Final

environmental statement

related to the

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

[redacted]

NORTHERN STATES POWER COMPANY

DOCKET Nos. 50-282 50-306

ATOMIC ENERGY COMMISSION · UNITED STATES OF AMERICA

MAY 1973

[redacted]

UNITED STATES ATOMIC ENERGY COMMISSION

DIRECTORATE OF LICENSING

FINAL ENVIRONMENTAL STATEMENT

BY THE

UNITED STATES ATOMIC ENERGY COMMISSION

DIRECTORATE OF LICENSING

RELATED TO THE PROPOSED ISSUANCE

OF AN OPERATING LICENSE FOR

THE PRAIRIE ISLAND NUCLEAR GENERATING PLANT

BY

THE NORTHERN STATES POWER COMPANY

DOCKET NOS. 50-282 and 50-306

May 1973

SUMMARY AND CONCLUSIONS

This is a Final Environmental Statement, prepared by the U. S. Atomic Energy Commission, Directorate of Licensing.

1. This action is administrative.

2. The proposed actions are the continuation of construction permits CPPR-45 and CPPR-46 and the issuance of operating licenses to the Northern States Power Company for the startup and operation of the Prairie Island Nuclear Generating Plant (Plant) located within the Burnside Township, Goodhue County, Minnesota (Docket Nos. 50-282 and 50-306). The Plant has two Pressurized-Water Reactors (PWRs), each of which produces 1650 megawatts thermal (MWt) and has a gross electrical output of 560 megawatts. A design power level of 1721 MWt and 583 MWe (gross) for each reactor is anticipated at a future date and is considered in the assessments contained in this statement. The condenser cooling system is operated in a closed-cycle mode (mechanical draft cooling towers) except when precluded by extreme cold weather conditions. In the closed-cycle mode, cooling water is withdrawn from the Mississippi River at the rate of 85,000 gallons per minute (gpm). The alternative mode is once-through cooling.

3. Summary of environmental impacts and adverse effects:

    a. Much of the 560-acre site was under cultivation before its acquisition. Approximately 240 acres have been disturbed and modified by the Plant construction activities. About 60 acres will be occupied by Plant structures and related facilities. Dredging of the cooling-water-system canals has resulted in some disruption of the aquatic environments in a limited area of the river.

    b. Water discharged into the main channel of the river will be limited to a temperature rise of 5°F when the natural river temperature is above 45°F, but not to exceed 90°F. The temperature of the discharged water is not to exceed 50°F when the natural river temperature is below 45°F.

    c. A maximum of 611,000 gpm of water will be circulated through the condenser, producing a 27.4°F temperature rise. In the closed-cycle mode, 96% of this heat will be removed by the cooling towers. In the process, a maximum of 17,000 gpm of water will be evaporated. If extremely cold weather conditions restrict the use of the cooling towers, the once-through cooling mode will be used, with restriction of the Plant power level, if necessary, to meet the temperature limit for the water discharged and thereby minimize the environmental impact.

d. The number of organisms entrained in the condenser cooling water will be minimized by closed-cycle cooling and an intake flow velocity of less than 1 foot per second. A bubble screen will be installed to reduce the number of entrained organisms. Some small organisms will pass through the water intake and condenser and many of these will be destroyed. However, the total effect of Plant operation on aquatic biota will be very localized and inconsequential in terms of total Mississippi River ecology. Chlorine (hypochlorite) will not be used to clean the condenser system, since a mechanical cleaning system has been provided.

e. The location and coordination of the transmission lines with the terrain traversed have been guided by current Federal recommendations. The corridors for the approximately 34 miles of transmission lines involve 973 acres of land (see pages III-1, IV-3, and V-4).

f. No significant environmental impacts are anticipated from normal operational releases of radioactive materials within 50 miles. The estimated dose to the population within 50 miles from operation of the Plant is 22 man-rem/yr, less than the normal fluctuations in the 270,000 man-rem/yr background dose this population would receive (see pages V-29, 30).

The Staff has calculated that, during normal operation, the Plant's annual release of radioactivity to the environment via liquid effluents will approximate 2000 curies of tritium and 10 curies or less of other radioactivity. Approximately 3400 curies per year of gaseous wastes will also be released.

g. The risk associated with accidental radiation exposure is very low.

h. The cooling towers will produce some localized fogging and icing, particularly during the winter months.

4. The following principal alternatives were considered:

a. Alternatives to construction of the Plant:

1) Do not produce the power.

2) Purchase the power from other utilities.

3) Install a fossil-fuel plant.

b. Alternate sites.

c. Alternative cooling methods:

1) Once-through cooling.

2) Natural-draft cooling towers.

3) Spray pond.

4) Cooling pond.

4) Dry towers.

5. The following Federal, State, and local agencies were requested to comment on the Draft Environmental Statement:

Advisory Council on Historic Preservation.
Environmental Protection Agency.
Department of Agriculture.
Department of the Army, Corps of Engineers.
Department of Health, Education and Welfare.
Department of Housing and Urban Development.
Department of the Interior.
Department of Transportation.
Federal Power Commission.
The Minnesota Department of Health.
The Goodhue County Board of Commissioners.
The Minnesota Agency of the U.S. Department of Interior's Bureau of Indian Affairs.

Comments on the Draft Environmental Statement issued in January 1973 were received from the following Federal, State, and local agencies, and other parties:

Advisory Council on Historic Preservation
Department of Agriculture
Department of the Army
Department of Commerce
Department of Interior
Department of Transportation

Department of Transportation, Region 5
Environmental Protection Agency
Federal Power Commission
Minnesota Pollution Control Agency
Northern States Power Company
State of Minnesota, State Planning Agency

These comments are appended to this Final Environmental Statement in Appendix C.

6. This Final Environmental Statement was made available to the public, to the Council on Environmental Quality, and to other specified agencies in May 1973.

7. On the basis of the evaluation and analysis set forth in this Statement, and after weighing the environmental, economic, technical and other benefits of the Prairie Island Nuclear Generating Plant against environmental and other costs, and considering available alternatives, it is concluded that the actions called for under the National Environmental Policy Act of 1969 (NEPA) and Appendix D to 10 CFR Part 50 are the continuation of construction permits CPPR-45 and CPPR-46 and the issuance of operating licenses for the facility, subject to the following conditions to be included in the operating licenses for the protection of the environment:

   a. The Applicant will define the comprehensive environmental monitoring program required for inclusion in the Technical Specifications (for the Plant operation), which are acceptable to the Staff for determining environmental effects which may occur as a result of the Plant (see Section V.C.5.).

   b. If harmful effects or evidence of irreversible damage are detected during the course of the monitoring program specified in "a" above, the Applicant will provide an analysis of the problem and a proposed course of action to alleviate the problem.

   c. The Plant will be subject to the Environmental Technical Specifications (Appendix B of the license) which include a requirement that the condenser cooling systems will be operated on closed-cycle mode (mechanical draft cooling towers) to the maximum extent practicable (see section XII.A.25).

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FOREWORD

This Final Statement on environmental considerations associated with the proposed issuance of operating licenses for the Prairie Island Nuclear Generating Plant (Plant), Docket Nos. 50-282 and 50-306, was prepared by the U. S. Atomic Energy Commission (Commission or AEC), Directorate of Licensing (Staff) in accordance with the Commission's regulation, 10 CFR Part 50, Appendix D, implementing the requirements of the National Environmental Policy Act of 1969 (NEPA).

The National Environmental Policy Act of 1969 states, among other things, that it is the continuing responsibility of the Federal Government to use all practicable means, consistent with other essential considerations of national policy, to improve and coordinate Federal plants, functions, programs, and resources to the end that the Nation may:

- Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.
- Assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings.
- Attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undersirable and unintended consequences.
- Preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity and variety of individual choice.
- Achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities.
- Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

Further, with respect to major Federal actions significantly affecting the quality of the human environment, Section 102(2)(C) of the NEPA calls for preparation of a detailed statement on:

(i) The environmental impact of the proposed action,

(ii) any adverse environmental effects which cannot be avoided should the proposal be implemented,

(iii) alternatives to the proposed action,

(iv) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and

(v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

Pursuant to Appendix D of 10 CFR Part 50, the AEC Directorate of Licensing prepares a detailed statement on the foregoing considerations with respect to each application for a construction permit or full-power operating license for a nuclear power reactor.

When application is made for a construction permit or a full power operating license, the Applicant submits an environmental report to the AEC. The Staff evaluates this report and may seek further information from the Applicant, as well as other sources, in making an independent assessment of the considerations specified in Section 102(2)(C) of NEPA and Appendix D of 10 CFR Part 50. This evaluation leads to the publication of a draft environmental statement, prepared by the Directorate of Licensing, which is then circulated to Federal, State and local governmental agencies for comment. Interested persons are also invited to comment on the draft statement.

After receipt and consideration of comments on the draft statement, the Staff prepares a final environmental statement, which includes a discussion of problems and objections raised by the comments and the disposition thereof; a final cost-benefit analysis which considers and balances the environmental effects of the facility and the alternatives available for reducing or avoiding adverse environmental effects, as well as the environmental, economic, technical, and other benefits of the facility; and a conclusion as to whether, after weighing the environmental, economic, technical and other benefits against environmental costs and considering available alternatives the action called for is the issuance or denial of the proposed permit or license or its appropriate conditioning to protect environmental values.

In addition, in a proceeding such as this which is subject to Section C of Appendix D of 10 CFR Part 50, the final detailed statement includes a conclusion as to whether, after weighing the environmental, economic, technical and other benefits against environmental costs and considering available alternatives, the action called for as regards the previously issued construction permit is the continuation, modification or termination of the permit or its appropriate conditioning to protect environmental values.

Single copies of this statement may be obtained by writing the Deputy Director for Reactor Projects, Directorate of Licensing, U. S. Atomic Energy Commission, Washington, D.C. 20545. Mr. Marshall Grotenhuis is the AEC Environmental Project Manager for this statement. (301-973-7588)

I. INTRODUCTION

The Northern States Power Company (Applicant), by application dated March 29, 1967, and subsequent amendments, has requested a construction permit and operating license for two pressurized-water reactors. The application was reviewed by the AEC's Regulatory Staff and by the Advisory Committee on Reactor Safeguards.[1,2] A public hearing was held before a three-man Atomic Safety and Licensing Board at Red Wing, Minnesota, on May 21 and 22, 1968. On June 25, 1968, the USAEC issued construction permits CPPR-45 and CPPR-46 for this facility. Regulatory material pertinent to this Plant is available for public inspection in Docket Nos. 50-282 and 50-306 at the AEC's Public Document Room (1717 H Street, N.W., Washington, D.C. 20545) and at the Environmental Library of Minnesota (1222 S. E. 4th St., Minneapolis, Minnesota 55414).

The Prairie Island Nuclear Generating Plant (the Plant) is a facility of the Northern States Power Company. The Plant consists of two pressurized water reactors. These reactors are identified as Units 1 and 2. The Plant is located on a site bounded in part by the Mississippi River in Goodhue County, Minnesota.

Each unit has a pressurized-water reactor which supplies steam to a turbo-generator, and is intended to operate initially at core power levels up to 1650 MW of heat (MWt). The design level is 1721 MWt. The Plant is located on a 560-acre site in the valley of the Mississippi River. River water is used in a cooling system, which is variable from open cycle to completely closed-cycle flow.

An Environmental Report (ER) for the Plant was submitted by the Applicant in May 1971 and a supplement was submitted in November 1971. The Applicant's revised Environmental Report, composed of the original report and the supplemental pages, has two volumes, the first containing the main text and the second eight appendices of related material. This Final Environmental Statement takes into consideration the Draft Environmental Statement; comments on the Draft Environmental Statement by Federal, State and local agencies and by interested parties; the Applicant's Environmental Report; errata dated October 23, 1972; additional information furnished by the Applicant in response to questions from the AEC on environmental matters (ER Supplement 1, dated June 7, 1972), on cost-benefit comparisons (ER Supplement 2, dated July 14, 1972) and on alternatives (letter from Mr. E. C. Ward, N.S.P., to Mr. D. R. Muller, dated November 15, 1972); information contained in the Final Safety Analysis Report (FSAR) as amended, including amendments through No. 18 (dated June 9, 1972); the Safety Evaluations;[1,2] the literature tabulated in the revised ER and that referenced in this Statement;* an inspection of the Plant site by the AEC Staff; and independent Staff calculations and evaluations.

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* See Bibliography p. R-1 for a more complete listing of basic references.

As of February 1973, construction of Unit 1 was 95% complete, fuel loading was scheduled for July 1, 1973 and commercial operation by late 1973. Corresponding data for Unit 2 are 33%, July 1974, and late 1974, respectively.

A. SITE SELECTION

As part of the company's long-range planning activities, the Applicant maintains continuing cognizance of future needs for new power-plant sites, availability of promising new locations, and the pertinent characteristics of the region in which they are located. Within the Applicant's service area, a number of sites are available for power plants. There are lakes and streams that could provide cooling water, and some of the relatively flat, rolling terrain is amenable to formation of cooling ponds.

Selection of a site involves achieving a reasonable balance among many factors of a physical, economic, social, and environmental nature. The items considered by the Applicant in the process of site selection include the following:[1]

1. System Requirements: service reliability, existing and future transmission facilities, pooling factors, and costs.

2. Zoning and Environmental Factors: population concentrations, present and future land and water use, zoning ordinances, community planning, taxation, air-space use, labor supply, and land prices.

3. Accessibility: topography, highways, railroads, navigable waterways, transmission corridors, and pipeline corridors.

4. Physical Features: area available, topographic changes required, geology as related to foundation conditions, hydrography (in particular, minimum and maximum flow rates), cooling water supply and control, waterfront requirements, groundwater supply, and meteorological conditions.

5. Federal, State, and Local Regulatory Factors.

In December 1965 representatives of the Applicant and three consultants considered three sites in terms of their suitability for nuclear plants. These were Monticello, Prairie Island, and Bayport, all in Minnesota near the Twin Cities. Based on the then-existing knowledge of the factors enumerated above, including hydrological, meteorological and geological data, the evaluation group ranked them in the order named in regard to suitability for a nuclear plant. These findings were discussed with representatives of the USAEC's Division of Reactor Licensing in February 1966. Subsequently, the Monticello site was selected for the Applicant's first commercial nuclear plant, the Prairie Island site for the second commercial nuclear site and the Bayport site for the A. S. King fossil plant.

The geological and hydrological nature of the general region precluded consideration of a hydroelectric plant to supply the projected need for additional system capability. The fuel options for a steam plant were evaluated. Because of supply problems, the choice was essentially limited to either fissile fuel or coal. The result of a 1966 evaluation of economics and ecological impact considerations of these alternates was that a nuclear plant would be the better method of supplying the additional capacity.

B. APPLICATIONS AND APPROVALS

Approvals for the construction and operation of the Plant, or parts thereof, are required from numerous Federal and State agencies. Tables I-1 and I-2 summarize the nature of the permits required and indicate their status.

At various stages of the planning and construction of the Plant, the Applicant has held discussions with the Goodhue County Board, Burnside Township officials, and the Red Wing Council and Planning Commission. Presentations have been made also to a variety of civic, educational, public-interest, technical and social groups, including the Citizens Advisory Task Force,* and representatives of the local press.

*This task force consists of representatives of the following organizations concerned with environmental matters:
- Minnesota Environmental Control Citizens Association (MECCA)
- Minnesota Conservation Federation
- Minnesota Association for Conservation and Education (MACE)
- Minnesota Committee on Environmental Information (MCEI)
- Minnesota-Wisconsin Boundary Area Commission
- Sierra Club
- Isaac Walton League
- League of Women Voters
- Clear Air-Clear Water
- St. Croix River Association
- Zero Population Growth

TABLE I-1 Status of Permits and Approvals from Federal Agencies

Subject	Application Date	Approval Date
Atomic Energy Commission (AEC)		
Construction Permit	March 29, 1967; revised July 26, 1967	June 25, 1968
Operating License	February 1, 1971	
Special Nuclear Material License	February 22, 1972	April 6, 1972
Corps of Engineers (CE)		
Dredging and Dikes	March 26, 1969	May 21, 1969
Revised Dredging Plans	May 26, 1971	July 27, 1971
Plant Discharges (Refuse Act of 1899)	September 17, 1971	Not Applicable*
Federal Avaiation Administration (FAA)		
Description of Aviation Lighting	July 31, 1968	November 27, 1968

*In regards to the Plant Discharges Permit application to the Corps of Engineers as required by the Refuse Act of 1899, the administration of the Refuse Act permit program has been assumed by the EPA and has been renamed, the National Pollutant Discharge Elimination System (NPDES). We expect the State of Minnesota will be granted authorization by EPA to issue permits. (See - Minnesota Pollution Control Agency Water Quality Compliance Certification.)

TABLE I-2 Status of Permits and Approvals from Minnesota Agencies

Subject	Application Date	Approval Date
Department of Natural Resources		
Groundwater Appropriation (Test Well)	June 30, 1967	July 11, 1967
Surface Water Appropriation (Cooling)	March 26, 1969; revised Nov. 30, 1970	August 17, 1971; revised Sept. 8, 1971
Plant Sanitary and Reactor Service Water Wells (2)	April 29, 1968; revised March 26, 1969	August 19, 1971
Fire Protection and Domestic Wells (2)	June 3, 1968	June 14, 1968
Dredging and Dikes	March 26, 1969; revised Nov. 30, 1970	August 17, 1971; revised Sept. 8, 1971
Temporary Barge Handling Facility	June 19, 1970; revised July 23, 1970	July 31, 1970
Transmission Line over Public Waters	October 1, 1970	December 15, 1970
Dewatering of Wells	January 17, 1968-October 28, 1972	January 24, 1968-November 29, 1972
Department of Health (DH)		
Permanent Septic Tank	April 10, 1968	April 17, 1969
Domestic Well	May 6, 1968	August 28, 1968
State Fire Marshal		
Fuel Oil Storage Tank	October 14, 1971	October 28, 1971

TABLE I-2, Continued

Subject	Application Date	Approval Date
Department of Highways		
Transmission Line over State Highways	September 4, 1970	October 27, 1970
Pollution Control Agency		
Discharge of Plant Water	March 26, 1969	May 13, 1971
Dredging Compliance Certification	November 20, 1970	January 12, 1971
Disposal of Dredged Spoils	November 20, 1970	February 24, 1971
Preoperational Cleanup Discharge	March 29, 1971	May 10, 1971
Water Quality Standards Compliance Certification	October 15, 1971	
Incineration of Construction Waste	November 10, 1971	November 19, 1971
Diesel Generator and Heating Boiler Operation	June 30, 1972	September 14, 1972
Department of Labor and Industry		
Heating Boiler Approval	Not applicable	June 4, 1969
Foreign Reactor Vessel Approval	November 6, 1969	April 5, 1971 (Unit [illegible] April 7, 1972 (Unit [illegible]
Burnside Township Board		
Building Permit	February 1968	February 29, 1968

In addition to required distribution to and by the USAEC, copies of the application documents have been sent by the Applicant to Federal, State, and local agencies and to special-interest groups. Both the Final Safety Analysis Report and the Environmental Report were sent to Minnesota's Department of Natural Resources, Department of Health and Pollution Control Agency. Copies of the Environmental Report were sent to Region V of the Environmental Protection Agency, the Saint Paul District of the U. S. Corps of Engineers, the Minnesota-Wisconsin Boundary Area Commission, The Environmental Science Foundation, the Environmental Research Center, and the Center for Population Studies.

II. THE SITE

The Plant is located in southeastern Minnesota, near the eastern edge of the territory served by the Applicant. The site is on the western bank of the Mississippi River in a predominantly rural area between the riverside cities of Hastings, 13 miles to the northwest, and Red Wing, 6-1/2 miles to the southeast. Prior to purchase of the site, the land area within the 560 acres acquired by the Applicant was used solely for farming. Subsequent sections of this chapter describe significant features of the site and its vicinity, including demography, land use, history, surface and groundwaters, climate, geology and interactions of the indigenous biota with the environment.

A. LOCATION OF THE PLANT

Figure II-1 is a map of the land area within approximately 75 miles of the site, showing major roads, population centers and principal rivers. Circles of 10-mile increments in radius, up to 50 miles, are indicated, centered on the site which is in the Burnside Township of Goodhue County in the State of Minnesota. The largest population center within 50 miles of the site is the Minneapolis-St. Paul metropolitan area, centered approximately 35 miles northwest. The only sizable community within 10 miles of the site is Red Wing, which had a population of 10,441 in 1970.

Figure II-2 shows the land and water areas within approximately 6 miles of the Plant. Except for the towns of Diamond Bluff and Hager City, and the Prairie Island Indian Community, this region is occupied mainly by farmlands, associated farmsteads, rural communities, water bodies, and wooded areas of limited extent. Figure II-3 shows the principal physical features of the site and adjacent region. The Mississippi River's thalweg* for Wisconsin and Minnesota is about one-half mile east of the Plant.

The site, as shown in Figure II-3, is split into two parts by the main line and associated right-of-way of the Milwaukee, St. Paul and Pacific Railway. This has a NW-SE orientation and is about one-half mile southwest of the reactors. The site is accessible by land from State Aid Highway 18 which follows a semicircular route from U. S. Highway 61 to Dakota County Road 68. Highway 18 extends about 1 mile west of the Plant, and a Township road from there to the Plant site extends beyond the site to the vicinity of Lock and Dam No. 3 on the Mississippi River.

Prairie Island is a low island terrace associated with the Mississippi River flood plain. It is separated from other parts of the lowland by the

*The middle of the chief navigable channel of a navigable waterway which constitutes a boundary line between states.

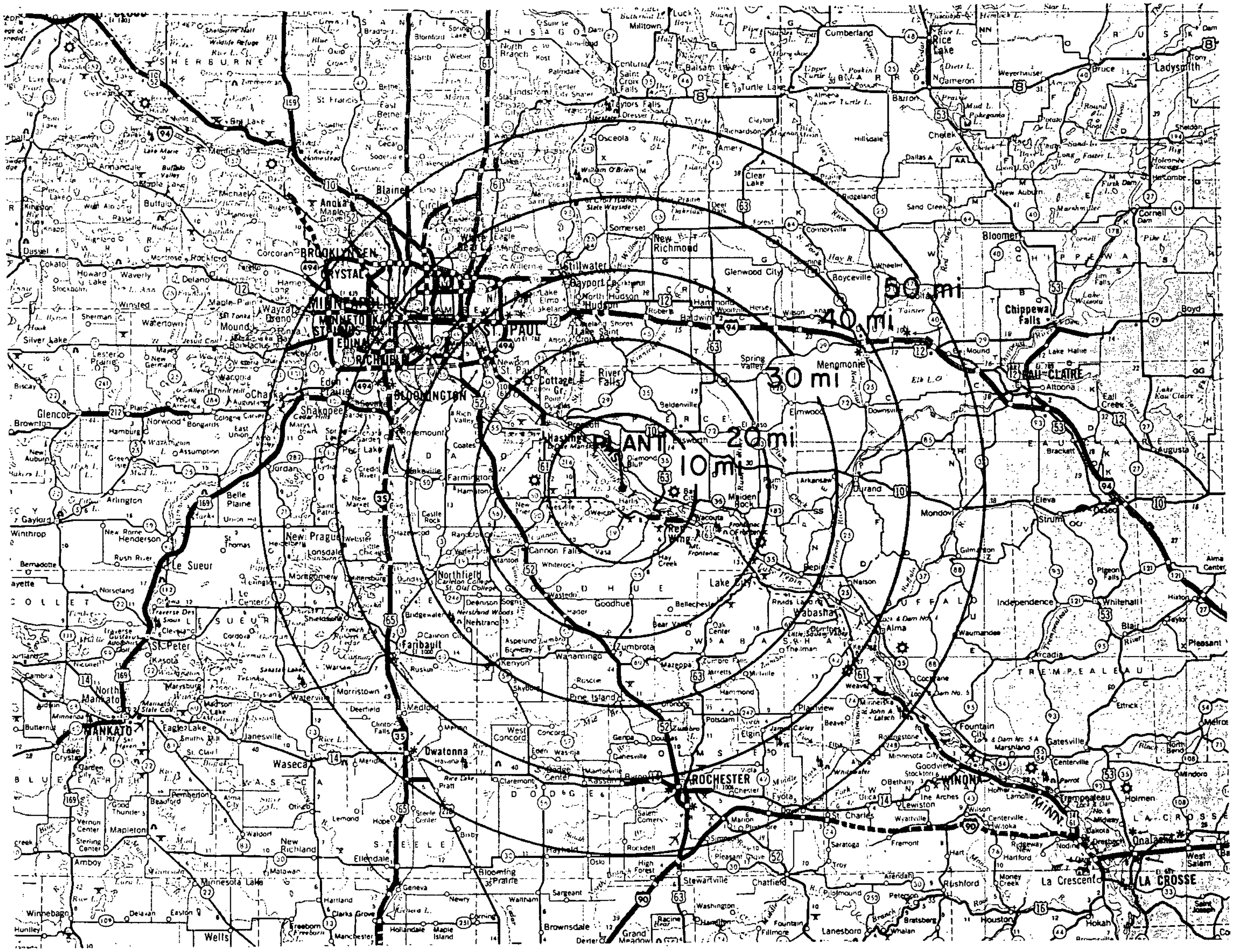

Fig. II-1. Map of the Region within 75 Miles of the Plant

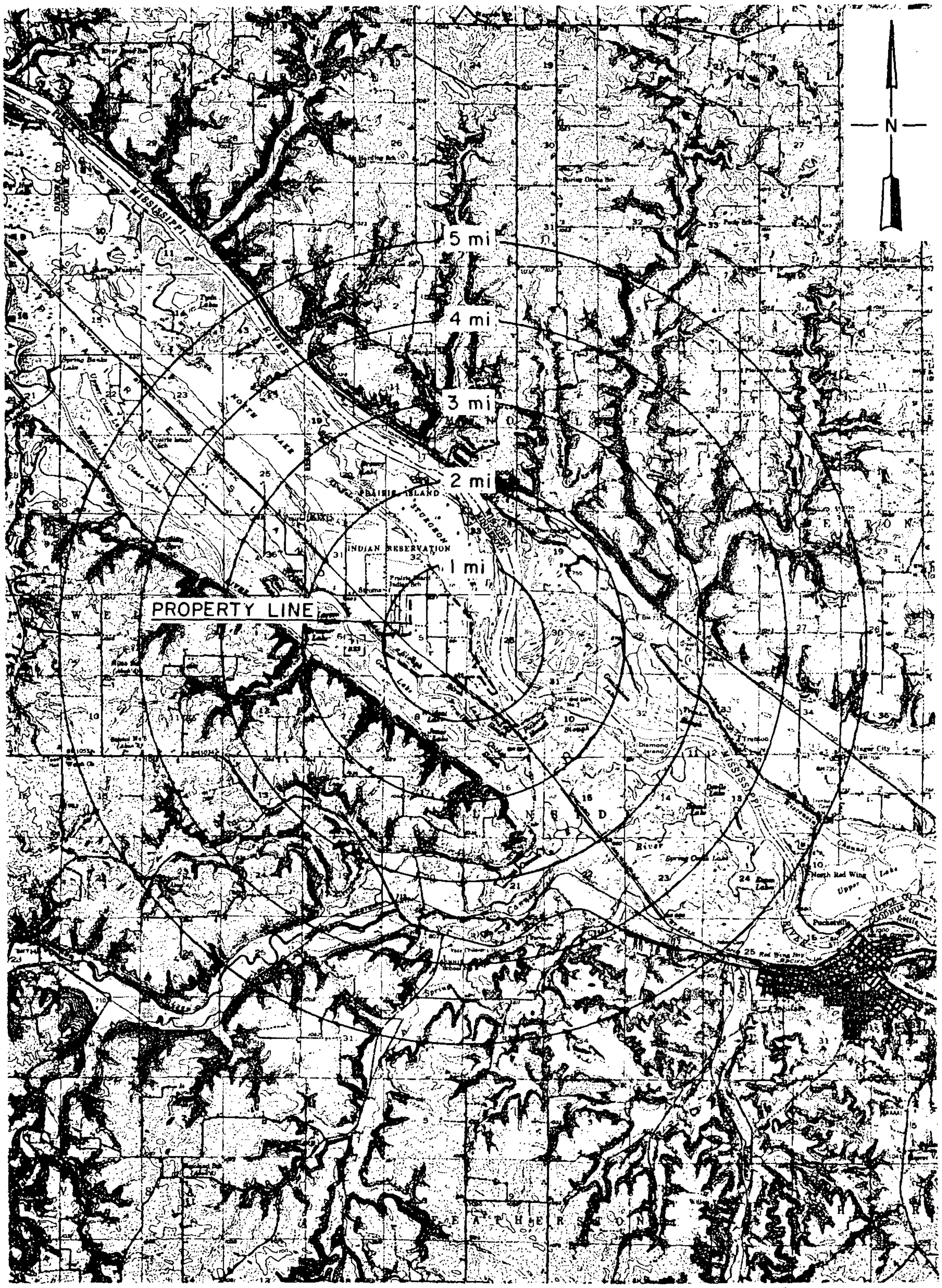

Fig. II-2. Topography in the Vicinity of the Site

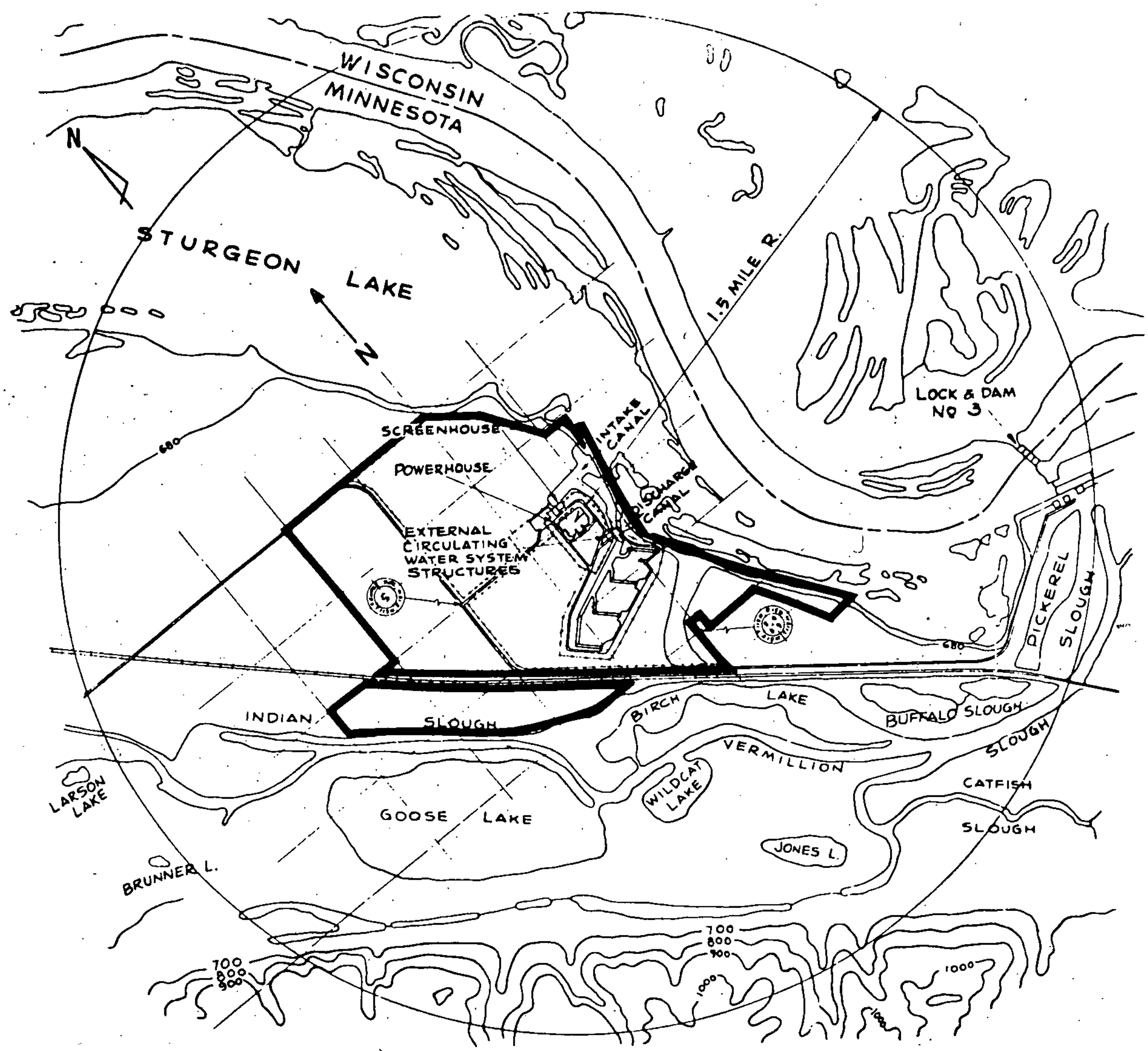

Fig. II-3. Principal Features of the Immediate Plant Area

Vermillion River on the west, and by the Mississippi River on the east. The ground is level to slightly rolling, and surface elevations range from approximately 675 to 706 feet above mean sea level (MSL). The normal elevation of the pool upstream from Lock and Dam No. 3 is 674.5 feet and the maximum recorded level during flood conditions was 687.8 feet.

The Mississippi River flood plain in this area is confined within a valley about 3 miles wide, as shown in Figure II-2. Rocky bluffs and heavily forested slopes rise abruptly from both sides of the valley to a height of some 300 feet above river level to the northeast and southwest of the site. The uplands immediately surrounding the valley reach elevations ranging from approximately 1000 to 1200 feet above sea level. They are deeply trenched by numerous streams emptying into the Mississippi River.

Most of the site's land was under cultivation before its acquisition, and much of Prairie Island continues to be used in this manner. Other low-land areas near the site are forested or covered by swamp vegetation. As shown in Figure II-3, much of the area around the site is covered by water. The site surface slopes gradually toward the Mississippi River on the northeast and to the Vermillion River on the southwest. The sandy, permeable nature of the topsoil precludes any pronounced drainage paths on the site.

B. REGIONAL DEMOGRAPHY AND LAND AND WATER USE

Less than 5% of the area within a 50-mile radius of the Plant is covered by water bodies. However, because of the proximity of the Plant to the Mississippi River and the importance of the latter and its tributaries for transportation and recreation, the use of both water and land for the needs of the population is considered here. Decreasing attention is given to zones at increasing distances from the Plant.

1. Population

a. Distribution

The population of the region, as determined by the 1970 census and projected to 1990, is given for successive annuli in Table II-1. Also included are the average densities for each annulus. The projected population in the region represents a growth rate of about 14% per decade. This is based on an assumption that the actual rate for 1960 to 1970 will be sustained. The data in Table II-1 demonstrate the low population density of about 23 people per square mile within 3 miles of the Plant, a moderate density of 55 people per square mile within 20 miles, and a sizable increase beyond, due principally to the Minneapolis-St. Paul metropolitan area.

TABLE II-1 Population Distribution in the Region

Annulus (miles)	Number of People 1970 Census	1990 Estimate	Average 1970 Density (No./per square mile)
0-1	86	111	27.4
1-2	288	373	30.6
2-3	280	363	17.8
3-4	1,016	1,318	46.2
4-5	1,597	2,082	56.5
5-10	16,134	20,862	68.5
10-20	49,513	64,021	52.5
20-30	177,026	228,896	112.7
30-40	1,005,963	1,300,712	457.4
40-50	583,091	753,935	207.8
0-5	3,267	4,247	41.6
5-50	1,831,727	2,368,426	235.6
0-50	1,834,994	2,372,673	233.6

Extended areas of high population density in the region exist in the vicinity of the major cities. Cities with populations in excess of 10,000 and Minneapolis-St. Paul suburbs in excess of 25,000 are listed in Table II-2.[1,2] The Twin Cities metropolitan area, with a 1970 population of 1,814,000, contains most of the people within the region. It is noteworthy that there is only a single Wisconsin city of more than 10,000 people within 50 miles of the Plant, even though about 40% of the land area within this distance is in Wisconsin.

The only communities within 5 miles of the Plant are Diamond Bluff, Wisconsin (130 people, 1.9 miles NNE), Skidmore Bluff, Wisconsin (rural, 2.5 miles E), Harliss, Minnesota (rural, 2.8 miles SSW), Trenton, Wisconsin (rural, 3.6 miles ESE) and Hager City, Wisconsin (100 people, 4.9 miles ESE). In addition, there is an unnamed community* of over 100 residences 4.5 miles SE on U. S. Highway 61. In the 5- to 10-mile annulus around the Plant there are only seven towns. These are Etter, Minnesota (35 people, 6.2 miles WNW), Welch, Minnesota (75 people, 6.5 miles SW), Red Wing, Minnesota (See Table II-2), Miesville, Minnesota (192 people, 8.6 miles W), Vasa, Minnesota (90 people, 9.1 miles SW), Bay City, Wisconsin (317 people, 9.3 miles ESE) and Esdaile, Wisconsin (50 people, 9.8 miles E).

b. Employment

Some perspective regarding the nature of the region is provided by a consideration of the distribution of employment among various activities. Such information is given in Table II-3 for Goodhue County (Minn.) in which the Plant is located and the nearby counties of Dakota (Minn.) and Pierce (Wisc.). These three counties have a total population of 201,223 and cover an area equivalent to that within 24.7 miles of the Plant. Data for agricultural employment are based on 0.55 and 0.95 worker per 100 acres of farmland for Minnesota and Wisconsin, respectively.[3,4] The remaining data are based on U. S. Department of Commerce compilations[5] of selected civilian employment. On a national basis, the scope of the County Business Patterns[5] includes 76.4% of such employment. The major omission is government employment (17.9%). Self-employed persons are excluded, and the compilation is by place of employment.

The data in Table II-3 reveal the difference in character of the three counties surrounding the Plant. Pierce County is predominantly rural. Goodhue County has a combination of agricultural and industrial activities. Dakota County is the most urbanized, particularly in the north (at larger distances from the Plant) where it is a fringe part of the Twin Cities metropolitan area. Agriculture provides employment for a significant

*On June 1, 1971, Burnside Township and the City of Red Wing consolidated. The entire Burnside Township, including this "unnamed community" is now part of the City of Red Wing.

TABLE II-2 Major Population Centers in the Region

City	1970 Population	Location from Plant
Menomonie, Wisc.	11,275	39 miles ENE
Red Wing, Minn.	10,441	6.5 miles SE
Rochester, Minn.	53,766	42 miles S
Owatonna, Minn.	15,341	46 miles SW
Faribault, Minn.	16,595	39 miles SW
Northfield, Minn.	10,235	28 miles WSW
Hastings, Minn.	12,195	13 miles NW
South St. Paul, Minn.	25,016	26 miles NW
Minneapolis, Minn.	434,400	40 miles NW
St. Paul, Minn.	309,980	33 miles NW
Twin Cities Suburbs		
Bloomington	81,970	
Brooklyn Center	35,173	
Crystal	30,925	
Edina	44,046	
Minnetonka	36,776	
Richfield	47,231	
Roseville	34,518	
St. Louis Park	48,883	
Coon Rapids, Minn.	30,505	50 miles NW
White Bear Lake, Minn.	23,313	38 miles NNW

TABLE II-3 Employment Patterns for the Three Counties in the General Area of the Plant

Type	Goodhue Co. No.	Goodhue Co. %	Dakota Co. No.	Dakota Co. %	Pierce Co. No.	Pierce Co. %
Agriculture	2139	21.0	1352	5.9	2925	46.6
Mining	28	0.3	76	0.3	9	0.1
Construction	323	3.2	1279	5.6	139	2.2
Manufacturing	3601	35.4	8380	36.7	535	8.5
Services	4083	40.1	11741	51.5	2680	42.6
Transportation & Utilities	456	4.5	933	4.1	270	4.3
Wholesale Trade	295	2.9	1646	7.2	163	2.6
Retail Trade	1816	17.8	5638	24.7	1349	21.4
Other	1516	14.9	3524	15.5	898	14.3
Total	10174		22828		6288	

part of the work force in these three counties, and it accounts for the predominant portion of land use. Hence, major attention is given to agriculture activities in the section that follows. Because of their importance to the economic vitality of the region, some information is given for industrial and transportation-related activities, in spite of their limited demand in terms of acreage. Data on construction workers are of interest here primarily because of the impact of Plant construction on the region.

2. Land and Water Use

The land area within a 25-mile radius includes most of Goodhue, Dakota, and Pierce Counties and limited portions of Washington, Wabasha, and Rice Counties in Minnesota, and St. Croix and Pepin Counties in Wisconsin. The region is predominantly rural, as indicated by the population statistics given in the preceding section. Land use is dominated by agricultural activities, related principally to livestock, poultry, and products derived therefrom.

a. Agriculture[3,4]

Table II-4 summarizes the agricultural land use of Goodhue County, in which the Plant is located, and the adjacent counties of Dakota and Pierce. Table II-5 demonstrates the dominance of dairy and animal products in the agricultural economy of these counties and of the entire states. The most recent data for the distribution of cash receipts from all farm marketings in the two states is given in Table II-6. Income from cattle is about equally divided between dairy products and slaughtering in Minnesota, whereas the former is dominant in Wisconsin. Income from field crops is far more significant in the agricultural economy of Minnesota than in Wisconsin's.

Table II-7 lists the principal field crops, in terms of both acreage and income, for the three counties closest to the Plant. The lower percentage of farmland occupied by such crops in Pierce County is consistent with the greater importance of dairy products in its agricultural pattern. Table II-7 also lists the numbers of the major types of livestock and poultry.

Dairy products and livestock account for 68% of the three-county farm receipts, with field crops and vegetables accounting for most of the remainder. Agricultural receipts in the three-county area totaled approximately $72,900,000 in 1968.

TABLE II-4 Agricultural Land Use Near the Plant

County	Area (sq. miles)	Number of Farms	Average Acreage	Area of Farms (sq. miles)	Percent of Total
Goodhue	753	1834	212	607	80.6
Dakota	576	980	250	383	66.5
Pierce	590	1649	188	483	81.9

TABLE II-5 Market Value of All Agricultural Products Sold in 1968 (Minnesota) and 1969 (Wisconsin)

Unit	Total Value	Crops, including Nursery and Hay		Livestock, Poultry, and Related Products	
	$1000s	$1000s	%	$1000s	%
Goodhue Co.	33,839	6,832	20.2	27,007	79.8
Dakota Co.	19,179	6,660	34.7	12,519	65.3
Pierce Co.	21,208	1,927	9.1	19,281	90.9
State of Minnesota	1,864,931	586,406	31.4	1,278,525	68.6
State of Wisconsin	1,455,477	195,838	13.7	1,255,689	86.3

TABLE II-6 Distribution of Cash Receipts from Agricultural Products Sold

Type	Minnesota (1969)		Wisconsin (1970)	
		%		%
Livestock, Poultry and Products	68.5		85.6	
Milk and butterfat		21.5		56.3
Cattle and calves		24.5		14.3
Hogs		14.1		9.4
Chickens and eggs		2.9		2.2
Other		5.5		3.4
Crops	31.5		14.4	
Field crops		27.8		6.0
Vegetables		2.9		5.6
Fruits		0.1		1.2
Other		0.7		1.6

TABLE II-7 Acres of Principal Field Crops Harvested and Population of Major Types of Livestock and Poultry in the Area of the Plant, in 1970

	Goodhue Co.	Dakota Co.	Pierce Co.
Field Crops			
Corn			
Grain	78,900	55,100	36,900
Silage	13,200	8,200	10,800
Oats	45,400	30,100	38,200
Barley	2,500	500	1,050
Wheat	3,000	4,800	750
Soybeans	51,200	34,100	4,400
Hay	59,300	28,600	57,300
Total acreage	254,400	161,400	149,400
% of farm acreage	65.5	65.8	48.3
Livestock and Poultry			
Cattle	84,000	45,400	76,000
Hogs	49,100	36,400	32,000
Sheep	11,200	2,900	3,900
Chickens	93,000	100,000	121,000

Within a 5 mile radius of the Plant, agriculture is the predominant activity. Principal crops include soybeans, corn, oats, hay, and, at about four miles from the Plant site, some cannery crops. The nearest dairy farm is located 2 miles east in Wisconsin. 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.

There are two dairy plants in Goodhue County, two in Dakota County and one in Pierce County. The nearest of these is located near Ellsworth, Wisconsin, more than 10 miles from the Plant site.

b. Other Nearby Land Use

Beyond the site boundary and within a 1 mile radius of the Plant, there are approximately 20 permanent residences and 3 summer cottages. The closest occupied offsite residence is approximately 3000 feet from the Plant.

On the Minnesota side of the river, one elementary school with 392 pupils is in use 4 miles south of the Plant. Expansion plans of Independent School District Number 256 at Red Wing will add several classrooms to this building. One elementary school is in use on the Wisconsin side of the river approximately 5 miles southeast, near Hager City. This school has room for 400 pupils. All other schools indicated on Figure II-2, including the Prairie Island Indian School, are no longer in use as schools.

Mississippi River Lock and Dam No. 3, located 1.3 miles southeast of the Plant, is owned and operated by the U. S. Army Corps of Engineers. Uses of the river for transportation and recreation are discussed in subsequent sections. The railroads that traverse the river valley near the site are also discussed elsewhere.

Pool No. 3, upstream from Lock and Dam No. 3, has several wildlife refuge and sanctuary areas under the management of the Minnesota Department of Natural Resources. These are located to the northwest and extend from that land peripheral to the Prairie Island Indian Reservation which is reserved for use by Indians to the vicinity of Prescott, Wisconsin (12 miles NW). The Plant is located at Mississippi River Mile 798.4 (measured from the Ohio River). The Indian Reservation is contiguous with the site to the north and this restricted peripheral land extends to Mile 802. The wildlife areas extend from Mile 802 to Mile 810. A smaller wildlife refuge is located along the river east of the Plant and extends southeast to Mile 796.

c. Manufacturing and Mining

As described above, the land in the vicinity of the Plant is devoted mainly to agricultural use. However, there are major industrial and commercial centers in the region. These coincide with the areas of high population described in Section II.B.1. Over 70% of the workers employed in manufacturing operations in the three-county area around the Plant are employed in the northern portion of Dakota County close to the Twin Cities metropolitan area. The nearest large center of manufacturing activity is the Red Wing area. In a tabulation of typical industries in the region (Table 1 of Reference 6), 20 plants are identified in Red Wing (6.5 miles SE). Others in the vicinity include one at Hager City (4.9 miles ESE), one at Welch (6.5 miles SW), two at Ellsworth (11 miles ENE), one at Wacuta (11 miles SE) and nine at Hastings (13 miles NW).

Table II-8 gives a more comprehensive view of the diversity and importance of manufacturing, which provides 32% of the employment in the three-county area around the Plant. The types include 16 of the 21 categories used for plant classification by the U. S. Department of Commerce, but most are small operations. Of the 132 plants included in this table, slightly more than half (67) employ less than 20 workers, and an additional 43 have less than 100 employees. Of the remaining 22 plants, 12 have less than 250 employees and 6 have between 250 and 500. The four with payrolls in excess of 500 persons are identified by type and county in the table.

Mining activities within the three-county area are limited to quarrying operations for sand, gravel, lime, crushed and cut limestone, portland cement, and clay for construction purposes. There are numerous pits and quarries in this area, but none of significance are located closer than 2.8 miles from the Plant.

d. Transportation

Large quantities of materials are moved by rail and boat in the vicinity of the Plant. As mentioned previously and shown in Figure II-4, two railroads have major lines in the river valley near the Plant, and the Mississippi River, which borders the Plant, is a major transportation route. Passenger traffic on these railroads and the river is much smaller than freight traffic. The nearest major highway is 2.6 miles from the site. The principal commercial airfield in the region is over 30 miles away, and the nearest pipeline approximately 10 miles away.

TABLE II-8

Types and Sizes of Manufacturers in the Three-County Area
Near the Plant [5]

Type	Goodhue County				Dakota County				Pierce County			
	No. of Plants	Employees <20	20-100	>100	No. of Plants	Employees <20	20-100	>100	No. of Plants	Employees <20	20-100	>100
Food & kindred products	13	5	8		20	7	9	4[a]	6	4	2	
Apparel & other textile products	1			1								
Lumber & wood products	3	2		1								
Furniture & fixtures	4		1	3								
Paper & applied products					3	1		2[a]				
Printing & publishing	9	7	2		10	7	3					
Chemicals & allied products					6	4	2					
Petroleum & coal products					3	1	1	1[a]				
Rubber & plastic products	4	2	2		5	2	3		1			1
Leather & leather products	3		1	2[a]								
Stone, clay & glass products					8	6	1	1				
Fabricated metal products					11	7	3	1				
Machinery, except electrical					12	7	3	2				
Electrical equipt. & supplies	3	2		1								
Transportation equipment					5	3	1	1				
Misc. mfg. industries[b]					2		1	1				
Total	40	18	14	8	85	45	27	13	7	4	2	1

[a] One plant with >500 employees.
[b] Toys, sporting goods and athletic goods.

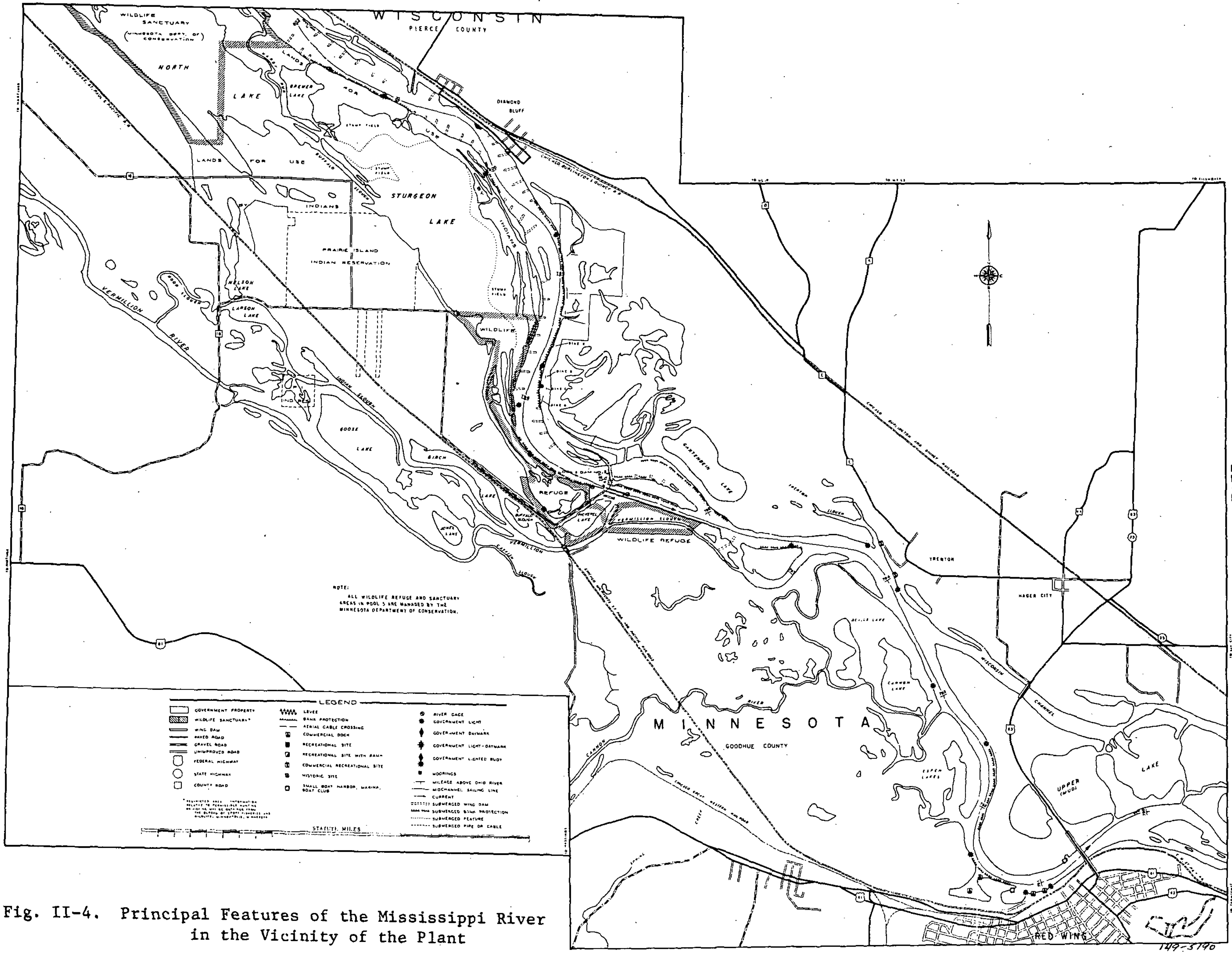

Fig. II-4. Principal Features of the Mississippi River in the Vicinity of the Plant

The major railroad routes between the Twin Cities and cities to the southeast parallel the Mississippi River near the Plant. The tracks of the Chicago, Milwaukee, St. Paul and Pacific are located along the west bank of the river and actually split the Plant site into two portions in a SE-NW direction, at a distance of about 0.5 mile from the reactor building. The tracks of the Burlington Northern (formerly the Chicago, Burlington, and Quincy) parallel these tracks, but on the east side of the river at a minimum distance of 1.8 miles from the Plant. In addition to the numerous freight trains, daily passenger trains operate each way between Chicago and Seattle by way of the Twin Cities on each of these lines, the Hiawatha (Amtrak No. 9 and 10) on the former, and the Empire Builder (Amtrak No. 7 and 8) on the latter.

The navigation channel of the Mississippi River passes within 0.5 mile of the Plant. Millions of tons of various materials are moved annually by barge past the Plant in the period from mid-March to mid-December. Table II-9 provides detailed information on the principal types of materials, the quantities, the directions, and the lengths of haul.[9] The principal materials are coal and petroleum products (moving up-river) and corn and soybeans (down). Other significant materials in terms of quantities include sand, gravel, and crushed rock, basic chemicals and fertilizers, and iron and steel products. There are no reported bulk shipments of munitions or other explosives on this part of the river.

Other than the Plant access road, which extends from Goodhue County Road 18 to the vicinity of Lock and Dam No. 3, and an unimproved road serving the Prairie Island Indian Reservation, the roads closest to the Plant are Goodhue County Road 18 and Pierce County Road E (see Figure II-4). These have only limited local use. The paucity of roads in the vicinity of the Plant reflects the low population density of that area. The closest Federal highway is U. S. 61 (between Red Wing and Hastings), at a minimum distance of 2.6 miles from the Plant. As shown in Figure II-1, other major arterial highways are at least 15 miles away. These include U. S. 52, which is the main route between Rochester and the Twin Cities, Interstate 35, which extends southward from the Twin Cities, and Interstate 94 from the Twin Cities east to Eau Claire, Wisconsin.

The nearest airport is Red Wing Municipal, 7.5 miles ESE on the Wisconsin side of the river. It has a single, paved, E-W runway 3000 feet long and is used by small aircraft about 30 times per day. Shorter, unpaved runways exist at the Meier (11 miles NNW), River Falls (15 miles north), and St. Paul Park (19 miles NW) airports. The major airports for the Twin Cities area are Wold Chamberlin Field (Minneapolis-St. Paul International), located 34 miles to the northwest, and Holman Field (St. Paul downtown), located 30 miles to the northwest.

Table II-9

Freight Traffic on the Mississippi River between Minneapolis, Minn. and the Mouth of the Missouri River in 1970 [9]

Group	Short Tons	%	% Upbound: Short Haul	% Upbound: Import	% Upbound: Export	% Upbound: Through	% Upbound: Total	% Downbound: Short Haul	% Downbound: Import	% Downbound: Export	% Downbound: Through	% Downbound: Total
Farm Products	17,152,528	31.8	< .1	0.3	0	1.1	1.4	0.5	0.9	35.5	61.7	98.5
Coal	8,541,208	15.8	0.3	53.4	0.1	46.1	99.9	0.1	0	0	0	0.1
Nonmetallic Minerals, except Fuels	5,175,873	9.6	33.5	19.1	0	29.1	81.7	16.4	0	0.2	1.7	18.3
Food and Kindred Products	1,723,026	3.2	0.1	5.9	0	29.8	35.8	0.5	0	45.4	18.3	64.2
Chemicals and Allied Products	4,887,783	9.0	0.6	30.8	0.5	59.2	91.1	0.5	0	3.3	5.1	8.9
Petroleum and Coal Products	12,189,820	22.6	14.5	18.1	15.3	33.6	81.5	1.7	0.3	13.3	3.2	18.5
Stone, Clay, Glass and Concrete Products	1,462,466	2.7	16.4	0.1	0	29.7	46.2	0	0	47.0	6.8	53.8
Primary Metal Products	1,945,705	3.6	0	5.6	0	20.1	25.7	0	0.1	4.4	69.8	74.3
Waste and Scrap Materials	395,326	0.7	0.5	5.7	2.0	6.6	14.8	4.8	8.8	17.1	54.5	85.2
Other Groups (13)	549,014	1.0	1.4	16.4	0.2	54.3	72.3	1.4	0	7.7	18.6	27.7
Total	54,022,749	100.0	7.1	17.8	3.5	26.4	54.8	2.3	0.4	17.7	24.8	45.2

Petroleum products and natural gas are transported by pipeline in the region. The nearest petroleum-products pipeline is 10 inches in diameter and extends in a NNW-SSE direction from South St. Paul to Rochester, Minnesota.[7] Its point of closest approach to the Plant is about 10 miles from the Plant, to the WSW. It serves the refineries at Pine Bend (22 miles NW) and south St. Paul (35 miles NW) which have a total annual crude capacity of about four million tons. A branch of a 24-inch-diameter natural-gas pipeline from North Branch, Minnesota, to Farmington, Minnesota, extends to the vicinity of Hastings (13 miles WNW).[8] Smaller natural-gas pipelines do exist in the vicinity of the Plant, such as those of the Applicant which supply gas to the residents of Red Wing (6.5 miles SE).

e. Outdoor Recreation[10]

With the increased amount of time devoted to leisure activities by individuals, the population of Minnesota and adjoining states has placed an increased demand on the state's recreational resources. In addition to providing adequate facilities to serve their own populations, the states of Minnesota and Wisconsin are active in promoting use of these facilities by visitors from adjacent states, as an added source of income for the economic vitality of the areas near the Plant.

The area available for recreational purposes varies markedly among the three counties in the vicinity of the Plant. The comparatively high population density of 243 people per square mile for Dakota County, compared with a density of about 45 for Goodhue and Pierce Counties, and its proximity to a major metropolitan area result in a difference in character for the outdoor recreational activities between it and the other two counties near the Plant. As would be expected, developed recreational facilities for such activities as swimming, golf, and competive games are more prevalent in regions of high population density, and those for camping, skiing, and snowmobiling are usually in rural areas. Underdeveloped or only slightly developed areas for fishing, hunting, boating, and hiking are usually located in rural areas which are essentially still in their natural state.

The region is deficient in lakes, compared with other parts of the two states. This is not too limiting in terms of recreational activities because of the presence of the Mississippi River and its numerous tributaries and backwaters.

Fishing and boating on the Mississippi River and its related waters are popular recreational activities in the vicinity of the Plant. There are numerous boat-launching ramps along the river, the closest being public ramps just north of the Plant site on the Minnesota side and on the opposite side at Diamond Bluff. Fishing is excellent in the tailwaters below the roller gates of Lock and Dam No. 3 and elsewhere in Pool 4. Walleyes, sauger, bluegills, crappies, northerns, white and black bass, and catfish are abundant. There are two resorts just downstream from the Plant on Pool 4 (River Miles 794.2 and 794.0). Smallmouth bass populate the rivers in the vicinity and there are several trout streams in the area. Swimming, water skiing, skin diving, canoeing, power boating, sailboating, houseboating, and sandbar exploring are among the other recreational activities provided by the waters in the region.

Various species of waterfowl nest along the Mississippi River. The more common types are blue-winged teal, mallard, and wood duck. During periods of migration, these are augmented by other species, so that waterfowl shooting is popular. The woods and brush in this area provide prolific breeding grounds for upland game birds and large and small game animals. Pheasant, ruffed grouse, snowshoe rabbits, and white-tail deer provide a challenge for the hunter.

The Cannon River, from Faribault to Red Wing, is popular with canoeists, and skiing enthusiasts are accommodated at Welch Village and Mount Frontenac. There are hiking trails along the Cannon and Mississippi Rivers. There are numerous areas in the region for snowmobiling, ice fishing, ice skating, ice boating, snowshoeing, and tobogganing.

The only State park within 30 miles of the Plant is the Frontenac State Park, about 19 miles to the southeast. It consists of rolling woodlands along the northwest shore of Lake Pepin and is near the site of a historic 1860 Mississippi River town. The park is still under development. It contains 721 acres and had 57,000 visitors in 1971. As additional facilities are developed and the park is expanded to an intended 2289 acres, use of this major park is estimated to grow to a level of about one million visitors per year.[11]

f. Commercial and Sports Fishing in the Mississippi River

The Mississippi River is the largest body of water in the vicinity of the Plant, and its use for commercial and sports fishing varies markedly with location, season, and year. For centuries, its fish have been a source of food, income, and pleasure for the region's inhabitants.

Pool 3 of the Mississippi River extends from Lock and Dam No. 3 (River Mile 796.9) to Lock and Dam No. 2 at Hastings, Minnesota (River Mile

815.2). The Plant, at river mile 798.4, is close to the downstream end of this pool. Pool 4 extends from Lock and Dam No. 3 to Lock and Dam No. 4 at Alma, Wisconsin. Much of the area of this pool consists of Lake Pepin, which is about 22 miles long, averages about 1-3/4 miles in width, and covers about 25,000 acres. Although actually a part of the Mississippi River, it has many of the properties of a large inland lake. Because of its width and average depth of about 21 feet, it has little current and is subject to much wave action. It is sometimes designated as Pool 4A, and the remaining area between Lock and Dam Nos. 3 and 4, which consists of an association of navigation and non-navigation channels, backwater, and sloughs, is then called Pool 4.

Wastes from the Twin Cities metropolitan area enter Pool 2, and hence Pool 3 functions as a recovery pool, with little sport and only limited commercial fishing. Pool 4 is important for both types, and during spring, the area just below Lock and Dam No. 3 provides the best fishing available on the Mississippi River.[12] An indication of a difference between Pools 3 and 4 is provided by data on the distribution of fish by type, obtained by sampling at several locations near the Plant. These results[13] are summarized in Table II-10. They are not necessarily representative of the population of the pools, because of differences in the water velocities at the sampling location.

The yields from commercial fishing for the pools near the Plant are given in Table II-11, and the distribution among species is indicated in Table II-12. The quantities harvested indicate that commercial fishing is a small-scale activity. The variation in annual yields indicates that the amount of effort devoted to it varies markedly. There are less than 200 licensed commercial fishermen in the entire state, and less than 10% of these harvest fish in excess of their own needs, that is, for sale.[12,14] Seines, gill nets, and set lines with baited hooks are used in these operations. The distribution of the harvest by species is for 1971, but it is representative of the catch in preceding years.

The Mississippi River is used extensively by sports fishermen, and Pool 4 is especially popular because of its size, variety of types of waters, productivity of game fish, and proximity to populous areas. The Upper Mississippi River Conservation Committee sponsors a creel census of selected pools every 5 years. The most recent completed survey was for the period from April 1, 1967 to March 31, 1968. The principal observations for Pool 4, consisting of 38,820 acres, were as follows:[15]

Annual fishing pressure:	14.8 man-hours per acre
Catch rate:	0.71 fish per man-hour
Yield:	377,925 fish, 387,291 pounds, and 9.9 pounds per acre

TABLE II-10 Game and Rough Fish Proportions in 1970 and 1971 Samplings Near the Plant Site[13]

Location	Method	Fish Distribution, % Game	Rough
Sturgeon Lake	Electrofishing	12.7	87.3
Below Lock and Dam No. 3	Electrofishing	83.5	16.5
Above Lock and Dam No. 3	Trapnetting	34	66
Islands at Plant Site	Trapnetting	29	71

TABLE II-11 Total Catch in Pounds by Commercial Fishermen in Pools Near the Plant for 1964 Through 1971[14]

Year	Pool 3	Pool 4	Pool 4A
1964	1,736	87,552	19,334
1965	1,180	45,023	3,160
1966	20,577	48,015	14,977
1967	46,330	58,699	8,809
1968	45,172	34,605	28,154
1969	26,051	25,002	36,405
1970	26,301	55,164	53,694
1971	27,837	27,343	14,860

TABLE II-12 Distribution by Species of the Weight of Fish Caught by Commercial Fishermen in Pools 3, 4, and 4A of the Mississippi River during 1971[14]

Species	Pool 3	Pool 4	Pool 4A
Carp	36.8%	73.9%	52.6%
Buffalo	62.0%	7.9%	18.7%
Sheepshead	0.2%	4.2%	3.4%
Catfish	0.5%	12.7%	24.7%
Other[a]	0.5%	1.3%	0.6%

[a] Bullheads, suckers, quillback, mooneyes, goldeyes, garfish, and bowfins.

This pool was fished mostly by residents of the counties bordering the pool and about three-fourths of the fishermen traveled less than 50 miles to fish in the river. Direct expenditures by fishermen were estimated to be in excess of $846,000 for fishing in Pool 4. The most prevalent species caught were blue gill (0.202 fish per man hour), sauger (0.155), crappie (0.113), and walleye (0.082). The fishing pressure was higher and the fishing success was lower in 1967-1968 than during a similar census conducted for Pool 4 in 1962-1963.

Fishing activity is concentrated at a few locations in Pool 4, notably the tail waters of Lock and Dam No. 3, certain areas of Lake Pepin, and specific backwaters and sloughs. Of special interest because of the proximity of the Plant are limited surveys conducted in the spring of each year regarding catches of walleyes and saugers in the tailwaters of Lock and Dam No. 3.[16] Selected observations made during these recent surveys are assembled in Table II-13. Many factors affect the catch, including weather, experience of the fishermen, popularity and publicity given to the location, and availability of leisure time. Hence short-term creel census statistics are not a reliable index of fish population structure, but trends may be reflected in such data. Fishing pressure at Lock and Dam No. 3 was low in 1969, due to the spring flood, but the 84% increase from 1968 to 1970 is indicative of what might occur in future years as more fishermen become familiar with this fishery.

g. Water Supplies

About 55 miles upstream from the Plant, the Mississippi River is tapped as the source of municipal water for Minneapolis and St. Paul, but the nearest downstream use for municipal supply is over 300 miles along the river, in Illinois.

Use of river water for irrigation by individuals or small communities in Minnesota and Wisconsin requires a use permit from the Department of Natural Resources of the appropriate state. The only downstream permit holder is near Wabasha, Minnesota (37 miles).

Groundwater tables and deep aquifers are the sources of water supply in the general area of the Plant. In addition to the two 300-gpm deep wells in the glacial drift, which are used for Plant make-up and potable water, the Applicant has identified 58 wells in the vicinity of the Plant. Their locations are identified in Figure II-5. Most are shallow wells of limited size, used for domestic purposes and livestock watering. The nearest public well is at Lock and Dam No. 3, about 1.5 miles from the Plant. The nearest-groundwater consumption of important magnitude is in the towns of Red Wing and Hastings.

TABLE II-13 Observations in Spring Creel Censuses for Tailwaters of Lock and Dam No. 3, 1968-1970[16]

	Period		
	3/1/68-5/3/68	3/1/69-5/2/69	3/1/70-5/1/70
Fishing Pressure (man hours)	22,350	3,540	41,067
Catch Rate (fish per man hour)			
Walleyes	.186	.083	.156
Saugers	.313	.126	.302
Fish Caught (No.)			
Walleyes	4,389	297	5,874
Saugers	6,955	1,323	13,332
Average Weight (Pounds)			
Walleyes	2.18	1.82	2.10
Saugers	0.89	0.78	0.90

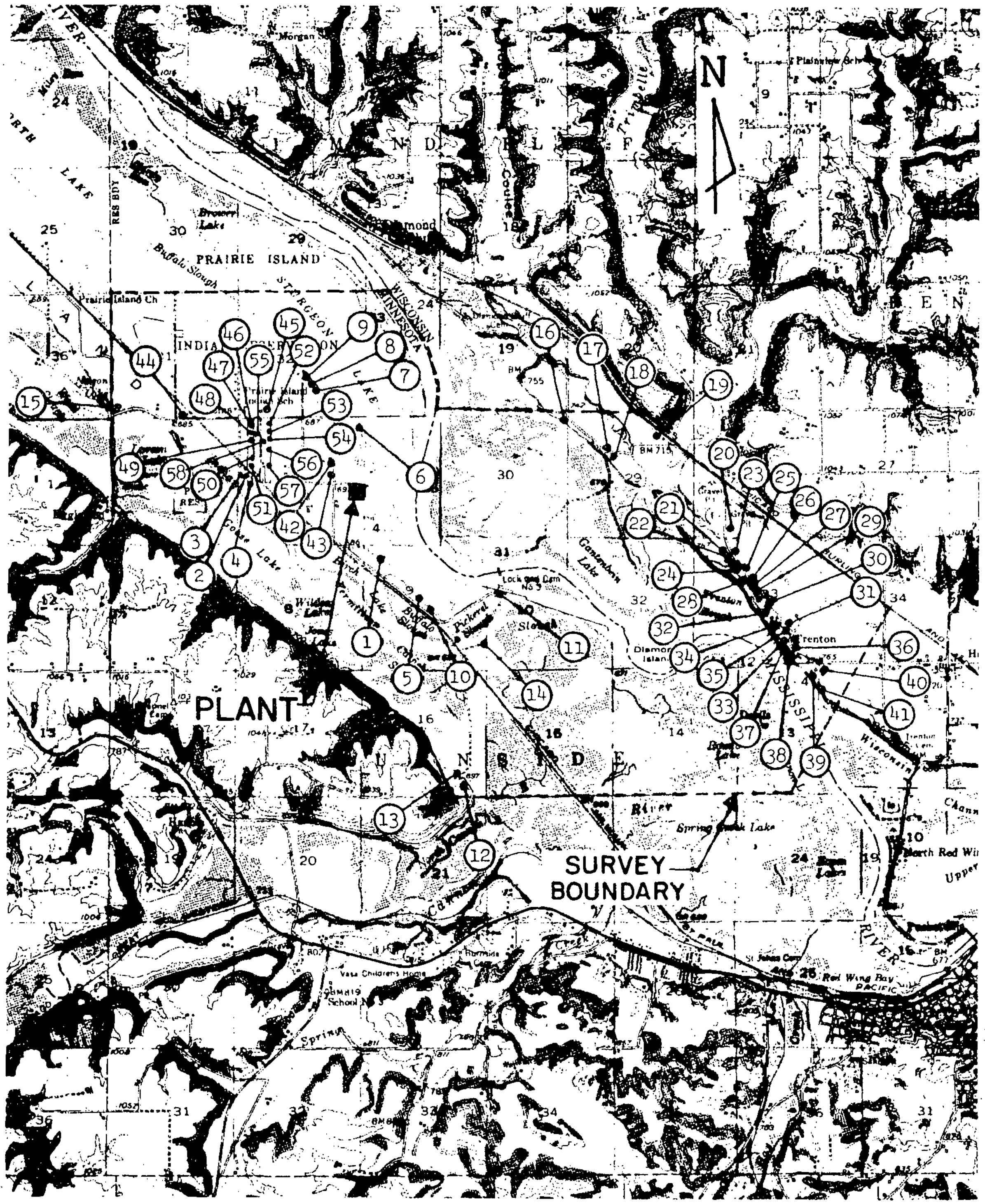

Fig. II-5. Location Plan of Wells in the Plant Vicinity

The municipal water supply for Red Wing requires an average of 1200 gallons per minute (gpm).[17] This is obtained from four wells at depths of 400 to 730 feet in the sandstone aquifers of the Dresbach and Hinckley formations. Several industries in the Red Wing area use a comparable quantity of groundwater from private wells. The municipal water supply system in Hastings has an average demand of 720 gpm.[18]

Communities further downstream from the Plant site than Red Wing also supply their water needs from wells in the bedrock. The closest are Lake City, 25 river miles downstream, and Wabasha, 37 river miles downstream.

C. HISTORICAL SIGNIFICANCE[22,24]

The Mississippi River and its tributaries have figured prominently in the history of the region, both in prehistoric times when only Indians inhabited the region, and during exploration and colonization by Europeans and their descendants. Until the coming of the railroad in the 1870's, the river was the only means of commerce and the major one for travel. Thus, it is not surprising that the important historic sites in the region, described in Table II-14, are all adjacent to the Mississippi River and connected waterways.

Wandering Indian hunters came to the scenic wooded bluffs and flat islands of the upper Mississippi valley after the last glaciers withdrew, some 11,000 years ago. By about 800 A.D. a group lived part of each year in a small hunting and fishing settlement on Prairie Island. From 1400 to 1500 A.D. a different group of Indians lived year-round in a small farming village there.

Three major historic sites associated with the Indian tribes of the region are located within 6 miles of the Plant. The closest, the Bartron site, is on the Plant site. Previous archeological work in the river valley near Red Wing had demonstrated a large number of prehistoric sites covering a long time span. Prairie Island is a key locality in this complex because of the many undisturbed burial mounds and a large village habitation occupied by late prehistoric peoples termed Mississippian. A part of this village, discovered by the State archeologist after the Applicant had requested an investigation of its property for possible archeological interest, has never been disturbed by cultivation of the land. The location of the Bartron site and a nearby burial mounds area,[25] relative to the Plant structures*, is shown in Figure II-6.

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*The cooling tower locations have been altered and the dikes have been relocated since this layout was made. (See Figure III-5 for the proper location of those features.)

TABLE II-14 Locations of Historical Significance in the Plant's Region [24]

Name	Location	Distance (miles)	Type	Description	Status[a]
Bartron Site	Prairie Island, Minn.	<1	Indian Ruins	15th century Indian village	Accepted
Silvernale Site	Near Red Wing, Minn.	4½	Indian Ruins	11th century Indian village	Proposed
Fort Sweney Site	Near Welch, Minn.	6	Indian Ruins	Pre-Columbian Indian works	Accepted
State Reform School Bldgs.	Red Wing, Minn.	8	Architectural	Richardsonian Romanesque style	Proposed
W. G. LeDuc House	Hastings, Minn.	14	Architectural	Rhineland Gothic style	Accepted
Old Frontenac	Frontenac Station, Minn.	16	Early Settlement	19th century river town on Lake Pepin	Proposed
Old Mendota	Mendota, Minn.	33	Early Settlement	Early 19th century trade center	Accepted
Fort Snelling	Near Minneapolis, Minn.	34	Frontier Fort	Guardian of the northwest frontier	Accepted

[a]As a National Historic Site

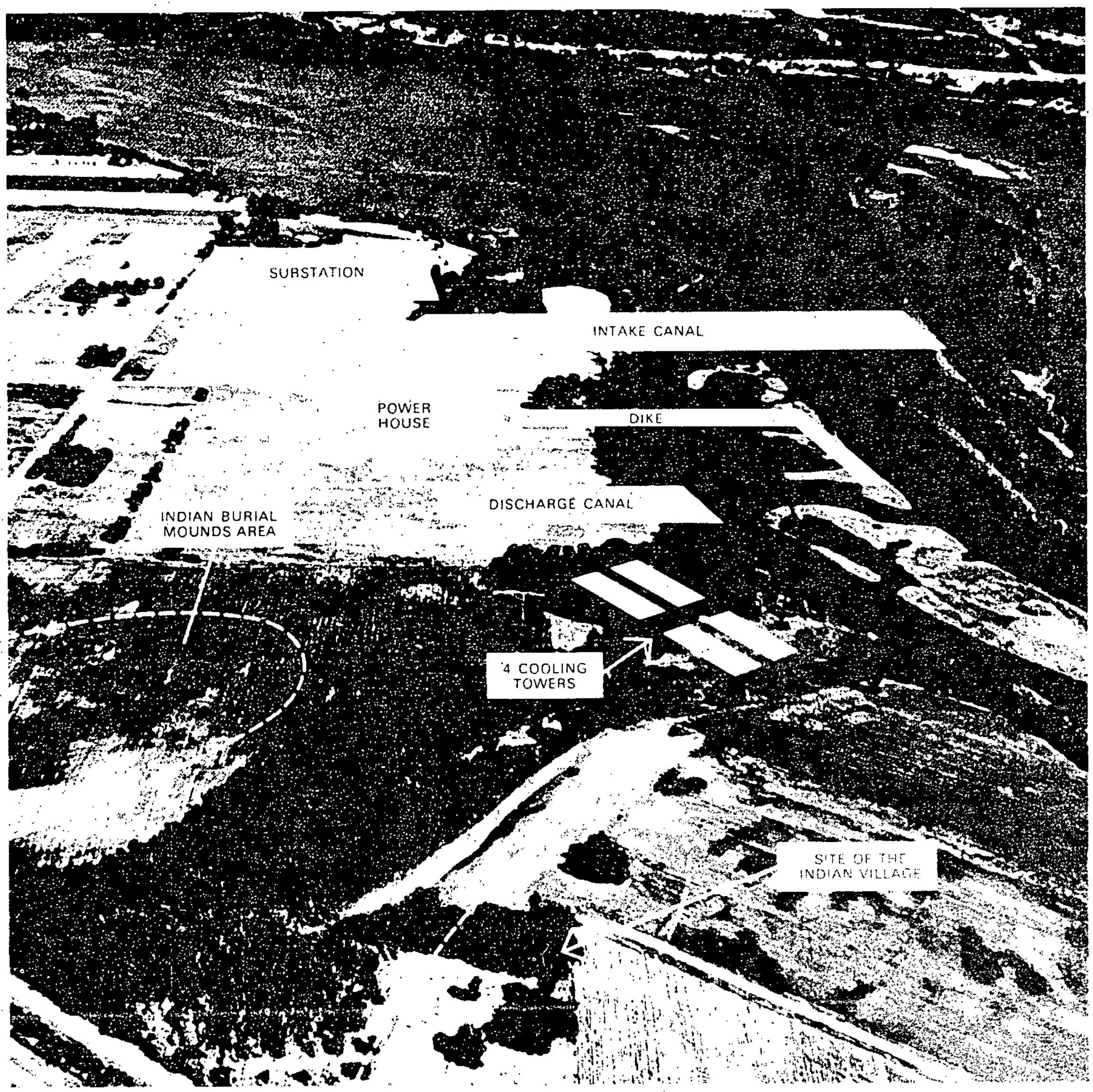


Fig. II-6. Location of Indian Village (Bartron Site) and Mounds Relative to Major Plant Structures

The other two major historic sites associated with the prehistoric Indians of the region are adjacent to the Cannon River. Silvernale, on the south bank at that river's junction with the Mississippi, is the only other major Mississippian culture site remaining on the Minnesota side of the upper Mississippi River valley. This settlement occurred around 1000 A.D., predating the Bartron site on Prairie Island by about 400 years. It has a clear component of Old Village focus cultural material like that found at Cahokia, Illinois, and may represent the earliest intrusion of Mississippian culture into the upper Mississippi valley. Fort Sweney, situated on a high hill overlooking the Cannon River valley near Welch, contains 41 pits, mounds, and other earthworks. It was originally thought that the site was a fortification used by the early Iowans to ward off the Sioux who were taking over the Minnesota territory. This was not substantiated by recent investigations, so the Fort may have been a burial ground or a ceremonial site.

The history of the white man in the region begins with Minnesota's first missionary and teacher, Father Hennepin, who, with two companions and 120 Sioux warriors, explored the upper Mississippi River in 1680. He was soon followed by Nicholas Perrot who established a French fort, St. Antoine, near Stockholm, Wisconsin, for trading with the warring Dakota, Fox, and Kickapoo Indians. He claimed the entire northwest for the king of France. In 1690, Pierre Charles LeSeuer explored the region at the confluence of the Mississippi and Minnesota Rivers, where Mendota and Fort Snelling were eventually located. In 1695, he established a trading post on Prairie Island.

In 1727 a party of French soldiers, voyageurs, traders, and priests established a fort and mission near Frontenac. This post was maintained for a quarter of a century as the most remote outpost of the French empire. Following the Louisiana purchase in 1803, there were concurrent explorations by Lewis and Clark on the Missouri River and by Lieutenant Zebulon Pike on the upper Mississippi. In 1805, Pike reached the confluence of the Mississippi and Minnesota rivers. The American Fur Company established a trading post there at Mendota in the early 1800's and the construction of Fort Snelling began there in 1820. The first steamboat to navigate the upper Mississippi River reached there in 1823.

Fur trading flourished there, but by 1835 Mendota still consisted of only a small group of log huts. Downriver a settlement was established at Frontenac in 1830. Thousands of settlers came to the area beginning in the 1840's, and the river towns of Hastings and Red Wing date from about 1850. Concurrently with the expanding population, Minnesota became a territory in 1848 and a state in 1858. Mendota, Hastings, and Red Wing evolved as centers of commerce, but Frontenac was developed as a resort town. A deliberate decision routed the railroad away from Frontenac when it reached that area in the early 1870's, so that its character has remained representative of the 19th century.

The other two historic sites included in Table II-14, although likewise associated with the development of the region, are primarily of architectural interest. The LeDuc House is an example of a style of architecture known as Rhineland Gothic. It was built shortly after the Civil War by William Gates LeDuc and occupied by him until his death in 1917. LeDuc is best known for his innovative activities in the field of agriculture, including service as Commissioner of Agriculture for President Rutherford B. Hayes. The Administration Building of the Minnesota State Training School has a tower built in the Richardsonian Romanesque style and the entire building has many of the typical Richardsonian or Romanesque Revival features that appeared in buildings constructed during the 1880's and early 1890's. The dining room of the school likewise has a number of interesting architectural features. These buildings were built between 1889 and 1891 and stand as a tribute to the imagination, craftmanship and diligence of the area's inhabitants.

D. ENVIRONMENTAL FEATURES

1. Surface Water

a. Description

As mentioned previously, the site is located on the Minnesota bank of the Mississippi River about 1 1/2 miles upstream from Lock and Dam No. 3. The flood plain of the river is about 3 miles wide in this reach, and is partly taken up by shallow lakes that connect directly to the Mississippi River and by the Vermillion River which borders the site on the southwest and enters the Mississippi 1 mile downstream from Lock and Dam No. 3.

Figure II-4 provides detailed information on the Mississippi River and connected surface-water bodies near the Plant site. Figure II-2 indicates some of the numerous coulees, runs, and streams that provide for drainage from the bluffs that flank the river. Figure II-7 displays the general features of the system of surface waters in the general region, including the Cannon River, which drains the area south of the Plant and empties into the Mississippi River downstream, near Red Wing. This figure also shows the junction of the St. Croix and Mississippi Rivers at Prescott, Wisconsin (River Mile 811.3).

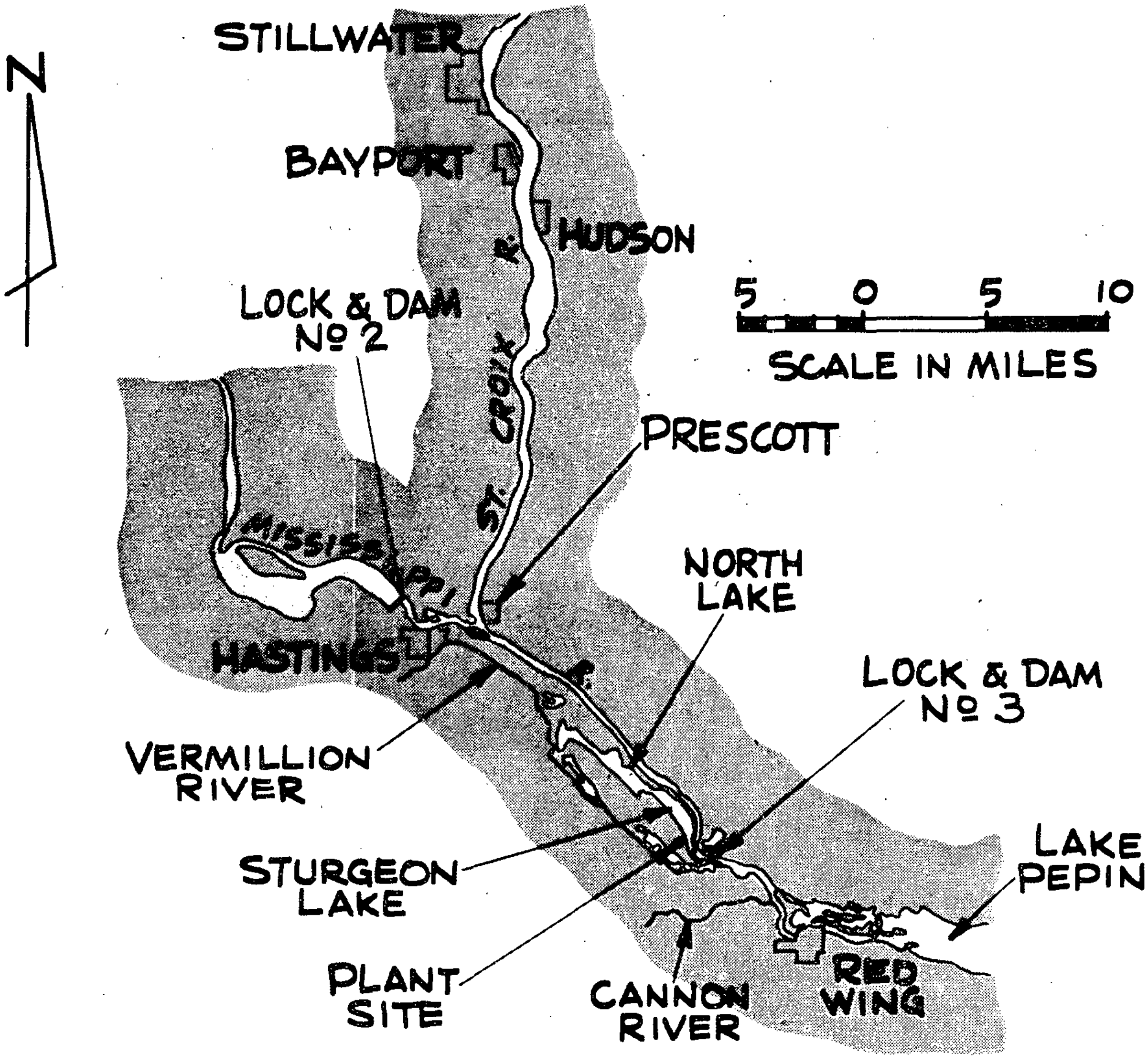


Fig. II-7. Mississippi River Navigation System for Pool 3

The locks and dams along the Mississippi River maintain the water levels suitable for navigation by forming stable pools, as illustrated for Pools 2, 3, and 4 in Figure II-8. These structures control the water level in the pools and can be used to partially modify the flow rate, which is influenced predominantly by meteorological conditions in the region drained by the Mississippi River. The river basin above the Plant site has a drainage area of about 45,000 square miles, predominantly in central and southern Minnesota, but including portions of Wisconsin, South Dakota, and Iowa.

Although lakes are rather uncommon in the region within 30 miles of the Plant, Figure II-1 reveals that they occur in increasing numbers at greater distances, particularly in the areas upstream from the Plant. These numerous lakes were formed in the surface depressions created by the ice sheets that advanced and then retreated from the area in prehistoric times. The flow characteristics of the Mississippi and its tributaries are largely determined by the natural storage provided by these lakes and the many swamps.

b. Flow Rates

The U. S. Geological Survey maintains gauging stations on the Mississippi River at Prescott, Wisconsin, upstream; at Winona, Minnesota, downstream; and on the Cannon River near Welch. The flow characteristics observed at these stations are indicated in Table II-15.

The observed flow rates at Prescott are of principal interest in connection with the Plant because the Cannon River empties into the Mississippi a few miles below the Plant, and Winona is far downstream. The consecutive-day, low-flow data obtained at Prescott are assembled in Table II-16. Because no severely low flows have occured since 1940, it is inferred that facilities constructed on the rivers since that time have served to augment low flow.

Based on observations from 1940 through 1965 at Prescott, the median flow rates and 7-day low-flow rates having a probability of occurring once in 10 years have been determined on a monthly basis. These are given in Table II-17. The probability of the flow rate exceeding a specific value, as obtained from these same observations, is given in Figure II-9.

c. Floods

Two types of flooding occur in the upper Mississippi River basin--open-water flooding and backwater flooding. Flooding while open-water conditions prevail is caused by runoff of rains or melting snow, or a combination of the two. Flooding because of backwater is usually caused by

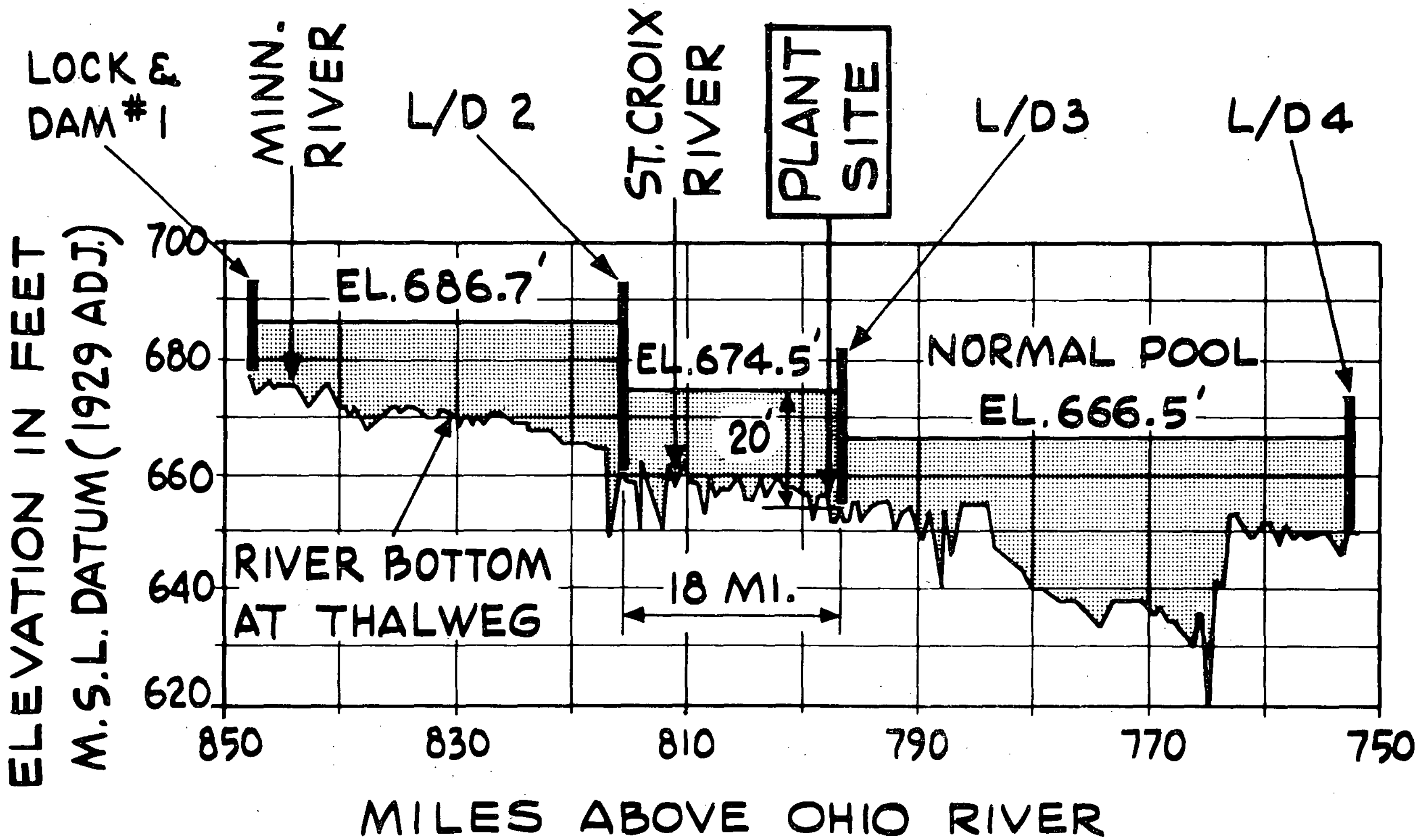


Fig. II-8. Profile in the Region Along the Mississippi River

TABLE II-15 Flow Rates of the Mississippi and Cannon Rivers, in cfs

	Mississippi River At Prescott	Mississippi River At Winona	Cannon River At Welch
AVERAGE	15,020	24,520	475
MAXIMUM	228,000 (4/18/65)	268,000 (4/19/65)	36,100 (4/10/65)
MINIMUM	2,100 (1936)	3,350 (12/29/33)	2.5 (1/3/50)

Table II-16 Minimum Consecutive-day Low-flow Rates for the Five Lowest Years of Record, in cfs

1 Day	(Year)	7 Days	(Year)	14 Days	(Year)	30 Days	(Year)
1380	(1940)	2190	(1936)	2260	(1936)	2350	(1934)
2100	(1936)	2240	(1934)	2260	(1934)	2650	(1936)
2210	(1934)	2640	(1933)	2650	(1933)	2860	(1933)
2270	(1939)	3110	(1931)	3190	(1931)	3360	(1932)
2520	(1933)	3270	(1932)	3320	(1932)	3370	(1931)

TABLE II-17 Mississippi River Flow at Prescott, 1940-1965, in cfs

Month	Median	7-day Low Flow, 10-year Recurrence
January	7,580	4,500
February	7,200	4,430
March	10,600	4,570
April	36,000	8,710
May	25,750	9,570
June	24,000	7,570
July	14,750	5,000
August	11,240	4,500
September	11,000	5,530
October	10,120	4,860
November	9,500	4,930
December	8,000	4,500

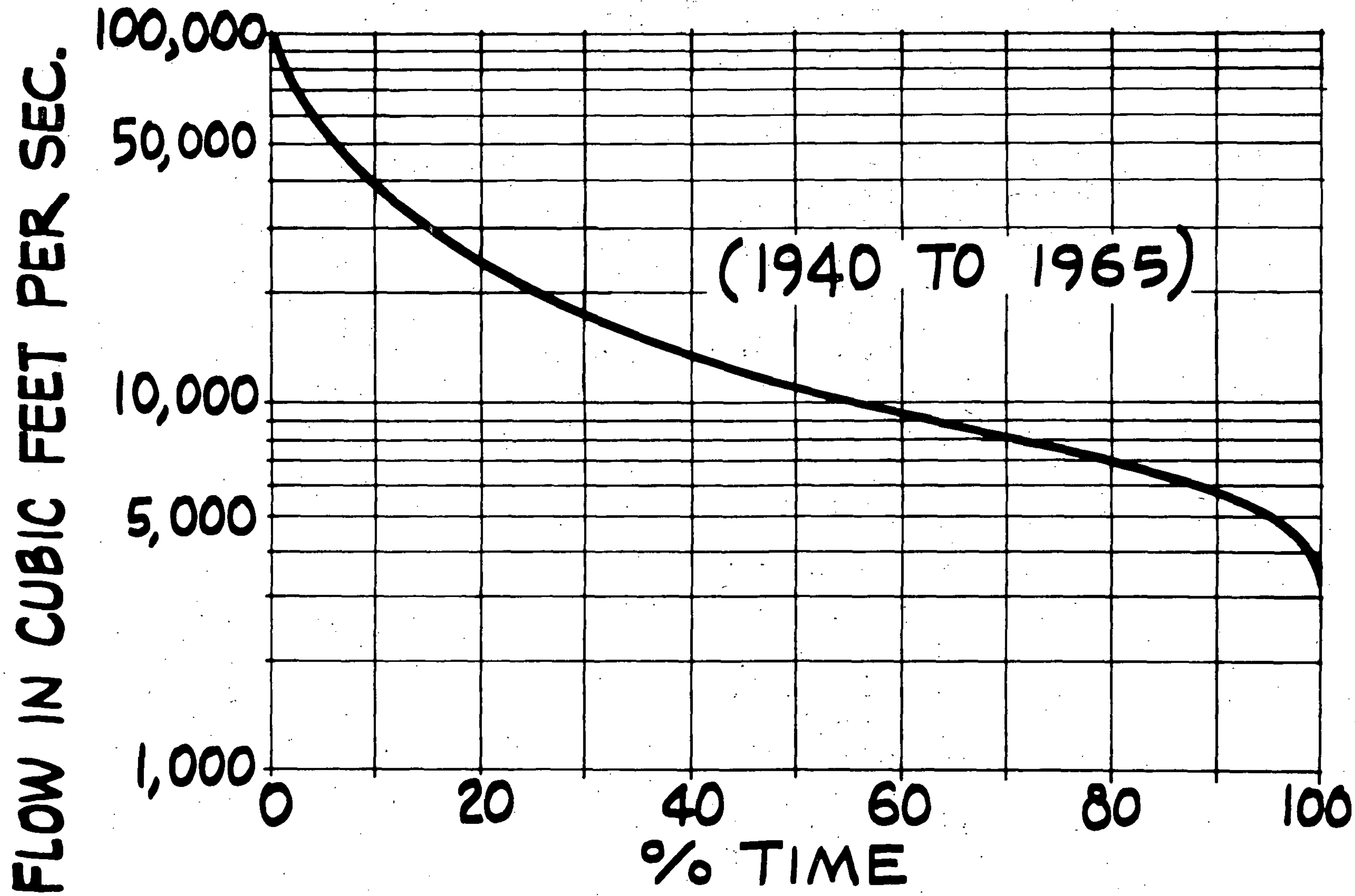


Fig. II-9. Flow Duration for the Mississippi River at Prescott ice jams. The most serious flooding throughout the basin has been associated with excessive snowmelt and rainfall. Major floods in the main streams occur on the average 2-3 years out of 10. The time of occurrence of floods shows the greatest frequency in April during the spring thaw. A second peak occurs in June due to thunderstorm-type rains. A smaller peak occurs in the fall. Local flash floods occur in the smaller streams during the spring thaw and also in the warmer season from intensive rainfall.

The maximum flood of record (since 1928) for the upper Mississippi River occurred in April 1965. The maximum flow rates given in Table II-15 were associated with this flood. Records for the gauging station at St. Paul indicated that this was probably the maximum flood since 1851. This flood resulted from a severe winter and a combination of climatic events that led to a deep snow cover on top of an ice layer. Moderate to heavy rainfall and a return to normal temperatures during April produced rapid melting and extremely high runoff.

The stage of this record flood was about 688 feet msl (above mean sea level) near the site, and much of Prairie Island, where elevations range from 680 to 706 feet msl, was inundated (Plant grade elevation is 695 ft). The frequency probability of this flood has been computed to be about once in 150 years. Other high water marks at the site for recent floods are 687 feet in 1969 and 685 feet in 1952. These should be compared with the normal pool level of 674.5 feet. The stage for probable maximum flood (PMF) at the site has been computed[19] as 704 feet, and a level of 692 feet would be associated with a flood having a 1000-year recurrence interval. The flood wall protects the Plant to 705 ft (Section 2 FSAR). Figure II-10 shows the cross section of the Mississippi River valley at the Plant site. The flood plain there is wider than its average width downstream.

d. Other Characteristics

The temperature of the water in the river just upstream from the roller gates at Lock and Dam No. 3 was monitored from September 5, 1969 to May 3, 1971 by the Water Quality Office of the U. S. Environmental Protection Agency and its predecessor, the Federal Water Pollution Control Administration in the U. S. Department of Interior. The Applicant initiated measurements at the same location on May 20, 1971. The monthly extremes observed through 1971 are given in Table II-18. Although of limited duration, these data are consistent with the pattern of seasonal variations observed in the river at St. Paul, Minnesota from 1957 to 1964. There the average temperature ranged from essentially freezing during the winter months to a summer peak of 80°F. Similar measurements at Red Wing, from 1949 through 1968, showed a maximum daily average of 85°F in August and 82°F exceeded only 1% of the time during July and August.

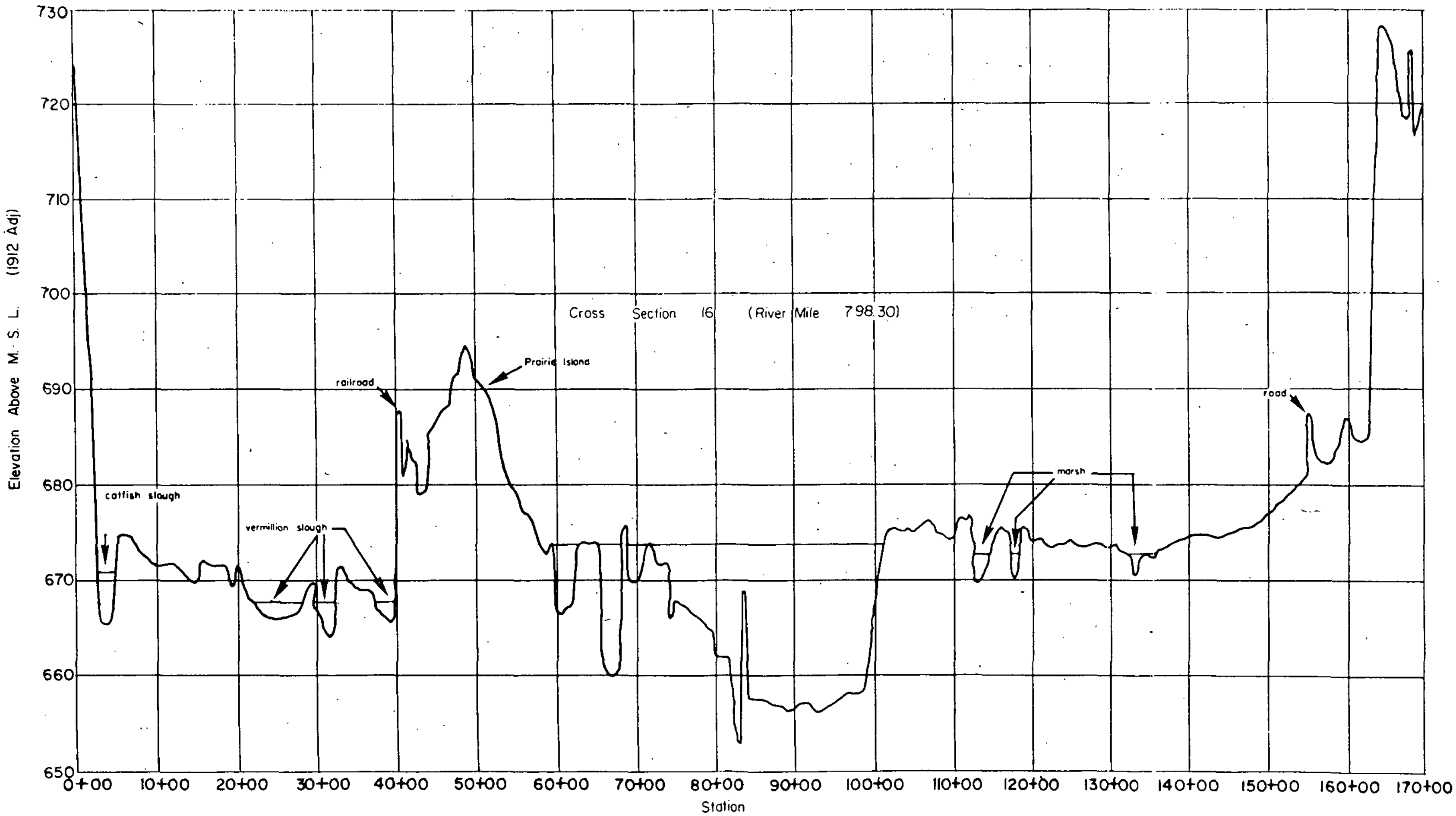


Fig. II-10. Typical Mississippi Valley Cross Section near the Plant

TABLE II-18 Observed Monthly Extremes in Mississippi River Temperatures above Lock and Dam No. 3, in °F

Month	High	Low
January	35	32
February	36	32
March	40	33
April	62	37
May	71	47
June	79	55
July	84	65
August	84	60
September	78	55
October	66	40
November	54	32
December	35	32

Many chemical and other physical properties of the river water have been measured by the Applicant and his consultants. The range and average value for several of these are given in Table II-19. They are based on determinations made between June 21, 1967 and December 16, 1971, although some of the properties shown were measured only in an expanded program initiated early in 1970. Analyses were made for water samples taken from three to six different times during each month except December. Of the 47 analyses, only two were for December samples.

2. Groundwater

Regionally, the movement of groundwater is toward the Mississippi River and its main tributaries. The groundwater table slopes from the higher, partially glaciated bedrock areas toward these surface streams, generally at low gradients. Groundwater enters the river valley from along the base of the bordering bluffs in the form of springs or as subsurface flow.

Beneath the flood plains and low terraces that border the Mississippi River, groundwater levels closely coincide with the elevations of the river surface and vary in accordance with river fluctuations. The average groundwater gradient in these bottomlands is downstream and essentially parallel to the stream gradient. At greater depths, important aquifer zones occur in the Jordan, Franconia, Dresbach, and Hinckley sandstone and shale strata that exist at successively deeper levels below ground in the region (see Section II.D.4).

The Vermillion River and connected lakes drain into the Mississippi River below Lock and Dam No. 3. Thus the elevations on the Vermillion River are lower than the Mississippi River adjacent to the site, so that the groundwater table slopes southwestward between the two rivers. Due to the permeable nature of the sandy alluvial soils forming Prairie Island, the groundwater table responds quickly to changes in river stage.

The surface waters are not used for municipal water supply for many miles downstream from the site because of the ready availability of groundwater in this area. Groundwater is obtained from aquifers in Keweenawan, Cambrian, and Ordovician rocks and from overlying Quaternary alluvial and glacial deposits. The Hinckley formation of the Keweenawan period is an important aquifer. The most productive Cambrian aquifers are the Mount Simon and Galesville members of the Dresbach formation and the Jordan sandstone. The principal Ordovician aquifer is the St. Peter sandstone.

Near the site, the Mississippi River valley has been cut through the Ordovician and approximately the upper 300 feet of the Cambrian rocks. Glacial and alluvial deposits in the valley cover the bedrock formations to a thickness of about 150 to 200 feet. These deposits yield small to large

TABLE II-19 Summary of Analyses for Mississippi River Water Samples Taken at the Plant Site

Analysis in mg/l	Minimum	Maximum	Average
Solids			
Total	209	427	286
Dissolved	167	366	254
Suspended	1.4	232	29
Hardness (as $CaCO_3$)			
Total	128	268	185
Calcium, Ca	84	180	120
Magnesium, Mg	44	88	65
Alkalinity ($CaCO_3$)			
Total	102	193	151
Phenolphthalein	0	24	3.4
Gases			
Ammonia nitrogen, N	0	1.1	0.38
Anions			
Chloride, Cl	2	32.9	12.5
Nitrate Nitrogen, N[a]	0.03	3.6	1.0
Sulfate, SO_4	10	80	38
Phosphorus (Soluble), P[a]	0.082	0.33	0.17
Silica, SiO_2	0.4	14.3	7.7
Cations			
Sodium, Na	6	28.5	12
Total Iron, Fe[a]	0.11	2.2	0.7
Total Manganese, Mn	0	0.08	0.03
Miscellaneous			
Color, APHA Units[a]	20	100	55
Turbidity, JTU	1	52	15.5
Ryznar Index at 77°F	5.9	8.5	7.2
Conductivity, mmhos	286	572	392
pH	7.4	9.2	8.0

[a]Samples from 1/8/70 to 12/16/71 only.

supplies to farms and small industrial users. Some municipal supplies in the valley are obtained also from the Mount Simon sandstone and from some wells that tap the Hinckley formation, the uppermost pre-Cambrian rocks. At some distance from the valley, the St. Peter sandstone is frequently tapped by wells for small to moderate supplies.

Groundwater in the vicinity has a high mineral content. For example, Table II-20 gives an analysis of a sample taken from a test well onsite that penetrated to a depth of about 71 feet (elevation 617). The pH for this sample was 7.7.

3. Meteorology

The climate of the region is continental in nature. In this area storms move generally in an easterly direction. Changes in weather are pronounced, as a consequence of the movement of polar and tropical air masses through the area.

a. Climatic Characteristics

Figure II-11 shows the seasonal variations in temperature and precipitation at Minneapolis. Extreme temperatures observed in the 1960's were -32 and +100°F. The average monthly temperatures ranged from 15 to 60°F. Rainfall averages about 25 inches per year, with almost two thirds occurring from May through September. Snowfall averages about 44 inches per year.

Figure II-12 shows the seasonal and annual wind roses observed onsite at 140 feet above ground level. The probability (in percent) that the wind originates in a 22 1/2° sector is displayed for all such sectors and for each season. Prevailing wind direction is strongly influenced by the orientation of the river valley near the site, which lies in a NW-SE direction. The wind direction is in these sectors 27% of the time on an annual basis. For the adjacent WNW-ESE and NNW-SSE sectors the probabilities are 21 and 13%, respectively.

The seasonal and annual average wind speeds for the site are as follows:

Spring	10.4 mph
Summer	8.0
Autumn	9.3
Winter	9.5
Annual	9.4

TABLE II-20 Results of Chemical Analysis of Onsite Groundwater, in ppm

Total dissolved solids	453
Noncarbonate hardness (as $CaCO_3$)	51
Carbonate hardness (as $CaCO_3$)	184
Total hardness (as $CaCO_3$)	235
Bicarbonate alkalinity (as $CaCO_3$)	185
Carbonate alkalinity (as $CaCO_3$)	0
Total alkalinity (as $CaCO_3$)	185
Calcium (as $CaCO_3$)	168
Magnesium (Mg)	67
Silica (SiO_2)	12.8
Iron (Fe)	0.08
Manganese (Mn)	Less than 0.01
Chlorides (Cl)	10.0
Sulphates (SO_4)	31.0

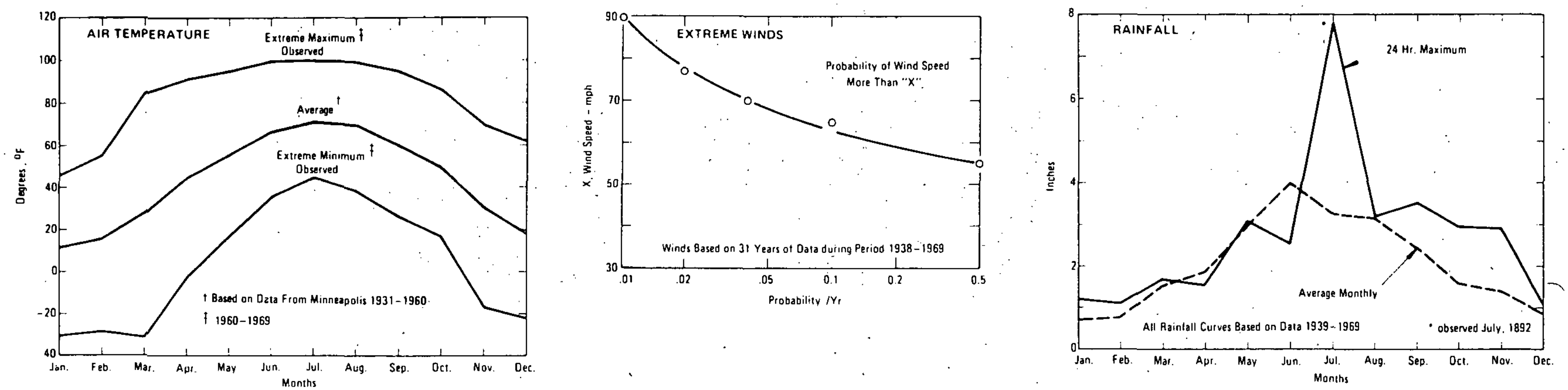
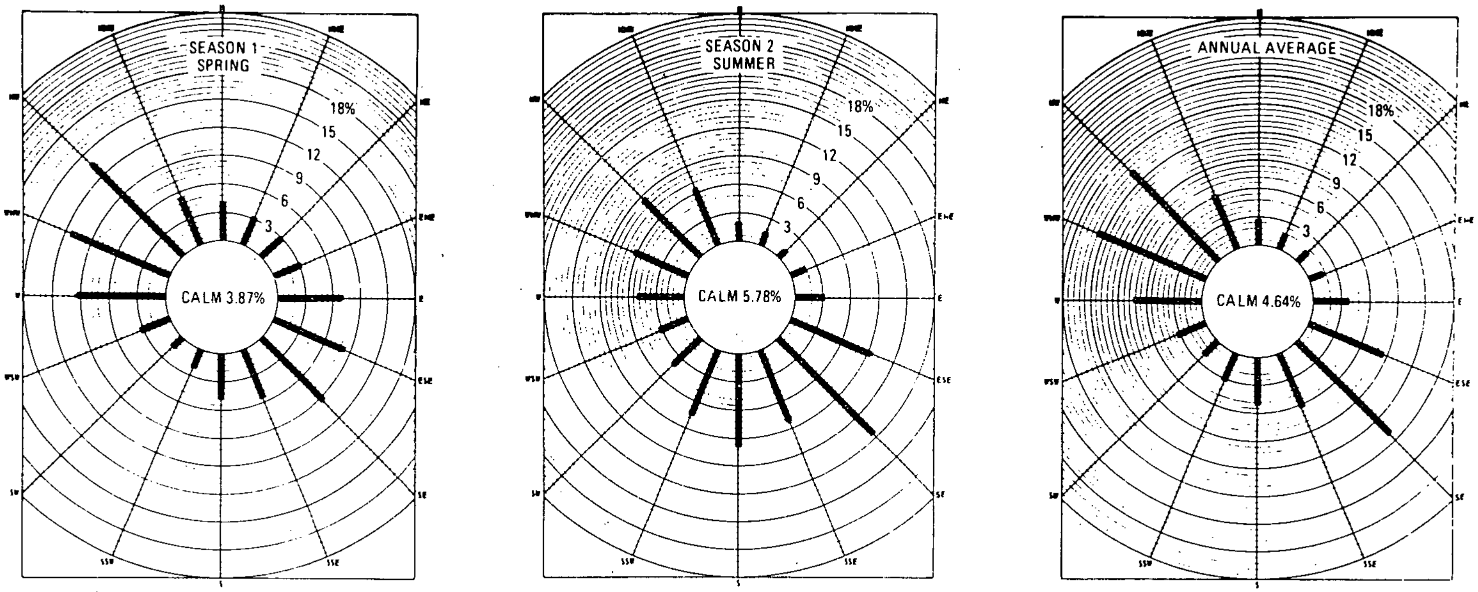


Fig. II-11. Climate of the Region



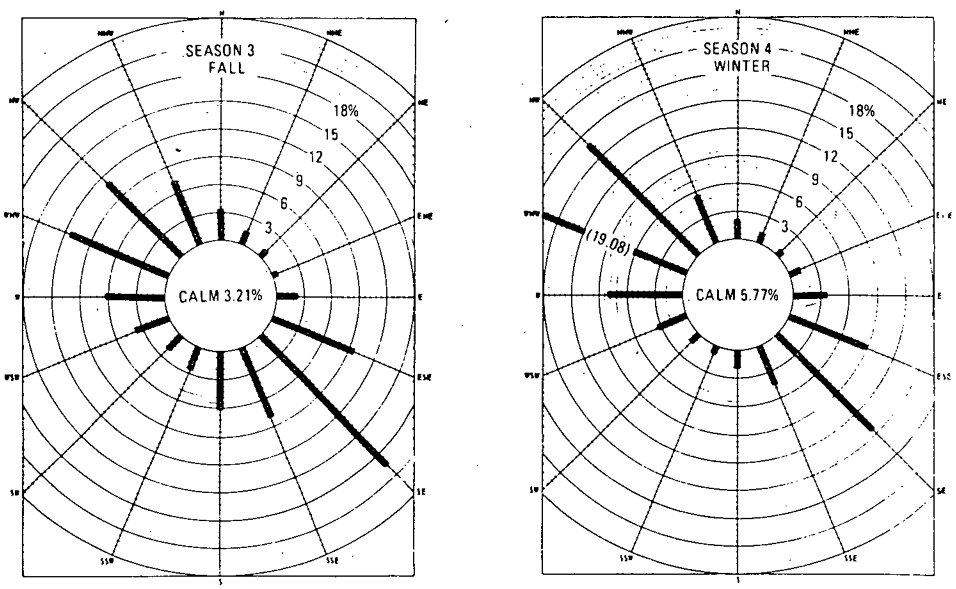


Fig. II-12

Gross Wind Roses Observed
at the 140-foot Level
of the Prairie Island Station

A comparison of these values with those for the Minneapolis airport reveals that the river valley reduces the average wind speed at the site.

b. Extreme Conditions

Some of the extremes in climatic conditions have already been indicated in Figure II-11. The maximum 24-hour rainfall was 7.80 inches in July 1892, and the maximum 24-hour snowfall was 16 inches in November 1940. The probability per year for the occurrence of a wind in excess of a specific value, based on past observations, is depicted in the central portion of Figure II-11.[20] Thus a wind in excess of 55 mph would be expected only once every 2 years.

The recurrence interval for a wind in excess of 100 mph is 100 years, and both this speed and frequency are comparable with those for tornadoes in the vicinity of the Plant. Minnesota is located north of the principal U. S. tornado belt. However, 15 tornadoes and 21 funnel clouds were reported in the 1° square (of latitude and longitude) centered about the site during the 7-year period from 1963 to 1969. The estimated[21] probability of a tornado striking a point within the area having this frequency of occurrences of tornadoes and funnel clouds (assumed to be tornadoes) is 0.0045 per year, or a recurrence interval of 220 years.

4. Geology

a. Regional Geology

The bedrock in the Minnesota-Wisconsin region is separated into two major divisions: (1) older, predominantly crystalline rocks of the Precambrian Era, and (2) younger, flat-lying sedimentary rocks of the Paleozoic. The Precambrain Era lasted from the time the earth cooled, over 4 billion years ago, until the Paleozoic Era which began about 500 million years ago. During this vast period, sediments, some of which now form existing iron ores, were deposited in ancient oceans, volcanoes spewed forth ash and lava, mountains were built and destroyed, and the rocks of the upper crust were invaded by molten rocks of deep-seated origin. Only a fragmentary record of these events remains. This oldest bedrock consists of granite, gneiss, schist, and volcanics.

The Paleozoic Era began with the Cambrian Period, the rocks of which indicate that the region was twice submerged beneath the sea. Rivers carried sediments which were deposited in the sea to form sandstones and shales. Animals and plants living in the sea deposited calcium carbonate and built reefs to form rocks which are now dolomite. These same processes continued into later geological periods. Deposits, built up in the sea when the land was submerged, were partially or completely eroded at times when they were elevated above sea level. The Precambrian bedrock is overlain by as much as 800 feet of Paleozoic sandstone, shale, and dolomite. Figure II-13 is a map of the bedrock formations of the region.

Available evidence indicates that toward the close of the Paleozoic Era, perhaps some 250 million years ago, a period of gentle uplift began that has continued to the present. During this time, the land surface was carved by rain, wind, and running water. The final scene took place during the last million years, when glaciers invaded the region from the north and sculptured the land surface. Younger formations originally present in the region have been removed by erosion, and an irregular topography has been developed on the exposed bedrock surface. Except for local areas in southeastern Minnesota and parts of Wisconsin, bedrock is concealed under 100 to 300 feet of Pleistocene glacial drift. In contrast, the extreme southeastern tip of Minnesota, including the site vicinity, is covered only by a thin veneer of drift. It is therefore considered a part of the "driftless" area commonly referred to by glacial geologists. In this driftless area of Minnesota and central and southwestern Wisconsin, the unconsolidated materials consist primarily of loess, recent alluvium, and residual soil.

The subsurface geologic features for the region are indicated in a generalized stratigraphic column in Table II-21. A geologic column showing the thicknesses and age relationships of the various bedrock units and surficial deposits of the region is also included there.

b. Local Conditions

The site is part of the lowland area of the Mississippi River flood plain. The plain is a broad valley bounded by rocky bluffs and forested slopes. The valley contains an assortment of land and water bodies. The site is located on a low island terrace, much of which is under cultivation. Other adjacent land areas are forested or covered by swamp vegetation.

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 sandstones with minor shale horizons.

Test borings were performed for the Applicant at several locations on the site to determine the soil, rock, and groundwater conditions. Borings

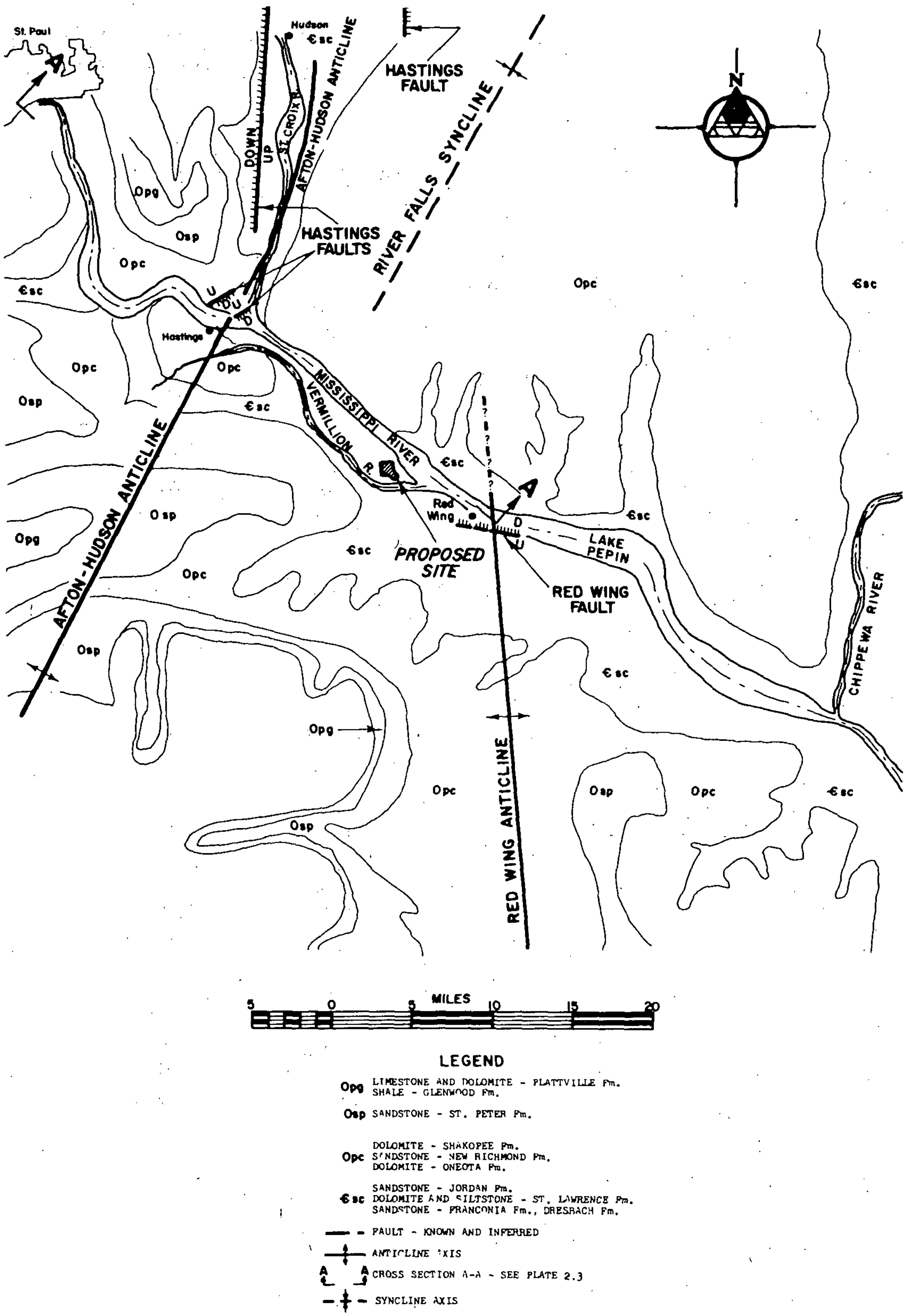


Fig. II-13. Regional Geologic Map of Bedrock Formations

TABLE II-21 Geologic Formations in the General Area of the Site

GEOLOGIC AGE ERA PERIOD	GEOLOGIC NAME	APPROX. THICKNESS IN FEET	DESCRIPTION	REMARKS
Cenozoic Quarternary	Recent deposits		Unconsolidated clay, silt, sand, and gravel	Largely Mississippi and Vermillion River deposits
	Pleistocene	20 to 200	Unconsolidated clay, silt, sand, gravel and boulders deposited as till, outwash and loess	Largely from Superior and Des Moines lobes of Wisconsin glaciation
Paleozoic Ordovician	Oneota	100	Dolomite	Exposed along river bluffs
Cambrian	Jordan	100	Sandstone	An important aquifer
	Saint Lawrence formation	43	Dolomite, siltstone and silty dolomite	
	Franconia Formation (St. Croix series)	180	Sandstone and shale	Aquifer zones. Uppermost bed-rock at site
	Dresbach formation (St. Croix series)	100+	Sandstone, siltstone	Aquifer zones
Precambrian Keweenawan	Hinckley formation	100+	Sandstone	An important aquifer
	Red clastic series		Sandstone and Red Shale	May not be present under the site
	Volcanics		Mafic lava flow with thin layers of tuff and breccia	May be present under the site
	Granite and associated intrusives			Principal basement rock under the site

from ground-surface elevations (ranging from 675 to 706 feet) to depths of from 174 to 213 feet revealed that the general subsurface conditions at the site are essentially a layered system containing three predominant soil zones, underlain by rock. These zones are described below:

Elevation in Feet	Description
690-665	Predominantly loose granular soils which exhibit relatively low strength and moderately high compressibility characteristics. These soils consist of brown loose fine- to-medium-grained sands, which are partially saturated above the water table (~674).
665-645	Predominantly medium-dense to dense granular soils exhibiting moderate strength and compressibility characteristics. The soils consist of brown fine- to-medium sands containing varying amounts of coarse sand and gravel. This zone contains interspersed, discontinuous layers of loose granular soils. These soils are located below the groundwater table and are denser than the overlying sands.
645-515	Predominantly dense to very dense, fine- to medium-grained granular soils containing interspersed discontinuous zones of coarse grained sands, gravels and cobbles. Generally, the lower 10 to 30 feet of this zone contains many cobbles and boulders. These soils exhibit moderately high strength and relatively low compressibility characteristics. These soils are saturated and are somewhat denser than the overlying sands.
515 to the depths penetrated by the borings	Paleozoic sandstone of the Franconia formation. The sandstone encountered in the borings consist predominantly of a gray fine- and medium-grained quartz sandstone containing loose and cemented zones.

The shoreline along most of the site is characterized by relatively steep stable slopes covered with dense growths of surface vegetation and trees. The shoreline has undergone minor erosion, principally by river action during high-water levels, but is reasonably well stabilized by the growths.

c. Structure and Faulting

The dominant structural feature in southeastern Minnesota and adjacent areas of Wisconsin and Iowa is the Keweenawan Basin. This basin was formed in Precambrian time and extends from Lake Superior into Iowa. A large basin in the Paleozoic rocks extends northward from Iowa into the southeastern corner of Minnesota. This basin is separated from a smaller basin in the Twin Cities area by the Afton-Hudson anticline. The anticline begins at Farmington and trends northeastward through Hastings, Minnesota, and Hudson, Wisconsin. A syncline lies to the east of this structure in the vicinity of River Falls, Wisconsin. Near the southeastern corner of Minnesota, a second anticline, the Red Wing Anticline, extends from Rochester through Red Wing and is postulated to extend a short distance into Wisconsin. The locations of these anticlines and syncline are shown in Figure II-13.

Several major faults in the Minnesota-Wisconsin region have been inferred from geophysical surveys. The principal movements along these faults, which amounted to thousands of feet, appear to have been restricted to Precambrian time. There is no evidence of recent activity along any of the known fault zones in the Minnesota-Wisconsin region.

The Hastings fault, located on the south side of the Keweenawan Basin, trends southwest near the city of Hastings, about 13 miles northwest of the site. Minor activity occurred along the Hastings fault during both Precambrian and Paleozic times. Minor movements occurred in the overlying Paleozoic strata 6 miles southeast of the site near the city of Red Wing. The Hastings and Red Wing faults are shown in Figure II-13. Other small movements in the Paleozoic strata have occurred in the River Falls syncline near Waverly, Wisconsin, about 20 miles northeast of the site.

Figure II-14 combines some of the structure and faults shown in Figure II-13 with subsurface data, such as given in Table II-21. This provides an illustration of the geologic features in the general vicinity of the Plant.

d. Seismic Activity

There are no identifiable active faults or other geologic structures that could be expected to localize earthquakes in the immediate vicinity of the site. However, details regarding either the local or regional geologic structures are not well known in this area, owing to the thick cover of overburden that obscures bedrock in most places. Because epicenters of earthquakes that have occurred in the area cannot now be related directly to any known geologic structures, it must be assumed that earthquakes of intensities characteristic of this general area may occur anywhere within the area.

Based on the limited records available, the region is considered to be among the least active seismic zones in the United States. The epicenters

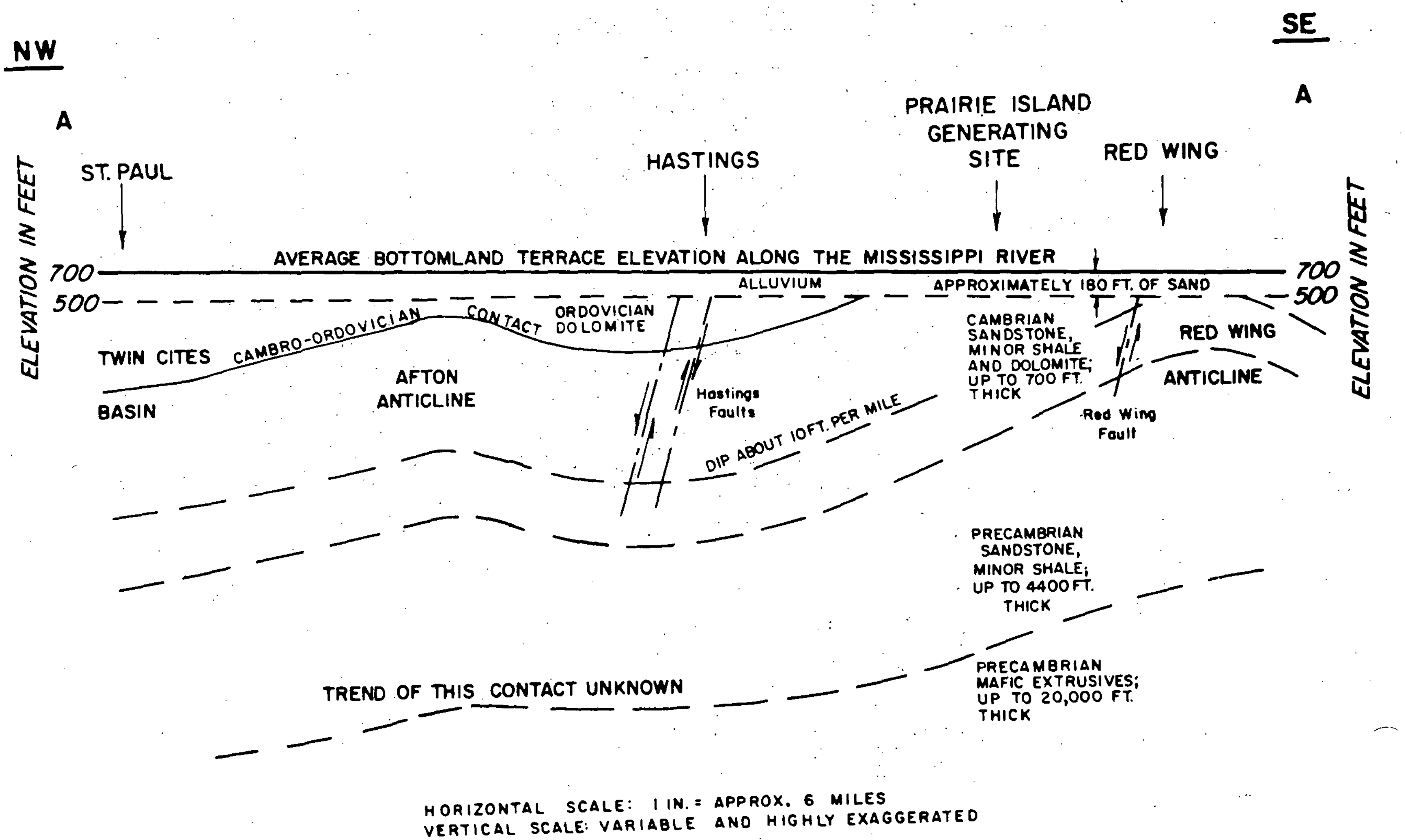


Fig. II-14. Regional Geologic Cross Section A-A for the six significant earthquakes reported for Minnesota are identified in Figure II-15. The earliest reported one occurred in 1860, and the intensities for all have been moderate, ranging up to VI on the Mercalli scale ("felt by all, damage slight").

No shock with an epicenter within a distance of 50 miles from the site is known. Minnesota's earthquakes have been centered in an area more than 100 miles northwest of the site. No other shock epicenters that close to the site have been reported for the states of Wisconsin and Iowa.

E. ECOLOGY OF SITE AND ENVIRONS

1. General

The Applicant, with the advice of the Minnesota Pollution Control Agency, the Minnesota Department of Natural Resources, and the Minnesota Department of Health, has designed and implemented an ecological study program in the region of the Plant. The purpose of this study has been to establish present ecological characteristics (biological, physical, and chemical composition of the environment) prior to plant operation. The Applicant will use the information obtained as a standard for the detection, through subsequent monitoring programs, of any detrimental impact of the Plant.[6]

Various aspects of this ecological study were started more than three years before the expected plant startup, now planned for the mid-1973. The Applicant will be required to continue ecological investigations and monitoring after startup. Many of the different species of plants and animals have already been identified, as have some of the approximate population sizes.[6,33]

Major tributaries of the Mississippi that influence the natural aquatic biota at and near the Plant are the Minnesota River, entering at the south boundary of the Twin Cities, and the St. Croix River, entering 13.0 river miles upstream from the Plant site. The Vermillion River enters 4 river miles downstream, and the Cannon River enters 4.5 river miles downstream.

Environmental factors presently influencing the Mississippi River ecosystem near the Plant are the Minneapolis-St. Paul sewage plant, the 9-foot minimum-depth navigation channel, and the nutrient runoff from the surrounding crop land. Generally, the structure of the biotic community in the river near the Plant is similar to that found considerably downstream from an area of high organic pollution, but still within its

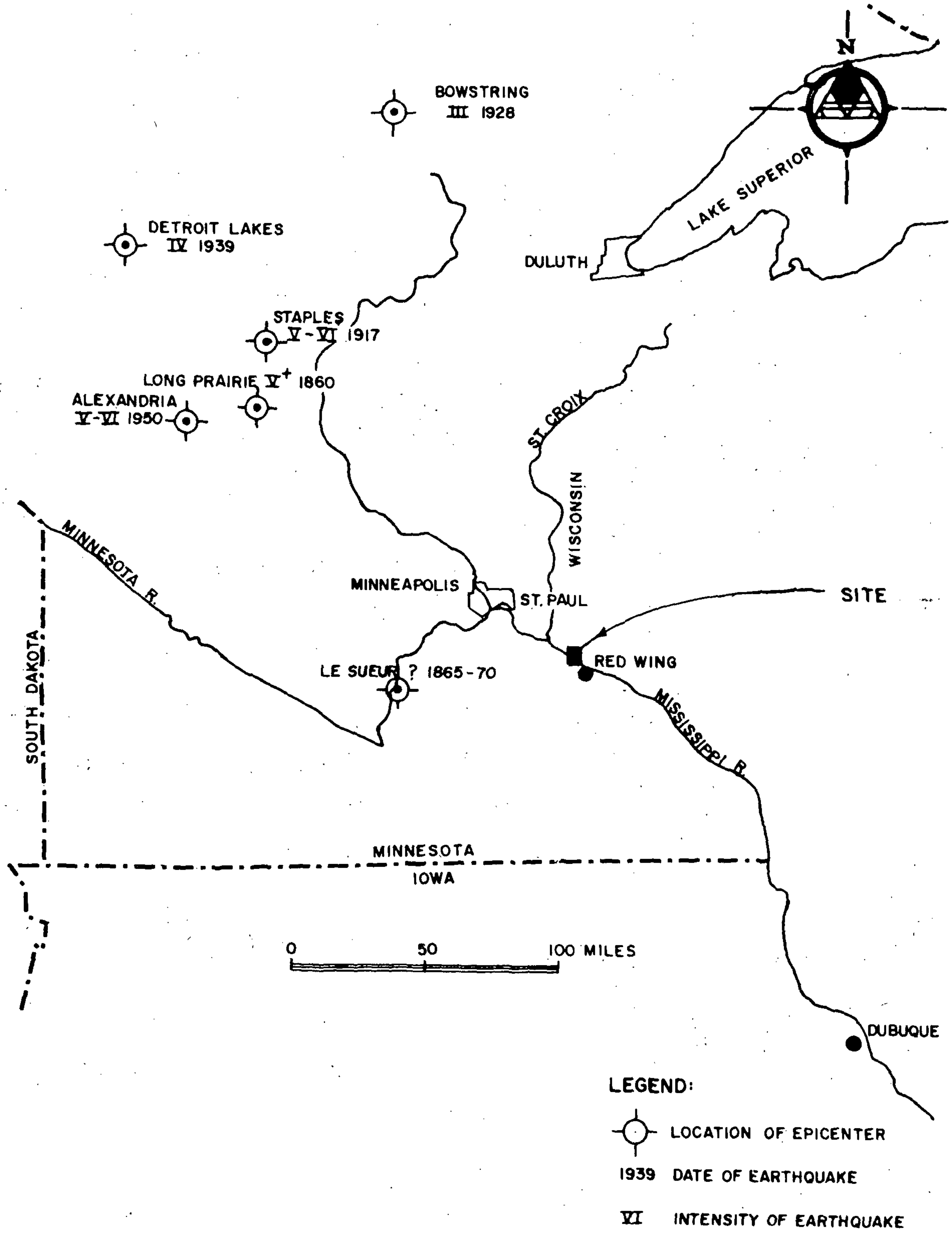


Fig. II-15. Earthquake Events in Minnesota influence. The presence of such species as redhorse, smallmouth bass, sauger, and walleye among the fishes and such invertebrates as Stenonema sp., Baetis sp., Pseudocleon sp., Hydropsyche sp., Cheumatopsyche sp., Isoperla sp., Perloden sp., and Unionidae clams would indicate that this is downstream from the major portion of the recovery zone. The diversity of the bottom invertebrates is greatly affected by the dredged navigation channel and wing dams. Within the channel, a sand-clay bottom exists above the Lock & Dam No. 3. The tailwaters below the dam give the bottom a coarse composition. As the water velocity decreases, the composition returns to a sand-clay bottom. Due to the scouring actions of barges, few bottom organisms exist within the navigation channel.

Along the shoreline, both upstream and downstream from the dam, relatively pollution-intolerant species are found (e.g., mayfly larva). Their presence indicates the ability of the river to recover from the organic loads of the Twin Cities metropolitan area. Coarse rock of the wing dams and riprap along the shoreline provide excellent substrate for these bottom organisms. Pollution-tolerant, as well as intolerant, bottom organisms are found in the Vermillion River near the Plant. The Vermillion drains a relatively large area of farm land and receives untreated sewage from sources in the Hastings, Minnesota, area.[6,33]

2. Terrestrial

The 560-acre Prairie Island site is primarily composed of sandy soil of marginal agricultural value. Principal crops have included soybeans, corn, oats, and hay. However, the site has now been withdrawn by the Applicant from farming and cultivation. The three most common grasses found on the site are Little Bluestem (Andropogon scoparius), Big Bluestem (Andropogon geraldi), and Kentucky Bluegrass (Poa pratensis).

The common weed species found on or near the site include several Aster species, goldenrod, and several legumes including Petalostemum purpureum. The floodplain flora is somewhat transient; each new high-water season may bring new species and remove old ones.

Prairie Island area trees may be classified into four major groups: 1) floodplain; 2) dryer flat upland areas; 3) north facing slopes of the valleys in the vicinity of the site; and 4) the dryer south facing slopes (Table A-1).[30]

Table II-22 lists the important shrubs that grow within a 10-mile radius of the Plant.[30] Blue-flag and prairie phlox herbs are considered rare, although they may be found on or near the site. Blue-lyed grass is also rare.

TABLE II-22. Major Shrubs within a 10-Mile Radius of the Plant

Staghorn sumac (*Rhus typhina*)

Poison ivy (*Rhus radicans*)

Bittersweet (*Celastrus scandens*)

Red-Osier dogwood (*Cornus stolonifera*)

River grape (*Vitis riparia*)

Red raspberry (*Rubusindaeus*)

Virginia creeper (*Parthenocissus quinquefolia*)

Prickly ash (*Xanthoxylum americanum*)

Insects of the Plant site and region, other than mosquitoes, are listed in Appendix A, Table A-2.[30]

Three genera of mosquitoes are present within a 30 mile radius of the Plant:

1) Aedes triceriatus: In 1971, this mosquito was indicated as the vector of a viral encephalomyelitis. A number of human cases were reported from the Mississippi River Basin area in Minnesota and Wisconsin, with some 17 cases from Minnesota. The species is not considered common in the area and constituted less than 1% of light trap catches near Hastings, Minnesota. It is found in wooded areas and is known to be a tree-hole breeder. It feeds primarily on the blood of small mammals (squirrels, etc.); it attacks at night, but humans are only incidental victims.

2) Aedes vexans: This species is one of the most common in Minnesota. It is a noxious human pest and sometimes transmits pathogens such as canine filariasis (Dirofilaria immitis) from dog to dog, and rarely from dog to man. D. immitis has been found in a patient at the Mayo Clinic in Rochester, Minnesota.[30]

3) Culex tarsalis: This mosquito has been reported in low abundance throughout the state and is a potential vector of equine and human encephalomyelitis viruses. It feeds primarily on bird blood.

Minnesota mosquitoes are in season from roughly May to late summer. Most Aedes species overwinter as eggs; the eggs are laid on moist, but not wet, land and will hatch only when these areas are flooded or wetted. Thus, seasons with spring and summers of higher precipitation result in greater populations of Aedes species in a given area than occur in drier seasons.

Four species of anophelines, each a potential vector of human malarial parasites, occur in the upper Mississippi River Valley. These are Anopheles quadrimaculatus, A. walkeri, A. punctipennis, and A. maculipennis. They have comprised less than 1% of light trap collections of females of all species over a 10-year period (1962-1971) in the Twin Cities metropolitan area.

Migratory waterfowl that may be found in the Plant area are mostly ducks which include the black, Gadwall, pintail, green-winged teal, American widgeon, shoveler, redhead, ring-necked, canvasback, greater scaup, lesser scaup, common goldeneye, bufflehead, and ruddy ducks.[30]

The geese in this area are composed of Canada, snow, and blue species. Other migratory waterfowl include whistling swans, horned grebes, common loons, red-breasted and common mergansers, and sea gulls (herring, ring-billed, Franklins, and Bonaparte's).

Waterfowl that nest within a 10-mile radius of the Prairie Island area are the great blue heron, American egret and mallard, blue-winged teal, and wood ducks; hooded mergansers, coots, and pied-billed grebes are also present. The abundance of the nesting waterfowl has not been estimated.

The Mississippi River Valley is a major migratory flyway for many birds in addition to the waterfowl already mentioned. Most of these birds, listed in Table A-3, are terrestrial. The trumpeter swan may migrate through the area, and the bald eagle is a regular migrant in the Mississippi River Valley.[30] A number of other birds, primarily terrestrial, nest in the Prairie Island area. These are listed in Table A-4.[30]

Reptiles within a 10-mile radius of the Plant are listed in Table A-5.[30] The most frequently observed amphibia in the Prairie Island area within a 10-mile radius are listed in Table II-23. No permanent-resident terrestrial animals in the area are threatened.[29] The Clam Lampsilis higginsii is an endangered species which has part of its natural range occurring within the Prairie Island stretch of the Mississippi River. The clam has been found in the St. Croix River downstream of Stillwater, Minnesota.

There are a number of terrestrial and aquatic wildlife refuge and sanctuary areas in the Plant region.[27] A wildlife refuge extends about a half-mile east of the Plant, a half-mile north, and 2 miles south-southeast. A wildlife sanctuary, managed by the Minnesota Department of Natural Resources, starts approximately 3 miles northwest of the Plant; a wildlife refuge adjoining it begins about 4.5 miles northwest of the Plant and extends further northwest for about 2.5 miles. To the west of these and Muskrat Lake lies a wood duck wildlife-management area. The Gores Wildlife Management area is north of the latter, beginning about 7 miles northwest of the Plant. The Mud Hen Lakes lie within the Gores area which is bounded on the north by the Mississippi River, and on the west by a branch of the Vermillion River and Truedale Slough. West-northwest of the Gores area lie the Ravenna Wildlife Management area and other wildlife refuge space that lies between it and the Mississippi River, extending farther west-northwest of the Plant.[27]

Another wildlife refuge begins about 2 miles southeast of the Plant and extends downriver into the Red Wing, Minnesota region. It is bisected by

TABLE II-23. Amphibia Characteristic of the Region

Caudata (Salamanders)

- *Necturus maculosus* - Mud puppy
- *Ambystoma tigrinum* - Tiger salamander
- *Plethodon cinereus* - Red-backed salamander (rare)

Anura (Toads and Frogs)

- *Bufo americanus* - American toad
- *Pseudacris nigrita* - Swamp chorus frog
- *Hyla crucifer* - Spring peeper
- *Hyla versicolor* - Tree frog
- *Rana pipiens* - Leopard frog
- *Rana clamitans* - Green frog
- *Rana sylvatica* - Wood frog

the Cannon River. The only known endangered species[29] in these areas is the American eagle. The bald eagle is a frequent migrant through the area, but no nesting sites within the vicinity of the Plant have been identified.

3. Aquatic (Mississippi River System)

a. Phytoplankton

The phytoplankton survey and monitoring program at Prairie Island began in May 1969 and is being conducted for the Applicant by Dr. Alan J. Brook, Professor and Head of the Department of Ecology and Behaviorial Biology, University of Minnesota.[33] The Applicant studied the phytoplankton in the Prairie Island region of the Mississippi River in 1970-71 to determine the algal species composition, density, and distribution, and to learn how these parameters vary in the different parts of this river, as well as in its feeder rivers, lakes, and sloughs. These data can be used as a basis for measuring the effects of the heated discharge from the Plant on the algal species composition, density, and distribution in the recipient water bodies.[28,33] Before the Plant startup, it is important to know the content and dynamics of the algal blooms in the region, their distribution in different parts of the river, and, if possible, the environmental conditions that bring about their formation. Numerous species of algae have been identified and are listed in Table A-6. There are two families and a total of 28 genera of cyanophytes (blue-green algae), three families and 46 genera of chlorophyte algae, two families and 21 genera of chrysophyte algae, and a total of 10 genera of Euglenophyta and Cryptophyta. Some authorities classify some organisms in the latter two groups as protozoa.[34] A planktonic algal community periodically develops in the Mississippi River at Prairie Island. The large sloughs (North Lake and Sturgeon Lake) just north of the Plant may develop populations quite distinct from those in the Mississippi River.[6]

In the spring and fall there are usually marked peaks of diatom production; in early summer, green algae predominate. Intense summer "blooms" of blue-green algae sometimes develop in the river in the vicinity of Prairie Island, in Sturgeon Lake, and in some other protected regions. As part of the Applicant's ecological studies of the Mississippi River in the vicinity of the Plant, phytoplankton population densities were measured. Phytoplankton measurements near the outlet of Sturgeon Lake between May 1969 and November 1970 indicated a population density in the range between 3.5×10^3 and 3.0×10^4 organisms per cubic centimeter.

The abundance of phytoplankton in a particular locality in the river will depend partly on environmental conditions existing a considerable distance upstream. The sparse knowledge of the ecology of most phytoplankton organisms, more than 90 different species of which have so far been identified near the Plant, does not indicate very clearly which factors cause or inhibit algal blooms or produce shifts in species composition.

Brook has shown[31] that the abundance of some species, especially members of Cyanophyta, is inversely proportional to current speed; other species, particularly the Bacillariophyceae diatoms, have the opposite response and their abundance is directly proportional to the speed of the river water current.

In the spring and fall, the dominant diatoms in the Plant region are eutrophic, but instead of Melosira granulata characteristic of the St. Croix River and eutrophic lakes, they are small centric diatoms (Stephanodiscus astraea), which are tolerant of polluted water. In 1969 and 1970 the latter were dominant in Sturgeon Lake (see below). However, Melosira granulata and Synedra acus may be present in significant numbers at certain times.

In midsummer the phytoplankton contains eutrophic chlorococcal species, with several varieties of Ankistrodesmus falcatus and several species of Scenedesmus. Other typically eutrophic species present are Pediastrum duplex and P. simplex, Dictyosphaerium, Crucigenia, and Tetraedron species.

The late-summer plankton are Cyanophytes, including such typical species as Aphanizomenon flos aquae, Anabaena flos aquae, Anabaena circinalis, Anabaenopsis raciborskii , and several species of Oscillatoria (the most prominent).

Quantitative studies in the river in the Plant region showed that there is a patchiness in plankton distribution from place to place, but certain trends are quite consistent. Just above Lock and Dam No. 3 there is usually a high concentration of phytoplankton, as well as in Sturgeon Lake (e.g., 20,000 organisms/ml or more in August). There are marked seasonal changes in the phytoplankton. Counting and analysis have shown that in addition to diatoms (Crysophyta), the blue-green algae (Cyanophyta) and green algae (Chlorophyta) are the major phytoplankton components. In 1969 the Cyanophyta peaked only once early in September, at 3600 organisms/ml, but in 1970 there was a very large late July peak of 5640 organisms/ml and an August maximum of 3700 organisms/ml. In both years the blue-greens were very abundant in Sturgeon Lake, and least plentiful just upstream from Lock and Dam No. 3. The most abundant species of blue-green algae in both years were Anabaena flos aquae, Anabaenopsis raciborskii, Aphanizomenon flos aquae, Oscillatoria agardhii, and O. limnetica.

Like the blue-green algae, the diatoms, largely the centric diatoms Stephanodiscus astraea and var. minutula, were most abundant in Sturgeon Lake and least so just upstream from Lock and Dam No. 3. Since S. astraea is a pollution tolerant diatom, its relatively low population density near the dam may indicate the absence of appreciable pollution. The Chlorophyta or green algae are represented in the river primarily by Chlorococcales, such as Ankistrodesmus falcatus varieties and several species of Scenedesmus and Pediastrum. Lock and Dam No. 3 mixes the water from Sturgeon Lake and the river as it passes through, reducing the phytoplankton concentration downstream from the dam. However, gross numbers above and below the lock and dam may be the same since the phytoplankton are stratified to some extent above the mixing area at the dam. Blooms reappear on Lake Pepin (11 river miles downstream from Lock and Dam No. 3) as the river's velocity decreases.

In 1969, the phytoplankters typically showed a clear midsummer maximum at all sampling stations. The greatest abundance (2500 organisms/ml) was found in Sturgeon Lake in early August. In 1970, there was a much greater range of abundance between stations than in 1969 with no clear midsummer maximum. This pattern of periodicity may be related to competitive effects from the large mid-summer maximum of blue-green algae which were present in July and August.

b. Zooplankton

Inclusion of a zooplankton study is based upon the recognition of the roles of protozoa and then rotifers and crustaceans in turn in the active consumption of bacterial and algal populations within the river, and as food organisms for the next trophic level. Many phytoplankters are located near the surface of natural bodies of water unless currents drive them to other levels. The zooplankters are generally situated in close proximity to their food sources, which include bacteria and algae. The bacteria are frequently adsorbed onto the surfaces of particulate matter and algae which may cause them to sink. When turbulence in the Mississippi decreased, algae had a tendency to either mass nearer the surface, which in turn resulted in greater numbers of surface zooplankton,[28,33] or to settle, followed by the zooplankton which sought them for food.

The most frequently observed zooplankters found during the 1970-1971 sampling seasons in the Mississippi River at Prairie Island were rotifers, crustaceans and protozoa as listed in Table II-24.[6] The average number of zooplankton per liter during July (1970) was 300, and the numbers per liter ranged from 600 to 800 from August through November. The predominant crustaceans during July and August were species of Daphnia, Cyclops, and Bosmina. During September the Daphnia were co-dominant with

TABLE II-24. Major Zooplankters Collected and Identified During 1971 in the Mississippi River/Sturgeon Lake Study Areas[33]

A. ROTIFERS		
Asplanchna		-------------------------
Brachionus	(cf.)	angularis
		calyciflorus
		caudatus
		havanaensis
		quadridentata
		rubens
		urceolaris
Keratella	(cf.)	cochlearis
		quadrata
		gracilenta
Monostyla		-------------------------
Ploesma		-------------------------
Polyarthra		-------------------------
Synchaeta		-------------------------
Trichocerca		-------------------------
B. MICROCRUSTACEANS		
Cladocerans		
Bosmina	(cf.)	coregoni
		longirostris
Daphnia	(cf.)	longispina
		pulex
		retrocurva
Copepods		
Cyclops		-------------------------
Diaptomus		-------------------------
C. PROTOZOANS		
Amoeba	(cf.)	radiosa
Difflugia		-------------------------

Organisms collected with surface and subsurface nets in open water.

Cyclops and its nauplii. Daphnia was abundant during the early part of October and appeared as the predominant genus during the latter part of October. No species was predominant during November. Data were not available from December through June.

The predominant rotifers from July through November 1970 were species of the genus Keratella. Species of the genus Brachionus were abundant during the same months except November. Trichocerca rotifers were predominant during July, August, and October. Several other species were abundant during one or more months of the sampling season, but they "bloomed" less frequently than those mentioned.

c. Bacteria

The coliform count (per 100 ml) in the Mississippi River at Lock and Dam No. 3 ranged from 4000 to 100,000 during the year studied (1965-66). The median count was 25,000. This is consistent with a high level of coliform pollution throughout the year in the Mississippi River at a location some 50 miles downriver from the Twin Cities.[26]

d. Benthos (Macroinvertebrates)

A substantial investigation of the benthic macroinvertebrates of the Plant region during 1970-71 was done for the Applicant.[6,28,33] It was learned that the Mississippi River in the site area has a rather firm substrate of sand, clay, and to some extent, muck mixed into these areas. This portion of the river is downstream from most of the deleterious effects associated with the Minneapolis-St. Paul urban area. Navigation by barges, however, creates a relatively "washed out" bottom substrate which further reduces the numbers and types of organisms that can survive in the area. The various benthos macroinvertebrate species found in the region of the Plant are listed in Table A-7.

The predominant organisms of the benthos outside of the areas scoured by shipping were midge fly larvae and oligochaetes. Tubificid worms were found throughout the site region's benthos during the entire summer of study. Various investigators[26] have linked high tubificid populations with organic pollution. During July and August, sponges and flatworms were found in about a dozen places upstream and downstream from the Plant. Bryozoa (one species) were found in samples taken primarily during August and September, upstream and downstream from the Plant.[6]

Due in part to scouring of barges, few dipterans and oligochaetes were observed in the main channel. In more protected areas the predominant organisms that appeared in the Peterson dredging samples were the pollution-resistant midge fly larvae and oligochaetes.

In the Mississippi River at Prairie Island the peak population of midges occurred in July (1970), and for oligochaetes the peak was in September.[28] A total of 1800 midges and oligochaetes were identified in this study. Those organisms that attach to underwater objects use the considerable number of wing-dams in the area for substrates, and are usually able to survive. Hand picking and sorting, which was required to sample the wing-dam fauna, yielded at least 67 species.

Most of the Twin Cities' effluvia are decomposed and diluted by the time they reach the general region of the Plant, which allows some of the more pollution-tolerant macroinvertebrates to survive and reproduce. Several of the Caddisflies and Mayflies, which are generally pollution-sensitive, have begun to establish themselves in the portion of the river just above Lock and Dam No. 3. The floating macrophyte debris affords its own faunal populations, but a few macrophyte plant associations are established along this portion of the river. High-water-level conditions annually pick up and move adjacent terrestrial macrophytes and debris into the main channels. These branches and trunks of trees all form food sources and floating "homes" for leeches, dipterans, beetles, and many other fauna. A few small clam beds are found near the community of Trenton, Wisconsin, but they are not dense enough or adequately large to sample regularly. Several clam beds in the site region have been destroyed by high siltation, which probably was deposited during floods.

A casual glance at the numbers of different species of organisms observed at the Applicant's A. S. King plant on the St. Croix River, and at the Monticello plant on the portion of the Mississippi River upstream from the Twin Cities, reveals that a larger variety of species has been found at each of these plant sites than at the Prairie Island site.[31,32] This is due partly to the A. S. King and Monticello environmental monitoring and ecological studies programs which have been operating for up to four years longer than the Prairie Island program, thus contributing to the larger number of species recorded at these plant sites. However, the river water downstream from the Twin Cities may be less pristine than at the upstream plants, thus accounting for a lower species diversity.[33]

e. Periphyton (Attached algae, etc.)

Data on underwater attached algae and associated organisms from the Plant site region are not presently available, but the Applicant plans to initiate studies on the periphyton group in 1972.[6] The Applicant has sponsored periphyton studies for 6 years on the St. Croix River (King fossil-fuel plant) and 3 years on the Mississippi River upstream from the Twin Cities (Monticello Nuclear Generating Plant), and developed methods to determine periphyton population changes within a thermal plume.[31,32] At Prairie

Island, sampling stations will be provided for control purposes, and experimental stations will be located within the area of influence of the heated water.[6]

f. Aquatic Macrophytes

As used here, an aquatic macrophyte is a plant that may, under normal conditions, germinate and grow with at least its base in the water and is large enough to be seen by the naked eye. Trees, except willows, are omitted from this analysis.

The aquatic macrophytes along the main channel of the Mississippi River in the region of the Plant are relatively few in number and widely dispersed, and they are of negligible ecological significance.[6,28] The channel conformation, river-level fluctuations, and scouring effects of various types of watercraft all contribute to the downgrading of the channel as an advantageous habitat for macrophytes. Hardy and perennial plants such as willows (Salix sp.), arrowhead (Sagittaria sp.) and rushes (Juncus sp.) are able to survive because their mode of asexual reproduction allows for propagation after severe injury.[28]

Above Lock and Dam No. 3, the river is a relatively contained channel from the St. Croix confluence, with side sloughs or water impoundments called North and Sturgeon Lakes. These lakes would more properly be thought of as marshes if they were not associated with the river. North Lake is set aside as a conservation area for waterfowl. Sturgeon Lake (0-12 feet) is a little deeper than North Lake, and closer to the Plant. A water-to-marsh ecological succession is gradually occurring in both of these lakes.[28] The usual cattail-arrowhead plant associations occur in the very shallow waters and mud flats.

Small "cuts" or passageways in Sturgeon Lake bring in water and build small sandbars in the delta side of the water movement. In these bar areas, the pondweeds (Potamogeton crispus) and P. pectinatus were observed in scattered patches. In the autumn, floating "islands" of smartweeds (Polygonum sp.) were observed during periods of high wind. There are few emergent plants in the upper Sturgeon Lake area, north of the cattail-arrowhead (Typha-Sagittaria) growth region in the middle and southern portions of the lake.[6]

The main channel transects studied by the Applicant are named in a downstream sequence from A-1 to G-2; A-1 through B-1 are upstream from the Plant.[6] The locations are shown in Figures II-16 and II-17. Transect A-1 has a shallow sand beach on the Minnesota side with no rooted or emergent vegetation evident. The Wisconsin shore shallows into a willow thicket (Sallix sp.) with little vegetation seen other

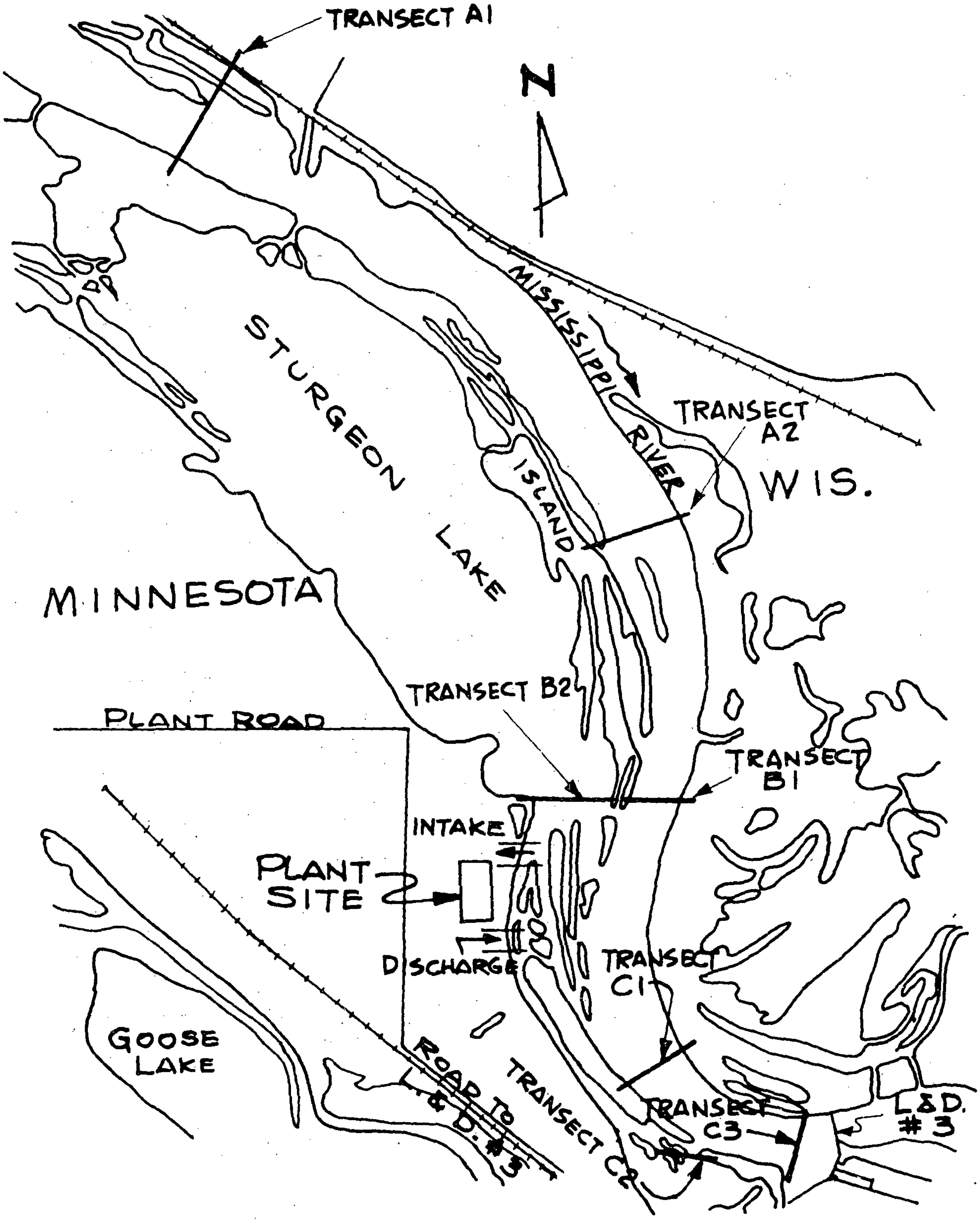


Fig. II-16. Ecological Sampling Stations in the Vicinity of the Plant.

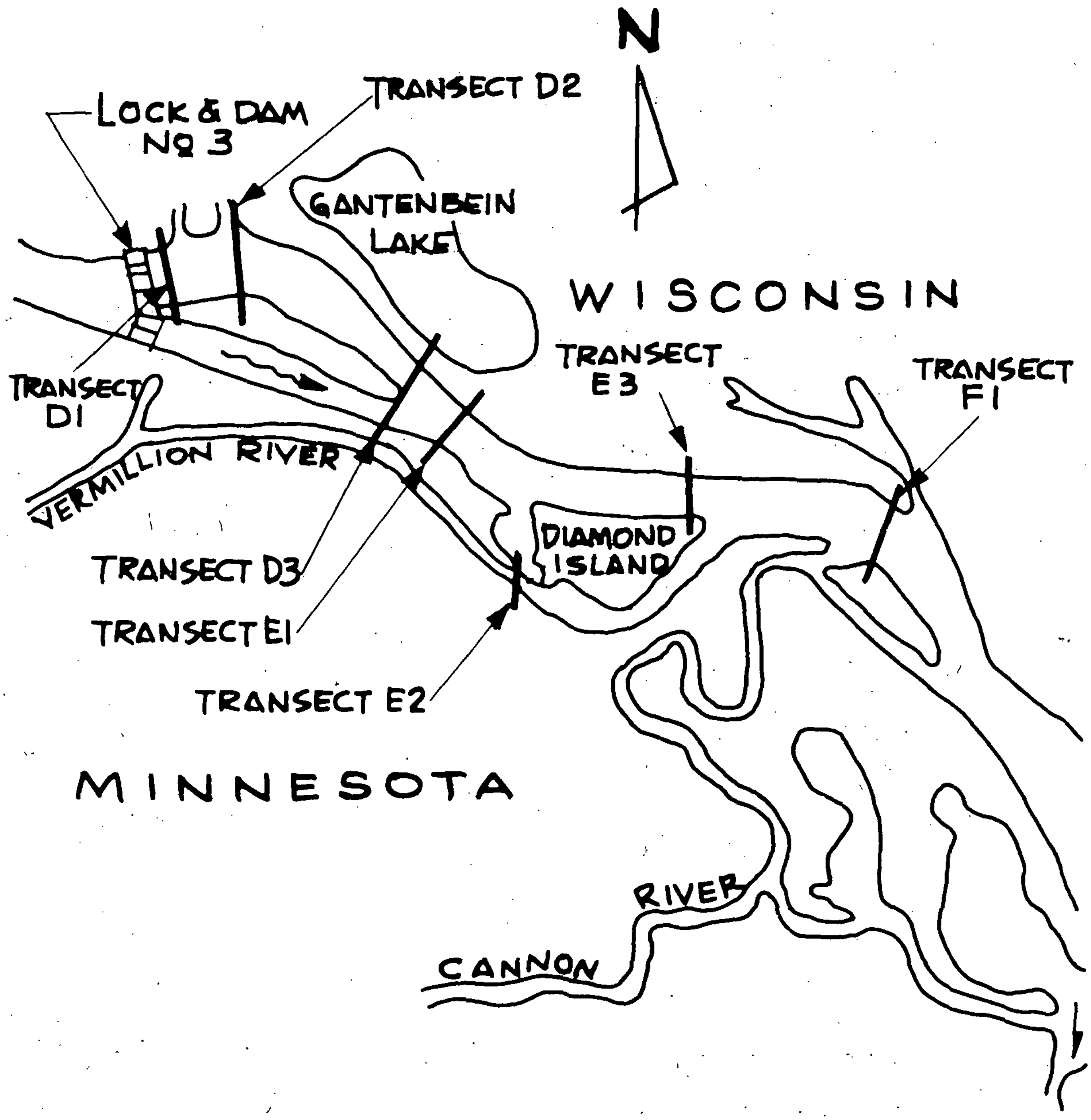


Fig. II-17. Ecological Sampling Stations Downstream from the Plant than smartweed (Polygonum sp.). Transect A-2 has a shallow beach with poplar trees on the Minnesota side. The Wisconsin shore at this level is marked by a short 50-foot sand beach. Small patches of smartweed protected by rocks grow in the bank.

Transect B-1 is marked on the Minnesota shore by an island formed by a series of wing dams. There are a few young trees on the island. Transect B-2 is located in the small channel that empties the major water flow through Sturgeon Lake. The Minnesota shore is based upon a sand bar with a series of smartweed clumps, willow thickets and a few arrowhead plants (S. latifolia). This area is very close to the Plant intake channel. The islands are formed by wing dams and silt deposition from the Wisconsin side of this transect. Some tree stumps and scattered smartweed plants were observed on this shore. This area has been altered by the Corps of Engineers and possibly others in the past and it was altered to some further extent by the Applicant (see III and IV) during the installation of the Plant intake system.

Transect C-1 is located just north of Lock and Dam No. 3. A few patches of pondweed (Potamogeton crispus and P. pectinatus) are present. Transect C-3 is on the north side and close to Lock and Dam No. 3. It crosses a conservation refuge that has extensive plant growth and is a nesting area for waterfowl. Just north of the dam on the Wisconsin side are two finger-like shallow sloughs containing a series of plants and a fair number of fish, turtles, ducks, and beaver.

There are nine families of aquatic macrophytes and a total of 14 genera. Nearly all of these were found at Lock and Dam No. 3 and between it and the Plant. Several species were found in Sturgeon Lake just north of the Plant. This lake flows into the Mississippi River in the site area.

The aquatic macroflora identified in the Plant region are listed in Table II-25.[6,28]

Just downstream from the dam (Transect D-1), the Mississippi River is essentially barren of aquatic plants. Farther downstream (D-2) there are shore trees of unspecified types; at D-3, about 1/2 mile upstream from Diamond Island, there is no vegetation of significance. At E-1, about 1/4 mile upstream from this island, there is a sandy beach that has willows and some smartweeds but is otherwise devoid of plants. This area receives heavy wash action from barges and other watercraft and is the narrowest part of the Mississippi River in the study area.

The main Mississippi River channel by Diamond Island (E-3) has no significant plants. Transect E-2 bisects the Vermillion River just upstream from Diamond Island. Both shores have mud banks with various grasses but no other plants of significance. This area is subject to heavy flooding; it is highly eutrophic, and may become anaerobic at times.

TABLE II-25. Aquatic Macrophytes on Ecological Transects

Family	Genus and Species	Family	Genus and Species
Alismaceae		Najadaceae	
	Sagitaria latifolia	(Pondweed)	Potamogeton pectinatus
	(Arrowhead)		Potamogeton crispus
Butomaceae		Polygonaceae	
	Anacharis	(Pondweed)	Polygonum natans
	(Waterweed, Elodea)		
	Vallisneria americana		
Gramineae		Salicaceae	
	Zizania aquatica		Salix spp.
	(Wild rice)		(Willow)
Cyperaceae		Typhaceae	
(Sedges)	Eleocharis spp.		Typha latifolia
	Scirpus spp.		(Cattail)
Lemnaceae			
(Duckweed)	Lemna minor		
	Spirodella polyrhiza		
	Wolffia punctata		

Transect F-1 cuts through the Mississippi River main channel, after the confluence of both channels of the Vermillion River bypass Diamond Island, and after the entrance of one branch of the Cannon River (see Figure II-17). There are willows on the Minnesota shore but no plants of significance on the Wisconsin side.

Transect G-1 bisects the Cannon River as it enters the Mississippi River main channel. The Cannon River drains a large watershed of steep-sloped dairy farms in Minnesota. There is much silt but no aquatic vegetation. Transect G-2 cuts across the Mississippi just above Lake Pepin at Baldwin Island. Little or no vegetation is present.

g. Fish

The adult fish found in the Mississippi River near the Plant in 1970 are listed in Appendix A, Table A-8.[28] These are in the same order of abundance as those found in 1957 which indicates stability in fish populations. The minnows and forage fish in the area of Lock and Dam No. 3 are listed in Appendix A, Table A-9. The types and proportions of game and rough fish that occurred in the Plant area (1970-71) are shown in Table II-26. Walleye and sauger are the preferred game fish near the site.

Composition of the fish population varies from the pool immediately upstream from Lock and Dam No. 3 to Pool 4 immediately downstream from Lock and Dam No. 3, reflecting the change from a slack water habitat to a fast water habitat between the lower end of Pool 3 and the upper end of Pool 4. Since the current is slower above the dam, the river resembles lake-like aquatic habitats which are quite stable compared to those below the dam. The fishery of the lower end of Pool 3 (where the Plant is being built) is composed principally of rough fish (carp, sheepshead, and redhorse). Game fish present in this pond are crappies, white bass, and sunfish. Few walleyes and sauger reside above the dam. Sturgeon Lake and North Lake seem to be rearing areas for large concentrations of immature fish. Below Lock and Dam No. 3, the swift-water habitat draws larger concentrations of walleye, sauger, and white bass. The Department of Natural Resources' regional fisheries manager has found that the area below Lock and Dam No. 3 is the major spawning and rearing area for game fish (sauger and walleye) when compared to the lower end of Pool 3 where Prairie Island is located. This fact is important in evaluating entrainment of the game species in the Plant's intake. The river below Lock and Dam No. 3 is used extensively for fishing and pleasure boating.[6]

Since fish represent one of the final organisms in the aquatic food chain, they are used as indicator organisms for radioactivity and contamination by chemical and biological agents. Samples of fish, benthic (bottom) animals and aquatic plants are collected by the Applicant for various types of monitoring. These fish samples are analyzed for gross radioactivity and radionuclides. Terrestrial biota are monitored separately.

TABLE II-26. Observed Game and Rough Fish Species and Proportions In the Plant Vicinity during 1970 and 1971[28]

Species	Location			
	Site Islands	Sturgeon Lake	Pool 3 (Above Dam No. 3)	Pool 4 (Below Dam No. 3)
Largemouth bass	x	x	x	x
Rock bass	x	x	x	x
Smallmouth bass		x		x
White bass	x	x	x	x
Bluegill	x		x	
Yellow bullhead		x		x
Channel catfish	x	x	x	x
Flathead catfish	x		x	
Black crappie		x		x
White crappie	x		x	
Mooneye		x		x
Northern pike	x		x	
Sauger	x	x	x	x
Walleye	x	x	x	x
Total game species, %	29	13	34	84
Bowfin (Dogfish)	x	x	x	x
Largemouth buffalo		x		x
Smallmouth buffalo	x	x	x	x
Carp	x	x	x	x
Freshwater drum	x	x	x	x
Shortnose gar		x		x
Greater redhorse	x		x	
Shorthead redhorse	x		x	
Silver redhorse	x	x	x	x
Gizzard shad	x		x	
Total rough species, %	71	87	66	16

III. THE PLANT

A. EXTERNAL APPEARANCE

The finished appearance of the major Plant buildings is shown in Figure III-1, as visualized from about ground level just northeast of the Plant. Figure III-2 is a view of the Plant during construction from an altitude of approximately 500 feet above and northwest of the Plant. The Mississippi River is seen in the background as it bends to the southeast and flows toward U. S. Corps of Engineers Lock and Dam No. 3 which is visible in the upper left-hand corner. The discharge canal, discharge control structure, cooling towers, and cooling-tower return canals are located behind and to the right of the two reactor containment buildings. Figure III-3 is a view of the Plant from approximately the same altitude southeast of the Plant. The Mississippi River, as it flows toward and past the Plant in a generally southeasterly direction, is seen in the upper right and at the right-hand side of the picture.

Principal features of the Plant are prominent in the photographs. The two containment buildings are 205 feet tall and 120 feet in diameter, slip cast of concrete. The auxiliary and turbine building which is attached to and lies north of the reactor buildings, is about 210 feet long, 100 feet wide, and 115 feet high (above grade level). Administrative offices are located along the north wall of the turbine building. The screen house is separated from and a short distance north of the other buildings.

The switchyard and transmission towers are over 700 feet north of the turbine building. They occupy about 14 acres of the 560 acres of total Plant site area.

B. TRANSMISSION LINES

The electrical energy generated at the Plant will result in a gross output of about 560 MWe from each of the two units. Generator output of each unit, at approximately 20 kV, will be fed to transformers which raise the voltage to 138 and to 345 kV for delivery to the transmission system.

New 345-kV transmission lines were required to connect Unit 1 to the Blue Lake substation and Unit 2 to the Red Rock substation, as shown in Figure III-4. However, of the total of about 78 miles of new line, only 32.8 miles are on newly acquired right-of-way. This extends from the site boundary to the Inver Grove substation, and covers 973 acres for an average of 29.6 acres per mile of corridor with an average width of 244 feet. Existing transmission corridors are used for the new lines from Inver Grove to Blue Lake and from the Plant to Red Rock.

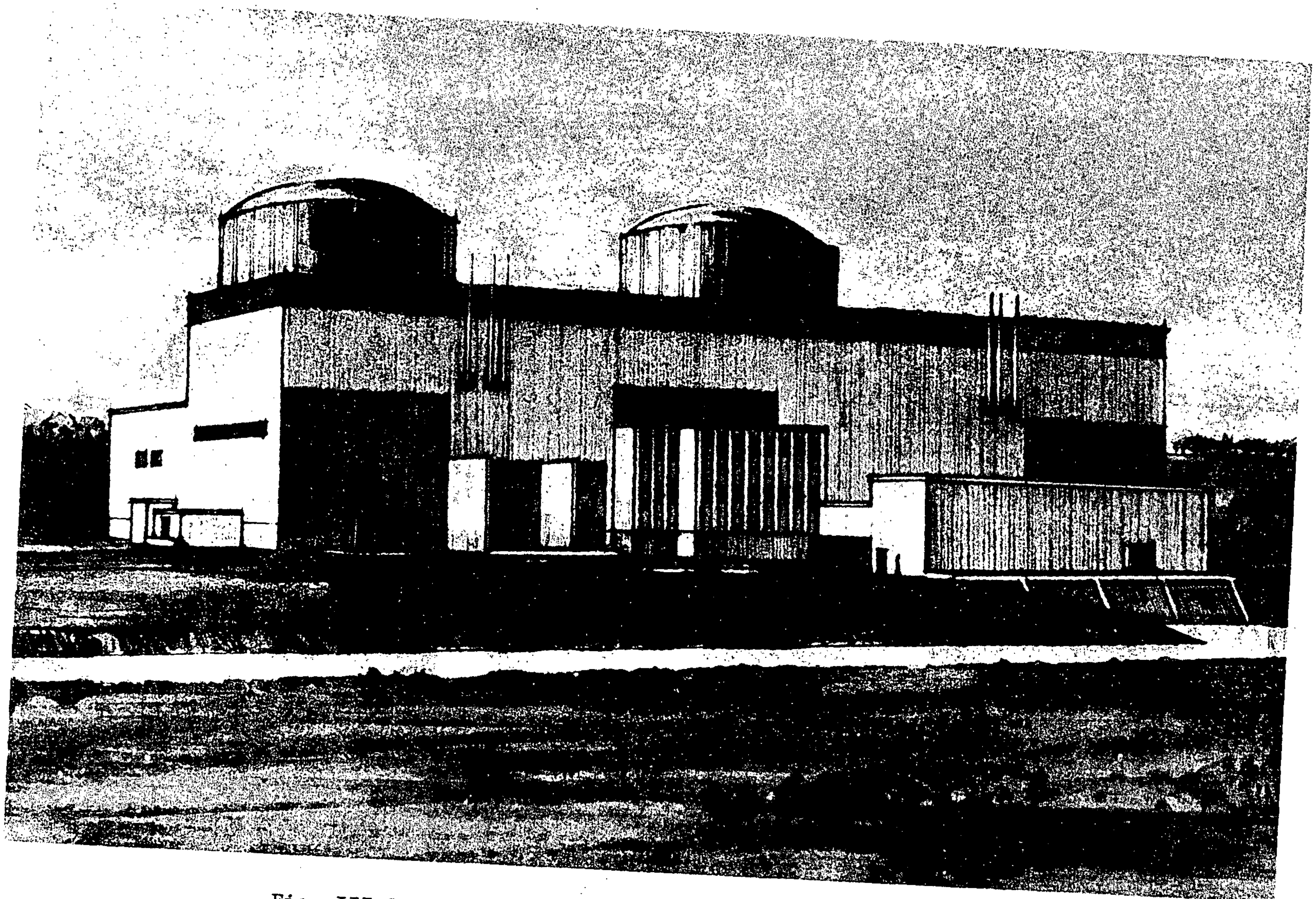


Fig. III-1. Artist's Rendition of the Main Plant Buildings

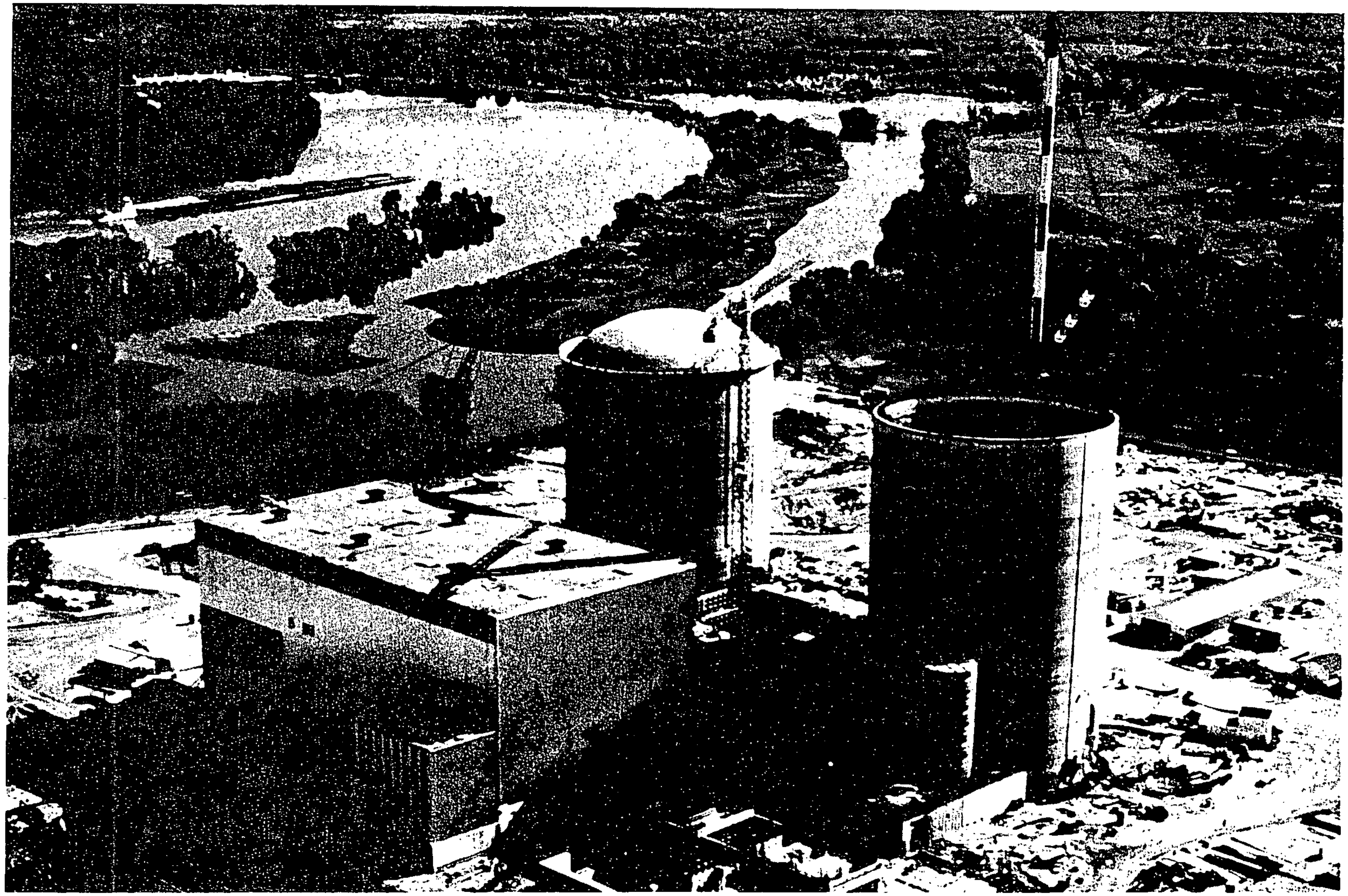


Fig. III-2. Plant During Construction, and Adjacent Water to the Southeast

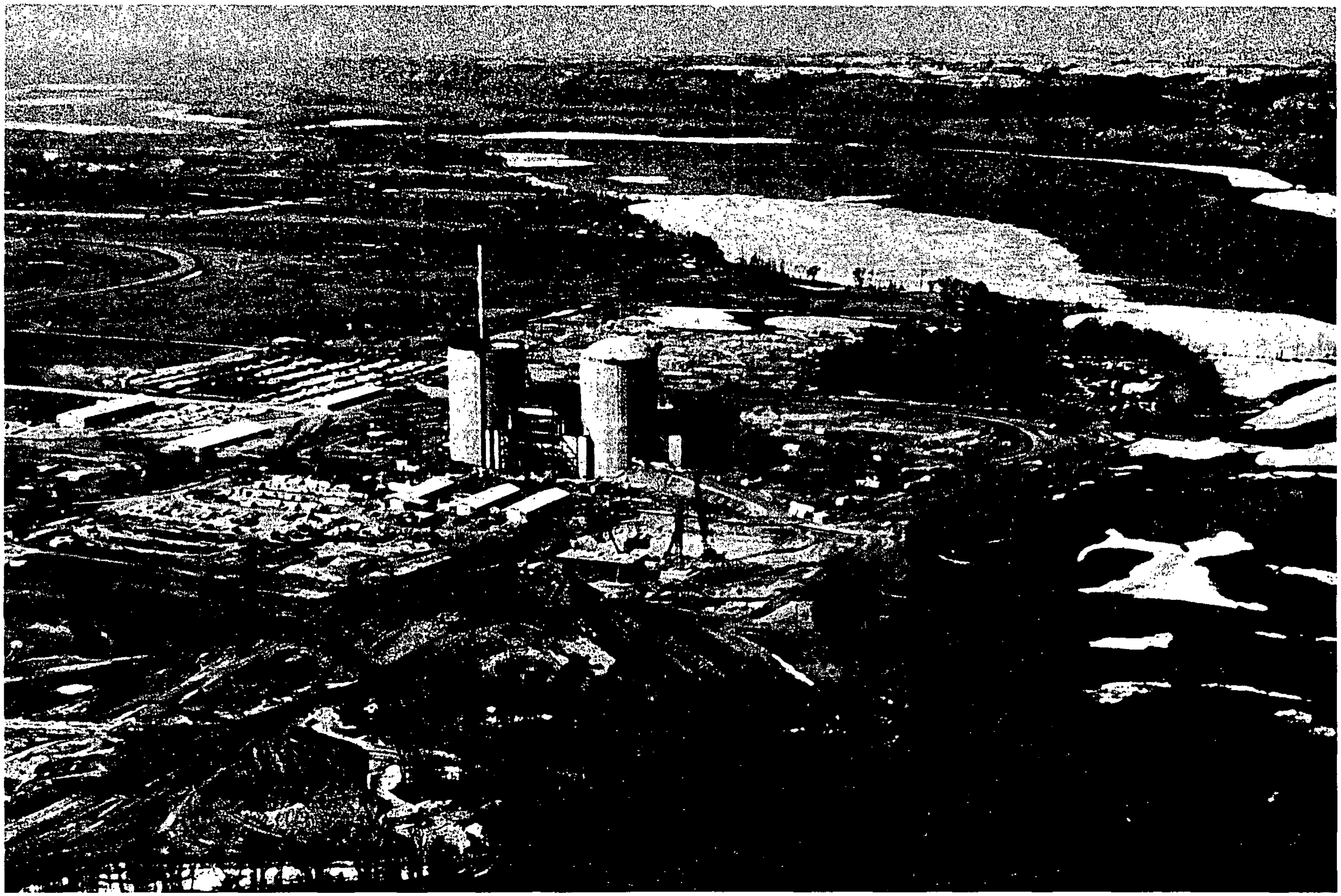


Fig. III-3. Plant Site and Adjacent Land and Water Areas

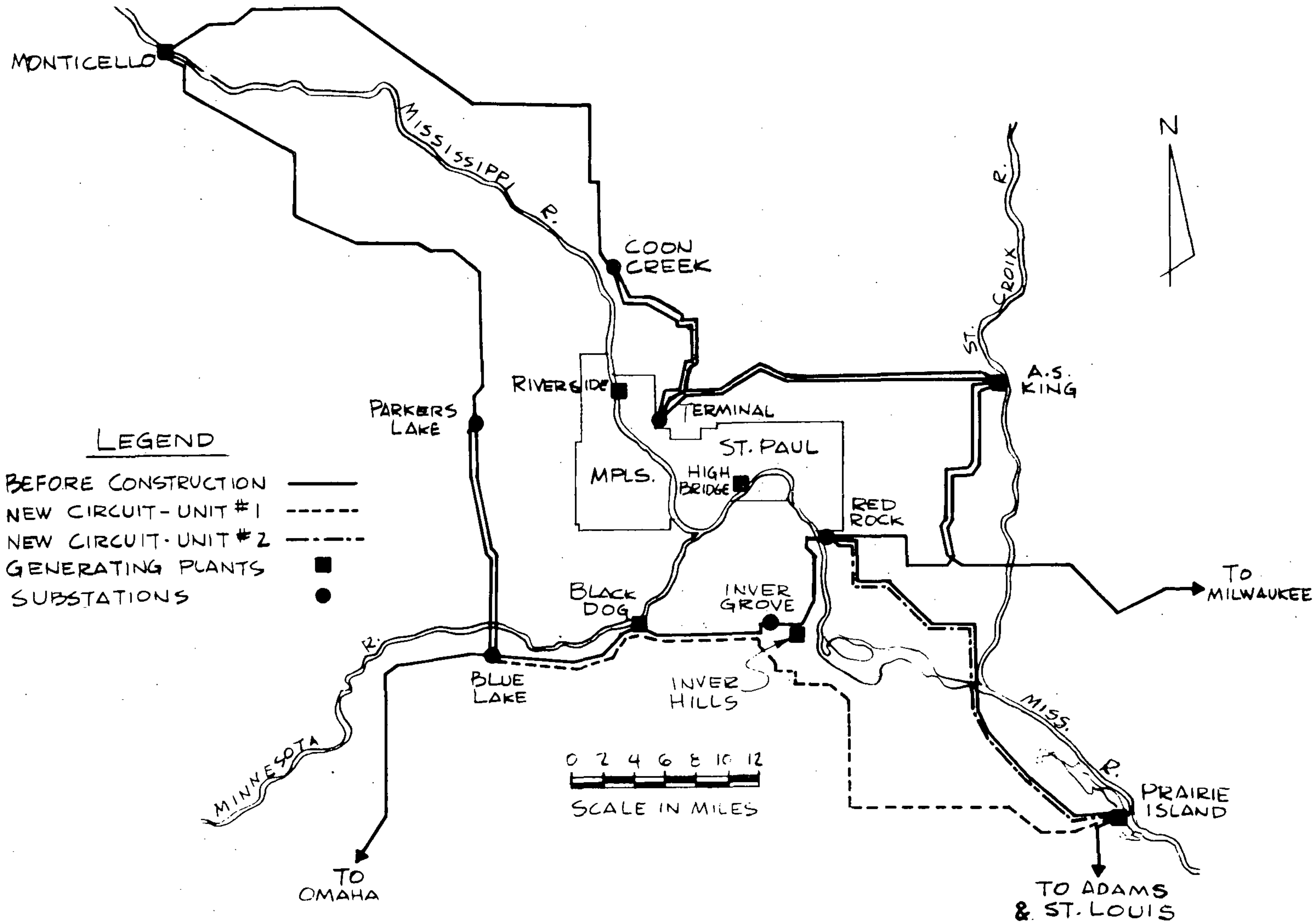


Fig. III-4. Twin Cities Area 345 kV Transmission System and Additions Required by the Prairie Island Plant

C. REACTOR, STEAM-ELECTRIC, AND COOLING SYSTEMS

The Plant has two separate nuclear steam-supply and turbine-generator units, namely, Unit 1 and Unit 2. Each unit is designed for an initial power level of 1650 MWt and 560 MWe (gross), and an ultimate power level of 1721 MWt and 583 MWe (gross). The Westinghouse Electric Corporation designed the nuclear steam supply and is supplying and installing many of the system components. Pioneer Service and Engineering Company designed the balance of the Plant and the Applicant was the construction manager.

Each nuclear supply and turbine-generator unit functions independently of the other. However, structures in common to both are: auxiliary building, turbine building, screen house, circulating condenser cooling water externals, control room, and administration building.

In normal operation, Mississippi River water is used only for makeup water. In this condition, the Plant's cooling towers are operating and its cooling-water discharge-control structure is set for maximum cooling water recirculation within the Plant. Once-through cooling will be used only if the cooling towers are inoperative due to weather conditions, repair or maintenance.

1. Nuclear Steam Supply System

The nuclear steam supply system of each unit consists of a pressurized water reactor, a reactor coolant system, and associated auxiliary fluid systems. Each reactor-coolant system is composed of two closed reactor-coolant loops connected in parallel to a reactor vessel. Each loop contains a reactor-coolant pump and a steam generator. An electrically heated pressurizer is connected to one of the loops.

The reactor core is composed of uranium dioxide pellets enclosed in Zircaloy tubes with welded end-plugs. The tubes are supported in assemblies by a spring-clip grid structure. The mechanical control rods consist of clusters of stainless steel-clad absorber rods and Zircaloy guide tubes located within the fuel assembly. The core fuel is loaded in three regions, new fuel being introduced into the outer region, moved inward in a checkerboard pattern at successive refuelings, and discharged from the inner region to the spent-fuel storage area.

The reactor is controlled by a coordinated combination of chemical shim and mechanical control rods. The control system allows the plant to accept step load-changes of 10% and ramp load-changes of 5% per minute over the load range of 15 to 95% power under normal operating conditions. It is designed to sustain reactor operation following a step internal electrical load-rejection of up to 50% of the full-power electrical output. Loss of turbine loads in excess of 50% actuates reactor and turbine trips. Both the reactor and turbine generator are supervised from the control room.

The steam generators are vertical U-tube units using Inconel tubes. Integral separating equipment reduces the moisture content of the steam at the turbine throttle to 1/4% or less.

The reactor coolant pumps are vertical, single-stage, centrifugal pumps equipped with controlled-leakage shaft seals.

Auxiliary systems are provided to charge the reactor-coolant system and to add makeup water, purify reactor cooling water, provide chemicals for corrosion inhibition and reactor control, cool system components, remove residual heat when the reactor is shut down, cool the spent-fuel storage pool, sample reactor cooling water, provide for emergency safety injection, and vent and drain the reactor-coolant system.

The reactor fuel-handling system is designed to handle spent fuel under water from the time it leaves the reactor vessel until it is placed in a cask for shipment from the site. Underwater transfer of spent fuel provides an optically transparent radiation shield, as well as a reliable source of coolant for removal of decay heat. This system also provides the capability for receiving, handling, and storing new fuel.

2. Turbine Generator System

The turbine of each unit is a tandem-compound, three-element 1800-rpm unit having 40-inch blades in the last row of the low-pressure elements. Four combination moisture separator-reheater units are employed to dry and superheat the steam between the high- and low-pressure turbine elements. The turbine is rated at 560 MW when operating with inlet-steam conditions of 720 pounds per square inch absolute (psia), 506°F, exhausting at 0.74 psia with zero makeup and five stages of feedwater heating.

For condensing steam leaving the turbine, a single-pass deaerating, double-flow surface condenser, steam-jet air ejector, two 50%-capacity condensate pumps, two 50%-capacity motor-driven feedwater pumps, and one stage of feedwater heating are provided.

One steam-driven auxiliary feedwater pump and two motor-driven auxiliary feedwater pumps capable of being shared between units are available to remove heat from the reactor-coolant system in case of loss of the main feedwater system.

The main generator is an 1800-rpm, three-phase, 60-Hertz, hydrogen inner-cooled unit. Electrical energy generated at 20 kV is transformed to 345 and 138 kV and delivered to the Applicant's 345/138-kV system. The Plant auxiliary electrical system consists of auxiliary transformers, 4160-V switchgear, 480-V motor control centers, and 125-V d.c. and 120-V a.c. equipment. Emergency power is supplied by alternate sources including two diesel generators.

3. Cooling System

a. Operating Modes

When power-generating units 1 and 2 are operating, the maximum flow rate of condenser cooling-system water is 611,000 gal/min or 1360 cu ft/sec with a rise in water temperature of 27.4°F. This cooling rate is equal to 8.37×10^9 Btu/hr.

The design of the condenser cooling-water system permits various operating modes: once-through flow of river water without cooling towers in operation (open cycle); once-through flow with cooling towers in operation to decrease the temperature of system water before it is discharged back to the river (helper cycle); and recirculation of up to 95% of the condenser cooling-system water through operating cooling towers (closed cycle). In the open-cycle mode, the cooling towers are bypassed and the full 1360 cfs is supplied from the river inlet and is discharged to the river without evaporative loss. This mode will be used if cooling-tower operation becomes impracticable because of problems due to cold weather or a need for maintenance work. In the helper-cycle mode, the cooling towers are used to the fullest extent, but without recycle and with the 1360 cfs direct flow. In the closed-cycle mode, the only water taken from the river is that required to compensate for evaporation and drift losses from the cooling towers and for blowdown to reduce buildup of mineral content of the circulating water.

The principal characteristics of these cooling modes are as follows:

Mode	Inlet from River, cfs	Maximum Tower Water Loss to Air, cfs	Discharge to River, cfs
Open cycle	1360	0	1360
Helper cycle	1360	28	1332
Closed cycle	188	38	150

The mode of operating may be changed, without disruption of power-generating operations, in the main control room. The capability for operating in these three modes is intended by the Applicant to allow optimum performance within the thermal-effluent limits set by the State of Minnesota. Those limits, which apply to the water discharged to the main stream of the river, are described in Section III.C.3.c below.

The flow pattern for the condenser cooling system is shown in Figure III-5. Cooling water entering the Plant flows through the main condensers and the service-water heat exchangers. The water, conducted in pipes, may then go to the cooling towers or bypass them, according to the cooling-cycle mode. Exit water from the cooling towers is carried in open channels to the discharge structures, which control the fraction of flow to the river discharge and to the recycle canal. Recycle flow may vary from zero to about 1200 cfs.

For closed-cycle operation, the water entering the throat of the intake canal mixes with water returned via the recycle canal from the cooling towers. For open-cycle or helper-cycle operation, the water entering the throat of the intake canal flows, without mixing, directly to the screen house. In all cases, the water for condenser cooling passes through the screen-house trash rack and traveling screens. For the maximum flow rate of 1360 cfs and a water level of 674.5 feet, the velocity is 0.9 ft/sec through the trash rack and 0.8 ft/sec immediately upstream from the rack. Beyond the intake barrier wall, under which all water taken from the river passes, the velocity is much lower, due to the greatly increased width of the intake canal there (see Figure III-5).

After passing through the condensers, the cooling water is piped to a sump from which it may be a) pumped to the cooling towers (closed cycle or helper cycle), or b) drained directly to the discharge canal (open cycle). If it is pumped to the cooling towers, the cooling-tower outfall may flow to the intake canal (closed cycle) or drain to the discharge canal (helper cycle). Velocities of flow at the gates of the discharge structure can be fixed by the number of gates used and the extent to which they are raised to accommodate the flow. For open-cycle operation at the maximum discharge flow rate of 1360 cfs, velocities of 2.83 ft/sec for four gates, and 11.32 ft/sec for one gate, are illustrative. For closed-cycle operation, water from the cooling towers (cooling-tower blowdown) at 150 cfs is discharged through two gates at an average velocity of 6.5 ft/sec.

b. Design Details

The intake canal was prepared by dredging a channel of about 700 feet long by 110 feet wide from the location of the screen house to the river

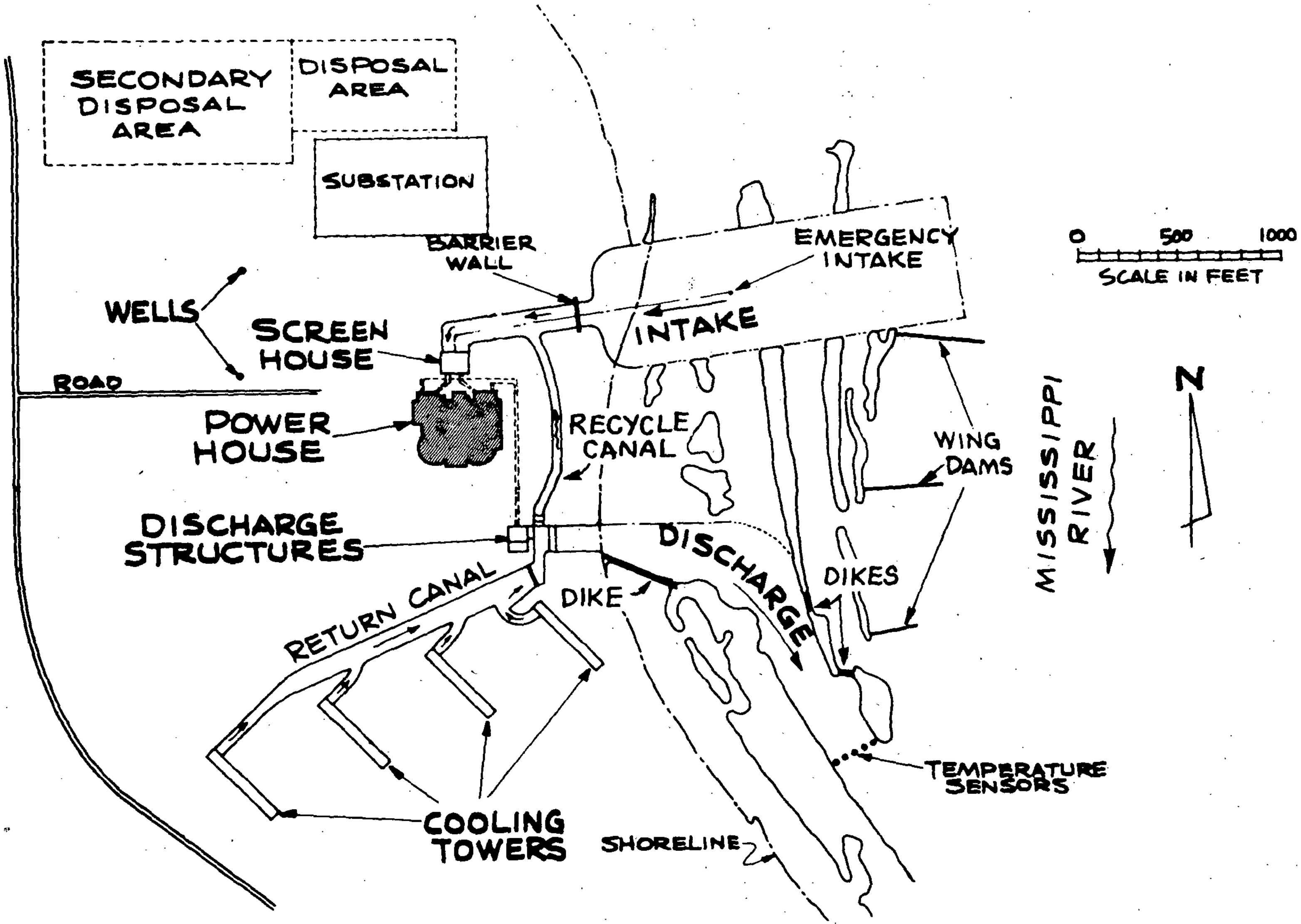


Fig. III-5. Plan View of Flow Paths in the Condenser Cooling System shoreline. The channel is widened as it intrudes into the river, forming an approach canal about 600 feet wide and 1800 feet long. Its purpose is to ensure an unobstructed flow of river water from the mainstream of the river to the screen house.

The barrier or skimmer wall shown in Figure III-5 prevents large floating objects from entering the intake canal and prevents the warm water of the recycle canal from flowing to the river. Figure III-6 shows the different elevations occupied by the warm recycle water and by the cooler, more dense intake water.

The layout of the screen house is shown in further detail in Figure III-7. The trash rack is a barrier to retain debris carried with the inlet water flow; it consists of vertical 3/8-inch-wide steel bars spaced on 3-inch centers. The traveling screens (four parallel units) are wire mesh with 3/8-inch-square openings; the mesh is on a moving, continuous belt, and collected debris is removed by an automatic backwash cycle. This debris is transported by sluicing to a collection basket, which is periodically emptied and the debris disposed of as solid waste. The velocity of flow at the trash rack and traveling screens is less than 1 ft/sec.

The emergency intake shown in Figure III-5 is the inlet water provision for the service-water system. Its intake structure is a bar-grill crib with an opening at elevation 664.0 feet (10.5 feet below normal water elevation). Inlet water from this point is conducted by a 3-foot-diameter steel pipe. The details of the emergency intake and the inlet canal are shown in Figure III-8. The reason for this emergency intake arrangement is that the service-water system must provide assurance of water supply, even under the unlikely conditions of a seismic shock which might liquify the sandy material along the river to such an extent that the main intake would be blocked. The bottom elevation of such movable deposits is indicated as the liquification level in Figure III-8.

The discharge basin receives circulating water from the Plant and serves as a forebay for the pumps that supply water to the cooling towers. These pumps are located at the side of the basin. The cooling towers are bypassed with discharge directly to the river by opening the discharge gates at the basin. The distribution basin receives flow either from the discharge basin or from the cooling towers via the open canals. Flow out of the distribution basin can be fractionally diverted to the recycle canal or to the river via the discharge control structure. Flow in this system is controlled by gates and safety overflow weirs. The gates are provided with local manual control capable of overriding the remote control from the main control room.

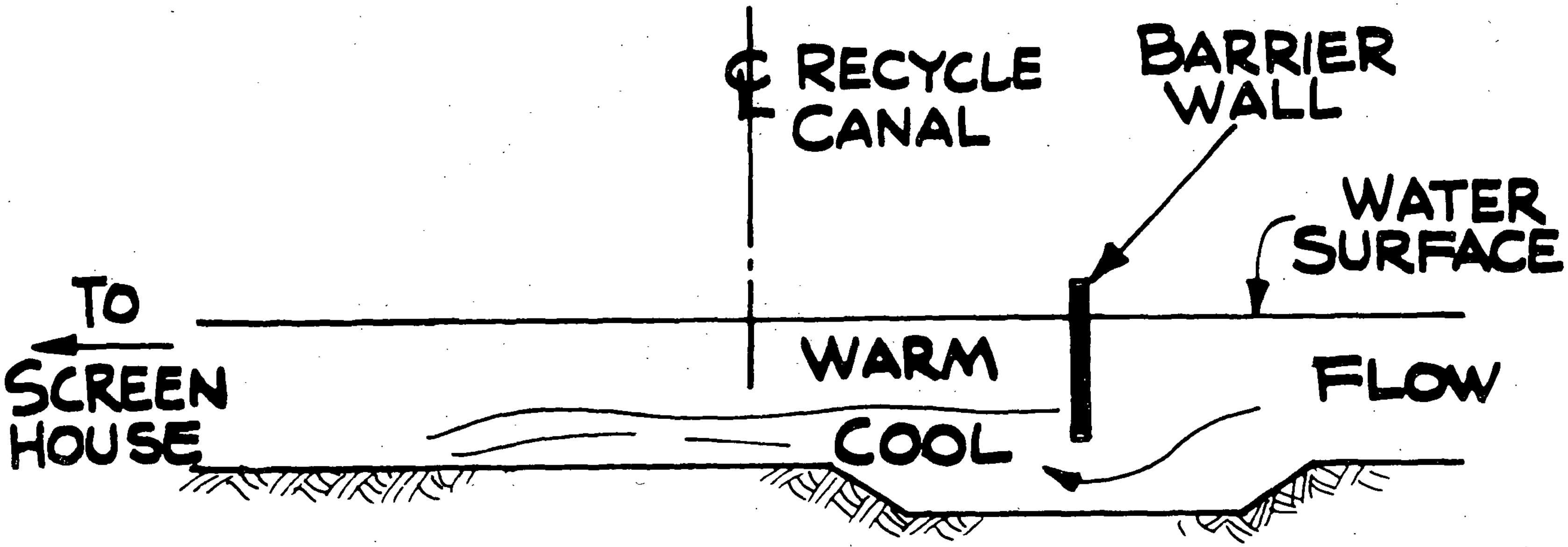


Fig. III-6. Schematic of Operation of the Barrier Wall and Mixing Structure in the Cooling Water Recycle System

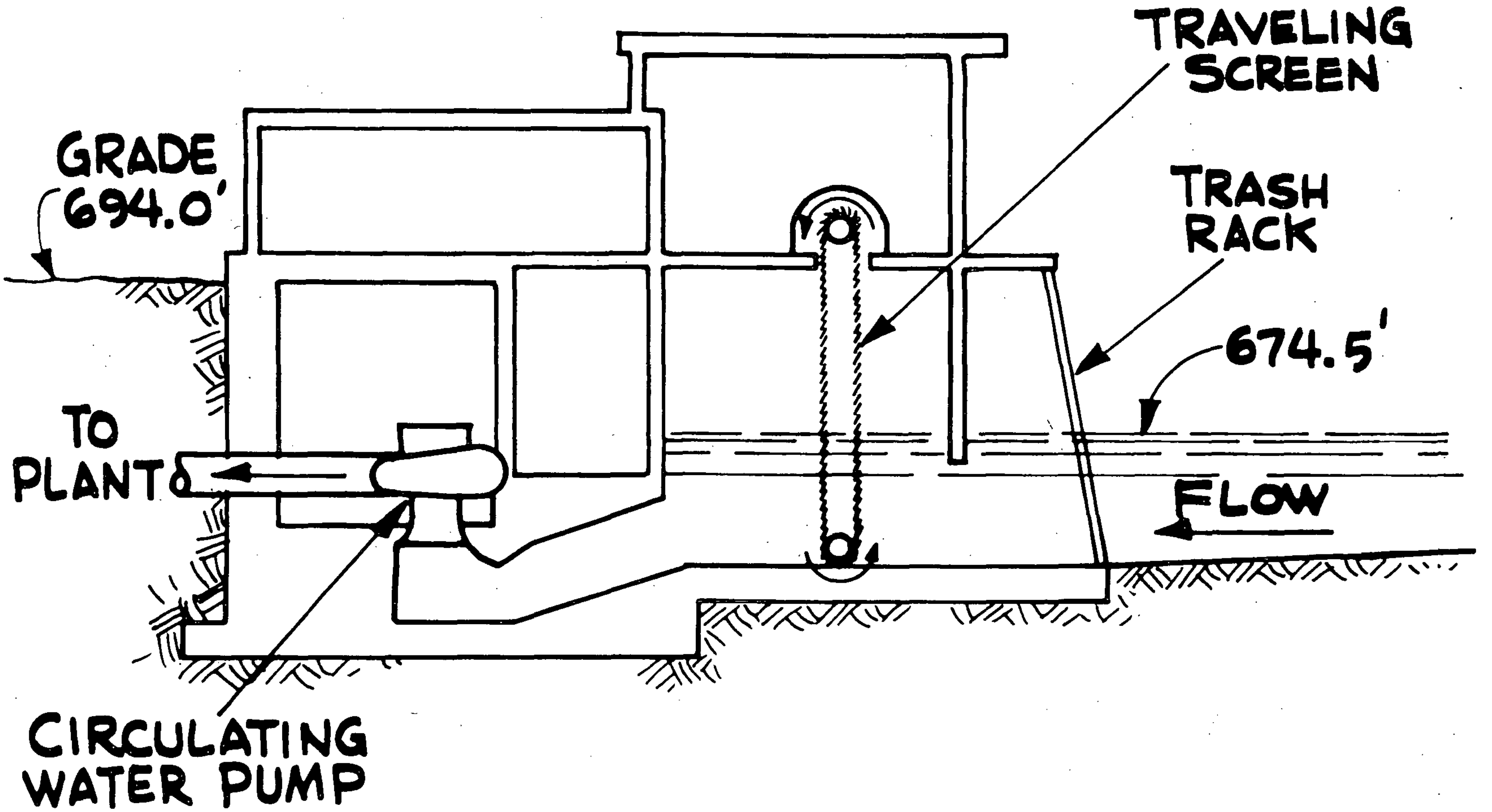


Fig. III-7. Screen House: Cross Sectional View

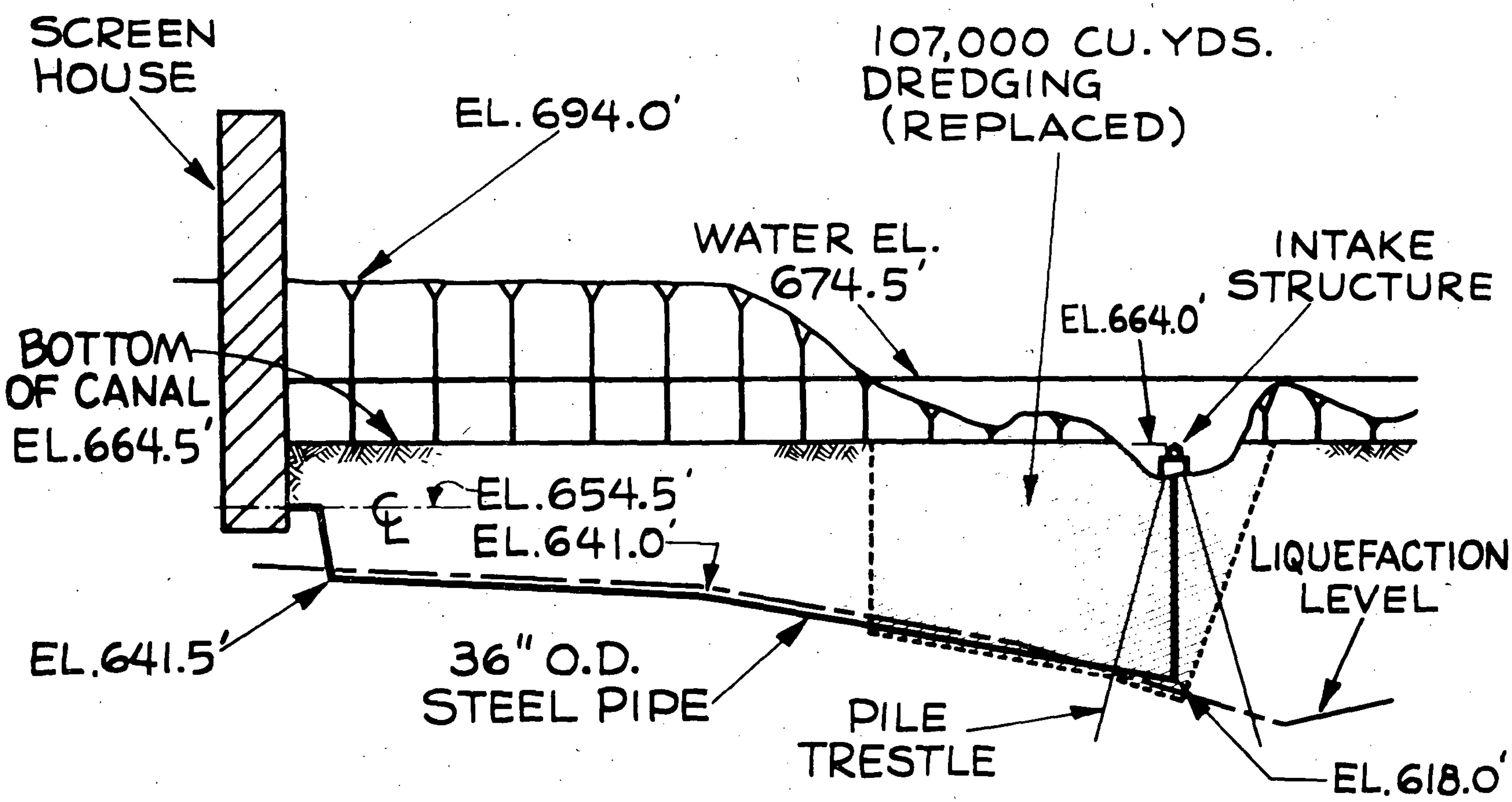


Fig. III-8. Water Intake of Emergency Service Water Supply

The entire discharge canal also was prepared by dredging. The width increases gradually from 100 ft at the discharge structure to over 400 feet at a distance of 700 feet from the shoreline. Three dikes were erected between existing sandbars to form the completed discharge canal. The nominal depth of water in the discharge canal is 10 feet as it flows from the discharge gates, for a distance of some 800 feet, through the dredged discharge canal toward the main stream of the river. The width of the canal increases from 110 feet at the discharge control structure to 180 feet at the shoreline. Hence, for open-cycle operation, the nominal velocity of water flow decreases in this dredged portion of the canal from 1.24 to 0.75 ft/sec, and for closed-cycle operation from 0.14 to 0.083 ft/sec.

Following movement from the shoreline position of the discharge canal, the stream of water flows for about 2000 feet, mixing in the meantime with river water which enters this portion of the discharge canal from upstream. The joined waters are then diverted gently toward the main channel of the river by dikes, which have been erected at three locations between naturally occurring sandbars. The maximum distance over which the discharge configuration has significantly affected the river bottom is about 800 feet from the west shoreline.

c. Cooling Towers

The Applicant expects to operate the condenser cooling system with all cooling towers in service (i.e., in either closed-cycle or helper-cycle mode) whenever the power generating units are functioning. The cooling towers were not originally designed to be operated under weather conditions that cause icing, but cold-weather operating equipment is now installed to allow their use year-round in meeting and improving upon, whenever possible, the discharge temperature limits stated in the Technical Specifications. These are as follows: 1) Temperature limits of the water discharged shall be no more than 50°F if the natural river temperature is at or below 45°F, or no more than 5°F above natural river temperature if the natural river temperature is above 45°F; 2) temperatures are to be monitored continuously at the downstream end of the discharge canal; and 3) under no circumstances shall the temperature at the sensors be permitted to exceed 90°F.

The cooling towers are of the mechanical-draft type designed by the Fluor Corporation. The basic unit of the tower is a "cell" containing a large electrically driven fan to draw air through the tower. A bank of 12 adjacent cells comprises one tower structure. Air enters the side of the tower through louvers and passes essentially horizontally through a "curtain" of water falling under gravity from a flow distributor at the top of the tower. An intimate contacting of air and water is promoted by internal baffles ("fill") inside the tower. In normal operation, air is exhausted vertically by the fans. The fans are reversible, so that reduction of icing at the outer edge of the towers is feasible. Water collected at the bottom of the tower is conducted to the exit channel.

The Prairie Island Plant has four towers of 12 cells each. Each tower structure is 55 feet high, 42 feet wide, and 433 feet long. The four towers accommodate the full circulating-water flow of the Plant and are capable of dissipating most of the Plant's waste heat, although heat dissipation is governed by weather conditions. Heat release to the river also depends upon the blowdown rate and the river condition.

The August design conditions for the cooling-tower system in the closed-cycle mode are as follows:

Wet-bulb temperature: 80°F

Inlet-water temperature: 120°F

Range (inlet temperature minus outlet temperature): 27.4°F

Outlet-water temperature: 92.6°F

Heat removed by cooling towers: 8.03×10^9 Btu/hr

Maximum heat discharged to cooling water from plant: 8.37×10^9 Btu/hr

Without heat dissipation in the discharge canal, the water effluent temperature of 92.6°F would violate the effluent limits. Actually, the 80°F wet-bulb design temperature is extremely high: the Applicant has stated that a 78°F wet-bulb temperature is equalled or exceeded 1% of the time during August. Furthermore, an average daily river temperature above 85°F has not been observed either locally (see Table II-18) or during more extended measurements downstream at Red Wing (see Section II.D.1.d). In addition, some mixing of the tower exit water occurs in the discharge channel before the temperature sensors at the main river canal are reached. These data thus show a tower capability to remove essentially all Plant waste heat from the circulating water system. Under extremely rare high-temperature conditions for both the air and the river, conformance to the effluent temperature limits can be achieved by reducing Plant power. This power reduction would make additional demands on reserve power in the Applicant's system. Such exceptional conditions are expected to be of short duration.

The operability of the tower for below-freezing conditions has not been defined due to limited experience in the operation of cooling towers in the winter on the part of the Applicant. It is expected that exit-water temperatures could not be allowed to approach freezing temperature when air temperatures are below freezing. For very low (subzero) temperatures, tower operation may not be feasible.

D. THE PLANT EFFLUENT SYSTEMS

1. Heat

This section describes the principle and method of controlling the heat release from the Prairie Island Plant. Most of the effluent heat is contained in the cooling water exiting from the main condensers. The only other significant source is the cooling water for the service-water system.

a. Thermal Release to River

The two circulating-water cooling systems are shown schematically in Figure III-9, and flow rates are indicated for the closed-cycle mode of operation. In this mode, the major portion of the cooling water is recycled, but 150 cfs is discharged to the river to limit buildup of dissolved solids in the circulating water due to evaporation from the cooling tower. The makeup water for the closed-cycle operation comes from the river via the intake canal, passing through the trash grill and the traveling screens. The screens and the circulating pumps are located in the screen house; all recycle and discharge flows proceed under gravity head. A 5-cfs side stream serves to wash debris off the traveling screens and deposit it in a collection basket for subsequent disposal.

The Applicant's intended mode of operation of the cooling system is with the cooling towers fully operative and with recycle and discharge to the river varied to meet the applicable limits and achieve the economic advantage of low condenser temperatures. The Applicant has made a commitment to operate the cooling towers to the maximum extent practicable, in order to minimize entrainment impingement and thermal impact on the river.[5,8]

This mode of operation is controlled by variable diversion of water by the discharge structure. The temperature drop achieved by passage through the cooling tower varies with the tower performance characteristics.

Most of the heat rejection by the Plant to the cooling water (8.4×10^9 Btu/hr with both units operating) occurs at the condensers, with the

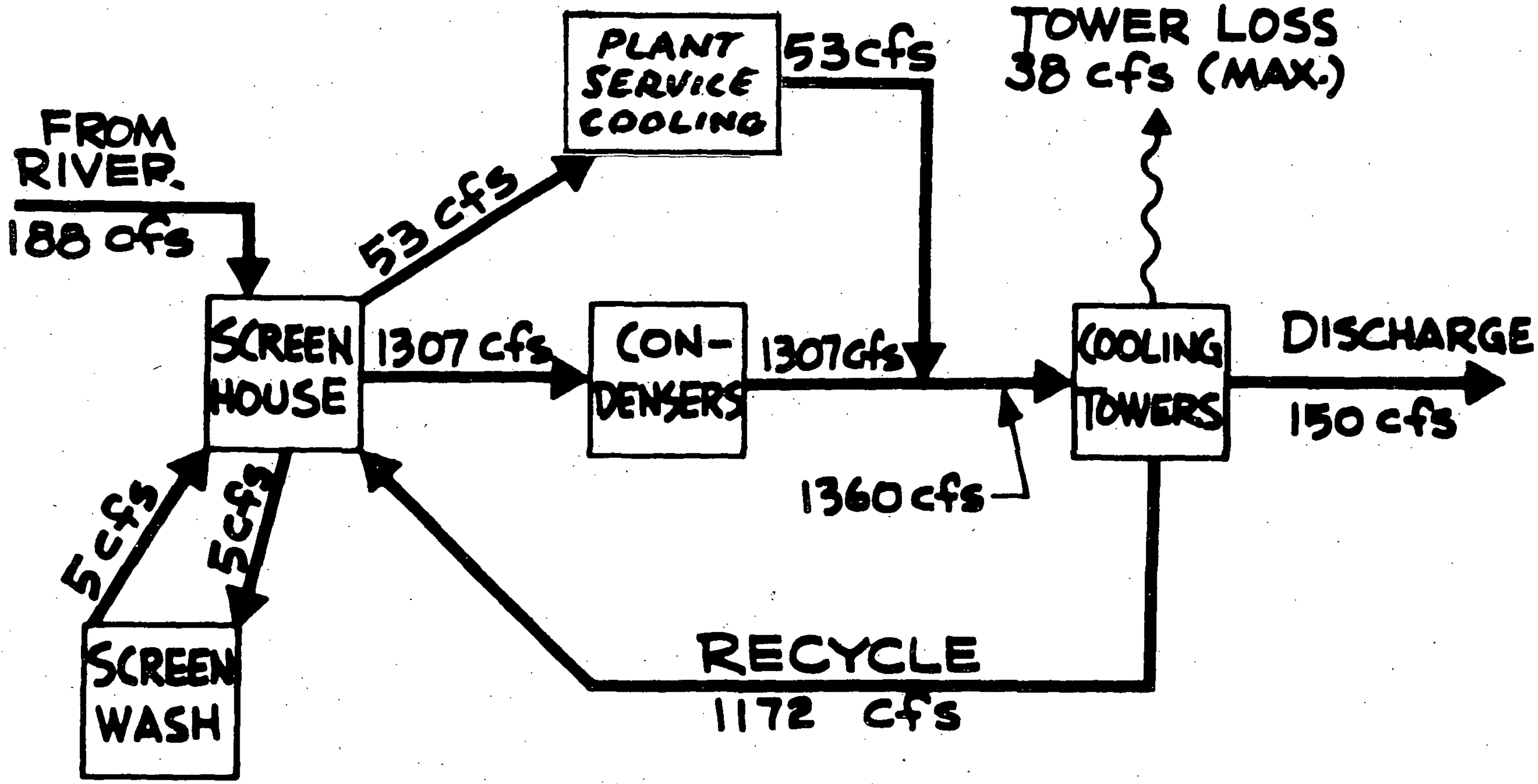


Fig. III-9. Flow Rates in the Closed-Cycle Mode for Condenser Cooling and the Service Water System balance at the service-water heat exchangers. The overall design water-temperature rise through the Plant is 27.4°F for the maximum design flow of 1360 cfs. The maximum evaporative loss from the cooling towers is less than 38 cfs, assuming that all Plant heat is dissipated to the air by evaporation during closed-cycle operation. Actual heat dissipation in the river will vary, depending on the mode of cooling. The maximum river diversion of 1360 cfs is about 9% of the average flow of the river and 31% of the 7-day average low flow which has a once-in-10-year probability of recurrence. For these flows, the temperature rise of the river during full-power operation in the open-cycle mode without towers would be 2.5 and 8.2°F, respectively, assuming uniform mixing and no heat loss. This is a maximum possible effect of the Plant without cooling towers. For normal closed-cycle operation, the equivalent temperature rise is only about 2% of the above maximum temperatures.

Because of the flexibility of cooling-system operation and variability of discharge (150 to 1360 cfs), no simple description of thermal plumes appears practical as a means of characterizing the temperature- and heat-dissipation patterns in the receiving-river waters. The possible maximum temperature differential above ambient is 27°F, but cooling-tower operation, and power reduction, if necessary, will hold maximum absolute and differential temperatures within the specified limits.

The temperature limits apply for the water leaving the discharge channel and entering the main channel of the Mississippi River. The location of the temperature sensors at the end of the discharge canal is shown in Figure III-5. The main channel of the Mississippi is beyond the wing dams shown. The cooling water is discharged into a side channel from Sturgeon Lake before it reaches the temperature sensors. The volume of water in the discharge canal is about 5 million cubic feet, and the inflow from Sturgeon Lake varies from 185 to 3400 cfs, depending upon the time of the year.

The maximum temperature of the water discharged to the river may be described in terms of the specified limits. The maximum allowed temperature of the discharge above ambient is related to the river temperature, as shown in Figure III-10. The corresponding maximum temperatures of the discharge are also shown in this figure. Note that these are allowable maximum temperatures, not necessarily actual ones. Since the cooling water discharge will be diluted by inflow from Sturgeon Lake before reaching the temperature sensors, the temperature of the discharged water is somewhat higher than the maximum temperature of Figure III-10. Figure III-11 illustrates the heat and temperature imported to the main channel of the river, assuming <u>no</u> dilution in the discharge canal. Thus in practice the maximum allowable heat discharge will be higher than indicated in Figure III-11, and will depend upon the temperature and volume of the inflow from Sturgeon Lake.

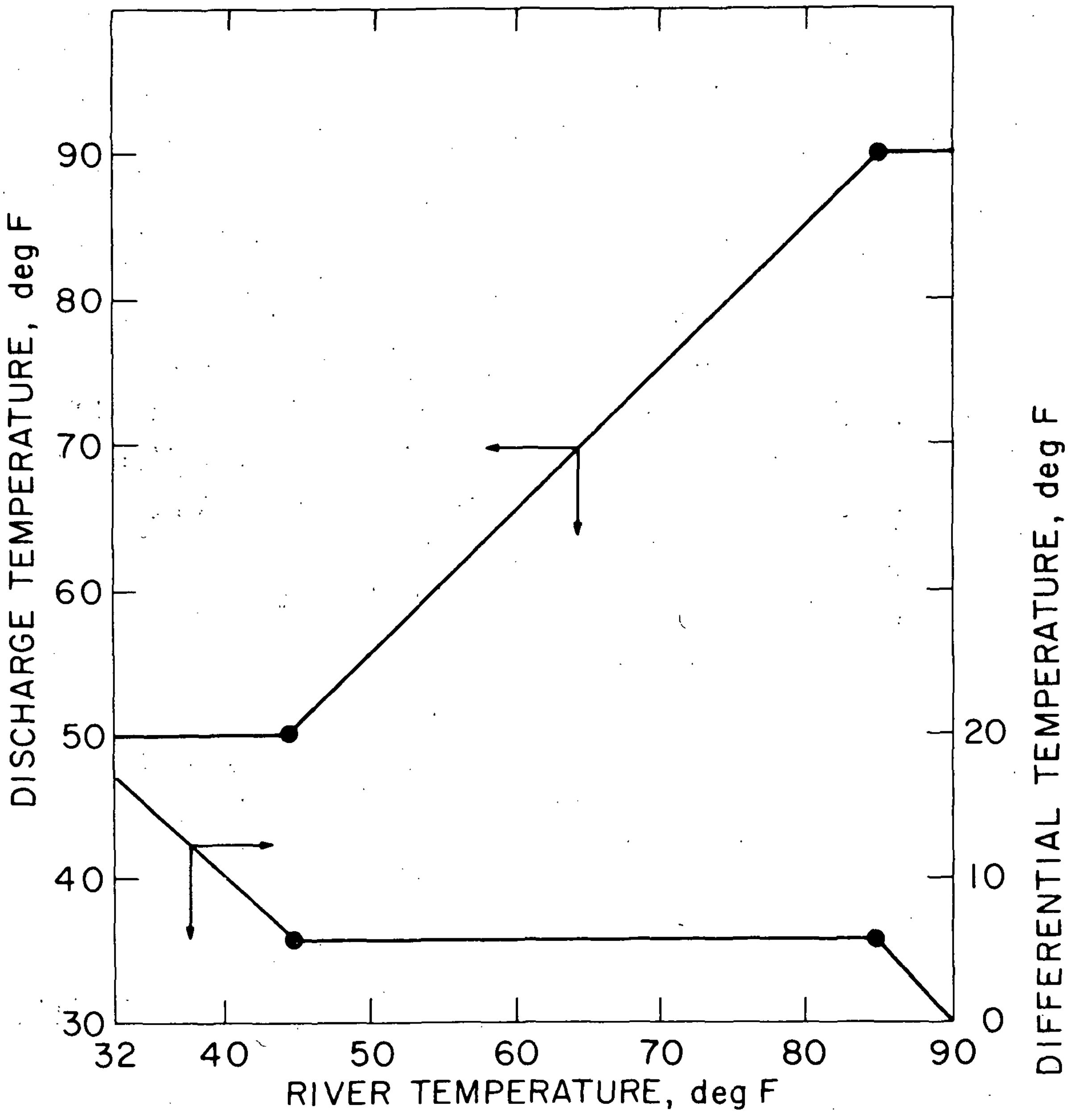


Fig. III-10. Allowable Maximum Discharge Temperature as a Function of River Temperature

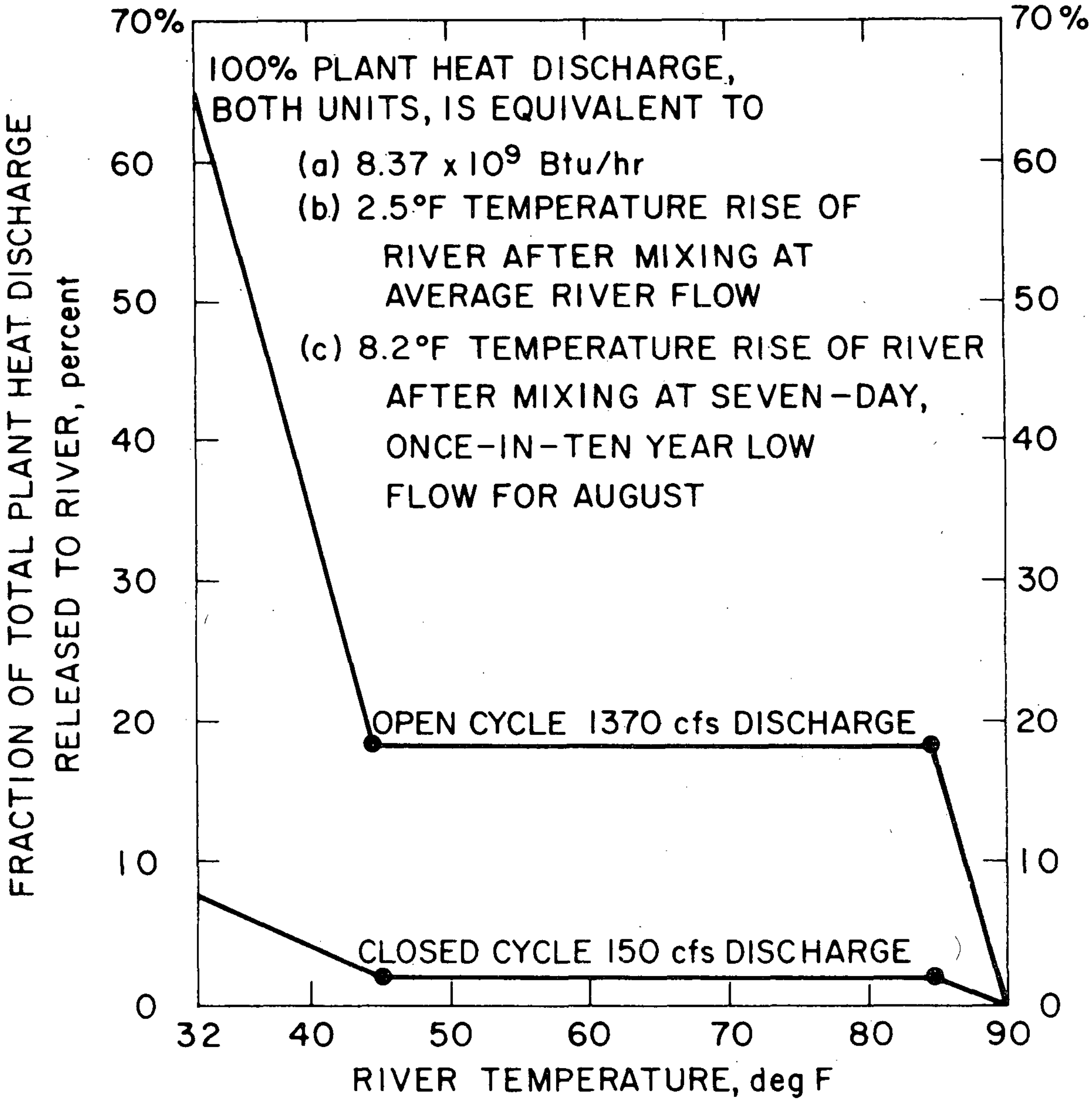


Fig. III-11. Maximum Allowable Heat Discharge to River as a Fraction of Total Heat Release

The Applicant has predicted the temperature of the blowdown released to the discharge canal for closed cycle operation based on a six-year history of river temperature and air humidity at its Red Wing plant a few miles downstream from the Prairie Island site.[6] Of particular interest are the conditions which will prevail during the winter months when extremely low temperatures might preclude use of the cooling towers. Design features such as reversible air flow, bypassing of cells and covered decks will be useful in combatting severe icing, but prior experience with such large cooling towers at temperatures as low as -30°F does not exist, so their functioning adequately on a year-round basis is not assured.

The blowdown water temperature which is expected to be exceeded only 5% of the time during closed cycle operation, T_{95}, is given for the winter months in Table III-1. The corresponding median and low flow rates (from Table II-17) and the maximum river temperatures (from Table II-18) are also included. The temperatures where the discharge canal reaches the main channel of the river were calculated for both median and low flow conditions, assuming dilution of the blowdown by the water flowing into the discharge canal from upstream. This inflow was based on an estimate that 10% of the river flow was through Sturgeon Lake and that one-half of this passed between the sandbars which form the boundaries of the discharge canal. These calculated values, given in Table III-1, indicate that power reduction to meet the specified 50°F temperature limit during these winter months is only likely during low flow periods in March, as long as closed cycle cooling can be utilized.

If open cycle cooling should become necessary, power reduction might be required. The estimated maximum temperatures at the canal outlet for full power operation, open cycle cooling and maximum intake temperature are given for both median and low flow during these winter months in Table III-1. Factors which tend to overestimate these temperatures are the assumptions of 1) continuous, full power operation; 2) the loss of no heat except by mixing with water from upstream; and 3) that no ice is carried into the discharge canal by the current. On the other hand, it was assumed that thorough mixing does occur (in spite of the lower density of the heated water). The major uncertainty arises from the limited information about distribution of flow between Sturgeon Lake and the main channel of the river and the flow pattern within Sturgeon Lake as a consequence of dredging the intake and discharge canals.

TABLE III-1. Estimated Water Temperature at the Outlet of the Discharge Canal, T_o, for the Blowdown Temperatures which are Exceeded Only 5% of the Time, T_{95}, During the Winter Months

Month	T_{95}	T max. °F	River Flow (cfs) Low	River Flow (cfs) Median	T_o, Closed Cycle Low Flow °F	T_o, Closed Cycle Median Flow °F	T_o, Once Through Low Flow °F	T_o, Once Through Median Flow °F
December	68	35	4500	8000	48.2	44.0	58.5	56.2
January	65	35	4500	7580	47.0	43.5	58.5	56.4
February	66	36	4430	7200	48.2	44.8	59.6	57.7
March	72	40	4570	10600	52.6	47.1	63.4	59.7

b. Airborne Effluents

The cooling-tower effluents to the air are water vapor, drift (entrained droplets from the tower and salts therein), plumes (rising cloud-like condensed droplets), and fog (plumes at ground level which reduce visibility). The maximum vapor effluent at rated Plant power is 38 cfs. The Applicant has stated that the guaranteed maximum drift is 0.19% of maximum water flow, or 2.5 cfs; more probable performance is 0.05%, or 0.7 cfs. Plumes become most extensive and visible at below-freezing air temperature, when tower operation may not be practical. Formation of fog depends on particular weather conditions for the locality and is discussed with other atmospheric effects in Section V.B.3.

c. Abnormal Conditions

Emergencies could lead to a temperature of the water leaving the discharge canal of higher than 5°F above the natural river temperature. Should this occur, water from the discharge canal would progressively mix with the river mainstream water as it approaches and passes through Lock and Dam No. 3. Heat energy loss from the discharged stream to the point at which it is completely mixed is estimated at about 4×10^8 Btu/hr. Under conditions of median river flow rate, the water temperature immediately downstream from Lock and Dam No. 3 is estimated to be 2 to 4°F higher than the temperature of the river water as it passes the Plant.

d. Summary

In summary, the Prairie Island Plant has a highly controllable heat-dissipation system, with cooling towers capable of dissipating about 96% of the heat released during operation. The appropriation and discharge of river water conform to the effluent-temperature limits set by the State of Minnesota, the principal requirements of which are the 5°F maximum differential temperature and the 90°F upper temperature limit. For a 5°F temperature increment and closed-cycle operation, the surface area of the discharge beyond the canal outlet having a temperature as high as 3°F above ambient river temperature has been estimated from correlated data[1] by the Staff as roughly three acres. The overall effect of heating the river, after mixing, is less than 0.1°F, even in low-flow conditions. In addition, the excess temperature of the river is reduced, with time and distance, by the natural processes responsible for thermal equilibrium between bodies of water and the atmosphere.

2. Radioactive Waste

During the operation of the Plant, radioactive material is produced by fission and by neutron-activation reactions in metals and other material in the reactor coolant systems. Small amounts of gaseous and liquid radioactive wastes enter the effluent streams, which are monitored and processed within the Plant to minimize the radioactive nuclides that will ultimately be released to the atmosphere and into the Mississippi River. The radioactivity that may be released during operation of the Plant will be as low as practicable and in accordance with the Commission's regulations.

The waste handling and treatment systems currently installed at the Plant have been described in detail by the Applicant[2-5]. The treatment systems discussed in the following sections are designed to collect and process gaseous, liquid, and solid waste that might contain radioactive materials.

a. Liquid Wastes

Nonaerated drains from components within the reactor coolant system and a portion of the coolant letdown stream used for boron management will be processed through the chemical and volume-control system (CVCS). Aerated drains from the floor drains, aerated equipment drains and leaks, decontamination drains, and laboratory and sample drains will be processed through the waste-evaporator system or the aerated drain evaporator-demineralizer treatment system. The laundry and shower waste waters and certain decontamination solutions will be treated in a special coagulation tank facility. The liquid radwaste system is shown schematically in Figure III-12. All equipment in the liquid radwaste system is common to both units, except the steam-generator blowdown flash tanks, reactor-coolant drain tanks, and the drain-tank pumps.

(1) Chemical and Volume-Control Systems (CVCS)

The normal letdown flow of reactor coolant, after pressure and temperature reduction, will pass through a letdown filter, a mixed-bed demineralizer, and a postdemineralizer filter, and then return to the volume-control tank. A cation-bed demineralizer, located downstream from the mixed-bed unit, will be used intermittently to remove cesium and lithium from the coolant. An anion-bed demineralizer will be used as a deborating unit toward the end of the core fuel-cycle.

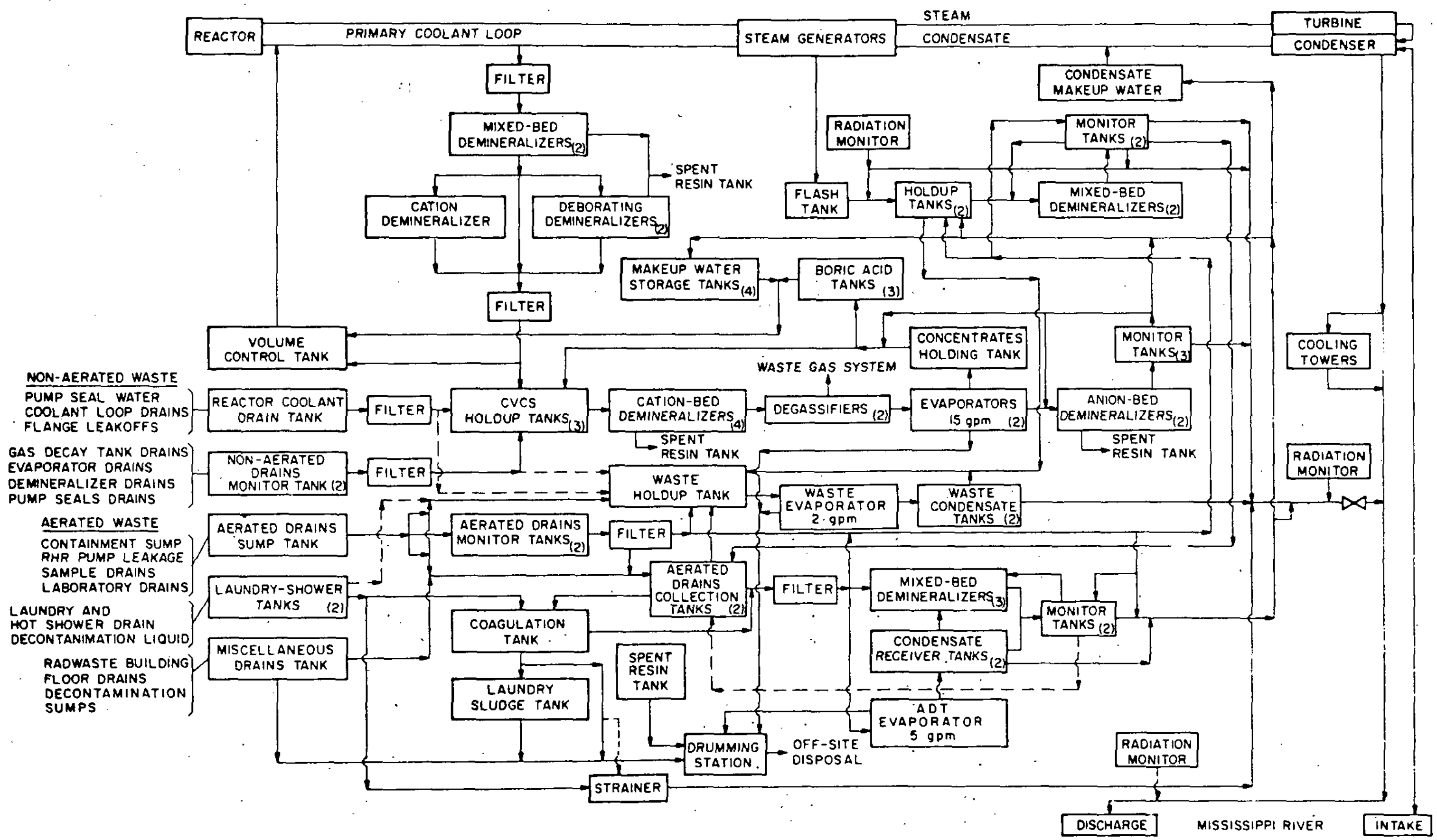


Fig. III-12. Prairie Island Nuclear Generating Plant Liquid Waste Disposal System

During normal Plant operation, part of the coolant letdown stream will be diverted to the CVCS holdup tanks and will be processed through the boric acid recovery system. This "shim bleed" and other nonaerated liquids collected in the reactor coolant drain tank and in the nonaerated drains monitor tank will pass through a cation-bed demineralizer, a degasifier, and an evaporator. The condensate will flow through an anion-form demineralizer and into a monitor tank. The contents of the monitor tank will be analyzed and either recycled through the demineralizer, returned to the CVCS holdup tanks for reprocessing, pumped to the makeup water-storage tank, or discharged from the Plant. The boric acid concentrate will be collected in the concentrates holding tank and analyzed. If of desired quality, it will be sent to a boric acid holding tank for reuse; otherwise, it will be drummed and shipped offsite for burial. Our evaluation assumed that 8,300 gallons per day per unit will be treated and that 10% of this water will be released under monitored conditions and 90% will be reused.

(2) Waste Disposal System

The Plant has four independent waste-processing systems, three of them interconnected for flexible waste treatment to facilitate the process requirements of both power units, and the fourth for miscellaneous nonreactor wastes.

Waste-Evaporator System: A waste-holdup tank will collect aerated wastes from both units. The waste liquid will be evaporated and the condensate sent to the waste-condensate tank, where it will be analyzed and discharged if the level of radioactivity is below a prescribed value. The waste-condensate tank can also be returned to the waste-holdup tank for reprocessing or be directed to a monitor tank in the steam-generator blowdown cleanup system. Normally, liquid collected in the aerated drains sump tank will be sent directly to the waste-holdup tanks or by the way of the aerated drains-monitor tank. Wastes collected in the aerated drains-collection tanks can also be sent to the waste holdup tanks. Nonaerated drains collected in the reactor-coolant drain tank and in the nonaerated drains-monitor tank will not normally be mixed with the wastes in the waste holdup tank, although provisions are made which interconnect these tanks. Our evaluation assumed that 190 gallons of the aerated wastes per day per unit were processed through the waste evaporator and the condensate discharged.

Aerated Drains-Treatment System: In addition to the waste-evaporator system, wastes collected in the miscellaneous drains tank and the aerated drains sump tank can be sent to an aerated drains-collection tank. The liquid in the collection tanks may be processed through a mixed-bed demineralizer, be evaporated and the condensate processed through a demineralizer, or be recycled if needed. The wastes may also be sent to a holdup tank in the steam-generator blowdown cleanup system for demineralization, to the waste-holdup tank for evaporation, or to the plant-makeup water system either before or after processing. Our evaluation assumed that 380 gallons of the aerated wastes per day per unit will be processed through the aerated drains-treatment evaporator and the demineralizer and that 10% of the liquid will be released.

Steam-Generator Blowdown-Treatment System: When the Plant is operating with little or no primary to secondary leak, the blowdown water will enter a flash tank and be discharged from the Plant site. During Plant operation with a significant primary-to-secondary leak, the blowdown water will be directed to a holdup tank after the flash tank. The contaminated blowdown water will be processed by mixed-bed demineralizers and retained for sampling and analysis in one of two monitor tanks. The contents of the monitor tanks can be recycled, processed through the aerated drains-treatment system, or released from the Plant directly. Contents of the holdup tanks can also be directed to the waste-holdup tank and processed in the evaporator.

Our evaluation assumed that the Applicant will process 10 gpm of blowdown water from each unit through one mixed bed demineralizer and discard the effluent without further processing. We also assumed that the steam-generator blowdown-treatment system will not treat waste received from the other waste systems.

System for Other Wastes: An independent treatment system not completely connected to the three reactor waste-treatment systems described above processes certain decontamination solutions and laundry and shower waste waters. The waste liquid can be discharged under monitored conditions to the onsite septic-tank system or to the discharge canal, or treated in the coagulation tank. The decantate from the coagulation process may be processed through the aerated drains-treatment system if needed. Sludge from the coagulation treatment will be drummed for offsite burial. Aerated liquids collected in the aerated drains-treatment collection tank can also be processed through the coagulation tank. For this evaluation, we assumed that no liquid wastes were treated by the coagulation process.

We estimate that, excluding tritium, less than 5 Ci of liquid radioactive waste per unit per year will be discharged. The Applicant estimates 0.22 Ci. To compensate for treatment equipment downtime and expected operational occurrences, the values listed in Table III-2 have

TABLE III-2 Anticipated Annual Release of Radioactive Material in Liquid Effluents from Each Unit of the Prairie Island Nuclear Generating Plant

Nuclides	Ci/yr/unit
Rb-86	0.00024
Sr-89	0.0020
Sr-90	0.000095
Sr-91	0.000024
Y-90	0.000025
Y-91m	0.000015
Y-91	0.000075
Y-93	0.0000060
Zr-95	0.00034
Zr-97	0.0000033
Nb-95	0.00042
Nb-97m	0.0000032
Nb-97	0.0000032
Mo-99	0.0042
Tc-99m	0.0039
Ru-103	0.00021
Ru-106	0.000074
Rh-103m	0.00021
Rh-105	0.0000061
Rh-106	0.000074
Sb-127	0.0000014
Te-125m	0.000018
Te-127m	0.0017
Te-127	0.0017
Te-129m	0.012
Te-129	0.0080
Te-131m	0.00044
Te-131	0.000080
Te-132	0.015
I-130	0.00073
I-131	3.8
I-133	0.44
I-135	0.032
Cs-134	0.18
Cs-136	0.031
Ba-137	0.17
Ba-137m	0.16
Ba-140	0.0010
La-140	0.0011
Ce-141	0.0029

TABLE III- 2 (Continued)

Anticipated Annual Release of Radioactive Material in Liquid Effluents from Each Unit of the Prairie Island Nuclear Generating Plant

Nuclides	Ci/yr/unit
Ce-143	0.0000095
Ce-144	0.00027
Pr-143	0.00014
Pr-144	0.00027
Nd-147	0.000048
Pm-147	0.000034
Pm-149	0.0000053
Sm-153	0.0000023
Eu-156	0.0000070
Cr-51	0.0046
Mn-54	0.0029
Fe-55	0.0087
Fe-59	0.0017
Co-58	0.077
Co-60	0.0087
Total	∿ 5 Ci

Tritium ∿ 1000 Ci

been normalized to 5 Ci. We estimate 1000 Ci of tritium released per unit per year based on present operating reactor discharges; the Applicant estimates 410 Ci of tritium. The dilution flow for liquid effluents is expected to be 72,000 gpm in the discharge canal.

b. Gaseous Waste-Disposal System

During power operation of the Plant, radioactive materials released to the atmosphere in gaseous effluents include fission-product noble gases (krypton and xenon) and halogens (mostly iodine); activated argon, oxygen, and nitrogen; tritium contained in water vapor; and particulate material including fission products and activated corrosion products.

The gaseous waste-disposal system for the Plant has been designed with the capability of processing the fission-product gases from contaminated reactor coolant fluids resulting from the operation of both units at the design-basis reactor coolant-activity limit. The system is shown schematically in Figure III-13. The Applicant states that this system is designed to allow for the retention, throughout the Plant lifetime, of all the gaseous fission products to be discharged from the reactor coolant system to the chemical and volume-control system and to the boron recycle system. This will eliminate the need for intentional discharge of radioactive gases from the waste-gas decay tanks.

Waste gases from both units are processed by one of two independent equipment trains. One train permits continuous purging of the volume-control-tank gas space into a low-volume loop designed to accumulate, concentrate, and contain fission gases at high levels of radioactivity. Operation of this high-activity-level train provides continuous removal of fission gases from the letdown coolant to maintain the coolant fission-gas concentrations at a low residual level. The other train provides sufficient storage capacity for low-activity-level cover gases from the nitrogen blanketing system so that there is no need to vent gases that accumulate as a result of load-following operations.

During normal operation, hydrogen gas containing fission-product gases will be vented from the volume-control tank to the high-activity-level train, where it will be transported in the circulating nitrogen stream. The nitrogen-hydrogen-fission gas mixture will be pumped by the compressor to the recombiner, where the hydrogen is combined with oxygen to form water vapor, thereby reducing the gas volume. The remaining nitrogen-fission gas stream will then flow to the high-level gas-decay tanks for decay and then back to the compressor.

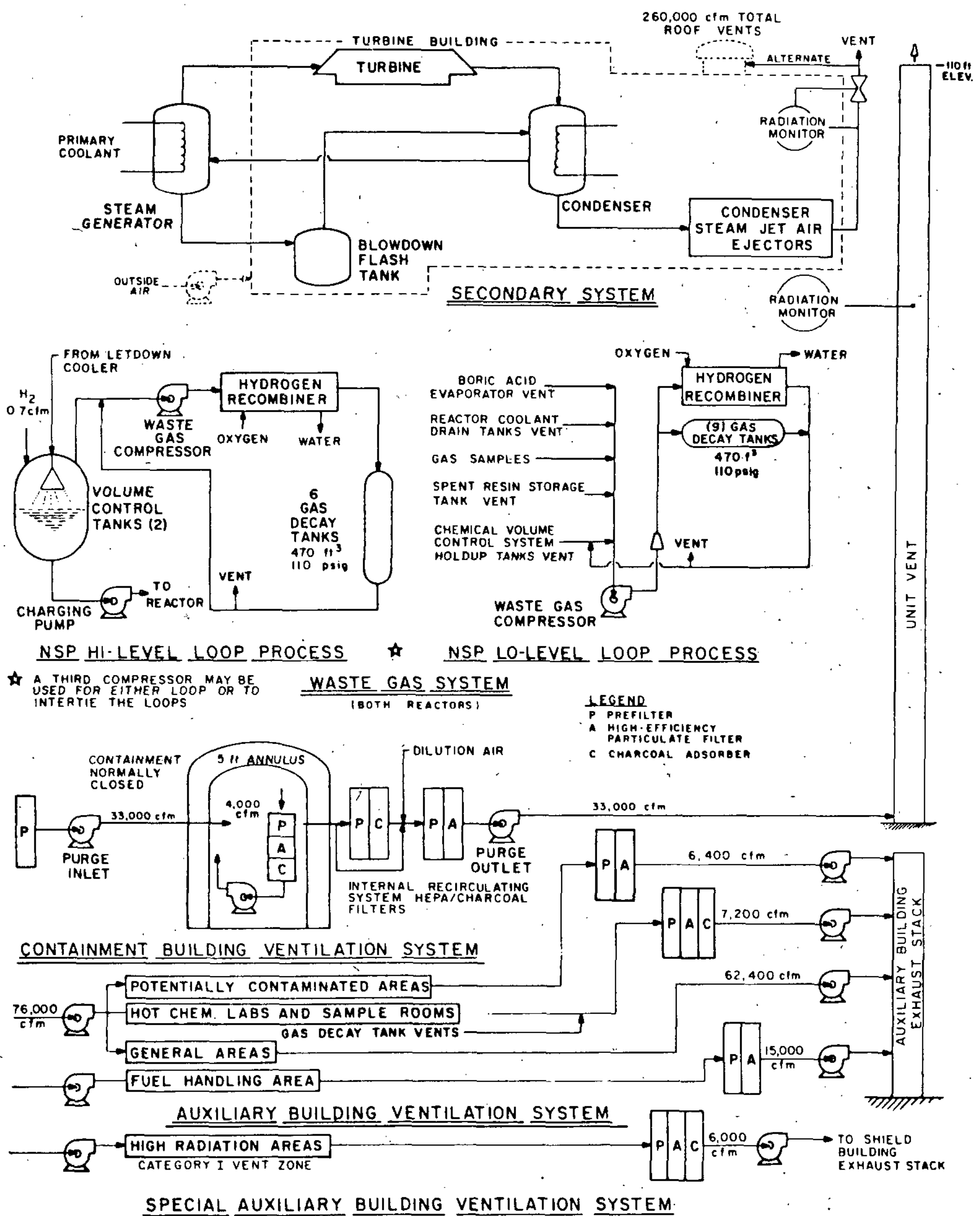


Fig. III-13. Gaseous Waste Disposal and Ventilation Systems for the Prairie Island Nuclear Plant

Most of the gases in the low-activity-level train will be cover gases displaced from the CVCS holdup tanks as they fill with liquid. The cover gas is primarily nitrogen, but will also contain hydrogen and small amounts of fission-product gases originally dissolved in the let-down coolant. Gases entering the low-level train are pumped by the compressor to the recombiner or to the low-level gas-decay tanks. These gases will be returned to the holdup tanks as they are emptied of liquid, and thus the system is essentially a constant-volume operation.

There will normally be no need to vent the gas-decay tanks to the atmosphere, although an occasional discharge may be required to dispose of gases accumulated from shutdown operations and inflows from miscellaneous vents. After decay, these nitrogen-containing gases may be discharged through the prefilter, high-efficiency particulate (HEPA) filter, and charcoal absorbers connected with the auxiliary-building hot-chemistry laboratory and sample-processing area before being discharged to the atmosphere. Our calculations indicate that the gas-decay tanks will have sufficient capacity to allow more than 60 days holdup time, although for calculation purposes it was assumed that all gases would be released after 60 days.

Additional sources of gaseous-waste activity include 1) ventilation air released from the auxiliary building, spent-fuel area and turbine building; 2) off-gas from the main condenser steam-jet air ejectors; and 3) air from purging of the reactor containment. The steam-generator blowdown flash vent will be vented to the turbine condenser.

Air from fuel-handling areas and from potentially contaminated areas of the auxiliary building will be treated by a prefilter and HEPA filter, and air from the hot-chemistry laboratories and sampling rooms by a prefilter, HEPA filter, and charcoal absorber. The auxiliary-building leak was evaluated assuming no treatment for noble gases or iodine during normal operation. A special auxiliary-building ventilation system will be used for processing air from high-radiation areas of the auxiliary building by a prefilter, HEPA filter, and charcoal absorber during periods of abnormal activity.

The turbine-building exhaust is not treated, and gaseous effluents from leakage in the turbine building are expected to be small. Off-gases containing radioactivity due to a primary-to-secondary system leak are released from the condenser air ejectors to the turbine-building vent without treatment.

The primary containment building is normally a sealed volume. However, during refueling and maintenance it is necessary to purge the containment, and, when this occurs, airborne radioactivity may be released to the environment. The system will be arranged so that the purge exhaust can be directed to either a prefilter and HEPA filter train or a prefilter, HEPA filter, and charcoal-absorber train. The containment-building atmosphere will also be treated internally by a HEPA filter and charcoal absorber before purging to reduce halogen and particulate concentrations. Our evaluation assumed operation of both internal cleanup systems for 16 hours at 4000 cfm per system before purging through the purge treatment train.

A potential source of radioactivity is from the atmospheric Steam Dump System during large power transients. These releases are expected to be infrequent and small. Technical Specifications will require an inventory of the activity released to assure compliance with effluent release limits.

Our estimated releases of gaseous effluent are listed in Table III-3. Conditions considered in our evaluation of the waste-treatment systems are given in Table III-4. The Applicant (using somewhat different assumptions) estimates that on the average about 9600 Ci of noble gases and 0.07 Ci of iodine-131 will be discharged each year, whereas our estimate is about 1700 Ci of noble gases and 0.14 Ci of iodine-131 per year per unit.

c. Solid Wastes

Miscellaneous materials, such as paper, rags, and glassware, will be compressed into 55-gallon drums. Spent resins and concentrates from the waste evaporators will be solidified in 55-gallon drums or other regulation containers and stored in a shielded area prior to shipment offsite for burial. It is estimated that approximately 630 drums of spent resins, filter sludge, and evaporator bottoms, at 15 Ci per drum, and 1400 drums of dry and compacted waste, at less than 5 Ci per drum, will be shipped offsite each year from both units.

3. Chemical Wastes

The sources of chemical wastes in the Plant and the methods used to control the release of these chemicals to the river are considered here. The chemicals are used in the Plant for regeneration of demineralizers used to purify Plant water supplies, for control of fouling of heat exchangers, for maintenance of water quality, for corrosion inhibition, and for cleaning. The chemicals released are from nonradioactive sources, with the exception of a small amount of chemicals contained in the purified effluent that is discharged from the liquid radwaste system. About 1/3 of the chemicals released in regeneration of the makeup water demineralizer are the natural constituents present in the well-water supply. This effluent is discharged into the circulating water system. A much smaller fraction of chemicals is released in the blowdown of the oil-fired heating

TABLE III-3 Anticipated Annual Release of Radioactive Nuclides in Gaseous Effluent from Each Unit of the Prairie Island Nuclear Generating Plant

Isotope	Discharge Rate (Ci/Year/Unit)					
	Containment Purge	Auxiliary Building	Gas Processing System for 60-day Decay		Condenser Air Ejector	Total
			Cold Shutdown	Letdown Degassing		
Kr-83m	--	1	--	--	1	2
Kr-85m	--	6	--	--	6	12
Kr-85	2	1	14	443	1	461
Kr-87	--	3	--	--	3	6
Kr-88	--	11	--	--	11	22
Xe-131m	1	2	1	1	2	7
Xe-133m	--	8	--	--	8	16
Xe-133	84	500	2	2	500	1088
Xe-135m	--	11	--	--	1	2
Xe-135	--	17	--	--	17	34
Xe-137	--	1	--	--	1	2
Xe-138	--	3	--	--	3	6
I-131	0.011	0.054	--	--	0.072	0.137
I-133	0.002	0.074	--	--	0.051	0.127

TABLE III-4 Conditions Assumed in Determining Releases of Radioactive Effluents from the Prairie Island Nuclear Generating Plant (Per Unit)

Reactor Power	1721 MWt
Total Steam Flow	7.26×10^6 lb/hr
Plant Capacity Factor	0.8
Failed Fuel	0.25%*
Containment Purges per Year	4
Rate of Primary Coolant Leakage into Steam Generators	20 gpd
Rate of Primary Coolant Leakage to Containment Building	40 gpd
Rate of Primary Coolant Leakage to Auxiliary Building	20 gpd
Rate of Shimrod Bleed	5.8 gpm
Primary Coolant Degassed, times per year	2

Iodine Partition Coefficients:

Primary Coolant Leak to Auxiliary Building	200
Primary Coolant Leak in Containment Building	10
Steam to Liquid in Steam Generator	100
Condenser Air - Ejector	2000

Decontamination Factors (demineralizers):

	All Cations except Cs, Mo, Y, Rb, ^3H	Anion	Cs & Rb
Mixed Bed (Li_3-BO_3 form)	10	10	2
Cation Bed	10^2	1	10
Mixed Bed	10^2	10^2	2
Anion Bed	1	10^2	1

Removal Factors (Plateout, etc.):

Mo & Tc	100
Y	10

Total System Decontamination Factors (including evaporators):

	I	Cs	Y	Mo&Tc	Others
Nonaerated wastes	10^4	10^4	10^4	10^5	10^5
Aerated wastes:					
Waste evap. system	10^2	10^3	10^4	10^5	10^3
Aerated drains treatment system	10^5	2×10^4	10^5	10^6	10^6
Steam Generator blowdown	10^2	10	10	10^2	10^2
Shim bleed	10^5	2×10^4	10^4	10^5	10^6

*This value is constant and corresponds to 0.25% of the operating power equilibrium fission product source term.

boiler; the boiler makeup is demineralized water and no chemicals are added. A slight concentration of the river water used for cooling takes place due to the operation of the evaporative cooling towers.

a. Purification of Well Water for Plant Use

The largest quantity of chemical waste is the liquid effluent from the regeneration of the demineralizers used to purify makeup water for reactor coolant loops from well water used as the source of supply. The regenerants used in the demineralizer will be analyzed and treated in accordance with regulatory limits set by the Minnesota Pollution Control Agency. In normal batch operation, the dissolved mineral content of this waste stream consists of 470 lb of various naturally occurring compounds from the well water and 720 lb of regeneration and neutralization chemicals (principally sodium sulfate) in up to 20,000 gallons of solution. The frequency of discharge is once per day. After monitoring in a holdup tank, this waste is released via the circulating water system to the river. Table III-5 presents the Applicant's estimate of the daily discharge of these chemicals, the calculated average incremental concentration in the discharge canal and in the river, and the observed natural concentration in the river. The calculated incremental concentrations are based on flow rates of 1500 cfs in the discharge canal and 11,000 cfs in the river. The concentrations are time averages. Since the holdup tank may be discharged in periods as short as 6 hours, the maximum concentrations could be 4-fold higher during this time. Some minor variations occur in local maximum concentrations depending on whether the Plant is operating with open-cycle or closed-cycle cooling. However the combination of blowdown and natural dilution ($\sim$ 10% of river flow) will result in concentration variations less than 4-fold in the discharge canal and in the river.

There is a maximum concentration of natural mineral content in the blowdown due to evaporation of river water in cooling towers. This maximum concentration factor in the 150 cfs blowdown is 1.25. The equivalent increase in concentration in the discharge canal is about 2.5% and in the river about 0.34%. All these variations are small compared to natural variations.

b. Chlorination of Service Water

The inlet water for the service-water system is chlorinated to prevent fouling of surfaces of heat exchangers by growth of algae or other organisms. The 53-cfs flow of the service system is about 4% of that for the (combined) circulating-water cooling system (see Figure III-9). The chlorine is injected for a 20-min period, three times per day; the

TABLE III-5 Chemical Concentrations from Chemical Holdup Tank Effluents[7]

Chemical	Daily Discharge (lbs)	Equivalent Discharge Canal Concentration[a] (mg/l)	Equivalent River Concentration[b] (mg/l)	Normal River Concentration (mg/l)
Regeneration Chemicals:				
Na^+	233	0.0288	0.0039	6 to 18
$SO_4^=$	487	0.0602	0.0082	10 to 75
	720			
Well Water Minerals:[c]				
Ca^{++}	74.4	0.0092	0.0012	34 to 72
Mg^{++}	23.2	0.0029	0.0004	11 to 22
Na^+	12.5	0.0015	0.0002	6 to 18
HCO_3^-	285.0	0.0352	0.0048	66 to 235
$SO_4^=$	31.3	0.0039	0.0005	10 to 75
$S_1O_2^=$	24.4	0.0030	0.0004	0.4 to 13
Cl^-	17.8	0.0022	0.0003	2 to 25
	∿470.0			

[a] Assuming a discharge dilution flow rate of 1500 cfs which includes blowdown and natural dilution in the discharge channel.

[b] Assuming an average river flow rate of 11,000 cfs.

[c] Based on well water analysis of 5/2/72 and on 150,000 gallon water purification per regeneration cycle (once per day).

injection rate is controlled so that the residual active chlorine is a maximum of 0.3 ppm at the point where the exit water of the service-water system joins the main circulating-water system. A large reduction occurs there as a consequence of dilution by the main circulating water.

The chlorination is carried out by injecting water with elemental chlorine gas in a controlled manner. This is a well-established procedure in power-plant practice. Chlorine is stored as liquid at room temperature in standard one-ton containers. As many as four containers may be stored at a time. In water solution, the active forms of chlorine are principally the hypochlorite ion and hypochlorous acid. However, active chlorine may also be present in certain reaction products, for example, as chloramine (formed by reaction with ammonia). Chloramine and perhaps some other reaction compounds are volatile and hence can be eliminated to some extent from the circulating-water system by contact with air in the cooling towers. The dissolved hypochlorite ion is not volatile, but its concentration is progressively reduced by physical dilution and chemical reactions.

As the water is discharged into the river, this residual chlorine concentration is reduced by three major processes: 1) the chlorine-bearing water from the service-water system is physically diluted by the flow of the circulating-water system (1360 cfs) and by the river (7-day, once-in-10-year low flow of 4430 cfs); 2) the instantaneous exit concentration is reduced by a factor of 24, by time averaging and overall mixing, since the duration of the injection is only 1 hr per day; and 3) residual chlorine is lowered further as the discharge is mixed with river water by reaction of the residual chlorine with the chlorine-demand constituents of the diluent water.

The chlorine-demand constituents of the circulating water are more than sufficient to deactivate the residual free chlorine of the exit water of the service-water system. Thus it is expected that the concentration of residual free chlorine entering the river (at the location of the temperature sensors) will be so low as to be undetectable, that is, less than 0.01 ppm.

c. Steam Generator Blowdown

The amount and frequency of steam-generator blowdown depend on Plant conditions (notably steam-generator leaks). During normal Plant operations, steam-generator blowdown could be as little as 250 gal/day. All blowdown is monitored before treatment and may be discharged to the river or processed to remove radioactivity before discharge. The steam-generator blowdown contains a maximum of 2 ppm phosphates and 5 ppm silica, a water-quality requirement for the steam generator. The blowdown also contains about 20 ppm of hydrazine (for oxygen control) and 5 ppm of morpholine (for pH control). These concentrations will be diluted by a factor of over 10^4 by the circulating-water discharge before reaching the main channel of the river.

d. Chemical Effluent from Radwaste Processing

Radioactive liquids are processed in the radwaste system by the methods described in Section III.D.2.a. After prescribed treatment and monitoring, certain portions of purified liquid waste are virtually free of radioactivity and may be released via the discharge canal. Because of the treatment methods used, namely, demineralization and distillation, essentially no chemicals are present in such discharges.

e. Preoperational Cleaning

Before Plant startup, some of the equipment in the steam cycle must be cleaned. All chemicals used in this cleaning are to be treated to meet applicable water-quality standards and monitored before release to the river. The same provision also applies to cleaning or other waste solutions generated at any time after startup.

f. Cleaning of Condenser and Cooling Towers

Because of the organic content of Mississippi River water, means must be provided to keep the condenser surfaces from fouling. The condenser, which uses about 96% of the cooling-water flow, employs a mechanical tube-cleaning system. This system ("Amertap") has been selected by the Applicant on the basis of satisfactory operating experience in its use in the Allen S. King (coal) plant. No chemical addition is used in this system, which consists of injecting a large number of rubber balls into the circulating water entering the condenser. These balls then pass randomly through the condenser tubes, wiping the dirt and algae from the tube walls. At the exit, the balls are collected by a screen system for reuse. The thermal efficiency obtained in a condenser using this method of cleaning is reported by the Applicant to be higher than with conventional chlorination.

The only significant problem with this system occurs when the circulating water contains appreciable amounts of debris. Then, occasionally, a ball and a twig will enter a tube simultaneously, plugging the tube. This has not been a major problem at the King Plant, since the circulating water there contains very little debris.

Fouling is of lesser importance in the cooling towers but it must be controlled. The cooling towers used have two features that minimize the possible need for chemical cleaning agents. The internal baffles of the tower, which distribute the water and facilitate efficient contact of the falling water with the rising air, are made of thin, perforated strips of polyvinyl chloride. This plastic material resists the attachment of bacterial or algal growths. Also, the water-inlet distribution reservoir at the top of the tower is enclosed. This feature, by excluding sunlight and open air, prevents algal or plant growth.

4. Sanitary and Other Wastes

a. Sanitary Wastes

The sanitary sewage-disposal system uses septic tanks and drain fields on the Plant site, without river discharge. A dual system with tanks of 3830- and 3050-gallon capacity, having separate drain fields, was provided for use during construction by as many as 1050 persons. Since less than 200 persons are to be employed during operations, the smaller of these two systems will be abandoned. The designs of both systems were reviewed and approved by the Minnesota Department of Health. No radioactive wastes will be processed in this system. The drain field of the permanent (remaining) system consists of 10 tile lines, each 70 feet long, 9.5 feet below grade, and spaced about 9 feet apart. The tile field is located about 200 feet southeast of the reactor building, between it and the cooling-water discharge-control structure. This design was based on a soil percolation rate of 4.5 minutes per inch, as determined by an engineering consultant firm engaged by the Applicant.

b. Gaseous (Nonradioactive) Wastes

Emergency diesel generators and auxiliary heating boiler are sources of combustion gases from oil fuel. The diesels have an aggregate power of 5700 kW, but will be used infrequently. The auxiliary heating boilers have estimated fuel-oil consumptions of 60,000 gal/yr during the construction and testing period and 20,000 gal/yr during operation of the Plant. The combined release of combustion gases is small, especially for a site area of this size, and complies with State Air Quality Regulations.

c. Solid (Nonradioactive) Wastes

All trash, debris, garbage, and other solid waste are removed from the site and buried according to Minnesota regulations. This includes debris and any fish trapped on the trash grill or traveling screens of the circulating-water intake structure.

IV. ENVIRONMENTAL IMPACT OF SITE PREPARATION AND PLANT CONSTRUCTION

A. SUMMARY OF PLANS AND SCHEDULES[1,2]

Key dates in the construction program for the Plant are given in Table IV-1. Figures III-2 and III-3 are a pictorial indication of the status of construction activities in early 1971. As of January 1, 1973, the construction of Unit 1 was about 95% completed. Unit 2, scheduled for operation one year later, was about 33% completed and the transmission lines for both units were about half completed.

The work force for the Plant construction peaked at 1300 persons during mid-1972. Approximately 3400 man-years of effort will be required to complete the Plant, extending over a seven-year period from late 1967. About 75% of these workers have been drawn from the regional labor force through local hiring halls, and it is estimated that about 65% of the remaining effort will be provided by workers who live within commuting distance of the site.

B. IMPACTS ON LAND, WATER, AND HUMAN RESOURCES

1. Land

The 560-acre site was acquired in 1959, along with five summer cottages there. These were removed when site development activities began in late 1967. Approximately 240 acres have been disturbed and modified by the Plant construction activities, and about 60 acres will be permanently occupied by buildings, roads, parking lots, canals, substation, transmission lines' corridor and cooling towers.

Most of the remaining acreage will be left in its natural state. Excavation for the Plant and the relocation of permeable sandy alluvium which covers the Plant site were carried out with regard to stabilizing the shore terrain against natural erosion. The 180 acres of disturbed land will be landscaped to give an appearance natural to the general area. Excavated muck and soils are being redistributed onsite, in accordance with the site development plans. The shoreline at the Plant site appears undisturbed by the construction, except for the openings required for the cooling system intake and discharge and the removal of a few trees. Stabilization at locations of potential erosion has been achieved primarily by sloping and riprap. Concrete wing walls were installed at the intake house to prevent bank collapse.

TABLE IV-1 Key Dates in the PINGP Schedule[1,2]

	Date	
	Unit 1	Unit 2
Construction Permit Application	March 1967	August 1967
Start of Site Preparation	October 1967	October 1967
Construction Permit Issued	June 1968	June 1968
Operating License Application	January 1971	January 1971
Initial Fuel Loading	July 1973	July 1974
Commercial Service	Late 1973	Late 1974

Much of the land around the Plant has been under cultivation, with fields separated by wooded and low swampy areas. Most of the impact of construction activities on lowland biota has already taken place. Clearing of this acreage has resulted in the loss of some nesting sites for birds, a loss of habitat for small mammals, reptiles, and amphibia, and destruction of some food sources for these species.

Approximately 210,000 cubic yards of river sediment and shore material were removed by the dredging operations for the intake and outfall channels, and at least another 110,000 cubic yards relocated. The dredged materials that were removed, including entrained water, construction debris, and surplus soil from excavations for the buildings, were put into a 25-acre diked disposal area located onsite just north of the substation. After the dredged materials have been drained of water and are workable, the area will be graded and seeded to blend into the surroundings. The graded elevation will be approximately 8 feet above natural grade.

The completion of the above-grade construction work, the continuation of work on the canals, and the placement of addition spoil and soil in the disposal area will have a small incremental adverse environmental impact. Much of this incremental adverse environmental impact will be temporary in nature, of the type that usually accompanies activities at large-scale construction projects. Impact factors include heavy truck traffic as construction materials are brought to and moved on the site, and the noises associated with crane operation, miscellaneous mechanized tools and equipment. These construction noises are unlikely to disturb the surrounding population since this is a relatively remote site.

Close attention to the avoidance of environmental damage was given during the routing and construction of transmission lines.[6] Thirty miles of these were for 345-kV lines, requiring a minimum 150-foot right-of-way, and 4 miles were for 138-kV lines with a minimum 100-foot right-of-way. The dominant use of the land in these corridors was for farming and it will continue as such. Extensive use of wooden H-frame structures for line support allowed considerable freedom in selecting structure sites at road and stream crossings and minimizes the loss of use of farmland since farm machinery can be operated in close proximity to the poles. Metal lattice towers were used at some locations to allow increased spans, for example, to span valleys without a need for cutting flanking slopes.

Ecological aspects of the transmission line impact are considered in Section V.C.1.a. Routing, construction, and appearance conformed to current Federal recommendations[3,4]. In essence, rights-of-way were selected to preserve the natural landscape and to minimize conflict with present or planned uses of the land. The new circuit is routed to avoid municipalities, park or wildlife areas, and private residences. Present land uses were retained, and rights-of-way were used jointly with other companies wherever possible. Railroad right-of-way was used in the more populated areas. Heavily timbered areas, steep slopes, and proximity to highways have been avoided. Scenic areas have also been avoided.

Clearing of natural vegetation was limited to material that posed a hazard to the transmission line, and line clearing was completed without using bulldozers. Open areas of water and marshland were avoided. Nearby Goose Lake was crossed at the north end of the lake. Topsoil was not removed along the banks of the lake or river, and trees and brush were cut instead of being plowed. Soil disturbance during construction was kept to a minimum, with restorative measures taken when any topsoil clearing was necessary. Native vegetation was allowed to grow within the right-of-way if it did not interfere with the transmission lines. Herbicides, when required for transmission-line maintenance (control of tree height), are used selectively, and application is consistent with the Department of Interior's Fish and Wildlifee Service recommendations.

2. Water

Two onsite deep wells, rated at 300 gpm each, are used for drinking, sanitary and construction purposes, during construction and will later be used to supply domestic water and reactor makeup water to the Plant. Expected maximum well-water demand is 500 gpm with a normal average use of about 85 gpm. The design of the wells exceeds the requirements of the Minnesota Department of Health standards for sanitary wells (double-cased for 50-foot depth and sealed with Portland cement grout between the casings). In addition, two temporary fire-protection wells have been provided, but will be abandoned in favor of river water when the Plant is in operation[2].

The nearest offsite well is 3000 feet away, and no draw-down effect is expected by operation of the onsite wells. Groundwater flows southwest from the Plant, toward the Vermillion River away from the Plant and area drinking-water supply.

The sanitary sewage-disposal system for the construction phase consists of two septic tanks and drain fields, one of 3830-gallon capacity and the other 3050 gallons. The latter will be abandoned upon completion of construction. The 3830-gallon septic tank and drain field will continue to be used for Plant operation following completion of construction. Since the maximum construction force numbered 1300 and less than 200 people will be involved in Plant operation, there should be ample sanitary-sewage-disposal capacity during the operational phase. No radioactive wastes (as defined by 10 CFR 20.303) will be processed in the sanitary-sewage-disposal system.[2]

The preoperational cleaning and flushing wastes will be held up and treated in accordance with the requirements of the State permit (see Table I-2). The material discharged to the Mississippi River is not expected to create a significant adverse impact because the quantities discharged are relatively small and such discharge will be a "one-time" occurrence for each unit.

Excavation and construction activities have unavoidably caused some minor changes in the surface water runoff from the site. However, the permeable sandy alluvium that is the site's topsoil results in only minor runoff. No additional significant adverse effects are anticipated on groundwater, loss of soil by erosion, pollution of water or air, or disruption of recreation as a result of the continuation of construction.

The impact on the aquatic environment was restricted primarily to that associated with the construction of the cooling-water intake and effluent canals. It is unlikely that the benthos of the total of 5 acres of river bottom dredged in these two areas survived this disturbance. Also, the increased silt loads during the dredging of the canals, particularly downstream for a few hundred feet in the Mississippi River side channels, were likely to have adversely affected the bottom organisms. However, no measure of such an impact is available. Although local damage to benthic animals occurred because of dredging, no prolonged effects are anticipated by the Staff, since the affected part of the river bottom will become recolonized.

Both Sturgeon Lake and main-channel waters will be drawn into the intake; a greater percentage of water from the main channel will enter the intake as a result of dredging. Dredging work at the outfall has sealed the north border of a slough to the south of the Plant site, along the western bank of the river. In effect, this will shunt the cooling-water effluent past this slough and more directly into the main channel of the Mississippi River.

3. Roads and Transportation

Dust from increased road traffic has been eliminated by black-top surfacing of the preexisting gravel-surfaced access road from U. S. Highway 61 on the bluffs west of the site. The improvement comprises 4.5 miles of preexisting Goodhue County Road 18 and 1 mile of Applicant-built extension to the Plant. A flasher signal has been installed at the crossing of this road with the main line of the Chicago, Milwaukee, St. Paul and Pacific Railroad. The Goodhue County Engineer's Office has estimated[2] that approximately 300 vehicles per day are using the road to the Plant and that approximately 50 continue past the Plant on the access road to Lock and Dam No. 3. Results of a current State Highway Department survey of traffic in the general area of the site are not yet available.

Riprap required for shoreline protection, particularly for the downstream side of the discharge channel, was moved by truck from a nearby quarry. Sand and gravel for the concrete mixed and used onsite was also hauled by truck from nearby quarries.

Large Plant components such as the steam generators and pressure vessels were moved by barge from the suppliers' plants to the site. The barges were sunk temporarily in a slip and the components were winched onto the site using rails installed temporarily for this purpose.[5]

After construction is completed, traffic in the region around the site will be only slightly increased. This increase will be due primarily to commuting of operating and maintenance personnel and the transport of essential materials such as fresh and spent fuel.

4. Human Resources

During the construction period, the major sociological impact has been a result of the requirement of a construction labor force numbering as many as 1050 skilled and unskilled workmen. Principally, these workers commute from the Minneapolis-St. Paul metropolitan area. Only a small portion of the construction force has established residence in the Red Wing area. Because of their small numbers, and since these workers will leave the project site after construction is completed, they have not and will not cause significant demands on community services such as hospitals, housing facilities or schools.[1] Thus the impact of the work force is largely economic, rather than social, and temporary, rather than permanent. The creation of additional jobs, although mostly temporary, is a positive contribution to the commercial activities in the region. The construction phase of the Plant will have a diffuse impact on the economy of the region, and a localized area of high unemployment will not occur after the Plant is built.

The Applicant has headquartered the Prairie Island Plant operating staff in Red Wing. This group, which will number about 100 people, is progressing through required operator training courses for AEC certification. Many of the other permanent Plant staff have now established residence in the local area. These new families have not created significant additional pressure on municipal services or schools.

The greatest sociological impact may result from the addition of the Prairie Island facility to the local tax base. The city of Red Wing has annexed the Township of Burnside, thereby including the Plant within Red Wing city limits. This annexation has caused demands for extending Red Wing city services to the people in the sparsely populated Burnside Township. However, the increased tax revenue that the city will derive from the Plant will more than offset the costs of expanded municipal services to the population of the annexed area.

A real estate tax of $613,000 was paid for the facility in 1971 and $2,370,000 in 1972. The assessment for 1973 is $3,600,000. If projected further, assuming that the Plant will be taxed at 3% of its original cost when completed, the tax would be $10,050,000 in 1974.

In 1971 the Goodhue County tax revenue was $1,650,082, that of the city of Red Wing $1,191,451, and that of the Red Wing School District $2,561,183. Based on the projected property tax to be received from the Prairie Island Nuclear Generating Plant in 1974 (at the current rate), these three units would experience a 194% increase in tax revenues. Thus, the overall effect of this Plant is to create an extremely favorable tax base for the local communities.

C. CONTROLS TO REDUCE OR LIMIT IMPACTS

The construction of the Plant is now nearing completion, particularly as it pertains to the disruption of the environment. The roads and parking lots will be paved before Plant operation begins, but during the construction phase they will continue to be subjected to water sprinkling and periodic oil treatment to control dust. Because of the isolation of the Plant, noise abatement procedures have not been considered necessary during the construction activities. The nearest residence is 0.6 mile away, and nearby areas were considered adequate retreats for any native wildlife disturbed by noise and other activity in the construction area.

In the preparation of the site land, care was taken to save the trees along the bank of Sturgeon Lake, and in the area south of the cooling towers, as well as in other scattered locations. Although two of the four cooling towers are yet to be built, the land has been cleared and graded in preparation for this work, and the basins installed. After the remaining towers are built, the surrounding ground surface will be restored to its natural condition.

Some physical disruption of the aquatic environment has resulted from dredging of the cooling-water-system channels, and from construction of the intake and discharge structures. The benthic regime was destroyed where dredging occurred, but the total area affected is a small part of the benthic community. After dredging and other construction are completed, the benthic community will recover naturally in accord with the new river-bottom conditions. These activities have altered slightly the previous patterns of water flow in the shoreline areas of the river near the Plant.

The controlled release of water from the dredging spoils has reduced siltation effects. Conversion of the construction areas back to natural grasslands will eliminate dust and erosion problems, and leveling the spoil piles, followed by landscaping, will remove the last evidence of construction activities. Thus, all local effects of construction will be temporary and will not produce any long-term significant adverse effects on the environment.

V. ENVIRONMENTAL IMPACTS OF PLANT OPERATION

The overall environmental impact associated with the operation of the Prairie Island Plant is a composite of many factors, some favorable and others which conceivably could be detrimental. Included in the former are the provision of power required in the territory served by the Applicant, the remote location of the Plant, and the release of small quantities and kinds of noxious by-products compared to fossil fired plants. Among the latter are the release of very low levels of radioactivity to the environment, the discharge of small quantities of chemicals, and possible consequences to aquatic biota from the heated water added to the river.

A. LAND USE

Preconstruction use of the land, including the exclusion area and the environs, has been summarized in Section II.B.2. The primary effect of the Plant on previous plans for the land use was to convert about 560 acres of land from agricultural to industrial use. About 60 acres of this will be occupied by structures related to generation and distribution of electricity (54 acres), and by parking lots and roads (6 acres). No other plans for the site are known. The extent to which the land use is altered by the Plant and its operating effects will be considered here.

1. Onsite Effects

The regional character is such that it provides some refuge for inland fowl and small ground animals. Hunting restrictions will be applied to the land in the immediate area of the Plant, to reduce the chance of damage to it. Also, fires in the Plant region will probably be prohibited, to reduce the possibility of grass fires on the site.

Access by the general public to the Plant area and its adjacent shoreline will be in accordance with Safety Guide #17, Protection Against Industrial Sabotage. Use of the access road in connection with the Plant operation will result in only a trivial amount of traffic, since the permanent work force will be small and distributed around the clock and the movement of fresh and spent fuel is very limited.

On the basis of the above discussion, the Staff concludes that operation of the Plant will not cause significant detrimental effects on the use of the onsite land. Historical sites are not expected to be adversely affected.

2. Offsite Impacts

There will be no new impact on land areas contiguous with the site, since the site's peripheral areas will be returned to natural, uncultivated conditions. No sites of historical value will be adversely affected. The principal offsite impacts will be those resulting from the permanent employees at the Plant, the appearance of the Plant, operating noise, additional traffic, the new transmission lines, and the provision of additional electrical energy in the Applicant's territory.

a. New Residents

Permanent employees at the Plant who have moved into the area from more distant points have not experienced difficulty in locating suitable accommodations. Most have settled in nearby towns of moderate size, such as Red Wing and Hastings, and they have been readily assimilated into these communities. The total permanent Plant staff will be 200 persons or less, which represents a minor perturbation to the population within a reasonable commuting distance (20 miles). No significant impact on local residential and commercial functions will occur.

b. Visual Impact of the Plant

The appearance of the Plant will be softened by judicious landscaping and maintenance of the plantings and natural vegetation. The external appearance of the entire Plant, and the clustering of component structures in an attractive, coordinated arrangement will reduce the visual shock of a massive, man-made facility situated in rural surroundings. On the remainder of the site, the original land character will be maintained or a natural state will be allowed to redevelop. Thus, much of the site will retain the appearance of the countryside characteristic of the agricultural activities in the region.

Reaction to the addition of a cluster of buildings and transmission facilities to this rural scene is highly subjective. Care has been taken to design the structures and ancillary facilities to conform with contemporary architectural practices, and the clean lines, color scheme and landscaping will afford a view pleasant to many people.

The Vermillion River, with a number of small lakes and sloughs in its flood plain, lies between the site and the near west bluff of the Mississippi River Valley. Trees are scattered along the edges of the lakes and the Vermillion and Mississippi Rivers. Due to the relatively low elevation of the site and the wooded nature of the area, as well as the distance of the Plant from normal travel routes, the Plant will not be seen by any substantial segment of the public. The residences in the area are very sparse; the closest dwelling is about 0.6 mile from the Plant.

c. Noise Level

Since this Plant has not yet operated, an indication of the noise level must be based on that for a similar plant. Recent observations[1] at the Applicant's 550-MWe nuclear boiling-water reactor generating plant at Monticello are pertinent. It is estimated that the noise scaling factor between Monticello and Prairie Island is unity. This estimate is supported by noting that the area immediately surrounding the Monticello and the Prairie Island sites is flat and largely unobstructed by trees or similar noise absorbers.

The three most significant noise sources associated with the Monticello Plant are the cooling towers, the switchyard, and the plant offgas stack. The noise level 15 feet from the side of a cooling tower is about 80 dB. The noise level 15 feet from the end of a cooling tower is about 65 dB. The sound from the cooling towers is that of cascading water since the fans are not audible above the sound of the falling water. The noise level at the side of a tower adjacent to the second tower, which is about 250 feet away, is 82 dB. This observation suggests the degree of noise attenuation with distance from a tower. The switchyard produces a typical 60-cycle hum that is clearly audible at the yard's exclusion fence. The offgas stack noise is from the exhaust fans and is in a relatively high-frequency range, but at a low level. The offgas stack noise is not audible above tower and switchyard noise at a distance of about 100 feet from the stack.

Subjective "listening" observations were made at various distances from the plant complex in the evening at a time when background noise was very low. At about 0.8 mile, the switchyard noise was barely audible, and the cooling tower cascade was indistinguishable. Plant noise at the point of observation was so low that it was completely masked by the sound of an automobile moving several miles away on Highway 152.[1] Thus, once the Plant is in operation, the cooling fans may be faintly heard by some offsite residents, but the noise is not expected to be objectionable to the nearest offsite residents or any other members of the public.

d. Road Traffic

Road use in the vicinity of the Plant is light, and the additional traffic resulting from the permanent work force and movement of materials associated with Plant operation will be readily accommodated. Thus, no interference with traffic flow will result from normal Plant operation. In the event of improbable accident conditions that could require rerouting of traffic, the routing could be done with a minimum of inconvenience to motorists. Residential and recreational traffic beyond the Plant in the direction of Lock and Dam No. 3 would experience difficulty, since that is a dead-end road.

Transportation associated with nuclear-plant operations is limited essentially to shipments of new fuel, spent fuel, and low-level radioactive wastes. Because of the extensive safeguards and precautions used in the shipment and handling of these materials, the probable environmental impact will be negligible. Fuel and radioactive wastes will be moved by truck, but this will not affect land use. These shipments must be handled in accordance with all requirements for such shipments on public highways (see Section V.E).

e. Transmission Corridor

Prior land uses along the new transmission right-of-way were predominantly agricultural, but also included some woodland, wetlands, and scrubland. These uses will remain virtually unaffected by the installation of the supporting structures for the lines. The Applicant's decision regarding structures and locations has been guided by the criteria mentioned in Section IV.B.1 to minimize the environmental and visual impact of the installations. This effort has extended from design procedures to planting within, and maintenance of, the right-of-way. The transmission lines are high enough to avoid a psychological visual partition or "fencing-in" effect. Routing of transmission lines across hilltops was avoided except on the bluff west of the Plant, and many of the towers were constructed of wood to harmonize with the environs. Heavily timbered areas (only 6 percent of the right-of-way was cleared of trees), steep slopes, and proximity to highways, shelterbelts, scenic areas, and open areas of water and marshland were also avoided. Towers were used sparingly when spanning bluffs. Trees and brush were cut rather than plowed, and along banks of lakes and rivers extra care was taken to leave topsoil undisturbed.

f. Availability of Additional Power

The expansion of the Applicant's capability is in anticipation of a continuing growth in power requirements for the region, and in turn the availability of adequate electrical power will foster a continuation of the region's development. Nonetheless, it appears that land use within the vicinity of the Plant site for the foreseeable future will continue to be devoted primarily to agriculture and to dairy and livestock products (see Section II.B.2.a). Thus the construction and operation of the Plant will not significantly alter land use in the vicinity, and the overall regional economy will be benefited.

B. WATER USE

The Mississippi River in the general vicinity of the Plant is used for navigation, recreation, and sport fishing (below Lock and Dam No. 3). Waterfowl frequent this area of the river. Sport fishing and hunting will likely be improved because of the open waters during the cold months. Navigation will not be affected adversely. Since the Plant is not adjacent to the main channel of the river, use of the river for movement of fuel is not planned, and fogging caused by cooling tower operation will occur predominantly during the winter months when the river is not navigable because of ice.

1. The Intake

The design objective for the Plant intake canal is to draw water primarily from the main channel of the Mississippi, rather than from Sturgeon Lake, and to use that deeper, colder water for condenser cooling. An intake curtain barrier at the mouth of the canal is designed to hold back the warmer water near the surface while allowing colder bottom water to enter the canal. Water from the lower, colder stratum cools the condensers more efficiently and has fewer aquatic organisms, particularly during the warmer summer months. During the fall and winter months, when the surface-water temperature is lower and the density gradient is weak, various mixtures of the upper and lower waters will be drawn under the curtain barrier. Weather and local mixing by winds will also have a strong influence at that time of year.

2. The Effluent Waters

After the Plant becomes operational, the condenser-water intake from the Mississippi River and Sturgeon Lake will be about 188 cfs during the normal, closed-cycle operation and the release of warmed water to the river will be approximately 150 cfs.[2] The difference (38 cfs) will be released to the atmosphere from cooling towers on a year-round basis.

The water loss of 38 cfs by evaporation and drift is relatively insignificant when compared with the 15,020 cfs average river flow (see Table II-15). Based on this comparison, the water used by the Plant will have no significant impact on the flow levels of the Mississippi River. There will be some local fallout of minerals from the tower plumes, but it is not likely to cause significant ecological damage.

The Plant will discharge controlled amounts of heated water into the river. At ambient river water temperatures at or above 45°F, this effluent water will not exceed 5°F above ambient beyond the outlet of the discharge canal (see Section III.C.3.c.). The heat released in the blowdown flow (only a small fraction of the heat released to the atmosphere during cooling-tower operation) will be variable. It will depend on the Plant load, weather conditions, mode of circulating-system operation, and blowdown flow. Monitoring studies of aquatic biota are required to be carried out by the Applicant and are expected to detect any significant heat effects on the biota if these occur, thus enabling corrective measures to be taken. The seasonal variation in river water temperature near the discharge structure will affect the patterns of resident fish movements above Lock and Dam No. 3. Based on evaluation of the expected flow patterns of the discharge water, there will be no thermal block across the river to inhibit fish migration.

Because of the low velocity of the Plant cooling-water effluent, no shoreline erosion is anticipated. Heated discharges are expected to create open water in the Mississippi River during winter between the Plant and Lock and Dam No. 3. The open water in winter above the dam will probably follow the Minnesota shoreline, whereas below the dam, mixing and turbulence are expected to keep the upper end of Pool 4 adjacent to the dam fairly free from ice across the pool. The ice-free area will allow use of warm-weather fishing techniques in the winter and will provide an open area for waterfowl.

3. Atmospheric Effects

Under certain conditions, the discharge of heated water to the river will cause steam fog. The discharge of heated air having a high moisture content from the mechanical draft cooling towers will at times result in a visible plume, fogging, and icing.

a. Steam Fog

Based on many years of observations at power stations with similar heat discharge systems in a similar climatic region, no serious atmospheric effects are expected from heat rejection from this Plant to the river. About the only observable effect expected is the generation of steam fog and/or freezing steam fog over the heated effluent in the discharge canal and over the river prior to complete mixing. The air layer next to the water surface is heated and has moisture added; mixing of this air with the unmodified air just above can lead to supersaturation and condensation. Further vertical mixing due to the instability generated tends to evaporate the steam fog.

Natural steam fog is fairly common on the Mississippi River, due to the frequent passage of cold air masses from the north over the open river. Due to higher water temperatures, steam fog will sometimes be formed over the heated effluent water at times when the surrounding river conditions would not permit the formation of natural steam fog.

Observations of steam fog over thermal discharges indicate that the visible plume will be thin and wispy and that the fog will rarely penetrate more than 10 to 50 feet inland before disappearing.[34,35] The density of steam fog will not be sufficient to cause navigational problems on the river. The fog is not expected to move inland far enough to cause problems on any public road. Some of the water droplets will be removed by vegetation and other surfaces as they move across the river bank, causing a local increase in humidity and dew. During periods of subfreezing temperatures, the droplets that are swept out will freeze and create a layer of low-density, rime ice on nearby vegetation and structures. Observations at existing stations indicate that this ice rarely, if ever, creates problems to roads, vegetation, power lines, or similar items.

With the cooling towers used in the closed cycle and helper modes, the temperature difference between air and water will be greatly reduced, and so will the frequency and density of induced steam fogs. Only very minor steam fog conditions are expected from these modes of operation.

b. Cooling Tower Effluent

(1) Wet Mechanical-Draft Towers

Compared with other types of evaporative cooling procedures such as cooling ponds and natural draft towers, mechanical draft towers have the greatest potential for creating significant amounts of low-level fogging and icing.[34-38] Mechanical-draft towers release large amounts of heat and water vapor over relatively small areas at low levels where wind speeds are lower, and the saturation deficit is less than that of natural draft towers. Tower drift potentials are also higher with mechanical towers. As a result of the high exit speeds (about 30 ft/sec), high turbulence levels (due to the fans), high entrainment rates and larger surface/volume ratio, plume rise is less with a mechanical-draft tower than it is for a natural-draft tower. Cooling ponds and spray canals discharge their heat and water vapor to the atmosphere over a much larger area than do cooling towers and therefore have a lower probability of creating dense plumes.[34-35,38]

Although wet mechanical-draft towers have been used to cool fossil-fueled power plants for decades, there is very little quantitative data available on the vapor plumes which they generate. There are even fewer references to significant adverse impacts of cooling tower operation.[39-41] Several studies have reported light rime icing from cooling tower operation. There are no known reports of severe icing as the result of the operation of modern, mechanical-draft cooling towers.[34,36,37,41]

(2) Observations

A limited field observational program to measure the dimensions of the plumes from forced-draft cooling has been conducted for the Applicant.[42] Some of these observations were made at two of the Applicant's small fossil-fueled plants, Pathfinder and Lawrence, near Sioux Falls, South Dakota, from March 16 through March 26, 1971. Twelve extended plumes were documented. The lowest air temperature at the time of an observation was +21°F. More extensive plumes and icing could be expected during the winter months.

With weak winds, the plumes tended to rise to heights between 200 and 500 ft before evaporating completely. When winds were greater than 8 to 10 mph, the plumes did not rise, and aerodynamic downwash brought the plumes immediately to ground level for distances of up to 1000 ft. Plumes as long as 1500 ft were observed. "Quite light" icing was observed on trees, fences, and road surfaces.

Four qualitative plume observations were made at the much larger (800 MWe) Cherokee Plant, located northeast of Denver.[42] On February 26, 1971, when the air temperature was 20°F, dew point 0°F, and wind 30 to 40 mph, a broad flat plume from the towers was in contact with ground for a distance of 1300 to 1400 ft before evaporating. On March 1 and again on April 19, 1971, humidities were high and the winds low (less than 8 mph). On both days, nearly vertical plumes were formed and developed into large cumulus clouds, with tops as high as 3400 ft. On April 5, the cooling tower plumes merged with a low overcast from which scattered light snow was falling. The air temperature was 29°F. For a short distance downwind of the towers, light drizzle and wet snow were observed to fall from the plume; at greater distances, out to at least five miles, additional dry snow which appeared to be due to the tower effluent was observed.

(3) Predicted Effects at Prairie Island

A computer model to predict quantitatively the atmospheric effects of mechanical-draft cooling tower effluents was developed for the Applicant, and tested with the data collected at the two Sioux Falls, South Dakota,[42-44] power plants described above. The description of the model is, unfortunately, so general that the Staff cannot assess its validity.

Based on a 100% Plant load factor for a full year, the Applicant's model estimates that the towers will produce surface fog somewhere near the Plant for about 450 hours per year.[1,43] At any one point, the maximum expected frequency is 50 hours per year. These locations are 0.5 to 2 miles NW and SE of the cooling towers, over the river. In other directions, cooling tower fog is expected from 10 to 30 hours/year. These calculations include those hours when cooling tower fog would coincide with natural fog. For reference, the Twin Cities area has about 70 hours of dense fog (visibilities less than 1 mile) and 400 hours per year of light fog (visibility less than 3 miles).

The Applicant's model further predicts that over 75% of all tower-induced fogs will occur during the winter months (December through March) when river traffic is minor or nonexistent.[42,43] Also, it predicts that tower-induced fogs will cover limited areas (a few miles long, up to 0.25 miles wide) and be brief (0.5 to 3 hours).

(4) Evaluation

Due to lack of a proven numerical model for mechanical-draft cooling tower plumes, the Staff is not able to state with certainty that the above estimates of fogging are quantitatively accurate. However, the estimates appear to be reasonable, and conservative for distances greater than two miles from the Plant, in light of experience near operating cooling towers.[34-36,38,39,41]

Fog induced by the cooling towers will occur most frequently in winter. When it does occur, it will probably be swept parallel to the river since the river channel coincides with the most prevalent winter wind directions. Use of the river by commercial and recreational craft is minimal during the winter months. Towns, major highways and airports are a considerable distance from the site. Red Wing, 6.5 miles to the southeast, is the nearest major population center. U. S. Highway 61 is a minimum of 2.6 miles away, to the southwest. The nearest airport is 7.5 miles east-southeast. Thus, fog problems and complaints thereof are not anticipated.

During the cool season, the cooling tower effluents will create extensive (up to 2 or 3 miles) plumes aloft that are visible from great distances. This will provide the most noticeable atmospheric effect of the cooling towers, but it is not considered to be a serious one.

4. Condenser, Cooling-Tower, and Service Water

The Amertap system will be used to clean the condensers. Past experience with this system has been satisfactory, so a need for chlorine or other biocides is not anticipated. Likewise, because of improved design features, biocides will probably not be required to clean the cooling towers. Thus no significant impact on river biota due to chemicals in the effluent is anticipated.

The service water is about 4% of the flow of water through the condenser and is combined and discharged with the cooling water. This service water will be withdrawn from the river at the average flow rate of 24,000 gpm and chlorinated to control algal growth in plant heat-exchanger equipment. Chlorine will be "slug-fed" at a rate that will produce a total chlorine concentration of approximately 0.3 ppm at the outlet of the service-water system. This water is discharged into the condenser cooling water (see Figure III-9). As a result of dilution in the condenser cooling water, the total chlorine concentration at the mouth of the discharge canal at the main channel will be undetectable by conventional methods of measurement.

5. Well Water (Makeup and Potable)

The Plant makeup and potable water will be supplied from two deep wells and demineralized at 200 - 300 gpm.[1] The regenerants used in the demineralizer will be collected in a holding tank and monitored before release to the river. The quantity of various compounds discharged from the chemical holdup tank is 720 pounds per day of sodium sulphate and 470 pounds per day of well-water minerals.

The daily discharge of well-water minerals for each chemical species is given in Table III-5. The concentrations of all of these species in the discharge canal (before dilution in the main channel of the river) are at least two orders of magnitude below those normally existing in the river.

Between 250 and 1400 gallons of steam generator blowdown will probably be discharged to the river per day. Steam-generator blowdown is used as a method for controlling and correcting steam and feedwater-system chemistry. As a result, blowdown frequency and duration depend on Plant conditions.

Either steam-generator or condenser tube leaks could noticeably increase the requirement for steam-generator blowdown above the normal 250 gallons per day.

A condenser tube leak can also result in increased steam-generator blowdown for chemistry control. Normally, this would not continue for more than a few days before the condenser tube leak was repaired and normal blowdown reestablished.

The steam-generator blowdown, whether processed or unprocessed, is ultimately released to the circulating-water discharge canal. The steam-generator blowdown will contain a maximum of 2 ppm phosphates and 5 ppm silica, since the steam-generator vendor imposes this requirement on the steam-cycle chemistry. The blowdown will also contain approximately 20 ppb hydrazine, which is used for oxygen control, and less than 5 ppm morpholine, which is added for pH control. The total quantity of these additives will be small compared to the quantities in Table III-5 and will be diluted by a factor of over 10^4 by the circulating-water discharge before going to the river. Hence any impact is insignificant.

6. Well Water (Sanitary)

After Plant startup, a maximum of 200 people will be required for operation. Based on the Applicant's experience with the system during construction, the 3830-gallon septic tank and drain field will be adequate to process the sanitary effluent. No radioactive wastes will be processed in the sanitary-sewage-disposal system.

The expected maximum well-water demand is 500 gpm with an average use of 85 gpm. The design and construction of the wells exceed the quality requirements of the Minnesota Department of Health standards for sanitary wells.

7. Water for Extinguishing Fires

After the Plant becomes operational, water for fire protection will be obtained from the river, and the two wells used for this purpose during construction will be sealed and abandoned.

8. Ground and Surface Waters

The effluents from the Plant will not contaminate the aquifers; public and private water supplies will not be affected by Plant operations. The movement of ground (subsurface) water is toward the Vermillion River, away from the Plant area drinking-water supply.[2]

Due to the permeable, sandy topsoil, the surface runoff water does not ordinarily cause problems at Prairie Island. Paving of roads and parking lots (about 6 acres) will increase water runoff, but not significantly. Comprehensive radiological and ecological monitoring programs will be conducted before and during the operation of the Plant to determine whether additional measures are needed to ensure that there will be no unacceptable effects on water quality in both surface and ground waters.

C. BIOLOGICAL IMPACT

1. Terrestrial and Aquatic Ecosystems

a. Terrestrial

Plant structures of various types, parking lots, and roads will occupy about 60 acres of the 560-acre property. Construction activities at the site have produced a loss of the sandy-soil substrate for plants and animals in the area involved, and this has resulted in the loss of a limited food source and cover for birds and mammals. New plantings will replace some of this loss after construction is completed. The remaining site land and ecological communities will be conserved by the Applicant and kept free from agricultural and other human disturbances.

There is expected to be very little radwaste in any form that is available to interact with the terrestrial plants and animals. Consequently, the radiation impact of Plant operation on wildlife and other biota of the area should be slight.

There will be some dampness and solids enrichment locally due to the condensates from the cooling towers. These effects will be monitored by the applicant when the Plant becomes operational.

The portion of the transmission line running from the Inver Grove area to Blue Lake was installed on an existing right-of-way (see Figure III-4). A new transmission right-of-way was acquired for the line connecting the Plant to Blue Lake Substation. The new tract is 33 miles long offsite and has an area of 973 acres. Where compatible, all existing land uses will be retained. The transmission-line areas that are not returned to agriculture, especially those beneath the cables and about 50 feet on each side, will be maintained by the Applicant. The height of vegetation (trees, etc.) will be kept down by the iso-octyl ester of 2, 4, 5-T (2, 4, 5-trichlorophenoxyacetic acid). This compound is used principally for control of woody vegetation[3].

b. Aquatic

There has been some physical disruption of the aquatic environment, resulting from dredging of the cooling-water-system channels, and from construction of the intake and discharge structures. After the Plant is placed in operation, occasional dredging to maintain the desired depth of the water channels may be required. However, frequency of dredging should be no greater than that required by the U. S. Corps of Engineers to maintain the long-established 9-foot-deep navigation channel in the river. As mentioned in Section IV.B.2, the benthic regime will be destroyed where dredging occurs, but the total area affected is a small part of the total benthic community. After dredging and other construction are completed, the benthic community will regenerate naturally and recover to a level normal for the new bottom conditions. The dredged area will be recolonized with bottom organisms from other places in the river and Sturgeon Lake[4]. The areas to be recolonized are comparatively small.

The velocity in the main body of the intake and discharge canals is well below that of the normal river current, so erosion is not expected. The intake channel will have a maximum velocity of less than 1 fps (see Section III.C.3). Normal river velocity in the Sturgeon Lake discharge channel is about 1 fps. The trash racks, which collect floating debris at the Plant end of the water intake channel, have vertical 2-5/8-inch openings. The trash racks are followed by conventional vertical traveling screens with 3/8-inch-square openings. Minnows and other fish that pass through the trash racks and are larger than 3/8 inch in width or body depth will be removed by the traveling screen. The water velocity through this grill is 0.9 fps and 0.8 fps immediately upstream from the grill. The Applicant will be required to monitor the screens, and, should the impingement of fishes on the traveling screens become a problem, he will be required to take corrective measures.

2. Cooling Water Intake and Entrainment Effects

a. Phytoplankton and Zooplankton

Water from Sturgeon Lake, as well as that from the Mississippi River, will be drawn into the Plant intake. Some plankton will be damaged as a result of stresses encountered in passing through the Plant. These stresses will be caused by chemical additives (if present), turbulence, elevated temperatures and pressure that the plankton encounter in the pumps, condenser, various pipes, cooling towers, and thermal plume. In Plant operation, mechanical and pressure damage to the plankton organisms cannot generally be distinguished from thermal or chemical effects and are evaluated as part of the total stress in studies of plankton populations. Both the plant forms (phytoplankton) and the animal forms (zooplankton) will be affected. These include the meroplankton and ichthyoplankton.

Damage to the phytoplankton is not considered as critical as damage to other forms for two reasons: (1) Regeneration of the population lost in passage through the condenser cooling system occurs rapidly because of the short life cycles; and (2) phytoplankton damaged in the Plant are still available as food for other organisms after being discharged.[20] Furthermore, there is a great abundance of phytoplankton in the Plant area. Different studies have indicated varying percentages of mortality and decreased motility of zooplankters that have been passed through a nuclear power plant[5-8]. Since the Plant will be operated on closed-cycle cooling to the greatest extent practicable, most of the entrained organisms will be destroyed. However, the amount of make-up water used for the cooling towers (188 cfs) will be a very small part (1.7%) of the medium river flow (11,000 cfs) and, therefore, the relative number of entrained organisms will be very small. We conclude that the loss of phytoplankton will be inconsequential in terms of the biological balances in this part of the river, but the impact on zooplanktons, particularly fish larvae, is more difficult to predict. Careful monitoring of plankton will be required during operation.

b. <u>Fish</u>

Because there will be a barrier wall placed across the intake canal to a depth of about seven feet, larval and older fish in the upper seven feet of the canal will not come any closer to the Plant. Most of the fish which enter beneath the barrier wall will probably in time swim back out of the intake canal because of their natural abilities and the low velocity (less than 1 fps) of the intake current. Some of these fish that pass under the barrier wall will encounter trash racks which have vertical gaps of 2-5/8 inches. These will stop the larger fish, and may inhibit others. Those fish which pass through the trash racks will most likely encounter the traveling screens (3/8-inch square mesh) at the screen house and will be prevented at that point from entering the system, unless they are smaller than 3/8 inch. Any fish that are caught, or floating dead fish collected by the rotating screens, will be buried in an approved area.

If fish (larger than the screen grid openings) enter the system, some might swim upstream in the recycle canal to the discharge structures. If this happened they could remain undisturbed in the discharge structures or cooling tower return canal, or they could swim out with the discharge flow back to the river.[45] Some small fish ($\leq$3/8 inch in each of two dimensions) that pass through the screens may survive after they pass through the condensers. The Applicant will be required to monitor the condenser intake, effluent and the outfall at the river for small fish and other biota.

Few data are available on local ichthyoplankton population densities. These are developing fish that spend only part of their lives in the planktonic stage. They have a high natural mortality and there is a relatively small amount of river water taken from a fringe area (where their densities usually are greatest), but the eventual effect on the adult fish population as a result of loss of ichthyoplankton through intake-system entrainment is difficult to predict.

3. Effects of Thermal Discharge

a. Temperature Limits

The temperature increase of the heated effluent water will be controlled to avoid significant damage to the river biota. The Applicant has designed the Plant for use with forced-draft cooling towers or once-through cooling, or a combination of these methods, but the Applicant now plans to use the cooling towers to the maximum degree practicable.[1] A much smaller area of the river will be warmed when the cooling towers are in use. However, icing may limit tower use during the coldest periods, which occur between November and March.

The temperature of the effluent cooling water, at the end of the discharge channel in the range above 45°F, will be limited to a maximum rise of 5°F above ambient river water, and there will be an absolute upper limit of 90°F. During the warmest summer months at Prairie Island, however, the river temperature equals or exceeds 82°F only 1% of the time. When the intake water is near freezing, some restriction of the Plant's power level may be required to control warming to less than 50°F if the cooling towers are not used. Specific monitoring measurements will be required during Plant operation to determine significant thermal, chemical, biological, or physical effects on river organisms (fish, etc.) that come in contact with the thermal plume during once-through cooling throughout the coldest weather.

b. General Effects of the Effluent

In evaluating the effects of the thermal plume, one must consider two points: (1) the temperature displacement from the temperature level to which the organisms have been previously exposed, and (2) the duration of exposure to the elevated temperature.[8,12,13] Organisms of all types exposed to the warm discharge plume will experience temperature changes that depend upon where they are in the plume and how long they remain within the plume's influence. These organisms include sessile and non-motile forms within the plume area, phyto- and zooplankton, and motile vertebrates and invertebrates.[7] The effects of these kinds of organisms are considered in the following subsections.

c. Phytoplankton Periphyton and Zooplankton

The discharge of heated water into the river may have some effect on the viability, reproduction, food-web relationships, and growth of aquatic animals and plants, including the photosynthetic capacity of algae.[5,6,9,10]

Impact of the cooling-water effluent on the biota can be discussed with reference to ecological studies for the Applicant's A. S. King plant,[11] located on the St. Croix River at the upper end of Pool 3 (see Figure III-4). Judging from those studies, the net effect of increased temperature on plankton in the thermal plume will be essentially nil. Since these organisms are entrained in the plume, they follow the decay of temperature in the heated-water zone.

Cairns[12] found that the blue-green algae grew best at 95-104°F in pristine water. The temperature of the river water is below 82°F for 99% of the time, and the temperature of the effluent will be limited to a maximum of 90°F at the end of the discharge canal. The more desirable diatoms and green algae grew best at 64-86°F and 86-95°F, respectively.[12] The expected temperatures within the Prairie Island effluent plume area will usually be within these ranges in the summer. Nevertheless, algal blooms including blue-greens occur at relatively lower temperatures in the Sturgeon Lake - Prairie Island Plant river areas because of a relatively high concentration of nutrients in these waters (see pp. II-62 to II-64). Monitoring for changes in baseline populations of phyto- and zooplankton will be required in waters near the Plant after operation begins.

In the St. Croix River, a zone extending from the A. S. King Plant discharge canal to approximately 1000 feet downstream has shown a seasonal successional change in periphyton due to the heated discharge. This zone extends about one-fourth of the distance across the river. A decrease in total abundance of blue-green algae in March and green algae in July and October occurs within this zone. An increase in abundance of diatoms and green algae in May, blue-green algae in August, and diatoms in September occurs within the zone.[1] The effect of the Plant cooling-water effluent on the periphyton is expected to be similar.

d. Effects of the Thermal Effluent on the Benthos

The factors of current and heat will be partially intertwined in the Plant discharge area, and interpretation of effects specific to current will be based on other studies and prior knowledge of species' preference or avoidance of current conditions. Data from ecological studies at the Ginna site,[7] where nonheated discharges occurred for a period, suggest that changes in bottom fauna and fish can occur from current alone. Within the limited area of bottom and water mass, where a current significantly greater than prevailing water currents occurs, the attraction of some species of fish and invertebrates can be expected. In a small area in which current velocity is high, scouring and loss of habitat for organisms that do not favor current will occur. This is not expected to influence a large area, particularly during closed-cycle operation. Although strictly local effects of the establishment of a current by the Plant effluent are anticipated, the overall impact is not expected to be great.

No statistically signficant difference has been found[11] in comparing the diversity of bottom organisms just below the A. S. King discharge on the St. Croix, with that of control stations and preoperational samples. Thus, bottom species may change somewhat in the discharge canal due to alterations in substrate and velocity, but the heated water apparently did not influence them beyond the outfall area.

Due to the nature of the bottom (see Chapter II.E.3.d.), the population of benthic organisms in the Prairie Island area is rather sparse. In addition discharge water will be more buoyant than the receiving waters, due to its reduced density, so that under most conditions the plume may not come into contact with the benthos. An exception will exist in the winter when the river water temperature falls below 4°C and a sinking plume occurs. Benthic organisms will be warmed in the plume area particularly near the outfall. The Applicant will be required to carry out a program to monitor temperatures and to study possible effects on the benthic animals in the discharge area during all four seasons.

e. Effluent Effects on Fish

(1) Effects of Temperature Increases

Thermal additions may affect fish in several ways:[8] (1) by inducing thermal shock due to relatively sudden increases or decreases in temperature; (2) by influencing species' composition in the area through differences in thermal preference and the possibility of increased or decreased food supply; (3) by influencing spawning times of fish; (4) by influencing the survival of eggs and young spawned in the area due to direct thermal effects or changes in predation rates; and (5) by influencing migration routes.

Wurtz and Renn[13] reported that many aquatic organisms are able to acclimate to higher temperatures in relatively short times, a day or less, and that they lose this acclimation slowly. The authors point out that the effects of sharp rises in temperatures are especially difficult to assess, as sudden change is common in many aquatic environments.

The Plant's cooling towers are designed to reduce the condenser coolant to temperatures that are compatible with fish and other aquatic organisms. Besides the physiological effects, behavior may be altered by the effluent plume. The discharge plume may interfere with near-shore movements of fish. An increased concentration of predator fish in the plume area could result in an increased predation rate on juveniles forced into the plume as they move along the shoreline. It is unlikely that juvenile or adult fish will voluntarily enter the warmer parts of the thermal plume abruptly, as fish are known to have definite temperature preferences and tend to stay in or move to waters of these preferred temperatures, if available. Nevertheless, the heated discharge is not expected to have a significant effect on the sport fish or the commercially important fish species. Sampling of fish in the plume area after startup is expected to reveal whether this is a major concern. The Applicant's monitoring program is designed to detect such problems, if they occur and take corrective measures, if necessary.

Game fish will respond to the heated water in a positive manner during the fall, spring, and winter. Game species have been found in the discharge canals of power plants when the effluent is at a more preferred temperature than the surrounding waters. When the temperature of the effluent exceeds this preferred temperature, the fish move to another portion of the stream. As shown by six years of study on the St. Croix River, the game-fish populations have not been affected by heated water.[11] Normal yearly class fluctuations are still found. During the attraction of game fish to the discharge, fishermen tend to concentrate their efforts in the heated zone.

(2) Effects of Temperature Decreases

Fish that become adjusted to plume temperatures may experience a shock when there is a Plant shutdown or an emergency stoppage. This could be a problem for the Plant since there is no retention pond of significant size to make possible the gradual release of heated water. However, since closed cycle cooling will be used extensively, the volume of water released will be a small percent of that required for once-through cooling. Thus the decrease in temperature of the water in the discharge canal will be gradual, and the fish in the vicinity will experience a temperature change extending over hours rather than minutes.

Gizzard shad, a rough fish species, may be killed if a rapid winter shutdown occurs while once through cooling is being used. This species, found principally in the warmer winter climates of the southern United States, has remained in the temperate climates during the winter partly due to heated discharges by electric generating installations and other industrial heated-water sources. Without artificial heat sources in the Plant area the shad lives close to its temperature tolerance limitations during winter. The shad that survive provide a source of forage for predatory game species in the winter and early spring. The increased spring hatch of gizzard shad, due to lower winter mortality, provides a food source for young piscivorous game fish. Thus, the effect of the heated effluent from the plant on gizzard shad can be an environmental benefit. If rapid shutdowns (e.g., 15°F per hour) while operating in the once through cooling mode are reduced in rate (e.g., 7.5°F per hour), significant fish kills may be prevented.

The absence of dikes in the river will provide freedom of movement of fish into and out of the thermal plume. In the spring, winter, and fall, fish will be attracted to the heated discharge. If an unscheduled plant shutdown occurs, the open area of the discharge will make it possible for the fish to avoid thermal shock by following the heated water as it spreads into the river. Depths of 10-15 feet will provide for vertical movement as well as horizontal movement as the remnants of the heated water pass downstream.

The fish could, at least partially, acclimate to the gradual change in plume temperature that occurs from mixing and heat dissipation to the atmosphere. Alternately, the fish will be able to reduce the impact of temperature change by moving to a preferred location.

(3) Effluent Impact on the Composition of Fish and Waterfowl

The vertebrate species composition in the vicinity of the Plant's thermal plume may be altered. Observations at other facilities have shown that fish are attracted to power-plant thermal discharges at various times of the year.

Experience at the Point Beach and other discharge areas has shown an increase in desirable sport fishes, primarily trout.[5,9,14] However, other species such as carp and alewives have also been attracted. The net impact appears to be beneficial for sport fishing.

The migratory waterfowl habitat in the effluent plume in the Mississippi River will be enhanced during the winter since the heated water will maintain an ice-free channel at least as far as Lock and Dam No. 3. An increase in duck hunting and fishing is expected as a consequence of the increase in open water in the area during cold-weather months.

4. Consequences of Chemical and Radioactive Releases to the River

Since fish are attracted to the warmer waters of the mixing zone, especially during the coldest months, any addition of toxic substances such as chlorine to the discharge water must be carefully controlled. The warm effluent tends to lower the pH, which increases the toxicity of chlorine.[15]

The use of antifoulants for the elimination of growths in the cooling system and for various water processing needs was anticipated, and the existing design has these provisions. However, the Amertap system has been installed and according to the Applicant, chlorination of the main condensers will not be necessary. The makeup water will be chlorinated, but it will be very much diluted by addition to the main condenser cooling water.

The use of chlorine as a biocide could entail considerable risk to fish attracted to the thermal mixing zone.[14] The potential impact of the total residual chlorine could conceivably be much greater than that of the warmed water of the effluent plume. Therefore, if the use of chlorine in the cooling system (condenser or tower) becomes necessary, it must be carefully controlled and monitored. If substantial detrimental effects occur, steps must be taken to reduce the chlorine residual in the effluent[14] or eliminate the use of chlorine.

Because of the transient and unstable nature of the chlorine released to natural waters, data concerning the effects of residual chlorine on fish and other organisms in natural systems are not well documented. The State of California's Water Control Board summarized the results of a number of investigators who report that constant exposure to 0.05 ppm is critical (a threshold dose for toxic effects) for young salmon.[4,14]

In waters with a relatively high biochemical oxygen demand (BOD), ammonia is present and combines with chlorine to form chloramines which are also toxic to fish and other aquatic organisms. Data from the State of Michigan's Bureau of Water Management[14] indicate that rainbow trout died in four days from chloramine concentrations on the order of 0.014 mg/liter at distances of up to 0.8 mile below monitored waste-discharge points. At Prairie Island, the five-day median BOD at Lock and Dam No. 3 during 1965-1966 was 3.4 ppm with a range of 2.1-4.9; this is a relatively low, and thus favorable, BOD, especially since the dissolved oxygen (DO) median was 9.2 ppm (range 5.0-12.5 ppm).[2]

The BOD measures the effect of a combination of substances and conditions. A high BOD is not harmful if the DO is not depressed to levels that are detrimental to beneficial uses of the water and to the natural life forms it contains, such as fish.[4] Ellis[16,17] showed that under average stream conditions, 3.0 ppm of dissolved oxygen, or less, should be regarded as hazardous or lethal, and that to maintain a varied fish fauna in good condition, the DO concentration should remain at 5.0 ppm or higher. For trout in soft water, the lower limit has been set as high as 6.0 mg/liter.[18] Thus, the DO at the Plant during the study was reasonably good.

Radiation doses to various components of the aquatic biota were estimated by assuming that organisms were continuously immersed in the undiluted plant effluent (cooling-tower blowdown of 150 cfs) containing the released radionuclides given in Table III-1 and using the bioaccumulation factors given in Table V-1. The doses so calculated were 40 millirads/year to a 4000-gram fish, 47 millirads/year to a 300-gram invertebrate, and 36 millirads/year to a 6-gram aquatic plant. These doses are below the level at which demonstratable radiation effects to aquatic organisms have been observed[26-28]. The doses to the biota of the Mississippi River proper will be further reduced by a factor of about 100 (15,000 cfs average river flow vs. 150 cfs blowdown).

5. Ecological Monitoring Program

The Applicant has sponsored an ecological study of the Mississippi River in the vicinity of Prairie Island since May 1970. Its purpose has been to characterize the aquatic ecosystem before Plant operation to provide a basis for detecting and evaluating the impact of Plant operation. The program is being conducted under the direction of faculty members from St. Mary's College, in Winona, Minnesota, and the University of Minnesota

TABLE V-1 Bioaccumulation Factors for Elements in Fresh-Water Species[19]

Element	Fish	Invertebrates	Plants
Chromium	200	2,000	4,000
Manganese	25	40,000	10,000
Iron	300	3,200	5,000
Cobalt	500	1,500	1,000
Niobium	30,000	100	1,000
Molybdenum	100	100	100
Technetium	1	25	100
Ruthenium	100	2,000	2,000
Iodine	1	25	100
Tellurium	1,000	10	1,000
Cesium	1,000	1,000	200
Barium	10	200	500
Cerium	100	1,000	10,000
Tritium	1	1	1

at Minneapolis, with the cooperation and advice of the Minnesota Pollution Control Agency, the Minnesota Department of Natural Resources, and the Minnesota Department of Health. Additional assistance is being provided by the Wisconsin Department of Natural Resources, the Environmental Protection Agency, and the U. S. Corps of Engineers.

The program is organized to investigate the aquatic community together with the physical and chemical parameters that characterize its environment. Biota samples include phytoplankton, zooplankton, benthos, fish, and aquatic plants. Periphyton analyses also will be included.[2] Food habits and reproductive cycles of fish are studied whenever possible. Water-quality studies include the measurement of flow rate, temperature, conductivity, turbidity, dissolved and suspended solids, dissolved oxygen, pH, alkalinity, ammonia nitrogen, and various anions and cations. Measurements are made throughout the year (weather permitting) with a frequency of once to twice a month at several defined locations along the river above and below the Plant site. Specific details of the program and results obtained are reported annually[19]. This biological monitoring program will be continued. It will identify and quantify the major biotic groups present in the nearby river area and will consider the influence of the Plant discharges on all major biotic groups present. Part of this program will also be the requirement to monitor fish caught on the traveling screens in order to measure the effectiveness of methods used to prevent fish from entering the intake system.

Measurement of both temperature and chemical constituents of the river, started during preoperational testing, will be continued for at least the first year of Plant operation in order to provide information on changes in the discharge plume area. Subsequent reporting after startup will be required, as specified in the Technical Specifications for the Plant.

D. RADIOLOGICAL IMPACT ON MAN

1. Introduction

During routine operation of the Plant, small quantities of radioactive materials will be released to the environment. The releases will be as low as practicable as provided in 10 CFR Part 20 and 10 CFR Part 50 and within the limits of 10 CFR Part 20.

Possibly significant pathways for radiation exposures to man are depicted in Figure V-1. The specific pathways considered for Prairie Island are:

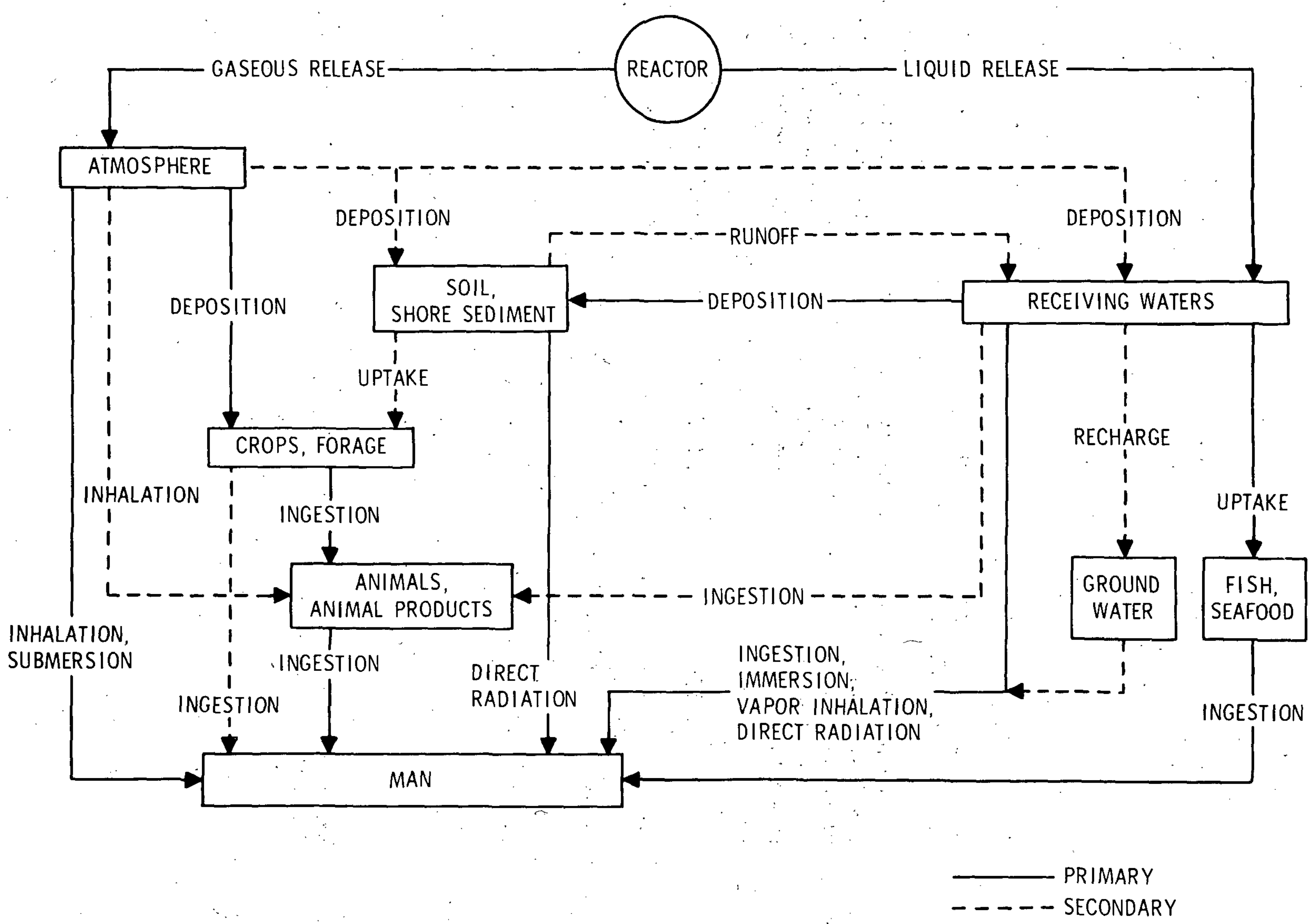


Fig. V-1. Pathways for Radiation Exposure to Man

a) Direct exposure to the off-gas plume;
b) Consumption of milk from cows fed on local pastures;
c) Consumption of fish from the Mississippi River;
d) Recreational use of the Mississippi River for boating, swimming, and shoreline recreation.

These pathways will be considered in terms of estimated yearly average release from the Plant. Two cases are considered: (1) dose to individuals living, working, and using recreational facilities in the vicinity of the Plant; and (2) total dose to all persons residing within 50 miles.

Case 2 presumes that such effects of radiation on a population are dependent on total dose to the population without regard to the details of its allocation. The man-rem evaluation for this Plant was based on the 1970 population estimate of 1.8 million persons living within 50 miles of the Plant.

The expected releases of radioactivity to the environment from this Plant are listed in Tables III-1 and III-2, and form the basis for the estimates of dose to humans presented in this section. The dose calculations were based on the models of the International Commission on Radiological Protection (ICRP)[21]. The doses were calculated for the whole body of adult individuals, except where otherwise noted.

2. Radioactive Material Released to the Atmosphere

Gas-borne effluents from this Plant will consist mainly of isotopes of the noble-gas fission products krypton and xenon, together with a small quantity of radioiodine.

Doses to individuals offsite were calculated for a single release point at ground level, using annual averaged meteorological data from the Prairie Island site. These data indicate that ground-level air concentrations will be a maximum at the northwest boundary of the site. The adult total-body dose from submersion exposure to noble gases at that location ($X/Q = 2.3 \times 10^{-6}$ sec/m^3) will be about 0.6 millirem/year; the dose from iodine inhalation will be about 0.0008 millirem/year. The inhalation dose to a child's thyroid will be 0.5 millirem/year. At the nearest occupied residence, (0.6 mile SSE, $X/Q = 1.6 \times 10^{-6}$ sec/m^3), the corresponding doses will be 0.41 millirem/year to an adult total body by submersion, 0.0003 millirem/year to an adult total body by iodine inhalation, and 0.3 millirem/year to a child's thyroid by inhalation.

The nearest dairy cows identified by the Applicant (see Figure V-4) consist of two herds about 2 miles from the Plant. The meteorological data indicate that the maximum dose through the iodine-cow-milk pathway will occur for the herd east of the site ($X/Q = 1.2 \times 10^{-7}$ sec/m^3). Assuming that the cows are on forage 6 months of the year, the thyroid dose for a child drinking 1 liter per day of this milk will be about 2.3 millirem/year. Using the same assumptions, if a cow were kept at the nearest occupied residence ($X/Q = 1.6 \times 10^{-6}$ sec/m^3), a child's thyroid dose would be 32 millirem/year. The child's thyroid dose from a milk sample pooled from the entire region would be about 1 millirem/year. The doses to individuals at these locations are summarized in Table V-2. As discussed in Section V.D.6., monitoring will be performed to assure that the levels of radioiodine in milk do not exceed acceptable limits.

3. Radioactivity Release to Receiving Waters

Liquid radioactivity released to the environment will be diluted in the cooling-tower blowdown (150 cfs minimum) released to the discharge canal. There it will be further diluted by about a factor of 10, by mixing with water entering the canal from Sturgeon Lake. The expected annual average concentration of radionuclides in the canal volume of 5×10^6 ft^3 will be 7.1×10^{-9} μCi/cc, excluding tritium; tritium concentration will be about 1.5×10^{-6} μCi/cc. These concentrations will be further diluted by a factor of about 10 upon entering the main flow of the Mississippi River (average flow of 15,000 cfs). Humans will be exposed to radiation from this effluent during activities on or along the river such as swimming, boating, fishing, and the eating of fish taken from the river. There is no known use of the river water for drinking or other domestic purposes within 50 miles downstream of the Plant[2]. The only use permit on record within that distance was issued for irrigation about 37 miles downstream.

Notwithstanding the fact that the river water is not used for domestic purposes, the dose to an individual drinking 1.2 liters of water per day from the river has been calculated and is shown in Table V-2. The dose so calculated is 0.02 millirem/year. This dose also represents the maximum dose to an individual taking water from a well where the water table is subject to recharge from the river. The dose to a child's thyroid would be 0.5 millirem/year.

The doses to the total body of adult individuals eating fish taken from the discharge canal and from the river were estimated to be 0.5 and 0.05 millirem/year, respectively. The fish and their supporting food web were assumed to be in equilibrium with the water at these

TABLE V-2 Summary of Annual Radiation Doses to Individuals from Prairie Island Plant Effluents, in Millirem

Pathways	Locations	Adult Total Body	Child's Thyroid
A. GASEOUS EFFLUENTS			
1. Air immersion	Site boundary (northwest)	0.58	--
	Nearest dwelling (0.6 mile south southeast)	0.41	--
2. Iodine inhalation	Site boundary (northwest)	0.0004	0.5
	Nearest dwelling	0.0003	0.3
3. Milk consumption	Nearest dwelling	0.012	32
	Nearest cow (2 miles east)	0.0009	2.3
B. LIQUID EFFLUENTS			
1. Drinking water	Mississippi River	0.02	0.5
2. Fish consumption (50 grams/day)	Discharge canal	0.5	0.2
	Mississippi River	0.0005	--
3. Swimming (100 hours)	Mississippi River	0.0005	--
4. Shoreline recreation (100 hours)	Discharge canal	0.13	--
	Mississippi River	0.013	--

locations, and the individuals were assumed to eat 50 grams of fish flesh each day. The corresponding doses to a child's thyroid would be 0.2 and 0.02 millirem/year. Concentration of the various radionuclides in fish were calculated using the bioaccumulation factors shown in Table V-1.

Calculation of the total body doses to adult individuals from activities on the river and along its shore, such as fishing, swimming, and boating, was based on 100 hours per year of participation in each activity. The results are also shown in Table V-2. The dose from radioactivity deposited in shoreline sediments along the river was estimated to be 0.013 millirem/year. Dose from immersion in the river and from boating on it were estimated to be 0.0005 and 0.0002 millirem/year, respectively.

4. Population Doses from All Sources

For the purpose of assessing the radiological impact of this Plant, the total dose to the population within 50 miles has been calculated and expressed in units of man-rem. The various components of the population dose are presented in Table V-3. Only total body doses are included.

The calculation of the population dose (2.4 man-rem) from direct exposure to the off-gas plume was based on annual averaged meteorological data furnished by the Applicant. The average dose to an individual in each of 160 annular sectors around the Plant was calculated according to the submersion model of the International Commission on Radiological Protection (ICRP).[21] These doses were multiplied by the population in the corresponding annular sector, and these products were then summed to obtain the population dose. The cumulative population dose, as a function of distance from the Plant, is given in Table V-4.

The population dose via the iodine-milk-human pathway was calculated using the following assumptions:

a) The total grade A milk production within the 50-mile region was 1.5×10^8 gallons per year;[22,23]

b) The production was distributed uniformly throughout the region;

c) The total dose commitment from consumption of this milk was charged to the Prairie Island Plant, regardless of where the milk would be consumed.

This pathway adds 4.4 man-rem to the annual population dose.

The population dose from fish consumption (1.8 man-rem) was based on a consumption rate of 2 grams of fish per day for each individual within 50 miles of the Plant. This rate is compatible with estimates (1964-1970) of 500,000 lb/year of commercial fish and 2.5 million lb/year of sport fish taken from Pools 3-9 on the Mississippi River.[24,25] For this calculation, it was assumed that half the catch was consumed by humans. The fish and their supporting food web were assumed to be in equilibrium with water having a radionuclide concentration equal to that in the Mississippi River just below the exit of the Plant's discharge canal.

The estimate of the population dose (4.7 man-rem) from recreational activities on or along the river was based on a continuous riverside population of 25,000 persons, 8 hours per day for 6 months. The dose from radioactivity deposited in sediments along the shore is the dominant contribution, exceeding that from swimming by a factor of about 20.

5. Evaluation of Radiological Impact

Some perspective may be gained by comparing the doses attributable to this Plant with those from the natural background and from medical diagnostic radiation.

The natural-radiation background includes contributions from cosmic rays, cosmic-ray-produced tritium and carbon-14 in air and water, uranium- and thorium-bearing soils, and radioactive potassium within the human body. These sources contribute about 150 millirem/year per individual in Minnesota.[31] However, the background is quite variable from place to place, depending mainly on altitude above sea level and the nature of the local soil. In the U. S., it ranges from about 60 to about 250 millirem/year. To the 1.8 million people living within 50 miles of the Prairie Island in 1970 it contributed a population dose of about 270,000 man-rem.

The results of a Public Health Service survey made in 1964[30] indicated that the genetically significant dose to the population averaged about 55 millirem/year per individual from diagnostic radiation. This would contribute about 100,000 man-rem to the population considered here.

By contrast, the total population dose of 21.7 man-rem/year attributed to the routine operation of this Plant (see Table V-3) is very small.

6. Radiological Monitoring of the Environment

In conformity with AEC Safety Guide 21, Measuring and Reporting of Effluents from Nuclear Power Plants, the undiluted Plant effluents will

TABLE V-3 Summary of Population Dose

	Dose to 50-mile Population (man-rem/year)
Gaseous Effluents	
Direct dose via off-gas plume	2.4
Dose via cow's milk (total body dose to 7-kg children)	4.4
Liquid Effluents	
Fish consumption	1.8
Mississippi River recreation (swimming, boating, fishing, etc.)	4.7
Other	
Transportation of radioactive materials[a]	8.4
Total	21.7
OTHER RADIATION SOURCES	
Natural background	270,000
Medical diagnostic radiation	100,000
Total	370,000

[a] See Section V.E.5

TABLE V-4 Cumulative Population and Average Dose from Exposure to Gaseous Effluents from the Prairie Island Plant

Radius (miles)	Cumulative Population	Cumulative Dose (man-rem/year)	Cumulative Average Dose (millirem/year/person)
1	86	0.065	0.76
2	374	0.071	0.22
3	654	0.088	0.13
4	1,670	0.11	0.063
5	3,267	0.13	0.040
10	19,400	0.29	0.015
20	68,920	0.43	0.0062
30	245,900	0.73	0.0030
40	1,248,000	1.9	0.0015
50	1,831,000	2.4	0.0013

be measured to determine the quantities of the principal radionuclides released to the environment. In addition, the Applicant will conduct a routine program of environmental surveillance to determine the fate of these radionuclides.

The preoperational phase of the program was begun in mid-1970 in order to establish baseline data that can be used to determine any effects that may accompany operation of the reactors. Sampling frequencies and the number of samples to be taken were determined in cooperation with the Minnesota Department of Health, which also performs the laboratory analysis of the samples under a grant from the Applicant. The samples are collected by the Applicant or by its consultants.

Samples are collected from the Mississippi and Vermillion Rivers and connecting lakes (water, biota, and sediments), from nearby wells (water), and from nearby fields (soil and vegetation) at frequencies ranging from weekly to yearly. Weekly air samples are taken at eight offsite locations and one onsite location (identified in Figure V-2) and analyzed for particulates and radioiodine. Ambient gamma radiation is measured at the eight offsite stations and at six onsite locations. The latter are identified in Figure V-3. Milk is taken from nine farms within 10 miles of the Plant and analyzed monthly. Included are the four dairy farms nearest to the site. The locations of the sampled farms are shown in Figure V-4. Details about sample types, frequencies, and location are given in Table V-5. Additional details concerning the program and results of the first year of preoperational monitoring have been reported by the Applicant to the Commission[19]

In addition to the program described above and summarized in Table V-5, the Applicant has set up a tritium monitoring network along the Mississippi River, beginning upstream from the Monticello Nuclear Plant and ending just downstream from the Prairie Island Plant, at Lock and Dam No. 3. Samples are collected by the Applicant and analyzed by Isotopes Incorporated of Westwood, New Jersey.

Independently, the Wisconsin Department of Health and Social Services periodically monitors radioactivity in air, soil, Mississippi River water, vegetation, and milk in the area of the Prairie Island Plant.

The Applicant's monitoring program will continue after startup of the Plant; modifications will be made as appropriate. The Staff will require that bottom sediments in the discharge canal be sampled before the effluent is diluted by the flow in from Sturgeon Lake. The operational monitoring program will be further defined in the Plant's Technical Specifications which are a part of any license issued.

E. TRANSPORTATION OF NUCLEAR FUEL AND SOLID RADIOACTIVE WASTES

The nuclear fuel for the Prairie Island reactors is slightly enriched uranium in the form of sintered uranium oxide pellets encapsulated in

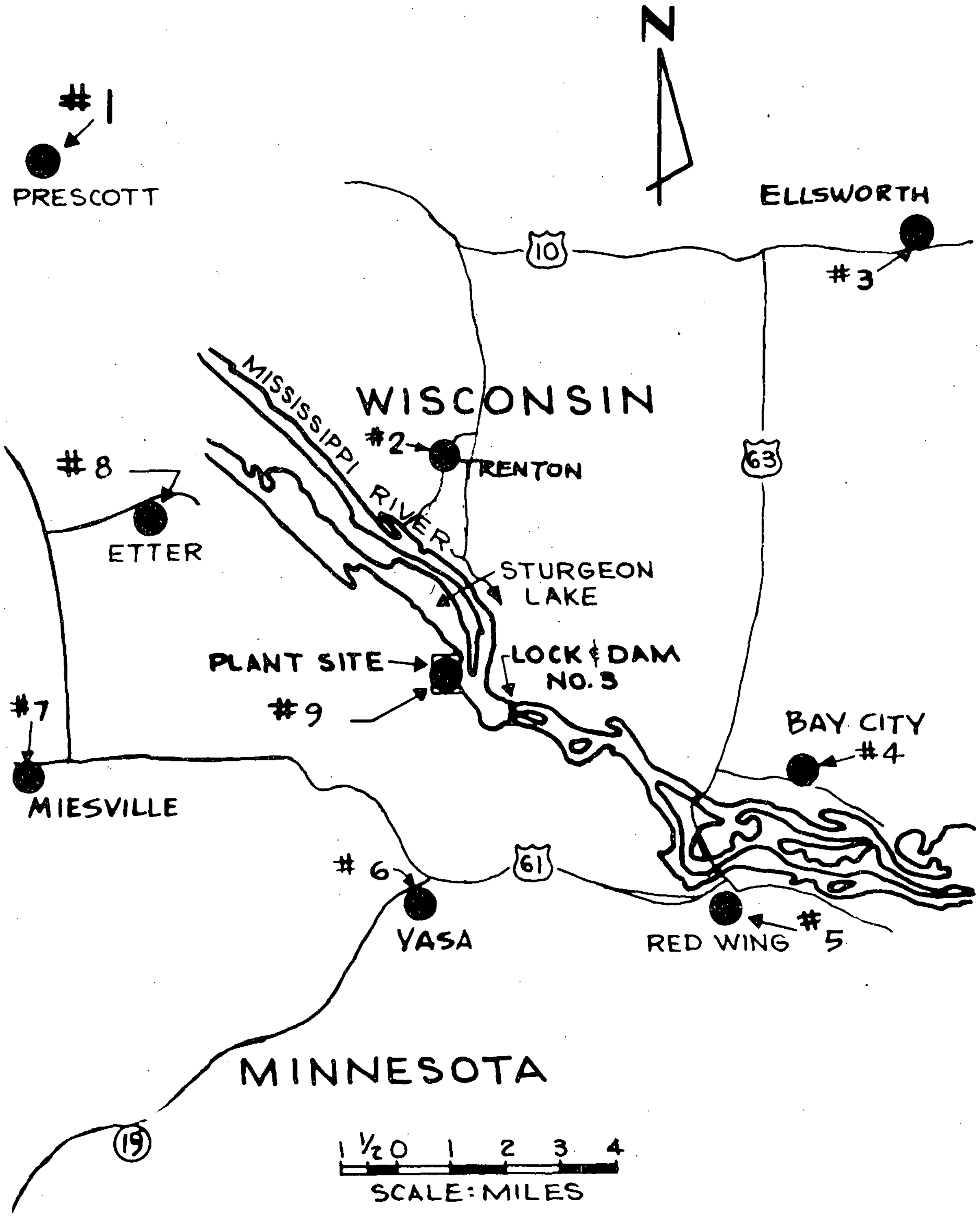


Fig. V-2. Locations of Air Sampling Stations

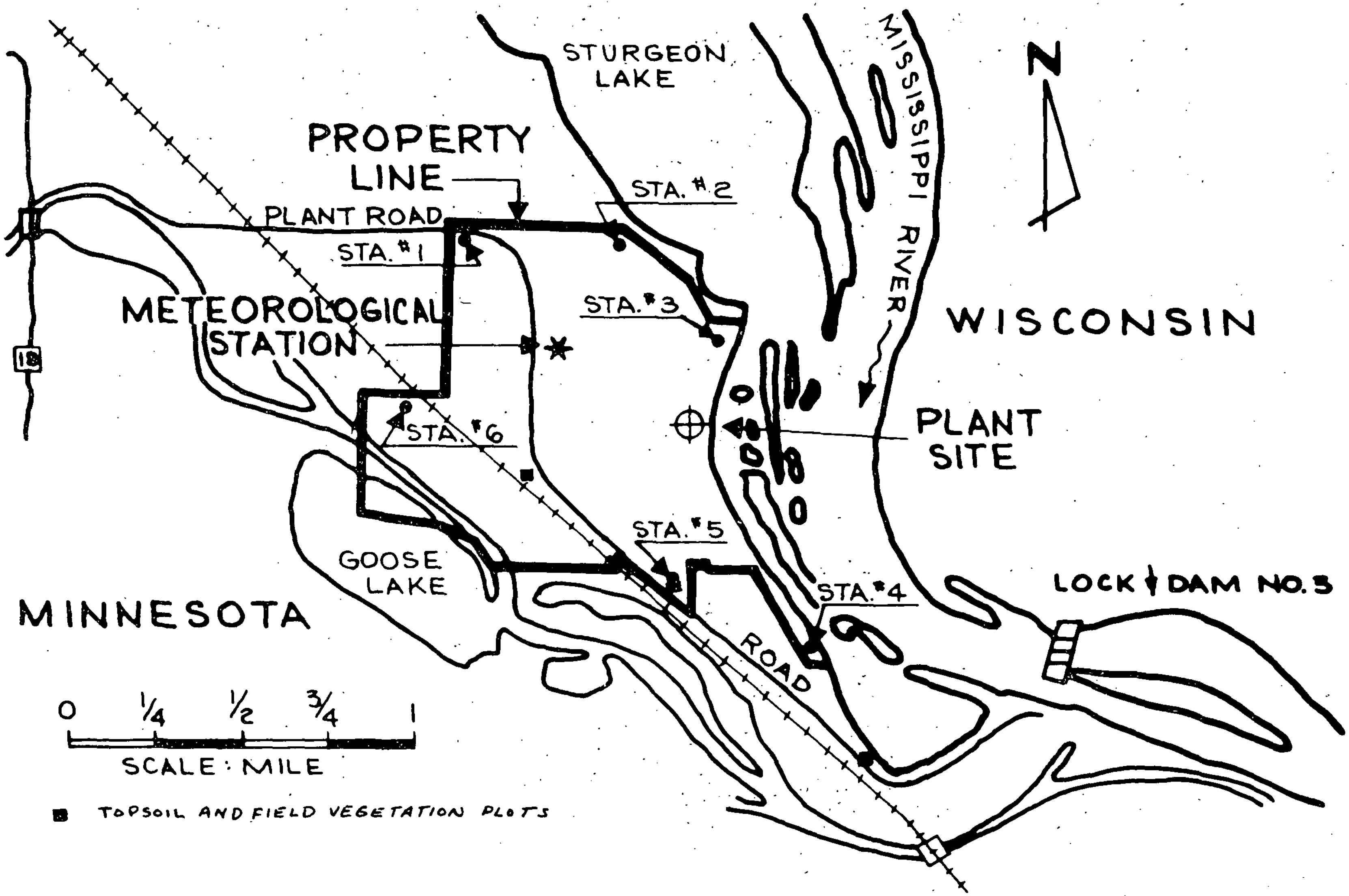


Fig. V-3. On-site Locations for Monitoring of Gamma Radiation

Fig. V-4. Milk Sampling Locations

TABLE V-5

RADIOLOGICAL SAMPLE COLLECTIC \ND ANALYSIS

Type of Sample	Type of Analysis	Collection Site	Collection Frequency
Mississippi River Water	GB, GS, ^{3}H (M)	Upstream within 1000 ft from intake canal. Downstream within 1000 ft from discharge canal.	Weekly (when safe)
Vermillion River Water	GB, GS, ^{3}H	Near downstream boundary of plant site	Monthly (when safe)
Lake Water	GB, ^{3}H, GS	2 local lakes	Quarterly (when safe)
Well Water	GA, GB, GS, ^{3}H	8 sites within 5 miles of plant site plus 1 City of Red Wing Well	Quarterly
Fallout/Precipitation	GB, GS, ^{90}Sr	Meteorological Station (Plant Site) State Health Dept. Bldg. Mpls.	Monthly (if available
Lake & River Bottom Sediment	GB, GS	2 local lakes Upstream of plant (Miss. River) Downstream of plant (Miss. River) Downstream of plant (Verm. River)	Semi-Annually (if available)
Aquatic Vegetation	GB, GS	2 local lakes Upstream of plant (Miss. River) Downstream of plant (Miss. River) Downstream of plant (Verm. River)	June and September (if available)

TABLE V-5 (Cont'd.)

RADIOLOGICAL SAMPLE COLLECTION AND ANALYSIS

Type of Sample	Type of Analysis	Collection	Collection Frequency
Plankton or Algae or Insects	GB, GS	2 local lakes Upstream of plant (Miss. River) Downstream of plant (Miss. River) Downstream of plant (Verm. River)	June and September (if available)
Clams (Shells and Flesh)	GB, ^{89,90}Sr*, GS	Upstream of plant (Miss. River) Downstream of plant (Miss. River)	Quarterly (when available)
Fish (Bones and Flesh)	GB, ^{89,90}Sr*, GS	Upstream of plant (Miss. River) Downstream of plant (Miss. River)	Quarterly (if available)
Milk	^{131}I, ^{90}Sr(Q), GS	Two farms per region, four regions	Monthly
Milk	^{131}I, ^{90}Sr(Q), GS(M)	Uncomposited samples from 2 nearest dairy farms	Monthly (except weekly during grazing season)
Topsoil	GB, GS	From 3 fields in the vicinity of plant site	Semi-annually
Field Vegetation Corps	GB, ^{131}I, GS	From 3 non-irrigated fields in vicinity of plant site	Annually (at harvest)
Air Samples (Filters)	GB, GS(M) ^{131}I (M)	Meteorological Station (Plant Site) and 8 other Stations located within 15 mile radius of plant	Weekly
Air Samples (Film Badge)	Beta-Gamma	Same locations as filters plus 6 on-site stations	Every 4 weeks
Air Samples (TLD)	Gamma	Same locations as filters plus 6 on-site stations	Every 4 weeks

TABLE V-5 (Cont'd.)

RADIOLOGICAL SAMPLE COLLECTIONS AND ANALYSIS

CODING SYSTEM:

^3H - Tritium
GB - gross beta
GS - gamma scan
(M) - monthly
GA - Gross alpha
(Q) - Quarterly analysis on composited samples.

*Analysis for $^{89,90}Sr$ must be performed if gross beta activity is 50% greater (at a 95% confidence level) than the background determined during the preoperational monitoring program.

zircaloy fuel rods. A fuel element consists of a cluster of 179 fuel rods or sealed tubes arranged in a 14 x 14 array. Each of the two reactors will contain 121 fuel elements.

1. Transport of New Fuel

The fuel elements will be transported by conventional trucks of the tractor-trailer type. The first fuel load for each reactor, composed of 121 fuel elements, will be transported from the Westinghouse Nuclear Fuel Division Plant at Columbia, South Carolina, to the Prairie Island Plant. These initial shipments are expected to be made over a six-week period for each reactor. There will be six or seven containers per truck load, with two elements per container, in fuel-shipping containers designed to protect the fuel element from damage. The fuel elements will be enclosed in a polethylene wrapper and covered with reusable steel-foil-reinforced corrugated-paper-board protective jackets. Each fuel element weighs approximately 1260 pounds. Of the 1260 pounds, approximately 945 pounds is UO_2.

The shipping container is a reusable metal container and is designed for leak tightness, humidity control, and shock and vibration isolation of fuel elements to protect them against damage during normal handling and shipping over a temperature range from -40 to +150°F. The fuel elements are supported in a rigid frame, which is shock-mounted to the container. All surfaces contacting the fuel elements are lined with a protective material. Each container is about 4 feet high by 4 feet wide by 16 feet long. A container will weigh approximately 6400 pounds; each has enough structural stength to support as much as twice its own loaded weight. It is expected that about six containers will constitute a truckload of about 20 tons.

The new fuel for subsequent annual loadings of approximately 40 elements per reactor will be shipped from either the Westinghouse Nuclear Fuel Plant in Columbia, South Carolina, or another qualified fuel fabricator's plant over a three-week period per reactor to the Plant.

2. Transport of Irradiated Fuel

Spent nuclear fuel elements will be shipped between the Prairie Island Plant and the Nuclear Fuel Services Reprocessing Plant (NFSRP) at West Valley, New York, by truck under carefully controlled and regulated conditions. The fuel elements will be carried in spent-fuel shipping casks designed and licensed specifically for this purpose.

The Applicant will be required to meet all the applicable State and/or Federal regulations. Specifically, the spent-fuel casks and selected mode must meet all appropriate Federal, State, and local regulations with the major controlling criteria being provided by Title 10, Code of Federal Regulations, Chapter 1, Part 70 - Special Nuclear Material and Part 71 - Packaging of Radioactive Material for Transport, and Title 49, Code of Federal Regulations, Parts 1-199 of the Department of Transportation (DOT), Hazardous Material Regulations. These regulations define the overall design and operational criteria, both normal and accident, that must be met by any type of spent-fuel shipping cask.

a. Shipping Casks

The shipping casks to be used for shipping spent fuel from the Prairie Island Plant to the NFSRP will be designed to comply with the above-mentioned regulations. Since the specific design for the Prairie Island shipping casks has not yet been finalized, a typical truck-type spent-fuel shipping cask for PWR fuel elements is described here. A typical cask is designed to accommodate from one to four PWR fuel elements. The cask is a circular cylinder approximately 17 feet long and about 6 feet in diameter. Lead or depleted-uranium gamma-ray shielding is used in conjunction with an hydrogeneous neutron shield to provide radiation protection.

Normally the spent fuel element will be shipped from the reactor to the reprocessing plant without any detectable release of radioactive material. The radiation intensity emerging from the cask will be well below the limit established by the Federal standards. In the unlikely event of a severe shipping accident, in which the maximum hypothetical accident conditions are assumed to exist, the environmental release of radioactivity will be at most limited to inert gas and low-activity coolant that would not pose a severe radiation hazard. The corresponding increase in external radiation levels, because of possible shielding reduction, will similarly not cause an unreasonable hazard to exist. Therefore, the environmental impact of transporting spent fuel elements to the reprocessing site is considered insignificant.

b. Timing

Spent fuel will normally be shipped from the reactor site about four months after it is discharged from the reactor installation, subject to both the reprocessing plant's detailed schedule and possible local weather or driving restrictions. The number of annual trips required for each reactor refueling will vary from 10 to 40 for a discharge of 40 elements and for casks with a capacity of from four to one PWR assemblies, respectively. It is anticipated that the cask will be loaded and shipped when convenient on a 24-hr/day, 7-day/week basis.

c. Drivers

High standards are used in selecting drivers for transporting spent nuclear fuel to achieve the desired benefits of a safe, overall transport. Additionally, these high standards are used because of the inherent value of a shipping cask ($100,000-$750,000) and its contents ($50,000-$200,000). All drivers must meet the normal ICC requirements (medical, sight, etc.), plus specific demands of individual companies, such as reasonably accident free records, and no felony charges. The drivers are provided instructions as to the normal operation condition of the shipping cask and the type of periodic inspections to make in transit. A simple radiation-monitoring instrument is normally supplied to the driver so that he can monitor radiation levels. Training and instructions are also provided to each driver to ensure familiarity with emergencies or accident procedures to be followed. A detailed listing of appropriate emergency contacts, i.e., USAEC Radiological Emergency Teams, local and state police, etc., is also provided for each planned routing.

d. Route

Routing from the Plant to the NFSRP at West Valley, New York, has not yet been determined in detail. A representative one is as follows:

(1) Local roads from the Plant to U. S. Route 61.

(2) U. S. Route 61 to U. S. Route 63 at Red Wing, Minnesota.

(3) Route 63 to Interstate Route 94 near Baldwin, Minnesota.

(4) I-94 to I-90 near Madison, Wisconsin.

(5) I-90 to I-294 around Chicago to I-80.

(6) I-80 across Indiana and around Cleveland to I-271.

(7) I-271 to I-90 across Pennsylvania to U. S. Route 20.

(8) Route 20 into New York to State Route 39 to U. S. Route 219.

(9) Route 219 to the county access road for the West Valley reprocessing plant site.

The spent-fuel shipment route will be approximately 1000 miles long.

Many alternate routes appear feasible, all being subject to change due to bridge restrictions, weather conditions, etc.

e. Loads

If the spent fuel is shipped three elements or more at a time, the shipping will be overweight. Permits for such overweight shipping are routinely issued for the weight ranges contemplated. The shipping of spent nuclear fuel by overweight trucks is expected to contribute to less than 4% of all overweight shipping.

3. Transport of Solid Radioactive Wastes

Spent resins, waste evaporator bottoms, and some process liquids will be dewatered and concentrated and, with other solid wastes, loaded into containers for shipment and disposal. The staff estimates 16 truckloads of wastes each year. This also may be shipped to West Valley, New York, for disposal, a shipping distance of about 1000 miles.

4. Principles of Safety in Transport

The transportation of radioactive material is regulated by the Department of Transportation and the Atomic Energy Commission. The regulations provide protection of the public and transport workers from radiation. This protection is achieved by a combination of standards and requirements applicable to packaging, limitations on the contents of packages and radiation levels from packages, and procedures to limit the exposure of persons under normal and accident conditions.

Primary reliance for safety in transport of radioactive material is placed on the packaging. The packaging must meet regulatory standards[32] established according to the type and form of material for containment, shielding, nuclear-criticality safety, and heat dissipation. The standards provide that the packaging shall prevent the loss or dispersal of the radioactive contents, retain shielding efficiency, ensure nuclear-criticality safety, and provide adequate heat dissipation under normal conditions of transport and under specified accident damage test conditions. The contents of the package also must be limited so that the standards for external-radiation levels, temperature, pressure, and containment are met.

Procedures applicable to the shipment of packages of radioactive material require that the package be labeled with a unique radioactive-materials label. In transport the carrier is required to exercise control over radioactive-material packages, including loading and storage in areas separated from persons and limitations on aggregations of packages to limit the exposure of persons under normal conditions. The procedures which carriers must follow in case of accident include segregation of damaged and leaking packages from people and notification of the shipper and the Department of Transportation. Radiological assistance teams are available through an inter-Governmental program to provide equipment and trained personnel, if necessary, in such emergencies.

Within the regulatory standards, radioactive materials are required to be safely transported in routine commerce using conventional transportation equipment with no special restrictions on speed of vehicle, routing, or ambient transport conditions. According to the Department of Transportation (DOT), the record of safety in the transportation of radioactive materials exceeds that for any other type of hazardous commodity. DOT estimates approximately 800,000 packages of radioactive materials are currently being shipped in the United States each year. Thus far, based on the best available information, there have been no known deaths or serious injuries to the public or to transport workers due to radiation from a radioactive-material shipment.

Controls over routing in transport have not been considered a factor in establishing safety standards. Emphasis was placed on package standards and quality-assurance procedures apart from any routing restrictions. The regulations require all carriers of hazardous materials to avoid congested areas[33] wherever practical to do so. In general, however, carriers choose the most direct and fastest route. Routing restrictions that require use of secondary highways or other than the most direct route may increase the overall environmental impact of transportation as a result of increased accident frequency or severity. Any attempt to specify routing would involve continued analysis of routes in view of the changing local conditions as well as changing of sources of material and delivery points.

5. Exposures During Normal (No-Accident) Conditions

a. New Fuel

Since the nuclear radiations and heat emitted by cold fuel are small, there will be essentially no effect on the environment during transport under normal conditions. Exposure of individual transport workers is estimated to be less than 1 millirem (mrem) per shipment. For the 10 or so shipments required for the initial loading of each reactor, with two drivers for each vehicle, the total dose would be about 0.02 man-rem* per year. For refueling requirements, the dose would be about one-third of this level. The

*Man-rem is an expression for the summation of whole-body doses to individuals in a group. In some cases, the dose may be fairly uniform and received by only a few persons (e.g., drivers and brakemen) or, in other cases, the dose may vary and be received by a large number of people (e.g., 10^5 persons along the shipping route).

radiation level associated with each truckload of cold fuel will be less than 0.1 mrem/hr at 6 feet from the truck. A member of the general public who spends 3 minutes at an average distance of 3 feet from the truck might receive a dose of about 0.005 mrem per shipment. The dose to other persons along the shipping route would be extremely small.

b. Irradiated Fuel

Based on actual radiation levels associated with shipments of irradiated fuel elements, we estimate the radiation level at 3 feet from the truck will be about 25 mrem/hr. The individual truck driver would be unlikely to receive more than about 40 millirem in the 1000-mile shipment. For 80 shipments by truck during the year with two drivers on each vehicle, the annual cumulative dose would be 6.4 man-rem or less.

A member of the general public who spends 3 minutes at an average distance of 3 feet from the truck might receive a dose of as much as 1.3 mrem. If 10 persons were so exposed per shipment, the total annual dose would be about 1.0 man-rem. Approximately 300,000 persons who reside along the 1000-mile route over which the irradiated fuel is transported might collectively receive a total annual dose of about 1.0 man-rem. The regulatory radiation-level limit of 10 mrem/hr at a distance of 6 feet from the vehicle was used to calculate the integrated dose to persons in an area between 100 feet and 1/2 mile on both sides of the shipping route. It was assumed that the shipment would travel 200 miles per day and the population density would average 330 persons per square mile along the route.

The rate of release of heat to the air from each cask will be about 30,000 Btu/hr. For comparison, 35,000 Btu/hr is about equal to the heat released from an air conditioner in an average sized home. Although the temperature of the air that contacts the loaded cask may be increased a few degrees, because the amount of heat is small and is being released over the entire transportation route, no appreciable thermal effects on the environment will result.

c. Solid Radioactive Wastes

The Staff estimates that about 16 truckloads of solid radioactive wastes will be shipped to a disposal site each year. Under normal conditions, the individual truck driver might receive as much as 15 mrem per shipment. If the same driver were used for all 16 truckloads in a year, he could receive an estimated dose of about 240 mrem during the year. The cumulative dose to all drivers for the year, assuming two drivers per vehicle, might be about 0.5 man-rem.

A member of the general public who spends 3 minutes at an average distance of 3 feet from the truck might receive a dose of as much as 1.3 mrem. If 10 persons were so exposed per shipment, the cumulative annual dose would be about 0.2 man-rem. Approximately 300,000 persons who reside along the 1000-mile route over which the solid radioactive waste is transported might receive a cumulative annual dose of about 0.2 man-rem. These doses were calculated for persons in an area between 100 feet and 1/2 mile on either side of the shipping route, assuming 330 persons per square mile, 10 mrem/hr at 6 feet from the vehicle, and the shipment traveling 200 miles per day.

VI. ENVIRONMENTAL IMPACT OF POSTULATED ACCIDENTS

A. PLANT ACCIDENTS

A high degree of protection against the occurrence of postulated accidents at the Prairie Island Nuclear Generating Plant, Units 1 and 2, is provided through correct design, manufacture, and operation and the quality assurance program used to establish the necessary high integrity of the reactor system. These factors were considered in the Commission's Safety Evaluation dated September 28, 1972. Deviations that may occur are handled by protective systems to place and hold the Plant in a safe condition. Notwithstanding this, the conservative postulate is made that serious accidents might occur, in spite of the fact that they are extremely unlikely; and engineered safety features are installed to mitigate the consequences of these postulated events.

The probability of occurrence of accidents and the spectrum of their consequences to be considered from an environmental effects standpoint have been analyzed using best estimates of probabilities and realistic fission product release and transport assumptions. For site evaluation in the Commission's safety review, extremely conservative assumptions were used for the purpose of comparing postulated doses resulting from a hypothetical release of fission products from the fuel against the 10 CFR Part 100 siting guidelines. The computed doses that would be received by the population and environment from actual accidents would be significantly less than those calculated for the site evaluation.

The Commission issued guidance to applicants on September 1, 1971, requiring the consideration of a spectrum of accidents with assumptions as realistic as the state of knowledge permits. The Applicant's response was contained in the Supplement to Applicant's Environmental Report, Operating License Stage dated November 5, 1971.

The Applicant's report has been evaluated, using the standard accident assumptions and guidance issued as a proposed amendment to Appendix D of 10 CFR Part 50 by the Commission on December 1, 1971. Nine classes of postulated accidents and occurrences ranging in severity from trivial to very serious were identified by the Commission. In general, accidents in the high potential consequence end of the spectrum have a low occurrence rate, and those on the low potential consequence end have a higher occurrence rate. The examples selected by the Applicant for these cases are shown in Table VI-1. The examples selected are reasonably homogeneous in terms of probability within each class, although the release of the waste gas decay tank contents is considered as more appropriately in

TABLE VI-1

CLASSIFICATION OF POSTULATED ACCIDENTS

AND OCCURRENCES

Class	AEC Description	Applicant's Example(s)
1.0	Trivial Incidents	Not Considered
2.0	Small releases outside containment	Miscellaneous small spills and leaks outside containment
3.0	Radwaste system failures	Radwaste systems failures-release of 10% of gas decay tank contents
4.0	Fission products to primary system (BWR)	Failed fuel
5.0	Fission products to primary and secondary systems (PWR)	Failed fuel and steam generator tube leak plus loss of load
6.0	Refueling accident	Fuel handling accident in containment
7.0	Spent fuel handling accident	Fuel handling accident-fuel handling building
8.0	Accident initiation events considered in design basis evaluation in the SAR	Gas decay tank rupture (100% contents), steam line break, steam generator tube rupture, control rod ejection, loss-of-coolant pipe break
9.0	Hypothetical sequence of failures more severe than Class 8	Not considered

Class 3 and the steam generator tube rupture as more appropriately in Class 5. Certain assumptions made by the Applicant do not exactly agree with those in the proposed Annex to Appendix D, but the use of alternative assumptions does not significantly affect overall environmental risk.

Staff estimates of the dose which might be received by an assumed individual standing at the site boundary in the downwind direction, using the assumptions in the proposed Annex to Appendix D, are presented in Table VI-2. Estimates of the integrated exposure that might be delivered to the population within 50 miles of the site are also presented in Table VI-2. The man-rem estimate was based on the projected population around the site for the year 1990.

To rigorously establish a realistic annual risk, the calculated doses in Table VI-2 would have to be multiplied by estimated probabilities. The events in Classes 1 and 2 represent occurrences which are anticipated during Plant operation; and their consequences, which are very small, are considered within the framework of routine effluents from the Plant. Except for a limited amount of fuel failures and some steam generator leakage, the events in Classes 3 through 5 are not anticipated during Plant operation; but events of this type could occur sometime during the 40 year Plant lifetime. Accidents in Classes 6 and 7 and small accidents in Class 8 are of similar or lower probability than accidents in Classes 3 through 5 but are still possible. The probability of occurrence of large Class 8 accidents is very small. Therefore, when the consequences indicated in Table VI-2 are weighted by probabilities, the environmental risk is very low. The postulated occurrences in Class 9 involve sequences of successive failures more severe than those required to be considered in the design bases of protection systems and engineered safety features. Their consequences could be severe. However, the probability of their occurrence is so small that their environmental risk is extremely low. Defense in depth (multiple physical barriers), quality assurance for design, manufacture and operation, continued surveillance and testing, and conservative design are all applied to provide and maintain the required high degree of assurance that potential accidents in this class are, and will remain, sufficiently small in probability that the environmental risk is extremely low.

Table VI-2 indicates that the realistically estimated radiological consequences of the postulated accidents would result in exposures of an assumed individual at the site boundary to concentrations of radioactive materials within the Maximum Permissible Concentrations (MPC) of Appendix B, Table II, 10 CFR Part 20. Table VI-2 also shows that the estimated integrated exposure of the population within 50 miles of the Plant from each postulated accident would be orders of magnitude smaller

TABLE VI-2

SUMMARY OF RADIOLOGICAL CONSEQUENCES

OF POSTULATED ACCIDENTS[1]

Class	Event	Estimated Fraction of 10 CFR Part 20 Limit at Site Boundary[2]	Estimated Dose to Population within 50 mile radius, man-rem
1.0	Trivial Incidents	3/	3/
2.0	Small releases outside containment	3/	3/
3.0	Radwaste System failures		
3.1	Equipment leakage or malfunction	0.056	3.4
3.2	Release of waste gas storage tank contents	0.22	14
3.3	Release of liquid waste storage contents	0.006	0.38
4.0	Fission products to primary system (BWR)	N. A.	N. A.
5.0	Fission products to primary and secondary systems (PWR)		
5.1	Fuel cladding defects and steam generator leaks	3/	3/
5.2	Off-design transients that induce fuel failure above those expected and steam generator leak	0.001	<0.1
5.3	Steam generator tube rupture	0.074	4.6
6.0	Refueling accidents		
6.1	Fuel bundle drop	0.012	0.72
6.2	Heavy object drop onto fuel in core	0.20	12

TABLE VI-2 (Cont'd)

Class	Event	Estimated Fraction of 10 CFR Part 20 Limit At Site Boundary[2/]	Estimated Dose to Population within 50 mile radius, man-rem
7.0	Spent fuel handling accident		
7.1	Fuel assembly drop in fuel rack	0.007	0.46
7.2	Heavy object drop onto fuel rack	0.03	1.8
7.3	Fuel cask drop	N. A.	N. A.
8.0	Accident initiation events considered in design basis evaluation in the SAR		
8.1	Loss-of-Coolant Accidents		
	Small Break	0.11	14
	Large Break	0.064	15
8.1(a)	Break in instrument line from primary system that penetrates the containment	N. A.	N. A.
8.2(a)	Rod ejection accident (PWR)	0.006	1.5
8.2(b)	Rod drop accident (BWR)	N. A.	N. A.
8.3(a)	Steamline breaks (PWR's-outside containment)		
	Small Break	<0.001	<0.1
	Large Break	<0.001	<0.1
8.3(b)	Steamline break (BWR)	N. A.	N. A.

1/ The doses calculated as consequences of the postulated accidents are based on airborne transport of radioactive materials resulting in both a direct and an inhalation dose. Our evaluation of the accident doses assumes that the Applicant's environmental monitoring program and appropriate additional monitoring (which could be initiated subsequent to an incident detected by in-plant monitoring) would detect the presence of radioactivity in the environment in a timely manner such that remedial action could be taken if necessary to limit exposure from other potential pathways to man.

2/ Represents the calculated fraction of a whole body dose of 500 mrem, or the equivalent dose to an organ.

3/ These releases are expected to be in accord with proposed Appendix I for routine effluents (i.e., 5 mrem per year to an individual from either gaseous or liquid effluents).

than that from naturally occurring radioactivity. The exposure from naturally occurring radioactivity corresponds to approximately 600 man-rems per year within 5 miles and approximately 350,000 man-rems per year within 50 miles of the site. These estimates are based on a natural background of 150 mrem/yr. When considered with the probability of occurrence, the annual potential radiation exposure of the population from all the postulated accidents is an even smaller fraction of the exposure from natural background radiation and, in fact, is well within naturally occurring variations in the natural background. It is concluded from the results of the realistic analysis that the environmental risks due to postulated radiological accidents are exceedingly small.

B. TRANSPORTATION ACCIDENTS

Provisions in transportation regulations are designed to assure maximum containment of wastes and minimum contamination from wastes in accidents. Shipments of wastes are likely to be made by exclusive-use truck, which means that the vehicle is loaded by the consignor and unloaded by the consignee. In most cases the shipments are made in closed vehicles. Since the shipment is exclusive use, the shipper can provide specific instructions to carrier personnel regarding procedures in case of accidents.

Commission and Department of Transportation regulations provide specific instructions to carriers for segregating damaged and leaking packages, keeping people away from the scene of an accident, and notification of the shipper and the Department of Transportation.

Each package containing radioactive material is labeled with the radioactive material label, a distinctive label which identifies the material and provides a visual warning. The regulations specify placarding on the outside of the truck for identifying the presence of shipments of large quantities of radioactive materials. An extensive program has been carried out over the past several years by which emergency personnel, including police departments, fire departments, and civil defense offices, have been advised of procedures to follow in accidents involving radioactive materials and other hazardous materials. Specific instructions with regard to radioactive materials have been provided through the AEC's efforts as well as those of carrier organizations such as the Bureau of Explosives of the Association of American Railroads, the American Trucking Association, and the Air Transport Association. An intergovernmental program to provide personnel and equipment is available at the request of persons (truck drivers, police, bystanders or other persons) at the scene of such accidents.

The procedures prescribed by existing applicable regulations, together with the other precautions discussed above are considered by the Commission to be adequate to mitigate the effects of infrequent accidents which might occur involving shipments of wastes from the Station.

Based on recent accident statistics,[1] a shipment of fuel or waste may be expected to be involved in accident about once in a total of 750,000 shipment-miles. The Staff has estimated that only about one in 10 of those accidents involving Type A packages or one in 100 of those involving Type B packages might result in any leakage of radioactive material. In case of an accident, procedures that carriers are required[2] to follow will frequently reduce the consequences of an accident. The procedures include segregation of damaged and leaking packages from people, and notification of the shipper and the Department of Transportation. Radiological assistance teams are available through an inter-Governmental program to provide equipped and trained personnel. These teams, dispatched in response to calls for emergency assistance, can mitigate the consequences of an accident.

1. New Fuel

Under accident conditions other than accidental criticality, the pelletized form of the nuclear fuel, its encapsulation, and the low specific activity of the fuel limit the radiological impact on the environment to negligible levels.

The packaging is designed to prevent criticality under normal and severe accident conditions. To release a number of fuel assemblies under conditions that could lead to accidental criticality would require severe damage or destruction of more than one package, which is unlikely to happen in other than an extremely severe accident.

The probability that an accident could occur under conditions that could result in accidental criticality is extremely remote. If criticality were to occur in transport, persons within about 100 feet from the accident might receive a serious exposure but beyond that distance, no detectable radiation effects would be likely. Persons within a few feet of the accident could receive fatal or near-fatal exposures unless shielded by intervening material. Although there would be no nuclear explosion, heat generated in the reaction would probably separate the fuel elements so that the reaction would stop. The reaction would not be expected to continue for more than a few seconds and normally would not recur. Residual radiation levels due to induced radioactivity in the fuel elements might reach a few roentgens per hour at 3 feet. There would be very little dispersion of radioactive material.

2. Irradiated Fuel

Effects on the environment from accidental releases of radioactive materials during shipment of irradiated fuel have been estimated for the situation in which contaminated coolant is released and the situation in which gases and coolant are released.

a. Leakage of Contaminated Coolant

Leakage of contaminated coolant resulting from improper closing of the cask is possible as a result of human error, even though the shipper is required to follow specific procedures that include tests and examination of the closed container before each shipment. Such an accident is highly unlikely during the 35- to 40-year life of the Plant.

Leakage of liquid at a rate of 0.001 cc per second or about 80 drops/hour is about the smallest amount of leakage that can be detected by visual observation of a large container. If undetected leakage of contaminated liquid coolant were to occur, the amount would be so small that the individual exposure would not exceed a few mrem and only a very few people would receive such exposures.

b. Release of Gases and Coolant

Release of gases and coolant is an extremely remote possibility. In the improbable event that a cask is involved in an extremely severe accident such that the cask containment is breached and the cladding of the fuel assemblies is penetrated, some of the coolant and some of the noble gases might be released from the cask.

In such an accident, the amount of radioactive material released would be limited to the available fraction of the noble gases in the void spaces in the fuel pins and some fraction of the low-level contamination in the coolant. Persons would not be expected to remain near the accident due to the severe conditions that would be involved. If releases occurred, they would be expected to take place in a short period of time. Only a limited area would be affected. Persons in the downwind region and within 100 feet or so of the accident might receive doses as high as a few hundred millirem. Under average weather conditions, a few hundred square feet might be contaminated to the extent that it would require decontamination (that is, Range I contamination levels) according to the standards[3] of the Environmental Protection Agency.

3. Solid Radioactive Wastes

It is highly unlikely that a shipment of solid radioactive waste will be involved in a severe accident during the life of the Plant. If a shipment of low-level waste (in drums) becomes involved in a severe accident, some waste might be released but the specific activity of the waste will be so low that the exposure of personnel would not be expected to be significant. Other solid radioactive wastes will be shipped in Type B packages. The probability of release from a Type B package, in even a very severe accident, is sufficiently small that, considering the solid form of the waste and the very remote probability that a shipment of such waste would be involved in a very severe accident, the likelihood of significant exposure would be extremely small.

In either case, spread of the contamination beyond the immediate area is unlikely and, although local cleanup might be required, no significant exposure to the general public would be expected to result.

4. Severity of Postulated Transportation Accidents

The events postulated in this analysis are unlikely but possible. Accidents more severe than those analyzed can be postulated and their consequences could be severe. Quality assurance for design, manufacture, and use of the packages, continued surveillance and testing of packages and transport conditions, and conservative design of packages ensure that the probability of accidents of this latter potential is sufficiently small that the environmental risk is extremely low. For those reasons, more severe accidents have not been included in the analysis.

5. Alternatives to Normal Transportation Procedures

Alternatives, such as special routing of shipments, providing escorts in separate vehicles, adding shielding to the containers, and constructing a fuel-recovery and -fabrication plant on the site rather than shipping fuel to and from the Plant, have been examined. The impact on the environment of transportation under normal or postulated accident conditions is not considered to be sufficient to justify the additional effort required to implement any of the alternatives.

VII. ADVERSE EFFECTS WHICH CANNOT BE AVOIDED

The residual adverse effects that could not be avoided in the Applicant's efforts to minimize environmental effects attendant to the main purpose of the Plant are considered here. These adverse effects are of the nature of unavoidable appropriations of certain portions of land, air, and water resources, which exclude other uses of an industrial, agricultural, or recreational nature. Such exclusions are either primary or secondary effects. The primary effects are describable in quantitative terms as changes or appropriations of those basic resources that directly exclude other uses; the secondary effects are describable only in qualitative terms, since they affect the quality of aesthetic appreciation and the character of the ecology (that is, habitat, species composition, and population of living species, including man).

The Applicant has demonstrated sensitivity to environmental effects related to the construction and operation of the Plant and has sought to reduce the number and intensity of the unavoidable impacts of the Plant on the region. Several Plant design features minimize detrimental environmental effects. These include the four forced-draft cooling towers, which will be operated on a year-round basis, the use of a mechanical instead of a chemical method for condenser cleaning, and an improved radwaste system. Remaining adverse environmental effects that will occur are essentially ones for which a significant further reduction was considered impractical or conjectural. Some of the latter, such as the appearance of the Plant or its transmission-line supports, are psychological in character and dependent upon the opinions and attitudes of various members of the public.

The classification of some effects as adverse may be debatable, but the basic assumption is that existing natural features of the environment have evolved over many millions of years and that man-made perturbations are more likely to be disruptive to the natural system than not. The implied judgment of "adverse" in this and later sections points to a general criterion of interest in human and ecological well-being, for both present and future generations. Adverse effects on land, water, and air are considered first. Biological effects are discussed next, and then some comments are made on aesthetic aspects.

A. LAND USE

The acquisition of the site and dedication of a portion of it to industrial activity are disruptive influences on the prior land use which was predominantly farming. However, the 500 acres not used by the industrial complex will be less disturbed than before, since they will not be farmed, according to present plans. Regardless of whether or not this unused site land is farmed in the future, other farmland is abundant elsewhere in Goodhue and surrounding counties.

Recreational use of the Mississippi River and its shores has been minimal at or near the Plant site. Only hunters are apt to be affected adversely on a long-term basis by the installation of the industrial complex, but this will be a local effect (roughly within gunshot of the Plant). The 500 acres withdrawn from agriculture will probably become a breeding place for wild game and should thus be an advantage to hunters in peripheral areas, and an attribute to the environment.

The Plant buildings and grounds will occupy about 60 acres of the 560-acre site. Substrate for plants and habitat for animals including birds has unavoidably been lost where the Plant buildings, parking lots, substation and roads were placed. New grading of areas around these structures will restore a small part of this loss after construction is completed.

Most of the permanent Plant employees will commute from various offsite locations and will probably place only a small added demand on the services provided in the communities and rural areas where they settle.

The disruption of the land during construction and the attendant noise have displaced wildlife in the immediate proximity of the Plant. However, this is temporary and will essentially end when construction of the Plant is completed.

Along the 34 miles of new transmission lines, some vegetation was and will continue to be disturbed because of the need for avoiding interference with the lines, and this too will displace some wildlife. This disturbance will be slight, because most of the land through which this narrow corridor passes is used for farming, and even where trees must be cut or trimmed to keep the lines clear, the narrow width of the tract will displace wildlife (for example, birds) only a small distance.

B. WATER

Construction, dredging, and sanitary landfill operations have resulted in localized changes, and some silting and erosion have been unavoidable. A channel was dredged across a portion of Sturgeon Lake to admit a greater proportion of water from the main Mississippi River channel into the Plant intake. Also, dredging at the cooling water outfall was done, as explained earlier (see Section III-C.3.b) and shown in Figure III-5.

Eventually, equilibrium at the intake and outfall will be restored, but under somewhat modified conditions. Localized water loss in excess of natural amounts will occur on a continuing basis, through drift and increased evaporation from the cooling towers (38 cfs maximum) and in the thermal plume from the outfall, due to higher than ambient temperatures. This redistribution of water is not significant in view of the average 15,020-cfs flow in the river near the site.

There will be a variety of chemical additions and increases in concentrations of dissolved solids in the waters immediately adjacent to the Plant. These additions, including the possibility of occasional chemical treatment of water to keep the cooling towers clean, were described in Section III.D.3. Some of the radioactive materials processed by the radwaste system will be diluted with the Plant water and released into the river, as explained in Section III.D.2. Thus, there will be a continuing addition of chemicals to the nearby waters. These chemicals will be diluted by the river. The total amount added is not significant in view of the volume of water flowing in the Mississippi River (see tables II-17, III-2 and III-5).

C. AIR

The principal materials released to the air by Plant operation are water vapor and drift from the cooling towers, additional water vapor from the thermal plume in the river, and small amounts of gaseous radionuclides from the radwaste system. Under certain conditions, localized steam fog will be caused or enhanced by the thermal plume. Eventually, the moisture released by evaporation from the cooling towers and the thermal plume will return to the earth's surface as precipitation, but this should be widely distributed. The quantity of water that becomes airborne in this way is a small part of the normal flow of the river.

D. BIOLOGICAL EFFECTS

Here attention is directed to the possible consequences to plants and animals of changes in land, water, and air due to the construction and operation of the Plant. A consideration of the impact of the water-intake structure on fish and other aquatic life is included.

Revegetation of some land areas disturbed by construction in the 60-acre industrial complex, and reversion of former farmland on the site to a natural state will compensate for some of the loss in certain of the wildlife habitats due to land being committed to the Plant. New grass and other vegetation planted by the Applicant may improve the food supply for endemic wildlife.

Based on area of river bottom affected, the temporary dredging operations for the coolant intake structure and discharge basin disrupted a relatively small part of the benthic populations in the river near the Plant.

The effluent outfall from the cooling towers will be released into the river side-channels and largely dissipated within a few hundred feet of the outlet. Free-swimming organisms are not expected to remain in the plume unless they are gradually adapted. Especially during the winter months, some fish will be attracted by the thermal plume in the river, but no significant adverse effect is anticipated because of it, unless it ceases abruptly due to sudden shutdown of the Plant. The ice-free water in the area of the effluent will provide an open space for waterfowl in winter.

Many minute organisms having a maximum diameter of less than 3/8 inch will be killed as a result of passage through the condenser cooling system. However, this should have little if any significant impact on the population levels of most plankton forms in the river since only about 1% of the average main channel flow passes through the condensers. Also, most phytoplankton and zooplankton have relatively rapid rates of reproduction and will tend to make up losses due to condenser passage without much delay.[1] From the data at hand, the meroplankton (e.g., developing fish and invertebrates), which have life cycles of greater duration, are rather sparsely distributed in the main-channel river water. However, seining has shown that Sturgeon Lake functions as a nursery area for young fish.[2]

Fish will often be discouraged from swimming into the intake channel by the barrier wall, and will probably swim back out of the channel if they do enter, since the flow rate is less than 1 fps.

E. AESTHETIC ASPECTS

The Plant's design reflects good judgment in architectrual use of construction materials, although the functional nature of some of the components cannot be camouflaged conveniently. The structures constituting the Plant contrast strongly with the typical construction on the surrounding agricultural land. The low density of population in the area surrounding the site means that comparatively few people, other than motorists, will experience the change in the countryside's appearance caused by the Plant. Its location at the west bank of the river is a peripheral location for most people in the area. Although the Plant is visible from several miles in some directions, the depressed level of the flood plain and scattered growths of trees serve somewhat to hide the Plant and reduce its prominence on the horizon.

VIII. THE RELATIONSHIP BETWEEN SHORT-TERM USES OF THE ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

On a scale of time reaching into the future through several generations, the life span of the Plant would be considered a short term use of the natural resources of land and water. The resource which will have been dedicated exclusively to the production of electrical power during the anticipated life span of the Plant will be the land itself and the uranium consumed. No significant commitment of water for consumption or use will have been made, since in the forseeable future the Mississippi River will continue to be seasonally renewed. No deterioration of water quality is anticipated to occur due to the Plant effluents.

Approximately 60 acres of the site will be devoted to the production of electrical energy for the next 30 to 40 years. The Applicant states that 320 acres were not disturbed during construction. An additional 180 acres, which were disturbed, will be regraded and seeded with grasses to resemble natural conditions. The entire 500 acres not associated with production of electricity will be left to reach equilibrium with its surroundings.

At some future date, the Plant will become obsolete and be retired. Many of the disturbances of the environment will cease when the Plant is shut down, and a rebalancing of the biota will occur. Thus, the "trade-off" between production of electricity and small changes in the local environment is reversible. Recent experience with other experimental and developmental nuclear plants has demonstrated the feasibility of decommissioning and dismantling such a plant sufficiently to restore the site to its former use. The degree of dismantlement, as with most abandoned industrial plants, will take into account the intended new use of the site and a balance among health and safety considerations, salvage values, and environmental impact.

No specific plan for the decommissioning of the Plant has been developed. This is consistent with the Commission's current regulations which contemplate detailed consideration of decommissioning near the end of a reactor's useful life. The licensee initiates such consideration by preparing a proposed decommissioning plan which is submitted to the AEC for review. The licensee will be required to comply with Commission regulations then in effect and decommissioning of the facility may not commence without authorization from the AEC.

The Applicant states [p. II-53 of The Environmental Report]: "NSP had not formulated specific plans for permanently shutting down the utilization facilities and maintaining them in a safe condition when it may occur. However, assuming permanent shutdown measures comparable to those authorized by the Atomic Energy Commission for the retirement of the Hallam Nuclear Power Facility, it is estimated that the cost of such shutdown for the Prairie Island Nuclear Generating Plant would not be in excess of $6,000,000,* based on today's cost, for each unit." This estimated cost is based on leaving all concrete intact and burying the pressure vessel rather than removing them from the site. This course of action would require long term surveillance and restrict the availability of the land for some other uses.

To date, experience with decommissioning of civilian nuclear power reactors is limited to six facilities which have been shut down or dismantled: Hallam Nuclear Power Facility, Carolina Virginia Tube Reactor (CVTR), Boiling Nuclear Superheater (BONUS) Power Station, Pathfinder Reactor, Piqua Reactor, and the Elk River Reactor.

There are several alternatives which can be and have been used in the decommissioning of reactors: (1) Remove the fuel (possibly followed by decontamination procedures); seal and cap the pipes; and establish an exclusion area around the facility. The Piqua decommissioning operation was typical of this approach. (2) In addition to the steps outlined in (1), remove the superstructure and encase in concrete all radioactive portions which remain above ground. The Hallam decommissioning operation was of this type. (3) Remove the fuel, all superstructure, the reactor vessel and all contaminated equipment and facilities, and finally fill all cavities with clean rubble topped with earth to grade level. This last procedure is being applied in decommissioning the Elk River Reactor. Alternative decommissioning procedures (1) and (2) would require long-term surveillance of the reactor site. After a final check to assure that all reactor-produced radioactivity has been removed, alternative (3) would not require any subsequent surveillance. Possible effects of erosion or flooding will be included in these considerations.

The staff concludes that the benefits derived from the Plant in serving the electrical needs of the area outweigh the short term uses of the environment in its vicinity.

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* Amendments 21 and 22 to the Prairie Island FSAR present a better estimate of dismantling cost and a description of what is included in this cost, which is about $8,000,000.

IX. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Numerous resources are involved in construction and operation of a major facility such as the Plant. These resources include the land upon which the facility is located, the materials and chemicals used to construct and maintain the Plant, fuel used to operate the Plant, capital and human talent, skill and labor.

Major resources to be committed irreversibly and irretrievably due to the operation of the Plant are essentially the land (during the life of the Plant) and the uranium consumed by the reactor. Only that portion of the nuclear fuel which is burned up or not recovered in reprocessing is irretrievably lost to other uses. This will amount to approximately 45 metric tons of uranium-235 assuming a 30-year life-time for the Plant. Most other resources are either left undisturbed, or committed only temporarily as during construction or during the life of the Plant, and are not irreversibly or irretrievably lost.

Of the land used for Plant buildings, it would appear that only a small portion beneath the reactor, control room, radwaste and the turbine-generator buildings would be irreversibly committed. Also, some components of the facility such as large underground concrete foundations and certain equipment are, in essence, irretrievable due to practical aspects of reclamation and/or radioactive decontamination. The degree of dismantlement of the Plant, as previously noted, will be determined by the intended future use of the site, which will involve a balance of health and safety considerations, salvage values, and environmental effects.

The use of the environment (air, water, land) by the Plant does not represent significant irreversible or irretrievable resource commitments, but rather a relatively short-term investment. The biota of the region have been studied, and the probable impact of the plant is presented in Sections 4 and 5. In essence, no significant short- or long-term damage or loss to the biota of the region has occurred or is anticipated.

Should an unanticipated significant detrimental effect to any of the biotic communities appear, the monitoring programs are designed to detect it, and corrective measures would then be taken by the applicant.

The staff concludes that the irreversible and irretrievable commitments are appropriate for the benefits gained.

X. THE NEED FOR POWER

A. CURRENT STATUS[1,2]

The Applicant serves nearly three million people in 630 communities in Minnesota, Wisconsin, North Dakota and South Dakota. Its service area covers 40,000 square miles in central Minnesota, west central Wisconsin, eastern South Dakota, and the Red River of the North valley and the Minot areas of North Dakota. In addition to electric service, which provided 82.2% of the company's income in 1971, the company also provides gas (16.7%), heating (0.3%), and telephone (0.8%) services to some of the communities within this territory.

The Applicant is obligated, by the common law covering providers of public-utility service, to provide reasonable and adequate service to the members of the public located within the territory in which it has established itself as the supplier of such utility service. To satisfy the demand for electrical energy in 1971, the company generated 17.236 billion kilowatt hours. Of this, 7.7% was used by the company or lost, 6.2% was sold to municipalities, other electric companies and co-ops for resale, and the remaining 86.1% was sold to its 898,749 customers. The geographical distribution of these sales was 81.8% in Minnesota, 11.3% in Wisconsin, 4.0% in North Dakota, and 2.9% in South Dakota. Although the company serves a large area, about 62% of its electric revenue in 1971 came from the Twin Cities metropolitan area, where 63% of its customers are located.

The distribution of energy among the retail customers during 1971 was as follows:

Residential	35.7%
Small commercial and industrial	15.1
Large commercial and industrial	45.6
Street lighting and other	3.6

Energy use by large commercial and industrial customers exceeded that by residential customers by 28%. On the other hand, the revenues from the former amounted to only 33% of the $306.4 million revenues from retail sales in 1971, while residential users contributed 42%.

The Applicant has identified some of the high-volume users of electric energy from its system.[3] In 1970, 84 customers had bills in excess of $150,000. Nineteen exceeded a half million dollars, and the largest, that of North Star Steel, was for two and one-half million dollars.

Since 1964, the maximum demand for power has occurred during the summer, but the demand varies significantly throughout the year. This is illustrated by the experience regarding the maximum demand, by month, during 1971:

Month (1971)	Integrated Hour Demand (MW)
January	2800
February	2776
March	2564
April	2481
May	2614
June	3111
July	2964
August	3191
September	3278
October	2637
November	2786
December	2968

At the time of the peak demand on September 3, 1971, the combined owned generating capability and net purchases resulted in a capacity of 143 MW in excess of the Applicant's required 12% reserve.

Table X-1 lists the variety of types of the Applicant's power Plants, the number of each, and the capability provided by these units to meet the power demand. Table X-2 identifies and describes the largest fossil Plants and the largest of each of the other types. Maps showing the location of all of the power plants and the power distribution system have been provided by the Applicant.[4]

B. FUTURE DEMAND

To date the Applicant has been able to satisfy the demand for power in its territory by a combination of internal generation and external purchase. Electrical load growth is currently doubling in less than 10 years. For example, the peak demand in 1966 was 2177 MW, compared with 3278 MW in 1971. During this period the Applicant increased the system's capability by the addition of the 560-MW A. S. King fossil plant in 1968, the 533-MW Monticello nuclear plant in 1971, and 194 MW of peaking units in 1967, 1969, and 1970. Because the time required between authorization and commercial operation is estimated as 76 months for a fossil plant and 90 months for a nuclear plant,[5] system expansion must be based on long-range forecasts of energy demands.

TABLE X-1 Operating Plants in the Applicant's System, as of January 1, 1972[4]

Type	Units	Capability (MWe) Summer	Winter	% of System's Capability
Fossil	47	2366	2303	70.0
Nuclear	1	533	545	16.2
Gas Turbine	7	209	266	7.1
Hydro	14	168	167	5.0
Diesel	23	56	56	1.7
All	92	3332	3337	100

TABLE X-2 Fossil Plants Larger than 75 MWe and the Largest Plants of Other Types in the Applicant's System, as of January 1, 1972[4]

Unit Name	Location	Date Operable	Rating (MWe) Summer	Rating (MWe) Winter	% of System's Capability
Fossil					
Black Dog #1	Minneapolis, Minn.	1952	76	77	2.3
Black Dog #2	Minneapolis, Minn.	1954	98	97	2.9
Black Dog #3	Minneapolis, Minn.	1955	108	110	3.3
Black Dog #4	Minneapolis, Minn.	1960	170	171	5.1
High Bridge #5	St. Paul, Minn.	1956	110	112	3.3
High Bridge #6	St. Paul, Minn.	1959	166	167	5.0
Riverside #8	Minneapolis, Minn.	1964	228	227	6.8
A. S. King #1	Oak Park Heights, Minn.	1968	560	574	17.0
Nuclear					
Monticello	Monticello, Minn.	1971	533	545	16.2
Gas Turbine					
Key City Peaking	Mankato, Minn.	1970	64	84	2.2
Hydro					
Wissota	Chippewa Falls, Wisc.	1917	36.4	36.4	1.1
Diesel					
Zumbrota	Zumbrota, Minn.	1967	10.96	10.96	0.3

Since the Applicant's system is summer peaking, the summer forecast is used to plan additions to the system. Reliance is placed on actual peaks for the past five years, with adjustments for deviations from normal weather conditions and consideration of the current status of large customers. The annual growth rates for summer demand now in use by the Applicant for planning purposes are 9%/year through the summer of 1973, reducing thereafter by 1/4%/year to a constant level of 7%/year for 1981 and beyond. This reduced rate reflects the anticipated ultimate saturation of the demand for air conditioning.

Kilowatt-hour sales of electricity to retail customers in 1970 were 8.7% higher than in 1969, but for 1971 the increase was only 4.6%. This lower than usual increase was attributed to abnormal weather and business conditions during 1971. These figures do contain a hint that the growth rate may be subsiding from its high value during the past decade. They may also reflect public response to a public-relations effort by the Applicant to discourage superfluous uses of electricity and to reduce the daily and seasonal variations in the demands. The Applicant discontinued promotional advertising and other promotional activities on June 1, 1970.[6]

Table X-3 shows the demand on the Applicant's system during summer (s) and winter (w) through 1977. The owned capability and net purchases over this period are also shown. The reserve margin is calculated from these, in both MWe and %. The table assumes that Prairie Island Unit No. 1 will be available for full-power operation late in 1973 and Unit No. 2 about one year later.

C. RESERVE MARGIN

Surplus capability is required to allow for scheduled shutdown of individual plants for routine maintenance and to provide some backup during unscheduled outages. As shown in Table X-3, the system's reserve margin will fluctuate markedly during the next several years. The Applicant is a member of an association of power suppliers termed the Upper Mississippi Valley Power Pool. This pool promotes cooperation among its members to increase the reliability of service within the territory served by each. Members of this pool, the Iowa Pool, and other utilities, totaling 25, have executed a Mid-Continent Area Reliability Coordination Agreement (MARCA). The members have agreed on the goal of maintaining, for mutual assistance in times of emergencies, an individual reserve of 12% through 1973 and 15% thereafter. The Applicant is also a part of a larger planning group, the Mid-Continent Area Power Planners (MAPP). The primary purpose of MAPP is to provide for transmission of electricity throughout the mid-continent region to meet emergency power needs. MAPP has 54 members in 10 midwestern states and the province of Manitoba. It works closely

TABLE X-3 Applicant's Capability-Demand-Reserve Data for 1971 through 1977 (in MWe)

	Owned Capability	Net Purchases	Adjusted Capability	Demand	Margin	% Reserve
1971						
w	3337	86	3423	2979	444	14.9
1972						
s	3639	480	4119	3678	441	12.0
w	3635	47	3682	3222	460	14.3
1973						
s	3595	221	3816	3982	-166	-4.2
w	4188 (a)	24	4212	3458	754	21.8
1974						
s	4308	50	4358	4330	28	0.7
w	4968 (b)	53	5021	3712	1309	35.2
1975						
s	4838	195	5033	4698	335	7.1
w	4968	-5	4963	3985	978	24.6
1976						
s	5518	95	5613	5086	527	10.3
w	5648	-6	5642	4277	1365	32.0
1977						
s	6198	94	6292	5493	799	14.5
w	6328	-6	6322	4591	1731	37.6

(a) PI#1 available

(b) PI#2 available

with similar regional planning groups to the east and southwest and with the U. S. Bureau of Reclamation hydroelectric system to the west. These cooperative arrangements have proven useful in the past to alleviate or eliminate localized power shortages. However, contiguous systems are experiencing and expecting power shortages of their own because of slippage in construction of new units and reduced operating levels in existing units because of air-quality requirements.

Table X-4 identifies the changes (additions, retirements, and derating) on which the owned capability in Table X-3 is based. It also includes additional peaking units and a new hydro plant proposed but not as yet approved. These proposed additions reflect concern that the authorized additions to the system may prove inadequate in meeting the expected demand and that other utilities would be unable to provide emergency assistance.

Table X-5 gives the reserve margins in the period from 1973 to 1977 for a variety of conditions. The first two columns represent the situation displayed in Table X-3 on the basis of firm plans to date but with the Prairie Island units assumed to be unavailable. The next column gives the cumulative increase in capacity resulting from additions and purchases under consideration. The final columns present the margins with this augmented capability. There the reserve margins are given for the Prairie Island units both unavailable and available. With the Prairie Island units available, the reserve margin would be inadequate only for a single season beyond the summer of 1973. This is in contrast with a margin always less than that required by MARCA and often negative without the Prairie Island units and the supplemental capability. Even with the supplemental capability, but without the Prairie Island units, the system's reserve is marginal in the winter and usually negative for the summer peaks.

The data of Table X-5 demonstrate a potentially difficult situation for the Applicant's customers if the Prairie Island units are delayed beyond their scheduled startup dates, even with the addition of peaking units and a hydro plant not as yet authorized. Furthermore, the projections in Table X-5 make no allowance for delayed startup of either the peaking units and fossil units now authorized or those under consideration.

TABLE X-4 Firm and Considered Changes in the Applicant's System

Unit	Location	Type	MWe Rating s - w	Status	Date
Inver Hills	Inver Grove Hts., Mn.	Gas Turbine	313-391	Committed	5- 1-72
13 Small Units	Mn. and S. Dakota	Fossil	41-87	Retire/Derate	12-31-72
Prairie Island #1	Red Wing, Mn.	Nuclear	530-550	Committed	9- 1-73
Riverside #7	Minneapolis, Mn.	Fossil	65-66	Retire	5- 1-73
Winona #3	Winona, Mn.	Fossil	6-6	Derate	5- 1-73
4 Small Units	Wisc. and S. Dakota	Fossil	4-13	Retire/Derate	12-31-73
Peaking	Wisconsin	Gas Turbine	329-414	Proposed (a)	5-31-73
Prairie Island #2	Red Wing, Mn.	Nuclear	530-550	Committed	9- 1-74
Blue Lake	Eagle Creek, Mn.	Gas Turbine	187-230	Committed	5- 1-74
Peaking	Wisconsin	Gas Turbine	136-176	Proposed (a)	5-31-74
Cornell	Wisconsin	Hydro	30-30	Proposed (a)	5-31-75
Sherburne Co. #1	Becker, Mn.	Fossil	680-680	Committed	5- 1-76
Sherburne Co. #2	Becker, Mn.	Fossil	680-680	Committed	5- 1-77

(a) Submitted to Applicant's Board of Directors for Approval.

TABLE X-5 Reserve Margins for Altered Conditions, 1973-7

	Planned (Table X-3), Without Prairie Island Margin, MWe	Reserve, %	Projected Additions, Retirements and Purchases, MWe (Cumulative)	Projected System: Without Prairie Island Margin (MWe)	% Reserve	With Prairie Island Margin (MWe)	% Reserve
1973							
s	-166	-4.2	549	383	9.6	(a)	(a)
w	204	5.9	470	674	19.5	1224	35.4
1974							
s	-502	-11.6	393	-109	-2.5	421	9.7
w	209	5.6	490	699	18.9	1799	47.5
1975							
s	-725	-15.4	423	-302	-6.4	758	16.2
w	-122	-3.1	520	398	10.0	1498	37.6
1976							
s	-533	-10.5	423	-110	-2.2	950	18.7
w	265	6.2	341	606	14.1	1706	39.8
1977							
s	-261	-4.8	207	-54	-1.0	1006	18.4
w	631	13.7	341	972	21.2	2072	45.1

(a) Prairie Island not available.
s = summer peak, w = winter peak

XI. ALTERNATIVES TO THE PROPOSED ACTION AND COST-BENEFIT ANALYSIS OF THEIR ENVIRONMENTAL EFFECTS

A. ALTERNATIVES

1. Basis for Consideration of Alternatives

The alternatives discussed in this section serve to illustrate the considerations for minimizing environmental impact that entered into selection of the site and the design features of the Prairie Island Plant. Such considerations involve basic policies established by law and precedent, the range of available options, criteria for assessment of alternatives, and a factual comparison of significant alternatives. Sections XI.A.2, .3, and .4 review alternative energy sources and sites. The need for additional power, which was treated separately in Chapter X, is assumed here. Thus the alternative of abandoning the Plant without any substitute is not considered further here. Site selection was briefly discussed in Section I.A.. Major plant-design features are considered in Sections XI.A.5, .6, and .7. The environmental and economic balancing of benefits and costs in terms of selected major alternatives is discussed in Section XI.B.

It is well known that the public's concern regarding the environmental impact of power plants has increased since the construction of this Plant was initiated. The Minnesota Environmental Control Citizens Association (MECCA) brought action to enjoin further development of this Plant because of the alleged failure of the USAEC to follow the requirements of the National Environmental Policy Act. In a memorandum and order issued July 28, 1972, by the Honorable Miles W. Lord, Judge of the United States District Court for the District of Minnesota and included in this statement as Appendix B, the USAEC was directed to "consider all environmental options that existed just after January 1, 1970, in addition to the options now available that are under review." Thus, it is necessary here not only to consider the Plant in its current state but also to take a retrospective view. For this purpose, information appropriate to conditions at the time that the National Environmental Policy Act (NEPA) of 1969 became effective is included. This will provide a reference framework for understanding the several changes which have been made in the Plant design since that time, in order to reduce the adverse consequences to the environment.

In accordance with the above requirement, two reference dates have been adopted: January 1, 1970, the effective date of the National Environmental Policy Act, and June 30, 1973, a time between the scheduled dates for publication of the Final Environmental Statement and commercial operation of Unit 1.

Here attention is focused on the consequences of past decisions in terms of environmental impact, and on examination of past and present options which might serve to reduce the impact.

Three alternative sources of power are considered in this section:

1. The purchase of power from other companies.

2. The construction of a nuclear generating plant at a different site.

3. The construction of a nonnuclear plant at the Prairie Island site.

Full acceptance of any one of these alternatives would imply that the proposed plant should be abandoned. A decision to abandon the Plant would imply that the loss of monetary and environmental costs already incurred is fully acceptable as part of the consequences of selecting an alternative source of power.

2. Purchase of Power

The consideration of power alternatives is based on the need for power demonstrated in Chapter X. The Applicant's projected need for power (Table X-3) shows peak-demand increases of 300 to 400 MWe each year through 1977. In order to reliably meet increasing energy demand in its service area, the Applicant is committed to the construction of both new base-load and peaking plants, as described in Chapter X.

The balancing of peaking and base-load units depends on load variation; an indication of seasonal variation of maximum demand is given by the Applicant's experience in 1971, as described in Section X.A. There was a 28% difference in maximum demand between September 1971 and April 1971. There was a 10% higher maximum demand in summer than winter. With such a pattern, modern, large economical base-load units could be expected to be combined with a substantial number of peaking units. Existing peaking units constituted about 9% of the system's capacity at the beginning of 1972 (see Table X-1); with the new peaking units, including those proposed (see Table X-4), the total fraction of the system's 1974 capability in peaking units will be about 30%. The schedule of additional base-load plants is shown in Table XI-1.

Plans for meeting the Applicant's projected demand include net purchases of 94 to 221 MWe for the summer peaks, in addition to the power to be obtained from Prairie Island Units 1 and 2, and from 652 MWe of new peaking units. In 1976 and 1977, Units 1 and 2 of the new coal-fired Sherburne plant, now under construction, will add a capability of 680 MWe each. According to this planning schedule, the system would have less than zero reserve generating capacity without Prairie Island (see Table X-5). Maintenance of reserves is a requirement of the Applicant's participation in its power pool. The Applicant is a member of several regional reliability groups, namely the Upper Mississippi Valley Power Pool (UMVPP), The Mid-America Interpool Network (MAIN), and the Mid-Continent Area Power Planners (MAPP), which has established the Mid-Continent Area Reliability Coordination Agreement (MARCA). Other participants in these groups are facing similar shortages of power[1,2,25] and need to augment generating capacity, as does the Applicant.

Table XI-1. Base-Load Plant Additions to the Applicant's Generating Capacity

First year of Service	Energy Source	Name / Net Summer Capability
1968	Coal	Allen S. King / 560 MWe
1971	Nuclear	Monticello / 548 MWe
1973	Nuclear	Prairie Island (#1) / 530 MWe
1974	Nuclear	Prairie Island (#2) / 530 MWe
1976	Coal	Sherburne (#1) / 680 MWe
1977	Coal	Sherburne (#2) / 680 MWe

The purchase of power by the Applicant from other power companies would be an available and acceptable alternative to completion and operation of the Prairie Island units if (1) sufficiently firm long-term commitments for power could be achieved to allow adequate system reliability, and (2) the vendor companies would have no need to construct additional generating plants, since such construction would merely transfer environmental impacts to other localities.

The Applicant's pool, the UMVPP, has an increasing power demand, requiring the purchase of large amounts of power and requiring substantial amounts of new power generating capacity to be built in the coming years.[1] This Pool, therefore, does not represent a source of power for purchase by the Applicant which would not require construction of additional generating plants.

The major producers of power within the mid-Continent region are members of MAIN and MAPP-MARCA, fact-gathering and coordinating organizations. MARCA and MAIN members as a group face a continuing need for additional generating capacity[1,2] comparable to that faced by the Applicant and the UMVPP. The projected annual peakload increases exceed 6.5 percent for both MAIN and MARCA. The conclusion is that, if the expected generating capacity of the Prairie Island units were replaced by purchases from other power companies within the MARCA or MAIN regions, the consequence would be either augmented construction elsewhere or delayed retirement of obsolete coal-fired plants within the region. Since, on the basis of the small environmental impact of the Plant (as described in this Statement), either consequence is likely to be no more acceptable than that expected from Prairie Island, we conclude that the purchase of power within the MAPP and MARCA regions is not a favorable alternative to the completion and operation of Prairie Island.

The Manitoba Hydroelectric Board, although not yet connected with the U. S. systems, is a member of MAPP and has been considered as an additional future source of power. According to the Applicant, Manitoba Hydro has the potential for developing over 6000 MWe on the Nelson River and proposes to install 1000 MW of generation by 1975 at Kettle Rapids. A purchase from this possible source would entail the cost of building two new high voltage transmission lines of about 500-mile length. In addition, Manitoba Hydro would have to advance the scheduling of future hydroelectric generating plants. Based on forecasts of system growth, Manitoba Hydro will completely utilize the Nelson River development by 1997 and is unwilling to commit to long-term power sales.[8] The Staff concludes that the costs and uncertainties make this alternative unattractive at the present time.

In general, purchase is not a practical long-term alternative to generation because of (a) generally increasing demand, (b) power losses and reliability reductions in long transmission lines, and (c) inability to avoid environmental impact merely by shifting the impact from one locale to another. Specifically, the Staff concludes that the provision of power by purchase rather than by constructing a Plant the size of Prairie Island was not practical in 1970 nor is it in 1973.

3. Alternative Sites

The territory of the Applicant includes 40,000 sq miles and nearly three million persons. While the Applicant serves a large expanse of rural area in Minnesota, Wisconsin, North Dakota, and South Dakota, approximately 62% of its electric revenue in 1971 came from the Minneapolis-St. Paul metropolitan area.[3]

Because of the central location of the Twin Cities in the Applicant's system and because of the high fraction of the Applicant's production of energy consumed within that metropolitan area, the location of generating plants near the Twin Cities is advantageous. The construction cost of transmission lines for a major plant is of the order of $200,000 per mile; thus, a site 100 miles away would require an investment of the order of $20 million.[4] Power losses and maintenance would entail additional costs.

The selection of a river site more remote from the population center would have the effect of converting wilderness areas to industrial use. Expressions of public interest in preserving natural wildlife areas have led the Applicant to transfer some of its extensive land holdings in Minnesota and Wisconsin to governmental agencies.[5]

Minnesota has more than 10,000 lakes, a number of which might be adequate for cooling a plant the size of Prairie Island. As discussed below, in Section XI.A.5 on cooling alternatives, a cooling lake would need a surface of at least 2.5 sq miles and an assured, year-round water supply of about 15,000 gpm. Those lakes within 100 miles of the Twin Cities have well-established residential and recreational uses and would not likely be available.

Dry cooling towers, by drastically reducing the water requirement, would allow a wider selection of sites. However, as discussed below in Section XI.A.5, dry cooling towers are not attractive for utility application in the present state of the art because of higher cost associated with available plant components, especially turbines.[4,21] Their eventual availability will alter the range of site selection, but only after further development and probably at a substantial increase in investment and operating costs compared to water-cooled units. Energy consumption for dry cooling towers is also higher.

In general, plant requirements are derived from basic system requirements for the provision of power, namely (a) provision of reliable service to meet demand in the Applicant's area, (b) adequacy of existing and future generation and transmission facilities, (c) arrangements with power pools and reliability groups, and (d) average costs. These requirements, of course, are to be made subject to environmental restrictions when considering the site. Site-specific requirements include (a) existing load distribution and transmission lines, (b) water supply for cooling, (c) population distribution, (d) land zoning and availability, (e) suitable land features for construction, for transmission and for accommodating region. The Mississippi River, the St. Croix River, and the Minnesota River have their confluences there, and a network of transmission lines exists around the Twin Cities.

The Applicant has listed[8] the following points which are used in comparing prospective river sites:

1. Area of potential site above and below flood stage for that site.

2. Ground contours and elevations.

3. Proximity to existing or planned transmission facilities.

4. Proximity to load centers and growth projections.

5. Distance to rail lines.

6. Distance to barge channel if on a navigable waterway.

7. Probable foundation conditions.

8. Probable zoning problems.

9. Land costs.

In addition, when a decision is made to consider a particular site for a nuclear generating plant, the Applicant asks consultants to determine the adequacy of the site with respect to the following points:

1. Geology.

2. Frequency and level of river flooding.

3. Population pattern within a 50-mile radius of the proposed site.

4. Hydrology.

5. Soil suitability.

6. Seismology.

7. Meteorology.

8. Water consumption.

Early in 1970, the Applicant's site selection procedure was changed. The previous method of closed executive sessions within the company was replaced with a special Plant Siting Task Force formed for the purpose of bringing the public into these deliberations at an early phase.[6] In the case of the first plant to be built after Prairie Island, the Applicant followed the siting recommendations of this Task Force[6] for what is now called the Sherburne Plant, a coal-fueled, base-load plant expected to be in operation in 1976.

In the period from 1967 to date, to our knowledge six sites have been considered by the Applicant for new base-load plants.[7,8,9,10,22] The six sites, with their approximate direct-line-distances from Minneapolis, are as follows:

1. Bayport site, on the St. Croix River, 25 miles east. (This is the location of the Allen S. King coal-fueled plant.)

2. Monticello Site, on the Mississippi River, 35 miles northwest.

3. Prairie Island, on the Mississippi River 43 miles southeast.

4. Carver Rapids, on the Minnesota River, 25 miles southwest.

5. River Lake, connected to the Mississippi, at Inver Hills, 17 miles southeast.

6. Becker Site in Sherburne County on the Mississippi River, 43 miles northwest. (This is the site of the Sherburne coal-fueled plant now under construction.)

We assume that the above sites were considered as large, multi-unit, expandable sites, spatially distributed around the Minneapolis-St. Paul urban region. The use of several peripheral sites allows short transmission line distances, while avoiding the excessive vulnerability to accidents that would exist for only one or two very large stations with massed transmission lines. The Prairie Island site was selected as very favorable for a nuclear plant after the Monticello site was chosen.

Other sites were considered less favorable for various reasons. River Lake, although given early consideration, was found to have a topography and water supply less favorable for a nuclear plant than Prairie Island. Bayport was rejected for a nuclear plant because of its proximity to of the post-Prairie Island coal-fired plant in Sherburne County. The Becker site, a few miles upstream from Monticello, was chosen for the Sherburne Plant because of more favorable ground conditions available there than the site considered across the river from the Monticello site. (It may be noted that of the two coal-fired plants, King was earlier and designed for Illinois and Kentucky coal, and Sherburne was designed for low-sulfur Montana coal. This change is due to more stringent restrictions on air pollution from coal-fueled plants, as discussed in the following section.)

In the Applicant's view, it was not necessary to consider a larger number of sites for its current expansion program, because the above sites met the criteria with respect to load, population, transmission lines, water supply, environmental impact, and transportation. From 1967 to date, these sites were considered adequate for several future plants with generating capacity up to a total of perhaps 10,000 MWe. Those sites selected for construction have been assessed for environmental impact and are subject to continuing monitoring programs.

The location of the Prairie Island Nuclear Plant on the Mississippi (Pool 3), downstream from the main population and industrial area of the Twin Cities, provides a water source that is of relatively large water flow and of less importance in terms of natural wildlife than some other stretches of the river. Pool 3 is a "recovery zone" of the Mississippi, below the point of receiving the sanitary and industrial pollution load of the Twin Cities (i.e., Pool 2) and above Pool 4, where there is an important sport fishery. The terrestrial and aquatic impacts expected from the construction and operation of the Plant at the Prairie Island site are very small, as discussed in Chapters IV and V. The Staff believes it likely that the Prairie Island site is a close approximation to the hypothetical best site which might be found by a more extended investigation of possible sites in the Applicant's territory. Further, in January 1970 the basis of site selection from the standpoint of environmental impact was no different than it is in January 1973.

4. Alternative Means of Power Generation

Potential hydroelectric capacity approaching 1100 MWe does not exist within the Applicant's service area. Natural gas is not available in the area in adequate quantity for large generating stations. For base-load (24 hours per day) operation, fuel costs for an oil-fueled steam plant would be about double those for a coal-fueled plant. Also, it is likely that oil will be in short supply over much of the expected life of the Plant. Thus, oil is not a viable alternative. The remaining commercially practicable alternative to the proposed nuclear steam-turbine plant is a coal-fueled steam-turbine plant.

Because of higher thermodynamic efficiency and because some of the heat passes up the stack with other combustion products, fossil-fuel plants release only about 65 percent as much waste heat to the plant condenser cooling water as do nuclear plants of the same electrical output. Also, although the release of radioactivity from current nuclear plants leads only to minor increments to the natural radiation levels, coal-fired plants release even less and oil-fired plants release virtually none.

Coal-fired plants, however, produce combustion products including dust, sulfur dioxide, and oxides of nitrogen in substantial amounts and these are a significant source of air pollution. The comparative environmental impacts expected for the reference Plant and for a coal-fired plant of the same generating capacity are given in Table XI-2. Combustion products are estimated assuming that the coal--fired plant just meets the Environmental Protection Agency standards for new plants.[11]

In 1967, the Applicant decided to construct a nuclear generating plant at the Prairie Island site on the basis of favorable economics and concern for atmospheric pollution. At that time, the state of the art for removal of sulfur oxides and other gaseous emissions was such that abatement of these emissions to meet emerging air-pollution control standards made fossil-fueled plants less advantageous. Although the Prairie Island Plant has a larger thermal effluent than a modern fossil-fueled plant would have, the use of a closed-cycle heat-dissipation system (mechanical-draft cooling towers) reduces the importance of this difference between nuclear and coal-fired plants in terms of environmental impact.

Because of the comparatively large volumes of fuel that must be handled in a coal-fired plant, the aesthetic factors are disadvantageous for coal, namely, transportation vehicles or barges, coal stockpiles at the site, and ash handling. When the closed-cycle cooling-tower system of the Plant is in operation, no more than 38 cfs of river water will be evaporated; otherwise, the smaller Plant size, the minimal effluents, and the low mass of fuel consumed in the nuclear Plant have aesthetic and ecological advantages over the coal alternative.

Because alternatives are to be considered with respect to the stages of plant construction, from January 1, 1970 to full operation, reference time schedules are presented in Tables XI-3 and XI-4. In Table XI-3, the time table of design authorization is given; in Table XI-4, the schedule of investment and construction status is given. Cost comparisons of the proposed nuclear Plant and an equivalent coal

TABLE XI-2. Comparative Environmental Impacts for Reference and Coal-Fired Plants

Category	Reference: Two 550-MWe Nuclear Units	Two 550-MWe Coal-Fired Units with Cooling Towers
Land use:		
Plant (including cooling towers)	60 acres	Similar to reference
Fuel storage	minor	20 acres
Total plant	60 acres (without exclusion area)	80 acres
Total heat discharged	150×10^9 Btu/day	110×10^9 Btu/day
Releases to air;[a]		
Radioactivity	11 curies/day	small
Dust	none	9 tons/day
Sulphur dioxide	none	110 tons/day
Nitrogen oxides	none	60 tons/day
Water evaporated	15 million gal/day	10 million gal/day
Releases to water:		
Radioactivity		
Tritium	7 curies/day	none
Other	0.04 curies/day	none
Chemical		
Chlorine[b]	3 lb/day	2 lb/day
Salts	950 lb/day	300 lb/day[c]
Fuel		
Consumed	24 tons/year	3 million tons/year
Transported	10 truckloads/year	440 trainloads/year
Wastes	~15 truckloads/year	320,000 tons/year
Aesthetic	Inoffensive	Similar to reference except for 20-acre coal pile, 500-ft stacks

[a] Assumes 80% load factor.

[b] Assumes 0.1 mg/liter residual chlorine in blowdown.

[c] Does not include discharge of ash-sluicing effluent.

TABLE XI-3. Schedule of Design Authorizations[8]

Date	
1966	Engineering studies
1967	Unit 1 authorized by NSP in January; Unit 2 in June.
September 1969	26-cell cooling tower, helper cycle agreed to in MPCA hearing.
January 1970	Tempering scheme provisionally adopted, with concurrence of MPCA, to meet new State thermal standards. (Further studies by NSP and MPCA showed this approach inadequate).
1970	NSP modification of liquid radwaste to provide increased versatility and water recycle.
May 1971	Permit granted by MPCA for flexible closed-cycle/open-cycle system, with NSP commitment for maximum practicable closed-cycle operation.
May 1971	NSP adopted the "augmented" gaseous radwaste treatment system announced by Westinghouse early in 1971.

TABLE XI-4. Schedule of Investment and Progress Toward Completion[8]

Date	Investment (10^6 \$)	Percent Completion Unit 1	Percent Completion Unit 2
Jan. 1970	140[a]	15%	2%
Oct. 1, 1971	185	74%	18%
June 1, 1972	242	83%	25%
Jan. 1, 1973	302	90%[b]	36%[b]
Jan. 1, 1974	350	∿100%	∿60%
Jan. 1, 1975	∿370	100%	∿100%

[a]The Applicant estimates that \$80 million had been irretrievably spent at this date.[22]

[b]Interpolated.

plant at the same site were made for the present stage of construction and for January 1, 1970. These are described below.

If a decision were to be made in the near future, e.g., June 30, 1973, to abandon the nuclear Plant and build a coal plant at the same site, about 90 percent of the total cost of construction of the nuclear plant would have been incurred. This includes interest during construction, but not core costs nor associated transmission cost. The amount of salvage that could be obtained from an abandoned plant is not easy to determine. Because of differences in equipment and in site utilization between a nuclear and a coal plant, direct conversion will not be feasible. In addition, re-sale or retention for later use is subject to penalties for obsolescence. Salvage values were estimated from data supplied by the Applicant[22] and from discussions presented at the Trojan Nuclear Power Plant hearings.[23]

In order to assess the comparative costs of completing the reference plant or constructing the alternative coal-fired plant, all costs are referred to June 30, 1974 for present-worth analysis. This is near the time when the Plant is scheduled for completion. Additional costs that would be incurred after an assumed decision date of June 30, 1973, are labeled incremental costs in Table XI-5. The cost comparison is the sum of the present-worth incremental costs of the lifetime operation in the two cases.

Since the alternative (coal) plant could not be operational for six years,[9] or until about June 30, 1979, the cost of providing power for about four or more years from other sources should be charged against this alternative, since Units 1 and 2 are expected to be operational in 1973 and 1974, respectively. A charge of 8.3 mills per kilowatt hour is used for this interim power, based on the Applicant's estimate of total cost of providing power in event of a delay in Prairie Island operation,[8] but it does not include certain administrative costs of program change.

However, the postulated combination of four years' purchase and 30 years plant life provides power for the 34 years, and credit is given for sale of power for four years after 30 years of the reference Plant life; this net present worth allowance for loss of generation is entered in Table XI-5.

The estimated economic costs associated with the reference plant and with an alternative coal-fueled plant of the same capacity are presented in Table XI-5. Capital costs of coal-fueled plant are estimated at \$240 per kWe and coal fuel costs at \$0.46 per 10^6 Btu. In order to achieve

TABLE XI-5. Comparative Economic Costs for Reference and Alternative Plants (in Millions of Dollars): Decision Date June 30, 1973

	1090 MWe Reference (Nuclear) Plant-First Operation June 30, 1974		1090 MWe Coal-Fueled Plant-First Operation June 30, 1979	
Construction Cost:				
Total Cost	$370		$260	
Sunk Cost	330		0	
Incremental Cost	40		260	
Salvage Allowance	0		-80[a]	
Net Incremental Cost	40		180	
Present Worth of Net Incremental Cost		$40		$118
Allowance for Loss of Power, PW		-		186
Annual Operating Cost:				
Fuel	13.0		30.0	
Other	5.4		3.7	
Total	18.4		33.7	
Present Worth of Capitalized Operating Cost		193		239
Decommissioning Allowance	16		0	
Present Worth		1.3		0
Present Worth of Incremental Life-of-Plant Cost		234		543
Annualized Equivalent of Life-of-Plant Cost Incremental		22.2		51.6

Note: Assumed decision date for abandonment of nuclear plant in favor of coal plant is June 30, 1973. Present worth date is June 30, 1974.

[a]Salvage allowance assumed on basis of discussion of Trojan Nuclear Plant[23]

comparability among costs which would be incurred at different times, all costs are reduced to present worth on June 30, 1974. The present worth of a future payment is equal to the sum which, drawing interest from the given (present) time at a stated interest rate, would just suffice to meet the payment when due at the future time. The discount rate used by the Staff is 8.75 percent, which is representative of the overall before-Federal-income-tax rate required for payment of interest on bonds and stock dividends by investor-owned power companies. This rate is not necessarily the same as the Applicant's. Estimated construction costs for the reference Plant are those provided by the Applicant. These figures include interest during construction and no present-worth adjustment need be made. To compute the present worth of the payments for fuel and other operating costs made during the entire Plant lifetime, a Plant life of 30 years is postulated for this analysis.

The estimated coal-plant and fuel costs used in Table XI-5 appear reasonable in relation to estimates published by the Federal Power Commission[12] when inflation and the rapid increase in minehead coal prices during recent years are taken into account. The coal plant capital and fuel costs are believed to be appropriate for this part of the country.[13] The nuclear capital costs are those furnished by the Applicant; in the absence of nuclear fuel costs from the Applicant, costs were estimated on the basis of those reported for a contemporary plant of about the same size in the same section of the country.[24]

The data in Table XI-5 show incremental costs, present-worth and annualized, would be more than doubled by abandoning the nuclear Plant at this stage and building a coal plant at the same site.

The coal-fueled plant would discharge less heat to the Mississippi River and less radioactivity to the atmosphere than the reference Plant. However, as assessed in Chapter V, the impacts of these discharges are very small for the reference Plant. The Staff judges their effect to be clearly outweighed by the air pollution intrinsic to the coal-fired plant and therefore considers the reference Plant to be, on balance, the better with respect to environmental impact. Considering the loss of reliability to the UMVPP during the four-year delay and the large economic penalty to the Applicant, which is ultimately paid by the public, there is no doubt that the reference Plant is the preferred alternative.

A similar economic analysis, summarized in Table XI-6, was carried out for the coal-fired alternative, but for a decision date of January 1, 1970. At that time about $80 million of "sunk" (irretrievable) costs had accrued for the Prairie Island Nuclear Plant, although there were

TABLE XI-6. Comparative Economic Costs for Reference and Alternative Plants (in Millions of Dollars): Decision Date January 1, 1970

	1090 MWe Reference (Nuclear) Plant; First Operation June 30, 1974		1090 MWe Coal-Fueled Plant; First Operation June 30, 1976	
Construction Cost:				
Total Cost	$370		$260	
Sunk Cost	140		0	
Incremental Cost	230		260	
Salvage Allowance	0		-60[a]	
Net Incremental Cost	230		200	
Present Worth of Net Incremental Cost		$230		$170
Allowance for Loss of Power		–		95
Annual Operating Cost:				
Fuel	13.0		30.0	
Other	5.4		3.7	
Total	18.4		33.7	
Present Worth of Capitalized Operating Cost		193		29.0
Decommissioning Allowance	16		0	
Present Worth		1.3		0
Present Worth of Incremental Life-of-Plant Cost		424		503
Present Worth of Total Life-of-Plant Cost		564		605
Annualized Equivalent of Life-of-Plant Cost				
Incremental		40.3		47.4
Total		53.6		57.5

Note: Decision date for abandonment of nuclear Plant in favor of coal plant is January 1, 1970. Present worth date is June 30, 1974.

[a]Applicant's estimate[22] of salvage allowance for the nuclear Plant.

other commitments. However, it was assumed in this analysis that these additional commitments could be converted to a fossil plant and that also \$5 million of salvage was obtainable from the sunk cost. With this time schedule, purchase of power for two years was assumed necessary to offset the lost output of the Prairie Island Nuclear Plant. Under the cost assumptions made, the coal alternative showed a present worth incremental cost penalty of about \$80 million. This penalty is 21% of the total Prairie Island construction cost. The 1970 decision case entails a smaller penalty than for the 1973 case, since the sunk costs of the Prairie Island Nuclear Plant were much lower at the earlier time.

In January 1970, the proposed EPA standards for stack emissions from coal-fueled plants had not been issued, although they were anticipated. The emissions from a coal plant equivalent in size to the Prairie Island Plant and designed to pre 1970 emission standards were estimated by the Applicant[8] to be as follows:

dust	88 tons/day;
SO_2	395 tons day;
NO_x	166 tons/day.

These emissions are several fold higher than the limits adopted by EPA in 1971 (see Table XI-2). Thus, from an environmental standpoint a coal-fueled plant based on the earlier standards would have a greater environmental impact than a coal-fueled plant built after 1971.

An indication of changes in capital costs for nuclear and coal plants in this time period is given by the compilation of engineering estimates summarized in Table XI-7.[14] Plants have experienced increasing costs for additional equipment related to control of air and water pollution. For 1972 plants in the 800-1100 MWe range, such additions can add \$25 million to nuclear plants and \$50 million to fossil plants. These figures are for typical sites without "extreme problems."[14]

An example of the increase in coal fuel costs is provided by the statement of an Iowa utility which elected to build a 550 MWe nuclear rather than a coal plant; fuel costs of 29.4¢ per million Btu in 1967 increased to 42¢ in 1973 and are estimated to reach 55¢ in 1974.[15]

Another report by a consultant in the field has indicated that early systems for removing SO_2 from coal gases cost \$10 to \$15/kW a few years ago. Future units are now being estimated in the range of \$30 to \$70/kW.[16]

The above instances of increasing costs of emission controls for coal--fueled units support the cost assumption made in Table XI-5 and the

TABLE XI-7. Changes in Capital Costs of Nuclear and Fossil-Fueled Generating Plants[14]

Capital Cost Ranges for 800 MWe Nuclear Generating Plants	1965-67	1970-71	1975	1980
Total Capital Cost				
Dollars - Million	100-110	200-240	240-320	320-400
Dollars - Per Kilowatt	125-140	250-300	300-400	400-500
Construction Labor Cost				
Percent of Construction Cost	20	30	30-40	35-50
Dollars - Millions	15-20	45-55	50-100	85-150
Dollars - Per Kilowatt	20-25	55-70	70-120	105-190

Capital Cost Ranges for 800 MWe Fossil Generating Plants	1965-67	1970-71	1975	1980
Total Capital Cost				
Dollars - Millions	70-100	145-190	175-240	260-320
Dollars - Per Kilowatt	85-125	180-240	220-300	325-400
Construction Labor Cost				
Percent of Construction Cost	25	30-35	30-45	35-55
Dollars - Millions	15-20	35-50	40-80	70-125
Dollars - Per Kilowatt	15-25	40-65	50-100	85-160

reasonableness of the decision made by the Applicant in 1967 to build a nuclear power plant.

An indication of the lower environmental impact of the proposed Plant, regardless of the economic issue, is provided by a compilation of air pollutant emission factors by the Environmental Protection Agency.[17] A summary of results of field measurements of the emissions from existing large coal-fired utility boilers is given in Table XI-8. These large effluents will be reduced by additional equipment required by present and future effluent standards, but they serve to indicate the potential environmental impact offered by large coal-fired plants.

On the basis of the above discussion relative to the selection of a coal-fueled alternative for the Plant, the Staff believes that the Applicant's choice of a nuclear plant for Prairie Island is supported by considerations of minimizing environmental impact as well as by economics. This applies to present conditions, to those which existed in early 1970, and to those in the intervening years.

5. Alternative Cooling Systems

Major alternative types of cooling systems for modern generating plants are:

a. Once-through cooling;

b. Evaporative closed-cycle cooling:

    1. Mechanical-draft towers

    2. Natural-draft towers

    3. Cooling lakes

    4. Spray canal;

c. Dry cooling towers.

All of these except dry cooling towers use water for cooling. Once-through cooling has generally the maximum overall impact on the water resources, but has the lowest evaporation rate and the least impact in regard to air and terrestrial effects.

TABLE XI-8. Emission from Bituminous Coal Combustion Without Control Equipment[17]

	Emission Factor, lb/ton of coal burned	Emissions, tons/day for 1090 MWe plant[c]
particulates (after cyclone removal)	16[a]	71.
sulfur oxides	19[b]	85.
carbon monoxide	1.0	4.5
nitrogen oxides	18.	80.
aldehydes	0.005	0.022

[a] factor for particulates is for 8% (wt) ash; proportional for coal of different ash content.

[b] factor for sulfur is for 0.5% (wt) sulfur content; proportional for coal of different sulfur content.

[c] for heating value of 10,000 Btu/lb, 80% plant availability factor and 40% conversion efficiency.

Cooling lakes must be of large size compared to other site-area requirements. For a plant the size of Prairie Island (two units), a lake surface of at least 2.5 sq miles is required and an assured continuous supply of water at a rate of at least 15,000 gpm is needed for evaporation and blowdown losses.[18,19] No natural lake in Minnesota has been proposed by the Applicant. The Applicant earlier had rejected River Lake for reasons of size and topography. Similar considerations[8] indicated a considerable impact for a cooling lake at the Prairie Island site. Based on the above considerations and in view of the relatively small environmental impact of evaporative cooling towers, the Staff does not consider a cooling lake preferable to cooling towers for Prairie Island.

A spray canal employs pumps to spray water into the air, thereby enhancing evaporation, and obtaining more cooling per unit of area than a cooling lake. A spray canal for a plant the size of Prairie Island would require about 200 four-spray modules and a canal length of nearly two miles. Although less land is required than for a cooling lake, this alternative uses electric power for the pumps, and is not nearly as compact as the cooling towers chosen for this Plant. Furthermore, under various atmospheric conditions, the performance of spray units is also not nearly so well known as for modern cooling towers. The spray canal shares with cooling towers certain difficulties for operation at low temperatures in winter.

Dry cooling towers require no consumptive use of water except the minor quantities used in filling and occasional external washing. However, dry cooling towers are physically larger than wet towers of the same cooling capacity, and their capital costs have been estimated to be about three times that of wet towers.[20] Dry towers also cause significant power loss from increased turbine back pressure. In a recent estimate, the increased cost and power loss would add about one mill per kWh to the bus-bar energy cost of a nuclear plant.[4] In the application of dry cooling towers to large nuclear plants, a number of modifications of the plant system, with uncertain costs, are to be expected.[4,21] Consideration of dry towers for the present Prairie Island Plant is not justifiable, in the opinion of the Staff.

The four most feasible cooling alternatives are once-through river-water cooling, mechanical-draft evaporative cooling towers, natural-draft evaporative cooling towers, and spray-canal cooling. The Applicant's comparison of costs for these are summarized in Table XI-9.

TABLE XI-9. Capitalized Cost for Various Cooling Alternatives, Relative to Once-Through Cooling[8]

	A[a] Mechanical-Draft, Wet Cooling Towers (Closed Cycle)	B Natural-Draft, Wet Cooling Towers (Closed Cycle)	C Once Through River Water Cooling (Open Cycle)	D Cooling Spray Canal (Closed Cycle)
Installation	∿$13,000,000	∿$20,000,000	Base	∿$16,000,000
Operating Cost	∿$18,155,000	∿$16,340,000		∿$19,970,000
Total:	∿$31,155,000	∿$36,340,000		∿$35,970,000

Note: Capitalized operating costs are based on an 8.75% annual interest rate over 30 years of Plant Operation.

[a]This system is the system being installed.

The effects of the effluent of forced-draft cooling towers are different from those of natural-draft towers, since the effluent from the latter is released at higher altitudes (400 ft vs. 80 ft) which reduces fogging and icing problems. Due to the relative isolation of the Plant site, however, fogging and icing are not significant problems even with the forced-draft cooling towers (see Section V.B.3). Forced-draft cooling towers are noisier than natural-draft towers and this noise will be noticeable to the few nearest neighbors. All cooling towers are subject to tornado damage, but reliability here is provided by low frequency of tornadoes at the Plant site, the flexibility of the cooling system which allows once-through cooling and reserves of power available on an emergency basis from power pools.

The Applicant selected mechanical-draft towers on the basis of lower capital cost, small size and visual impact, and operating capabilities better suited to conditions in this area and in the specific Plant location. The Staff concurs in this choice among the stated alternatives for the present Plant.

The reference cooling system for Prairie Island is a flexible one that allows closed-cycle operation or once-through operation with or without cooling towers. The cooling towers have reversible fans and are capable of cell-by-cell shutdown to facilitate low-temperature operation; nevertheless, operation of the towers may not be feasible under icing conditions. The question of operability of the cooling towers in winter is an uncertainty in assessing the environmental impact, since once-through cooling is required when the towers are inoperative.

The water intake and discharge structures are typical of designs used in power plants. The discharge of water to the river is tempered by natural water flow in the side channel of the river coming from Sturgeon Lake before the water enters the main channel of the river. The design of the warm water discharge system is one which evolved over several years in the course of negotiations with agencies of the State of Minnesota. The main steps in this evolution were indicated in Table XI-3. Certain changes in proposed dikes governing flow of water in the vicinity of the discharge have also been made.[8,22] The final reference system (as described in this Statement) appears to the Staff reasonably low in impact on the river. Any unforeseen effects of operation would be expected to be detected in the monitoring program, and further modifications could be made if the situation warrants it.

The design of the Plant changed in the time period from January 1970 to January 1973. The changes were all designed to reduce the environmental impact of the Plant. The cooling towers designed for Prairie Island, while not guaranteed operable for very cold weather, have features making them more capable of winter operation than earlier tower designs, such as those proposed for the Monticello Plant. Certain other cooling alternatives, spray-canal or dry cooling towers, are only beginning to be established in the state of the art, and hence were even less likely to be selected in January 1970 than in January 1973.

6. Chemical and Biocide Systems

The biocidal action of chlorine is used in cooling-water systems to prevent fouling of heat transfer surfaces by the formation of bacterial slimes; this practice is nearly universal. However, at Prairie Island a mechanical cleaning system is used for the main condenser, greatly reducing the amount of chlorine required and ultimately discharged.

The Amertap mechanical-cleaning system selected for cleaning the Plant's condensers has been used successfully in the Applicant's Allen S. King plant. The Applicant believes that the higher condenser efficiency possible with the cleaner heat-transfer tubes, as obtained with the Amertap system, provides an economic justification for the higher cost of the mechanical-cleaning system as compared with a chlorine-injection system.

The cooling towers used in the Plant have incorporated some new features that are expected to reduce the tendency for fouling by algal slimes. The "fill" of the new units is made of strips of perforated sheets of polyvinyl chloride (PVC), a plastic material. This provides a less adherent surface to which slimes might become attached. Also, the inlet-water "box" on the top of the tower has been enclosed at the top, thereby excluding sunlight and various extraneous materials. Thus, the conditions for algal growths are less favorable. For these reasons, these cooling towers are expected to require less of any chemical cleaning agent to maintain efficient operation than other cooling towers without the above features.

No changes were made in the Plant between January 1970 and January 1973 with respect to the chemical and biocide systems. As cited in the paragraphs above, the Plant has employed advanced features of the state-of-the-act for these systems. As discussed in Chapters III and V, the overall amount of chemicals discharged into the river is favorable compared to state-of-the-art alternatives and small compared to existing chemical loads in the river.

7. Alternative Radwaste Systems

Systems are provided in the Plant to restrict chemical and radiochemical emissions to the air and water to very low levels, in compliance with applicable State and Federal standards. These are well below the levels at which significant adverse effects are detectable, and the levels do not appreciably exceed those in the natural background. The performance of these systems and the impact of their effluents on the environment are described in Chapters III and V. As shown in Table XI-3, the liquid radwaste system was redesigned in 1970 and the gaseous radwaste system in 1971, to give improved performance. Because of the low impact of the proposed systems, the consideration of any other alternative systems at this time does not appear justifiable to the Staff. Nevertheless, monitoring of the Plant effluents and environs will be performed to assure that the levels of radioactivity released do not exceed acceptable levels. Superior systems were not available prior to January 1970.

8. Alternatives to Normal Transportation Procedures

Alternative transportation procedures, such as special routing of shipments, providing escorts in separate vehicles, adding shielding to the containers, and constructing a fuel recovery and fabrication plant on the site rather than shipping fuel to and from the Station, have been examined by the regulatory staff for the general case in an analysis in preparation. The impact on the environment of transportation under normal or postulated accident conditions is not considered to be sufficient to justify the additional effort required to implement any of the alternatives. The Staff reaches the same conclusion when considering the situation as of January 1, 1970.

9. Summary

The alternatives to certain key aspects in the as-built Plant are indicated in Table XI-10. The principal reason for rejections of these alternatives are indicated.

This Section XI.A has reviewed the principal alternatives for the provision of electric power in the Applicant's area and for the principal plant-design features. Evaluation of the proposed Prairie Island Nuclear Plant was made with respect to these alternatives, over the range of time from the first commitment of the Applicant to build Prairie Island (1967) to the early years of the proposed operation of this plant (1980). Specifically, comparisons were made at the effective date of the National Environmental Policy Act of 1969, namely January 1970, and the earliest probable date, June 1973, at which a firm decision could be arrived at to abandon the Prairie Island Plant in favor of an alternative power source. In this period of time, a notable increase in awareness of environmental issues has been apparent on the part of the Applicant, the public, the government, the courts, and the scientific community. Emission standards for both coal and nuclear plants have changed. Review and decision procedures in compliance with the National Environmental Policy Act of 1969 are evolving.[26]

TABLE XI-10 Summary of Reasons for Rejection of Alternatives

Action or Decision	Alternative	Reason for Rejection of Alternative
Policy Options:		
A. Meet increasing demand of users for electric power	Not meet increasing demand	Franchise requires meeting demand
B. Build new generating capacity for increased demand	Purchase additional power	Assured purchases not available
C. Build new baseload and peaking plants	Build new peaking plants only	Insufficient baseload generation; old plants are inefficient and inadequate
D. Build nuclear plant	Build fossil-fueled plant	Coal plant more costly for new emission standards; gas supply inadequate and too costly
E. Locate near load center in Twin Cities industrial area	Locate remote from population	Greater transmission cost; greater construction cost; loss of pristine natural area
Plant-Design Options:		
A. Mechanical-Draft closed cycle and once-through capability	Once-through only	Will not meet state standards; greater aquatic impact
	Natural-draft towers	More costly; more conspicuous
	Spray canal	Larger land area; costly due to technical questions of performance
	Cooling lake	Very large land area required; more costly
B. Mechanical condenser cleaning	Chlorination treatment of cooling water	Greater hazard to aquatic biota; not quite as thermally efficient as mechanical

TABLE XI-10 (Contd.)

Action or Decision	Alternative	Reason for Rejection of Alternative
Policy Options:		
C. Reference radwaste system	Additional processing steps and effluent dilution	No practical effect of reducing radioactivity further, relative to background levels and existing standards
Environmental and Radiological Monitoring:		
Program as defined	Expanded program	Present program is flexible; systematic publication of results and program review is intended (technical specifications will define the monitoring programs)

The evaluation outlined in this Chapter addressed the main environmental issues and made conclusions as a matter of practical judgment over the full range of concerns and with regard to changing environmental standards and to developing technology. The Staff notes that changes in the Plant, principally in respect to river use and thermal and radioactive effluents, have been made since January 1970, and that these constitute use of advanced technology and will reduce impacts on the environment. In general, the situation in January 1970 did not offer alternatives more favorable to protection of the environment than those currently available.

B. SUMMARY OF COST-BENEFIT ANALYSIS

The overall balance of benefits and costs, both environmental and economic, is considered here for the proposed Plant. This cost-benefit analysis is able to use quantitative measures of value to only a limited extent (based on available information and criteria) and has attempted to use reasonable standards of judgment that would be acceptable to most informed and concerned citizens. From information previously developed in this Statement, the costs are the minimized residuals of the unwanted and undesirable effects of the Plant on the environment that could not be avoided practically, and the benefits are the net advantageous features which the Plant offers as a trade-off against the costs. The elements of uncertainty and risk are believed to be controllable and progressively reducible under the conditions of proposed Plant operation, by the programs of continuing surveillance, study, and monitoring of environmental impact.

1. Costs

Although the prime purpose of the Plant is to furnish electric energy as required, the focus in this analysis is on environmental costs. Therefore, costs will be surveyed first and benefits will be cited in balance. In monetary terms, the total investment cost of the Plant is $370 million. The cost of abandoning the Plant in favor of an alternate means of providing the required power has been described in Section XI.A.4. Various environmental costs are considered below.

a. Land Use

The Plant occupies a 560-acre site which was largely under cultivation before its acquisition. Approximately 240 acres have been disturbed and modified by construction activities. About 60 acres will be occupied by Plant structures and related facilities. The before- and during-construction views of the site are shown in Figures 8 and 9 of the Applicant's Environmental Report.[23] The choice of a nuclear plant with mechanical-draft cooling has resulted in a smaller land-area requirement than for a coal-fired plant. In addition, the visual impact is less pronounced than for either a coal-fired plant or a nuclear plant with natural-draft cooling towers.

The selection of the Prairie Island site among alternatives was discussed in previous portions of this Statement. Other sites appeared to offer no net advantage and the Applicant preferred the present site for a combination of economic and other considerations.

The loss of the land used for the Plant site is not considered a significant adverse impact on the land use in the area.

b. Water Use

The Minnesota Pollution Control Agency permit of May 1971 requires operation of the cooling towers in the closed-cycle mode to the maximum degree practicable consistent with AEC staff evaluation of impact on the environment. The details of temperature limits on warm-water effluent were discussed in Section III.D.1. The minimal impact on water use by this mode of cooling is illustrated in a tabular comparison of (1) the alternative cooling methods in terms of monetary cost (Table XI-9), (2) the environmental impact of alternative cooling systems (Table XI-11), and (3) the environmental impact of alternative modes of water circulation (Table XI-12).[8]

In summary, the tables indicate that the effects of entrainment and thermal outfall are small compared to the fraction of river flow and the fraction of river habitat involved. Effects, except in the discharge channel itself, are within normal ranges of natural fluctuations. For interpreting thermal effects, note the normal ranges of temperature shown in Table II-18. Temperature fluctuations of greater than 20°F are observed for all except winter months. In addition, sizable daily temperature fluctuations are not uncommon in backwaters of the river.

Cooling-water flow rates in Table XI-11 are expressed as fractions of the average annual flow of 15,020 cfs. Monthly data on variations in river flow rates are given in Table II-17. The range of these variations does not change these conclusions.

TABLE XI-11: COMPARISON OF COOLING SYSTEMS BY ENVIRONMENTAL ATTRIBUTES [8]

Environmental Attribute	A* Mechanical Draft Wet Cooling Towers (Closed Cycle)	B Natural Draft Wet Cooling Towers (Closed Cycle)	C Once-Through River Water Cooling (Open Cycle)	D Cooling Spray Canal (Closed Cycle)
1. Effect on aquatic life by river water intake	Intake: ~188 cfs ~1.7% of normal river water flow is drawn into condenser causing 1.7% of fish, primary producers, primary consumers, fish larvae (ichthyoplankton), and other aquatic biota less than 3/8" in size that occur at the intake location to be destroyed or damaged. (1)	Same as A (1)	Intake: ~1370 cfs ~12.5% of normal river flow is drawn into condenser causing ~12.5% of fish larvae (ichthyoplankton), primary consumers, and other aquatic biota less than 3/8" in size that occur at the intake location to be destroyed or damaged. (The assumption that 100% of living things swept through the condenser will be destroyed or damaged is a worst case condition. Since no proof exists to substantiate this assumption, it is expected that the actual mortality damage rate is significantly less than 100%.) (4)	Intake: ~200 cfs ~1.8% of normal river flow is drawn into condenser causing ~1.8% of fish, primary producers, primary consumers, fish larvae (ichthyoplankton), and other aquatic biota less than 3/8" in size that occur at the intake location to be destroyed or damaged. (3)
2. Effect on aquatic life by coolant discharge and heat load	Coolant discharge: ~150 cfs Thermal discharge: ~3.6 x 10^8 BTU/hr ΔT over ambient river temperature: 5°F (Tempering may be required during summer months to meet 5°F discharge limit) Consequence: No significant effect on fish and aquatic biota; no significant effect on wildlife habitat; tendency for fish to linger in warmer discharge water when the discharge temperature is at their preferred range. (1)	Coolant discharge: ~150 cfs Thermal discharge: >"A" ΔT over ambient river temperature: 5°F (Tempering may be required greater than "A" to meet 5°F discharge limit) Consequence: Same as A except thermal discharge plume is larger than A. (2)	Coolant discharge: 1370 cfs Thermal discharge: 8.4 x 10^9 BTU/hr ΔT over ambient river temperature: 28°F Consequence: Tendency for attached algae to increase within the immediate discharge area and to decrease during the hot summer months. Surface blooms of phytoplankton will be uneffected. The increase in periphyton (attached algae) corresponds to the time when the warm water attracts fish. Therefore, the increase in periphyton is available to support the local increased fish population. Total plant shutdown could cause more fish to be killed than for A, B & D; however, the discharge location offers the fish great mobility to follow the thermal plume so that they can gradually adjust to the temperature change. During winter months, due to ice-free conditions, there will be more rapid reoxygenation of the water than for A, B & D. Thermal plume is larger than A, B & D. (4)	Coolant discharge: ~150 cfs Thermal discharge: >A & B ΔT over ambient river temperature: 5°F (Tempering may be required greater than A & B to meet 5°F discharge limit) Consequence: Same as A except thermal discharge plume is larger than A & B. (3)
3. Consumptive use of water by evaporation	~38 cfs (2)	~38 cfs (2)	~20 cfs (1)	~48 cfs (4)

* This system is the system being installed.

TABLE XI-11: COMPARISON OF COOLING SYSTEMS BY ENVIRONMENAL ATTRIBUTES (Cont's)[8]

Environmental Attribute	A* Mechanical Draft Wet Cooling Towers (Closed Cycle)	B Natural Draft Wet Cooling Towers (Closed Cycle)	C Once-Through River Water Cooling (Open Cycle)	D Cooling Spray Canal (Closed Cycle)
4. Consumption of land	~4 acres (2)	~6 acres (3)	~0 acres (1)	~35 acres (4)
5. Fog (Since the nearest highway is 3 miles away and the nearest populated area is over 4 miles away, the only expected adverse effects from fog is related to river navigation.)	~330 hrs/yr over natural fog occurrence. Fog over river occurs ~100 hrs/yr mostly (75% of the time) during December - March when navigation is restricted or non-existent. Maximum fog cloud will be approximately ¼ mile wide by ~2 miles down wind of towers. (4)	Increase in fog frequency over natural occurrence but less than for "A". Fog cloud size less than for "A" due to greater fog dispersion associated with high (~400 ft) cooling towers. (3)	No significant fog increase over natural occurrence. (1)	Frequency of fog is expected to be less than for A & B. (2)
6. Additional chemicals in cooling discharge water associated with cooling system.	Practically zero chemical discharge from cooling water. (1)	Same as A (1)	Same as A (1)	Chlorine plus anti-fouling chemicals may be used to prevent algae growth in canal. (4)
7. Heat rejection to air and effect on flying insects	Heat will be added to air but with no adverse air effect. Some insects may be destroyed by being swept through the cooling tower by air circulation fans. (3)	Heat added to air will cause local thermal updrafts. Some restriction on light airplanes flying above towers. Some insects may be swept through the towers and destroyed. (4)	No noticeable adverse effects on air and flying insects. (1)	No expected adverse effect on air. (2)
8. Esthetics	4 towers (~60 ft tall by 400 ft long) Cooling towers would occupy a portion of the site and the plume would be visible at times for miles. Moderate adverse esthetic impact. (3)	2 large towers (400-500 ft tall by 400-500 ft in diameter at bottom); towers would dominate the site and plume would be visible for miles. Major adverse esthetic impact. (4)	No towers No adverse esthetic impact (1)	Canal and sprays: spray height ~17 ft; No. of sprays ~200; Canal length ~6500 ft. Canal "carves up" the landscape. Moderate adverse esthetic impact. (2)
9. Recreation	During the winter season, some ice-free fishing will occur in the neighborhood of the discharge plume. The ice-free area will also provide a waterfowl loafing area. (2)	Same as A (2)	Ice-free fishing would extend from discharge canal downstream to lock & dam No. 3. No ice on navigational dam will reduce dam operational problems and create a large waterfowl loafing area. (1)	Same as A (2)

* This system is the system being installed.

TABLE XI-12. COMPARISON OF COOLING TOWER OPERATING MODES BY ENVIRONMENTAL ATTRIBUTES[8]

Environmental Attribute	A Cooling Towers Closed Cycle	B Once-Through with Helper Cooling Towers Open Cycle	C Once Through Cooling
Thermal Discharge	$\Delta T < 5^\circ F$ max. at discharge (1)	$\Delta T < 5^\circ F$ max. in river after mixing (2)	$\Delta T = 28^\circ F$ max. at discharge (3)
River water appropriation ratio (compared to "once-through" system)	$\sim$.073 (1)	1.0 (2)	1.0 (2)
Consumptive use of water ratio (compared to "once-through" system)	$\sim$2.0 (3)	$\sim$1.6 - 2.0 (2)	1.0 (1)
Plankton, Eggs, Larvae, Damage ratio (compared to "once-through" system)	.2 - .5 (1)	$\sim$1.9 (3)	1.0 (2)
Fish Damage ratio (compared to "once through" system)	<0.07 (1)	1.0 - 1.3 (3)	1.0 (2)
Fuel Resource Penalty Ratio (fuel consumptive requirements compared to "once-through" system)	1.05 (3)	$\sim$1.01 (2)	1.0 (1)

Note: The numbers in the bottom of each block indicate the priority of the operating mode for that environmental attribute.

Chemical discharges were described in Section III.D.3, particularly in Table III-5. Discharged chemical and sanitary wastes are so small compared to natural levels that any measurable effect is unlikely, even within the discharge canal.

c. Potential Damage to River Resources

To evaluate the significance of the impact of the Plant on the river resources, the nature of this portion of the river must be considered. As described in Section II, Pool 3 functions as a biological "recovery zone" of the river, lying between Pool 2, which receives wastes from Minneapolis-St. Paul, and Pool 4, which has an important sport fishery (387,000 pounds in 1971). Included in Pool 3 is Sturgeon Lake, a side channel of low flow with a nursery function. Phytoplankton near the outlet of Sturgeon Lake had an average measured population density of 3×10^8 organisms per cubic foot (with threefold variations) in 1969-1970. A zooplankton density of 8100 per cubic foot was reported for the river at the site for July 1970.

The annual yield from commercial fishing in Pool 3 has varied considerably in the past 10 years. In 1966 there was a nearly 20-fold increase in reported catch over the previous year, and in 1969 there was a nearly twofold decline. In 1971 the commercial catch was 28,000 pounds, of which 62% was buffalofish and 36% carp. Comparable data on sport fish are lacking, but sport catches are known to be smaller than commercial.

From the above description of the main features and benefits presently obtained from Pool 3, potential damage can be estimated. Pool 3 has a distinctly limited present value and is comparatively of much lower value than the adjacent Pool 4. The Plant is expected to have an incrementally small impact on Pool 3, both in terms of proportional effect and in overall effect or derived benefit. However, further studies are required to determine the conditions under which Pool 3 or the more valuable Pool 4 could be improved.

d. Meteorological Effects

Meteorological effects, as shown in Item 5 of Table XI-11, are based on estimates presented in Supplement 1 of the Applicant's Environmental Report.[8] The Staff's evaluation of the atmospheric impact of cooling tower operation was summarized in Section V.B.3.

e. Radiological Effects

An assessment of the radiological impact of the Plant has given the following estimated doses:

(1) The maximum child's thyroid dose via the milk pathway is 2.3 millirems per year for the nearest herd of cows.

(2) The maximum adult body dose via air exposure at the site boundary is 0.58 millirems per year.

(3) The maximum adult body dose via fish is 0.5 millirem per year for fish in the intake canal. The dose for the nearest fish in the river is a factor of 10 lower.

(4) All other pathways (recreation, drinking, etc.) result in lower individual doses than the above.

The total population dose, calculated for a 50-mile radius, is estimated at 22 man-rem/year maximum. This is about 0.008% of natural background dose.

2. Benefits

The need for power was discussed in Chapter X. Supplying the required electrical energy is the prime benefit. In addition, there are certain indirect benefits.

a. Electric Energy Supply

In 1971, 16.0×10^9 kilowatt hours (kWhr) of electrical energy was supplied to the Applicant's customers at a total price of $318 million, or 1.98 cents per kWhr. In 1961, 7.2×10^9 kWhr were sold at 2.26 cents per kWhr. The increased electrical demand and pattern of uses in this region have been previously discussed in this Statement. The Prairie Island Plant is expected to supply an average annual net generation of 7.5×10^9 kWhr (at 80% plant factor) for future demand, with the following annual proportional distribution:[8]

Residential: 2.54×10^9 kWhr
Small commercial and industrial: 1.08×10^9 kWhr
Large commercial and industrial: 3.25×10^9 kWhr
Municipalities, rural co-ops, and others: 0.77×10^9 kWhr

Local taxes and employment at the Plant may be considered indirect benefits to the locale occupied by the Plant and compensation to the local residents. The estimated annual tax to be paid to local taxing units during Plant operation is 3% of original cost, or $10 million per year.[8] The annual payroll for the 150 employees is $2.25 million per year.[8]

b. Environmental Benefits

In comparison with an alternative coal-fired plant, the Prairie Island Nuclear Plant requires less land for plant structures and related facilities, contributes no significant increase in traffic on the river (transportation of fuel is an important item for coal), and avoids the air emissions associated with coal combustion (Table XI-2): 40,000 tons/year of SO_2, 23,000 tons/year of NO_x and 3,300 tons/year of particulates.* From an environmental viewpoint, these are all beneficial consequences of the selection of a nuclear plant.

Although the Prairie Island site will not offer recreational and educational facilities, the presence of the Plant and the normal public-information activities of the Applicant will contribute to the education of local residents and visitors. The information gained from operation of the Plant in conjunction with ecological studies and monitoring programs can be expected to contribute to increased scientific and public understanding and to lead to design of future plants which are, on balance, both more economical and minimal in their effect on the environment.[8]**

In 1971, the Applicant spent about $500,000 on study and monitoring programs associated with its Prairie Island, Monticello, and A. S. King plants.[3] These are flexible programs and are to be continued in accord with further specifications.

* These emissions are based on EPA regulations for new plants. They are lower than emissions from older coal-fired plants and also lower than the Applicant's estimates.

**Consideration of balances are discussed by the Applicant in Appendix E of the ER as well as in Supplement 2 of the ER.

3. Balancing of Costs and Benefits

The potential environmental costs of the Plant's operation have been discussed in previous sections of this Statement and are summarized below. Thermal, chemical, and radioactive effluents and their probable effects have been characterized; these effects appear to be only fractional incremental additions to natural background effects and well within natural fluctuations. Residual uncertainties in the magnitude of these effects will be reduced as a consequence of preoperational and operational surveillance in the environmental monitoring programs.

COST-BENEFIT SUMMARY FOR PRAIRIE ISLAND 1 AND 2

BENEFITS	
Primary Benefits:	
Electrical energy to be generated (at 80% plant factor)	7.5×10^9 KWh/yr
Generating Capacity contributing to reliability of meeting electrical demand in NSP Service Area (net summer capability)	1060 MWe
Secondary Benefits:	
employment during construction, peak	1300
total construction employment	3400 man-years
operating staff employment	150
operating staff payroll	$2,250,000/yr
monitoring & environmental studies	250,000/yr
Local Taxes (estimated by Applicant to be 3% of capital cost)	$10,000,000/yr
ENVIRONMENTAL COSTS	
Land Use	
Site	
Total site area	560 acres
Site occupied by structures	60
Transmission Lines	
Total access area of new transmission lines	592 acres
Total length	34 miles
Cooling Tower Operation	Barely Noticeable Noise at Nearest Residence

Water Use

Water evaporated (closed cycle)	$\leq$ 38 cfs
River surface area over 5°F excess isotherm of thermal plume	None
Chemicals discharged to river	
chlorine residual	Less than 4 lb/day
sulfates, bicarbonates, chlorides	1200 lb/day
Well water use	150,000gal/day

Radiological Impact

Normal operation:	
Cumulative population dose in 50-mile radius	21.7 man-rem/yr
fraction of natural background	<0.01%

Biological Impact

Water: Local small destruction of aquatic life

Land: Apart from 60-acres of structures, undetectable effects on terrestrial life forms.

Based on the above comparative evaluations, it is evident that none of the alternatives considered produces a significant environmental benefit or a reduction in environmental costs with respect to the reference case. Furthermore, each of the alternatives results in economic costs that cannot be balanced by economic or environmental benefits. Significant expenditures have been and are being made by the Applicant to protect environmental quality by monitoring and maintaining the environmental impact at a practicable minimum. It is concluded that the Plant will provide the needed increased generation of electric power with a minimal environmental impact.

XII. DISCUSSION OF COMMENTS ON THE DRAFT ENVIRONMENTAL STATEMENT

Pursuant to paragraphs A.6 and D.1 of Appendix D to 10 CFR Part 50, the Draft Environmental Statement was transmitted, with a request for comment, to:

Advisory Council on Historic Preservation
Environmental Protection Agency
Department of Argiculture
Department of the Army, Corps of Engineers
Department of Commerce
Department of Health, Education and Welfare
Department of Housing and Urban Development
Department of the Interior
Department of the Transportation
Federal Power Commission
The Minnesota Department of Health
The Goodhue County Board of Commissioners
The Minnesota Agency of the U. S. Department of Interior's Bureau of Indian Affairs

In addition, the AEC solicited comments on the Draft Environmental Statement from interested persons by a notice published in the Federal Register on January 22, 1973 (38 F.R. 2345). Comments in response to the requests referred to in the preceding paragraph were received from:

Advisory Council on Historic Preservation (ACHP)
Department of Agriculture (AGR)
Department of the Army, Corps of Engineers (ARM)
Department of Commerce (COM)
Department of the Interior (INT)
Department of Transportation (DOT)
Department of Transportation, Region 5 (TR5)
Environmental Protection Agency (EPA)
Federal Power Commission (FPC)
Minnesota Protection Control Agency (MPCA)
State of Minnesota, State Planning Agency (SPA)
The Northern States Power Company (NSP)

Our consideration of these comments is reflected principally by the following discussion and in part by revised text, as identified in Section XII.B. The source of the comments is indicated by the letter code indicated in the above list. The full texts of the comments received are given in Appendix C.

A. RESPONSES TO COMMENTS

1. Impact on Historic Sites in the Area (ACHP, pp. C-18 and 19; EPA, p. C-51; and INT, p. C-41)

Table II-14 (p. II-29) identifies the locations of historical significance in the general area of the Plant. After due consideration, we have concluded that only the Bartron Site is sufficiently close to the Plant that an impact due to the Plant is possible.

The Bartron Site is a 15th century Indian village, discovered by the State archeologist after the Applicant had requested an investigation of its property for possible archeological interest, is located at the southern boundary of the site. It is located in part within the site boundaries and in part on a privately owned farm to the south. It is accessible from a private road on the farm, from the public road which extends to Lock and Dam No. 3.

The Bartron Site is beyond the limits of Plant construction and it was not disturbed. Plant operation will have no significant effect on that Site. Some fogging is expected, and there will be a minor deposition of solids on the ground in the vicinity of the cooling towers, including the Bartron Site. The monitoring program during initial operation of the Plant will include observation of plant and animal life on the Bartron Site.

The Staff concludes that there will be no significant impact on any historic site due to operation of the Plant.

2. Thermal Plume Effect (COM, p. C-3; INT, p. C-45; and EPA, pp. C-51, 55, 58, 60, 61, 62, 63 and 64)

Comments were made that even though thermal plume characteristics downstream of the Plant discharge may be difficult to describe, diagrams for once-through and closed-cycle cooling should be included as a basis for estimating the area (and volume) affected by the heated discharge under extreme conditions. Once-through cooling is to be completely avoided during non-winter months. However, during short periods in winter when ambient river temperatures are at or near their seasonal lows, once-through cooling is permitted if 1) the Plant cooling towers are inoperable; and 2) temperature restrictions at the Plant discharge canal outfall are not exceeded.

For extreme winter-month conditions, plume characteristics were estimated by modeling of the river region downstream of the Plant discharge canal outfall to Lock and Dam No. 3. Conditions set for the modeling were:

River:	
Flowrate (7-day low flow, 10-year recurrence)	4430 cfs
Temperature (minimum)	32°F
Plant:	
Power (reduced to 66% of design to meet 50°F canal outfall limitation)	720 Mw(e)
Cooling water intake rate from river	1360 cfs
Temperature rise across condenser	18°F
Plant Discharge Canal:	
River water flowrate into Plant discharge canal	0 cfs
Temperature at outfall of canal (at location of sensors, and consistent with limitation)	50°F
Flowrate of water from Plant discharge canal outfall to river	1360 cfs

Note that the Plant power is reduced from full design power of 1100 MW(e) to avoid exceeding under all circumstances the 50°F temperature limitation at the Plant discharge location. If river temperature is above 32°F, a larger power reduction would be necessary (on the assumption that no dilution or heat loss occurs in the discharge canal).

The accompanying figures (page XII-4 and 5) show the surface isotherms and depth isotherms corresponding to the surface isotherms which are predicted by the models of Motz-Benedict[1] and Prych,[2] respectively. Major assumptions are that the discharge canal outlet is rectangular (9 ft x 200 ft), and that the river channel between the outfall and Lock and Dam No. 3 is uniform. Heat loss from the plume surface was computed for a "no wind" condition and no allowance was made for enhanced vertical mixing induced as the denser water (maximum density approximately 40°F) sinks, so that the predictions tend toward the conservative.

Assumptions and the modeling method used may lead to predicted surface and depth isotherm locations that disagree with those which will be observed in practice. However, it is significant that the warmer waters hug the shoreline to (and perhaps beyond) Section C-C which is 4000 feet downstream of the discharge. Beyond this location, they are expected to bend sharply toward Lock and Dam No. 3.

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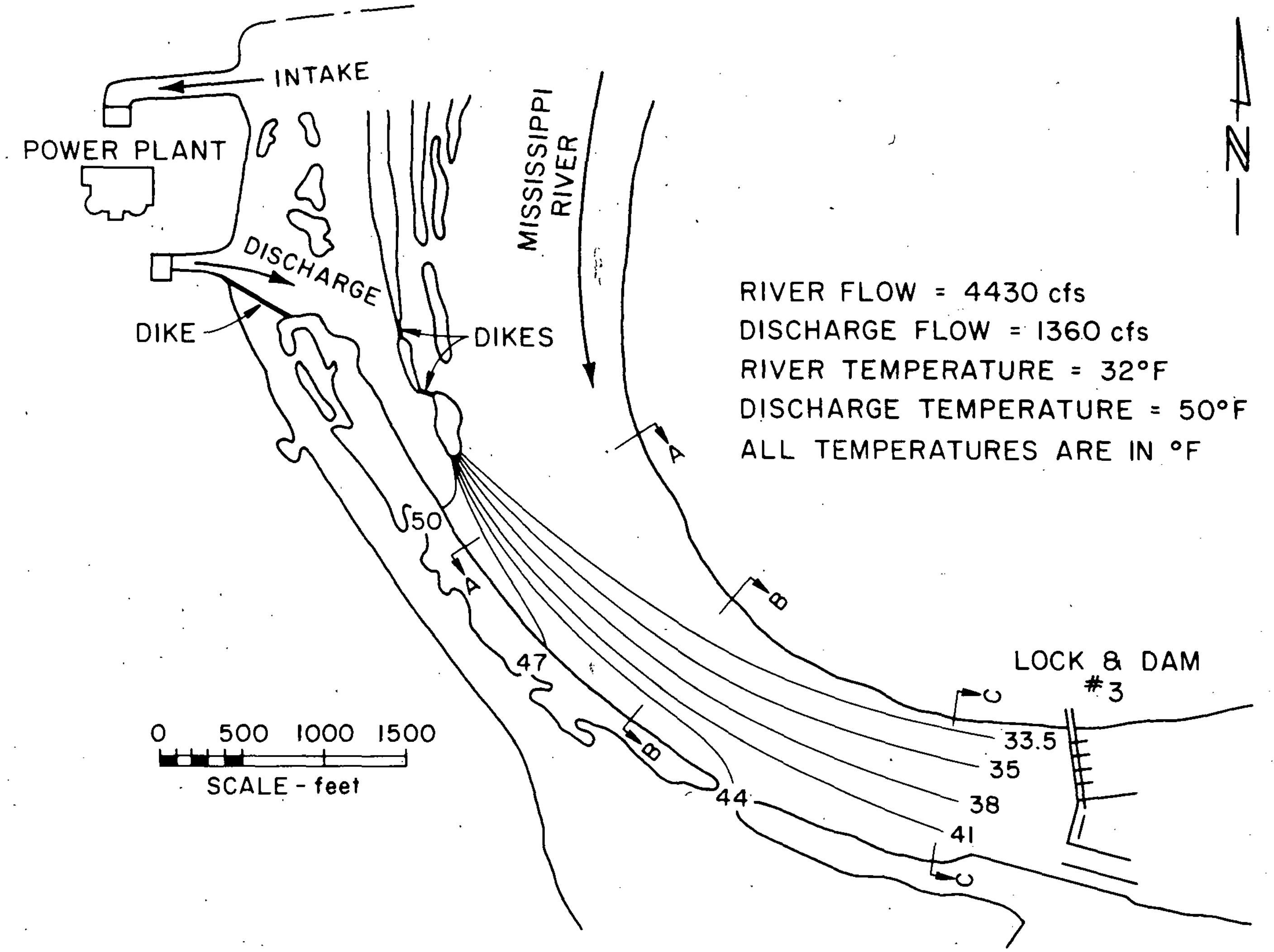
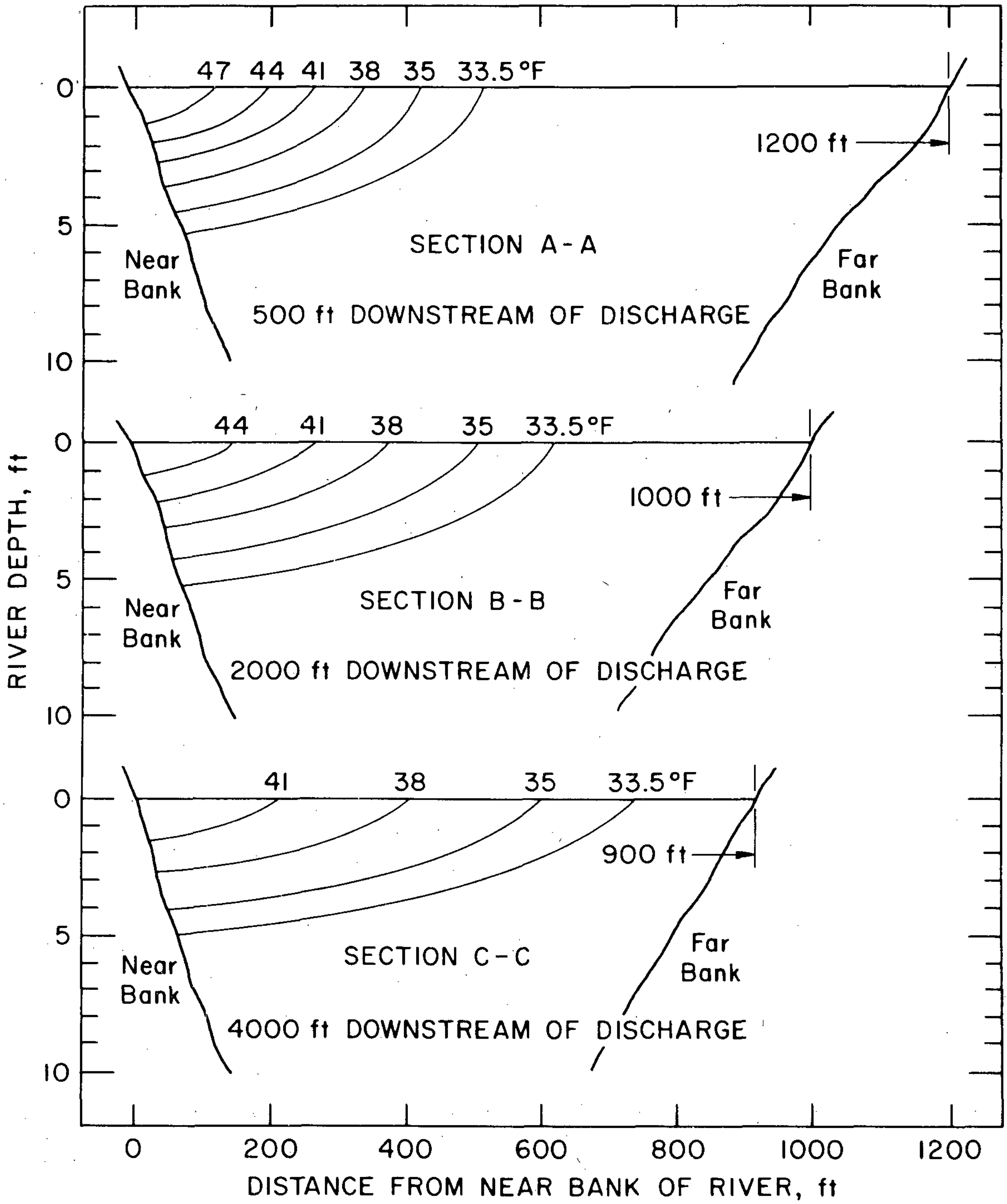
[1] Louis H. Motz and Barry A. Benedict, "Heated Surface Jet Discharged into a Flowing Ambient Stream," 1613 OFDQ 03/71, Environmental Protection Agency, March 1971.

[2] Edmund A. Prych, "A Warm Water Effluent Analyzed as a Buoyant Surface Jet," Notiser och preliminära rapporter Serie HYDROLOGI. No. 21.



Predicted Surface Isotherms for Prairie Island Plant;
Once-through Cooling at Low Winter River Flow



Predicted Isotherms at Several River Cross Sections for Prairie Island Plant; Once-through Cooling at Low Winter River Flow

Of greater significance is that the 35°F isotherm, for example, does not drop below about one-third of the river depth, even along the near bank, which falls off rapidly from the shoreline to the river bed of depths averaging 15 feet. Also, the cross-section areas occupied by waters that are 35°F and above are less than one-quarter of the river's cross section. Thus, the zone of passage for fish between the Plant discharge and Lock and Dam No. 3 at the 3°F above-ambient isotherm is more than three-quarters of the cross-section of the river at winter low-flow conditions.

The isotherm configurations between Section C-C and the roller gates of the dam cannot be forecast. Based on the location of the 37°F (5°F above-ambient) surface isotherm at Section C-C, movement of the 37°F surface isotherm to a distance beyond the surface half-width of the river may occur as the waters approach the roller gates. However, the tendency for further broadening of the area of warmer surface waters can be expected to be quickly upset by the strengthening undertow as the waters approach the gates. Therefore, nominally at no transect between the Plant and the dam are the mixing zone surface waters anticipated to extend beyond 50 percent of the width.

Based on this plume analysis, possibilities of fish kills, due to Plant operation in the open-cycle mode under conditions where the Plant discharge canal outfall temperature limitations are not exceeded, as well as Plant shutdowns during such operation, appear to be negligible.

The thermal plume will be formed by the cooling tower blowdown during spring, summer and fall. During the winter season, it may be necessary to use once-through cooling part of the time. Thus, during most of the year, the volume of warmed water in the plume will be small (150 cfs).

The adult and juvenile fish will tend to remain in their preferred temperature environment and can avoid the warmest plume isotherms (page V-18). The transit time of the phytoplankton and zooplankton, which drift through the plume, will be brief, on the order of a half hour. Some minimal growth effects on these organisms may occur (pp. V-15 to 17; also see section XII.A.17), but no problems (e.g., algal blooms) are anticipated.

The possible effects of temperature decreases on the fish in winter were discussed (p.V-19). When the cooling towers are used in winter time, no cold-shock problems are foreseen since the blowdown volume is small, and the volume of the warmed cooling water which is recycled is large. However, the Applicant will be required to regulate the release of warmed water during shutdown in winter to avoid a possible fish kill, even though the amount of warmed water would be small.

During scheduled winter shutdowns when the open-cycle mode is being used, the Applicant will be required to gradually reduce the plume temperature to avoid a possible fish kill (page V-19).

3. Flow in Sturgeon Lake and Adjacent Waters (COM, pp. C-3 and 4; INT, pp. C-42, 45; ARM, p. C-6; NSP, p. C-9; and EPA, pp. C-51, 52, 55, 60, 62, 63 and 64)

More complete information on the distribution of flow between Sturgeon Lake and the main channel of the Mississippi River, and the flow pattern within the lake itself is required in order to evaluate the impact of entrainment of aquatic organisms on the role of Sturgeon Lake as a nursery area. Figures II-2 and II-4 show that partitioning of some river water between the main channel and the North Lake-Sturgeon Lake side channels occurs over a distance of five miles upstream from the Plant site.

a. Sturgeon Lake Outflow

Preliminary results[1] from a study recently undertaken for the Applicant indicate that the outflow from Sturgeon Lake, through its outlet channel of about 1500 ft width, is approximately 20,800 cfs for a Mississippi River total flowrate of 64,000 cfs. The outlet flowrate for a total river flowrate of 5000 cfs is approximately 1420 cfs. Thus, about 30 percent of the total river flow immediately upstream of the transect of the outlet extended to the Wisconsin riverbank is through Sturgeon Lake. Measurements were made at a time when the total river flowrate was 64,000 cfs. Using measured channel cross section information, the distribution at the low flowrate of 5000 cfs was computed by applying the Manning equation.[2]

At the total river flowrate of 64,000 cfs, the rate of water flow from the outfall of the Plant discharge canal (temperature sensor location) was measured as 11,000 cfs, or 53 percent of the Sturgeon Lake outlet rate of 20,800 cfs. If the fraction of Sturgeon Lake outflow that enters the Plant's discharge canal (Truttman's Slough) is constant, the discharge canal outflow rate would be 860 cfs for a total river flowrate of 5000 cfs.

b. Flow Into Sturgeon Lake

The study to date has revealed important flow mechanics and volumetric relationships prevailing between Sturgeon Lake and North Lake, and between the lakes themselves and the main stem of the river. North Lake receives most of its water directly from the river through three "runs" which

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1 Letter, E. C. Ward to Gordon K. Dicker, "Applicant's Response to Comments on the Draft Environmental Statement," Northern States Power Co., April 19, 1973, Docket Nos. 50-282 and 50-306.

2 King, "Handbook of Hydraulics," 5th ed., McGraw-Hill, New York, 1939.

penetrate the strip of land between the river and this four-mile-long lake. Combined flows to the lake through these three rather widely separated runs entering its lower portion are 12,600 cfs for a river flowrate of 64,000 cfs, and 800 cfs for a river flowrate of 5000 cfs. The combined flows ultimately empty to the uppermost end of Sturgeon Lake, constituting 56-60 percent of the water that flows through it to its outlet. All other water to Sturgeon Lake (except precipitation) is from the river, rather directly at its upper end through Brewer Lake (6-10%) and directly near its upper end through two connecting cuts (30-38%). All locations of influx to Sturgeon Lake, namely, North Lake, Brewer Lake and the two cuts, are evident in Figures II-4 and II-16.

c. Levels in North and Sturgeon Lakes

Flowrates through North Lake and Sturgeon Lake are related principally to the total river flowrates and to only a minor degree to the lake levels. On the other hand, the water level in each of the lakes is of direct bearing on the cross section open to flow and on the water inventory. Hence, the levels as well as the flowrates have a direct bearing on the average flow velocities, the velocity distributions and convection patterns, the mean and local resident times of the moving waters, and the horizontal and vertical thermal configurations within the lakes.

The level alone affects the volumes of contained waters and the surface areas of the lakes. This is particularly dramatic for North Lake where, for yxample, a decrease in level of 2-1/2 ft (below the "normal" of 674.5 ft (MSL)) would lead to a 62 percent reduction in water volume and a 50 percent reduction in surface area. Corresponding reductions for Sturgeon Lake, which is deeper than North Lake, would be 30 percent and 22 percent, respectively.

The area covered by water in Sturgeon Lake is normally about one-half that of North Lake (800 vs 1500 acres), and normally Sturgeon Lake is about twice as deep (6.5 ft vs 3.5 ft, excluding the large backwater region of North Lake). In the study, the level in North Lake was computed to be about three inches above that in Sturgeon Lake for the river flowrate of 64,000 cfs. The difference in level will be much less than this at average river flowrates. The average depth of the main stem of the Mississippi River flowing near the lakes, which in effect are bypassing to downstream about 30 percent of the main stem waters, is 20 ft or more. The navigation channel depth is maintained at nine feet (minimum).

Because of the several interconnections of the lakes with the river, their levels maintain themselves in general agreement with the pool level immediately above Lock and Dam No. 3. The pool created by Lock and Dam No. 3 extends for 18 miles upstream to Lock and Dam No. 2 at Prescott, and over this distance the pool is synonymous with the river. The pool is managed by the U. S. Army, Corps of Engineers, so that the level at the control point at Prescott is maintained constant at 675.0 ft[1] for all river flowrates above 17,000 cfs. This region of constancy at Prescott is defined as the normal pool level. Meanwhile, to maintain this constant level under conditions of increasing flowrates, from very low to 17,000 cfs, the gates at Lock and Dam No. 3 are judiciously opened to decrease the level at this lower end of the pool to 674.0 ± 0.2 ft and thereby accelerate flow through the 18-mile length of the pool. The lower end of the pool is held constant at this level of 674.0± 0.2 ft for flowrates[2] of from 17,000 cfs to about 30,000 cfs as the pool level at Prescott increases from 675.0 ft to about 678.0 ft. As river flowrates increase above 30,000 cfs, the pool levels at both Prescott and Lock and Dam No. 3 are permitted to rise such that at a river flowrate of 75,000 cfs, for example, the levels are 682.7 ft and 677.6 ft respectively.

Based on the data of Table II-17 for the river from 1940-1965, median flowrates are above 30,000 cfs for April, between 17,000 cfs and 30,000 cfs for May and June, and below 17,000 cfs for all remaining months of the year. The average for these remaining nine months is 10,000 cfs. As mentioned above, the level at Lock and Dam No. 3 is maintained at 674.0 ft at the river flowrate of 10,000 cfs.[3] For this pool level, the depths of water in North Lake are 2-4 ft, with an average of 3.5; and in Sturgeon Lake, from 3-8 ft, with an average of 6.5 ft. For all median flowrates (January through December, inclusive), and for 7-day average low-flow 10-year recurrence flowrates, the depths of the lakes vary by no more than 0.5 ft above nor 0.5 ft below the reference. For river flowrates of greater than about 40,000 cfs, the lake depths will increase as follows:

River Flowrate (cfs)	Percent of time flowrate is exceeded	Pool Level (ft), approx.	Average Depth (ft), approx.	
			North Lake	Sturgeon Lake
40,000	10	675	4	7
75,000	2	679	8	11
100,000	1	681	10	13
228,000*	0	688	17	20

* Highest flowrate of record (4/18/65).

1 All elevations noted are relative to a mean sea level (MSL) datum (1912 adjusted).

2 For river flowrates of 17,000 cfs and above, the control point (reference) is at Lock and Dam No. 3, rather than at Prescott. Control is on "secondary." Secondary control is in effect for "high" flowrates, that is, flow rates of 17,000 cfs and above.

3 The average pool level at the locations of the lakes, which stretch for several miles upstream from Lock and Dam No. 3, is about 0.5 ft higher.

For the river flowrate of 2100 cfs, the lowest trustworthy flowrate of record, average depths of water in North Lake and in Sturgeon Lake are estimated to be 4.0 ft and 7.0 ft, respectively. At this total river flowrate, 1400 to 1500 cfs are expected to pass through the main stem of the river parallel to the lakes, and 600-700 cfs are expected to pass through the lakes to the Sturgeon Lake outlet.

d. Flow Velocities in North and Sturgeon Lakes

At its normal level, almost one-half of the inundated area of North Lake with its 4000 acre-feet of water is made up of backwater areas remote from perceptible water movement between the locations of influx from the pool (main stem of the river) and efflux to Sturgeon Lake. Average velocities have been estimated by the Staff for the sections of the lakes below the major influx locations, using information from the study. Relative to river flowrates, approximate average velocities are 0.1 fps (5000 cfs), 0.4 fps (17,000 cfs), 0.8 fps (30,000 cfs), and 0.6 fps (64,000 cfs). The attenuation of the range of velocities by the pool level management is apparent. Relative to river flowrates, average velocities through the two neighboring outlet channels from North Lake to Sturgeon Lake are 2.0 fps (5000 cfs), 1.0 fps (17,000 cfs), 2.0 fps (30,000 cfs), and 1.9 fps (64,000 cfs). Over the period from 1940 to 1965, flowrates of less than 5000 cfs were observed 12 percent of the time, and flowrates of more than 64,000 cfs, 1.6 percent of the time.

In contrast to North Lake, Sturgeon Lake is without backwater areas of consequence. The estimated average flow velocities through the cross section that is one-half mile above the Sturgeon Lake outlet are less than 0.1 fps for 5000 cfs, 0.2 fps for 17,000 cfs, 0.4 fps for 30,000 cfs and 0.7 fps for 64,000 cfs. Estimated average velocities through the single 500 ft wide outlet channel of Sturgeon Lake are 0.3 fps for 5000 cfs, 0.8 fps for 17,000 cfs, 1.5 fps for 30,000 cfs and 2.8 fps for 64,000 cfs. Again, the attenuating effect of the pool level management on the average velocities relative to the river flowrates is apparent.

e. Holdup in North and Sturgeon Lakes

From information provided by the study, the mean residence times of the waters in movement through North Lake and through Sturgeon Lake have been estimated by the Staff. As with much of the other information presented here, the estimated values are useful for providing perspective, but provide limited insight into the length of time that any given unit volume of water resides in any given zone of the lake--vertically or horizontally from the main paths of flow to the temporary or relatively permanent tranquil regions. Flow configurations in both lakes, particulary North Lake, are nonuniform. It is obvious that whereas some river waters may flow through North Lake under certain conditions in an hour or less, others will find immunity from movement, except for the motivating forces of winds, thermal convection, alterations in pool level, etc., in remote regions of the lake. However, regardless of whether the waters have escaped flow for a period of time and gradually returned, or whether they have taken the most direct route, all will be quite thoroughly mixed in passing through the outlet to Sturgeon Lake, and the contained biota will encounter a significant, although not necessarily a major, change of habitat. The higher turbidity of North Lake is attributed to its mud bottom and shallowness in contrast to that of Sturgeon Lake with its greater depth and mud-gravel bottom. Therefore, not only are Sturgeon Lake's waters clearer, but because of their greater average depth they average cooler in summer. These and other factors enable Sturgeon Lake to support a more diverse biotic spectrum than North Lake.

Estimated Mean Resident Times of Lake Waters

	North Lake		Sturgeon Lake	
River Flowrate (cfs)	Flowrate (cfs)	Residence Time* (hours)	Flowrate (cfs)	Residence Time (hours)
40,000	7,800	6.1	12,000	5.3
30,000	5,800	4.8	9,000	5.9
15,000	2,900	9.5	4,500	12
5,000	970	49	1,500	42
3,000	580	82	900	71

* Includes backwater areas above uppermost "run." Residence times in these areas may be expected to be in the order of weeks, while those in the areas of most active flow below the runs may be much shorter than the indicated means. Corresponding residence times in the river main stem directly opposite North Lake, from the uppermost run to the outlet, range from about 2 to 30 hours. Water in the main stem of the river owes its residence times in large measure to the depth of the pool; that in the lakes, to their widths.

f. Effect of Winter Icing

Mean residence times in,and average flow velocities through the lakes, when parts of the lakes are frozen in winter, have been reported by the Applicant to be not greatly different from those of summer. The Applicant has stated that even during severe winters, when river flowrates are low and river temperatures are near or at 32°F, the one-mile long runs into North Lake remain completely open. Similarly, flows continue into Sturgeon Lake through the much shorter cuts. Also, ice formations do not restrict channel flows between North Lake and Sturgeon Lake, although "treacherous" ice develops along the banks and may completely bridge the flows. Thus, even under prolonged severe cold, the bypassing of waters from the main stem of the river through the lakes to the Sturgeon Lake outlet continues unabated.

g. Flow in Truttman's Slough

The outlet of Sturgeon Lake is substantially at the location designated in Figure II-16 as Transect B_2. Also, the maze of long narrow islands, between which the outlet waters discharged before the Plant intake canal was dredged through them to the main stem of the river, is depicted in Figure II-16. The distribution of water and land near the intake canal after dredging, and downstream of the intake canal to beyond the outfall (temperature sensors) location of the Plant discharge canal, is apparent in Figure III-5. The width of the lake outlet at Transect B_2 is about 1500 ft. The Plant intake canal is dredged along this length from the river main stem to the river shoreline. Not shown in Figure III-5, but shown in Figure II-16, is the outermost triangular shaped island that was almost completely removed by the dredging.

By projecting the 1500 ft width of Sturgeon Lake outlet flow southward across Transect B_2 it can be seen that about 500 ft of shoreline end of Transect B_2 is in direct line with the mouth of Truttman's Slough.[1]

The projection suggests that waters from this 500 ft width of Sturgeon Lake outlet nearest the shoreline will cross the dredged Plant intake canal and enter the mouth of the slough if: 1) the flow is relatively rapid; 2) no water is withdrawn from the canal by the Plant; and 3) the slough is of adequate cross section throughout for unrestricted flow. Results of the study at the river flowrate of 64,000 cfs confirm that this occurs. Indeed, they indicate that the flowrate through the slough is even somewhat greater (by about 9%) than predicted from the straight projection. The flow configuration strongly suggests that all waters entering the mouth of Truttman's Slough are from Sturgeon Lake, when the Plant is not in operation. Moreover,

[1] The slough is bounded at the upstream end by the intake canal, on the west by the river shoreline and on the east by the needle-shaped island now extended by dikes between two islands to the location of the temperature sensors.

experimental results demonstrate that there is a sizeable flow through the slough channel. When the Plant is in operation, this observation is of interest, in connection with dilution of the thermal effluent of the Plant for meeting outfall temperature limitations, and regarding questions concerning unwanted recirculation of the thermal effluent discharge back to the Plant intake canal (see Section XII.44).

Because of the locations of the Truttman Slough inlet relative to the Sturgeon Lake outlet, and the flowrates at these two locations relative to total river flowrates, there can be no question but that all waters into Truttman's Slough are from Sturgeon Lake when the Plant is not operating, and when the Plant is operating in the closed-cycle mode. When the Plant is operated in the open-cycle mode, a plausible distribution of Sturgeon Lake outlet waters and sources of water in Truttman's Slough are shown in the following tables:

Estimated Distributions of Sturgeon Lake Outlet Waters

Total River Flowrates (cfs)	Sturgeon Lake Outlet Flowrates (cfs)	Plant intake rate: 188 cfs Fraction of lake waters to: Plant	Truttman's Slough	River Mainstem	Plant intake rate: 1360 cfs Fraction of lake waters to: Plant	Truttman's Slough	River Mainstem
2100*	630	0.30	0.57	0.13	1.0	0	0
4430**	1330	0.14	0.57	0.29	1.0	0	0
5450	1630	0.12	0.57	0.31	0.83	0.17	0
17000	5100	0.04	0.57	0.39	0.27	0.57	0.16
30000	9000	0.02	0.57	0.41	0.15	0.57	0.28

* Lowest trustworthy one-day low-flow of record

** Lowest 7-day 10-year recurrence flow for period 1940-1965 (February).

Estimated Sources* of Plant Discharge Canal Outfall Waters

Total River Flowrates (cfs)	Plant intake rate: 188 cfs Fraction of waters from: Plant Effluent	Sturgeon Lake	River Mainstem	Plant intake rate: 1360 cfs Fraction of waters from: Plant Effluent	Sturgeon Lake	River Mainstem
2100	0.34	0.66	0	0.79	0	0.21
4430	0.20	0.80	0	0.64	0	0.36
5450	0.17	0.83	0	0.59	0.12	0.29
17000	0.06	0.94	0	0.32	0.68	0
3000	0.04	0.96	0	0.21	0.79	0

* Based on outfall flowrate composed of normal influx to Truttman's Slough (assumed constant at 17.2 percent of total river flow) and Plant effluent discharges, corresponding to intake rates, of 188 cfs and 1360 cfs, respectively.

h. Impact on Biota

The Applicant will operate the Plant in the closed-cycle mode to the maximum extent practicable. Under no circumstances will open-cycle operation be permitted during non-winter months when biotic activities are at their higher levels.

Operation in the open-cycle mode will be permitted only if severe weather conditions during the coldest days in the winter preclude the use of the cooling towers. During this time, the fish will be primarily adults or juveniles, capable of swimming against the weak intake canal current of about 0.5 fps, and avoiding the bubble screen.

During closed-cycle operation, the intake flow into the Plant will be 188 cfs, or about 14% of the intake during open-cycle operation. The closed-cycle operation will be used during spring, summer, and fall, as well as at least part of winter. The Applicant is of the opinion that the bubble screen (see pages C-9, 10) will be highly effective in preventing the entrance of fish that are strong enough to swim against the current (ca. 0.5 fps). The Staff believes that the barrier wall and bubble screen combination will serve to deter fish and other biota from entering the Plant. However, the Applicant will be required to monitor the effectiveness of the barrier wall and bubble screen in preventing the biota from entering the Plant.

4. Meteorological Impact of Cooling Towers (COM, p. C-2)

The Applicant's meteorological consultant has developed a computer model to predict plume lengths and the frequency of surface fogging from the cooling towers at Prairie Island (Chapter V references 42, 43, and 44). As indicated in these references, the accuracy of the model was tested using plume length data collected from operating natural draft cooling towers in Sioux Falls, S. D.; reasonable agreement was reported. The model's predictions and the Staff's evaluation of these results are given on pages V-9 and V-10.

Mechanical draft cooling towers have been used for several decades to cool power plants, oil refineries, industrial plants, etc. Despite this period of use, there is an almost complete lack of plume data from operating mechanical draft cooling towers during periods of extreme cold. The lack of such data as well as a lack of reports of extensive dense fog and/or icing caused by the plumes is likely to be an indication that plumes from such cooling towers do not in fact create serious problems for a properly located and designed plant.

The Applicant will be required to monitor the frequency and density of tower-produced fog at critical areas (nearby roads, houses, river transportation, etc.) and for icing problems in the area. These data will be reported, as required by the Technical Specifications, so that the magnitude of the problem can be established and corrective action, if indicated, can be applied.

5. Offsite Processing of Radioactive Materials (ARM, p. C-6 and 7; INT, p. C-44; and MPCA, p. C-39)

The offsite waste disposal site for radioactive material is, as discussed on pp. V-37 to V-40, West Valley, New York. The AEC considers the environmental effects of a nuclear power plant up to but not including the effects of mining, preparation and processing of fuel, and radioactive waste storage. Such environmental effects, beyond the transportation of radioactive materials are outside the scope of the environmental review for the Plant and have been considered separately.[1]

6. Increase in Chemical Releases (EPA, p. C-67; INT, p. C-43; and NSP, p. C-10)

a. Increased Release of Chemicals in Blowdown

Acording to the Applicant, water-treatment specifications for the steam-generator system are being revised by the vendor. The new specifications will apparently require higher volume rates of blowdown (5 to 10 gpm continuous, per unit) at higher phosphate concentrations (15 to 80 ppm as PO_4). The concentrations of hydrazine and morpholine (or cyclohexylamine) are expected to be at about the same low levels as before. These new blowdown conditions will result in considerably higher rates of release of these chemicals as compared to those stated on p. III-39. At the above maximum discharge rate, the release of the major component, phosphate, is less than 16 lb/day for the two units. This discharge will be diluted first by more than a factor of 3000 by inclusion in the discharge of the circulating-water system and then by an additional factor of more than 10 by the river, even at low river flow. At a river flow of 5000 cfs (which is exceeded 95% of the time), the estimated maximum increase in concentration at the end of the discharge canal is as follows: phosphate 8×10^{-4} ppm; hydrazine, 2×10^{-4} ppm; morpholine, 5×10^{-5} ppm.

On the basis of the Applicant's 1970-71 measured phosphate concentrations in the river (p. II-43), the incremental concentration of phosphorus added to the river from this source is (a) less than 1% of the minimum concentration now present in the river and (b) less than 0.4% of the range of variation of phosphorus concentrations in the river. Such a small increase would be undetectable and of negligible impact.

[1] Environmental Survey of the Nuclear Fuel Cycle, U.S. Atomic Energy Commission, Directorate of Licensing, November 1972.

b. Increased Release of Chemicals from Makeup Demineralizer

The increased rate of steam-generator blowdown will also increase the requirement for makeup water, with a consequent increase in discharge of chemicals for regeneration of the makeup-water demineralizer. However, this increase is less than 10% of the amount stated previously (Table III-5, p. II-38). As stated, the chemicals discharged from the demineralizer regeneration add an increment of concentration to theriver of only about 0.02% of the range of natural variation of the concentration of those chemicals (principally sulfate) in the river. This small increment constitutes a negligible impact.

c. Basis of Increase of Chemical Release and Consideration of Applicable Standards

The increased chemical release (see (a) and (b) above) apparently stems from the vendor's effort to improve system performance. The chemical additives in the steam-generator system are needed to control scaling and corrosion due to impurities entering via supply water or condenser leakage. The specific water treatment requirements are subject to change, and the Applicant has made no definite commitment.

The comparatively small amounts of chemicals released are well below presently applicable standards of the State of Minnesota. The current State standards do not make specific reference to phosphorus or to compounds such as hydrazine or morpholine. However, pursuant to Public Law 92-500, the EPA, in a January 16, 1973 letter to the State of Minnesota (reproduced in Appendix D), has given a phosphorus limit such that "a maximum single value of 0.1 mg/l (as P) must be applied to all streams." This limit on allowable phosphorus concentration in receiving waters is less than presently observed average concentrations in the river. Under this circumstance, the very small incremental addition of phosphate from the Plant cannot be considered to constitute infraction of the EPA criterion.

In summary, since the incremental addition of phosphorus and other chemicals cited above in (a) and (b) are very small in comparison with the present range of variations of the concentrations of these chemicals in the river, the Staff believes that the releases from these sources will conform to the intent of the EPA recommendations as well as to present State standards.

7. Radwaste System Design (MPCA, p. C-34; and EPA, p. C-64)

The possibility that certain decontamination solutions and laundry and shower waste water could be discharged to the on-site septic system was mentioned in a discussion of a fourth independent liquid radwaste treatment system (page III-28). The Applicant has stated[1] that this will not be done and Figure III-12, page III-26, has been appropriately modified for consistency with this intention. Thus the statements elsewhere (pp. III-41, IV-5, and V-11) that no radioactive waste will be processed in the sanitary sewage disposal system are valid.

8. Tritium Estimates (ARM, p. C-6; and EPA, p. C-70)

The Applicant has based the tritium discharge estimates on the operating experience at Ginna only. We considered operating data from other reactors. More recent considerations, which have not been incorporated into this Statement, indicate that our value of 1,000 Ci is conservative by nearly a factor of three.

9. Long Term Low Level Dose (ARM, p. C-6)

The comment was made that some scientists feel that every dose of radiation increases the incidence of cancer. The Staff has calculated the total dose to the population within 50 miles of the Plant, over the life of the Plant, as 900 man-rem (40 x 21.7 man-rem p. V-30). This is an extremely small risk (0.008%) compared to the 10,800,000 man-rem (40 x 270,000 man-rem p. V-30) dose to the same population group due to natural backgroundd.

10. Combined Environmental Effects from More than One Plant (ARM, p. C-6)

At present, there are no regional siting criteria which relate to operation of multiple reactors in a region. Multiple plants are now considered, from the standpoint of radiological impact, only in the following instances:

1. If there are multiple units on the same site (e.g., North Anna, Peach Bottom).

2. If two or more plants share a common discharge canal.

3. If two or more plants have a common boundary or boundaries (e.g., FitzPatrick and Nine Mile Island).

This does not mean to imply that the AEC is not cognizant of, or unwilling to examine, the potential impact of multiple plants in the same region, even if the above criteria are not met. This is evidenced by considerations upon which 10 CFR 50 proposed Appendix I is based. The proposed

[1] Letter, E. C. Ward to Gordon K. Dicker, "Applicant's Response to Comments on the Draft Environmental Statement," Northern States Power Co., April 19, 1973.

site boundary dose of 5 mrem per year was developed on the basis that, from the standpoint of radiation exposure to humans and projected U. S. power needs to the year 2000, regional effects would be minimal.

The total man-rem dose (page V-30) includes all effects due to the Plant.

11. Site and Transmission Corridor Alterations (ARM, p. C-6; AGR, pp. C-16 and 17; SPA, p. C-47; and MPCA, p. C-34)

The site purchased by the Applicant for the Plant was predominantly farmland, although there were a few summer cottages located adjacent to the river. Site modifications included removal of trees, burning of cleared vegetation, and dredging of the intake and discharge canals. Only the local animal populations were disturbed by these activities. The experience obtained from dredging done by the Corps of Engineers since 1960 has shown that benthic organisms can reestablish themselves following dredging operations.[1,2,3]

Figure 8 of the Applicant's Environmental Report is an aerial photograph of the site taken prior to the start of construction activities. It shows sizeable groves of trees on the northern, northeastern, and southern portions of the site. The Plant and its related components were so located that it was not necessary to destroy any of these trees. The figure also shows a narrow region of trees along the river boundary of the site, several small clusters of trees elsewhere on the site, and a few trees along boundaries of cultivated areas. The Staff estimates that less than 200 trees were removed to make room for Plant structures. There will be some restoration, since the Applicant is required by Condition VII of the Dredging Permit from the Minnesota Department of Natural Resources to "... undertake grading and planting so as to screen the plant from view from the river as much as reasonably possible and otherwise cause the excavation and structures to blend with existing surroundings." At this time, the plan for the final landscaping is being developed. As stated in the above permit requirements, the landscape planting has to "blend with existing surroundings." Therefore, the landscaping will reflect both location and type of species that were present prior to construction.

[1] Sternberg, R. B., "Upper Mississippi River Habitat Classification Survey Hastings, Minnesota, to Alton, Illinois." Minnesota Dept. of Natural Resources, St. Paul, Minnesota, March 1971.

[2] Robinson, J. W., "The 1969 Upper Mississippi River Dredge Spoil Survey from Hastings, Minnesota to Cairo, Illinois." Upper Mississippi River Conservation Committee, Fish Technical Section, 1970.

[3] Quad-Cities Nuclear Power Station Units 1 and 2. Final Environmental Statement, USAEC, 1972, p. IV-2.

The Applicant's Supplement #1 to the Environmental Report describes the new corridors for transmission lines in detail. The on-site corridor is 1.21 miles in length, and the off-site corridor extends 32.84 miles. The width off-site varies from 130 to 1000 feet and the off-site corridor has a total area of 1.52 square miles (equal to 973 acres). Selective clearing of approximately 34 acres of trees along the offsite corridor was required in order to avoid interference with the transmission lines. This is an upper limit, based on the fraction of the transmission lines' corridor which was wooded. Where the lines spanned a valley, depression or gulley, complete clearing of the trees was not required. Usable timber from corridor clearing operations was given to the land owner if he so chose. Otherwise, the timber, all scrap, and removed underbrush were burned under the conditions specified in a permit from the local Fire Marshal.[1] Maintenance of the right-of-way will require subsequent trimming or removal of trees which pose a hazard to the transmission lines.

12. <u>Sealed Shoreline Slough</u> (COM, p. C-3 and 4; and INT, p. C-42)

The Applicant has committed its staff to study the effects of the elimination of river flow through the downstream backwater refuge area. After a fairly highwater fall season, the refuge area became a stagnant water slough prior to the 1972 winter freeze-up. As the ice thickened and the surface snow cover grew more dense, dissolved oxygen levels decreased to a critical level (3 ppm). Water (at 11 ppm of dissolved oxygen) was then pumped across the upstream dike into the refuge to protect the aquatic biota. Within a week, the oxygen levels had recovered and, as the ice melted, the natural surface area became an adequate means of aeration. Therefore, the pumping was stopped.

The Applicant is now investigating different methods to permanently alleviate the winter oxygen depletion. This may include pumping water over the dike, diverting water after discharge at Barney's Point through a canal into the refuge, or installation of piping under the dike to tranfer more highly oxygenated water into the refuge. All interested State agencies will be informed of the final solution, according to the Applicant. Tests will be made to determine the effectiveness of the solution to insure protection of the refuge biota.

13. <u>Monitoring Program</u> (NSP, p. C-8; COM, p. C-4; INT, p. C-42, 45; and ARM, p. C-6)

The monitoring program, both radiological and non-radiological, is described in this Statement (pp. V-21 through V-29). These programs

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[1] Letter, E. C. Ward to Gordon K. Dicker, "Applicant's Response to Comments on the Draft Environmental Statement," Northern States Power Co., April 19, 1973.

will be described in more detail in the Technical Specifications which are now being developed and which will be available in proposed form at the time of the hearing. After the hearing, the Technical Specifications will be revised if necessary to reflect any modifications that may result from the hearing board's decisions and made a part of any license issued. The monitoring program descriptions in an Environmental Statement are intended to present the objectives of the program rather than the detailed implementation that is included in the Technical Specifications.

After the Ecological Monitoring Program section (p. V-23) was written, additional results from the monitoring program became available (Applicant's 1971 Annual Report), and later monitoring data (the Applicant's 1972 Annual Report) are in preparation for publication this year (1973). Sampling methods, equipment used, frequency of sampling, and results are presented. This information includes studies on fish, aquatic macroinvertebrates, zooplankton, aquatic plants, phytoplankton, and water chemistry. The food habits and reproductive cycles of fish are studied when possible (p. V-23), and the reproductive cycles of invertebrates are investigated in regard to their annual population dynamics.

14. Effect of a Flood Like That of 1965 (ARM, p. C-6; and EPA, p. C-69)

The effect of floods on the Plant has been discussed on pages II-34 through 39 and fully considered in the safety review.[1] The Plant grade (695 feet) is seven feet above the 1965 flood level (688 feet), and the Staff has concluded that the Plant can be operated safely up to levels approaching plant grade.

15. Need for Power (NSP, pp. C-8 and C-12; FPC, pp. C-24 to 29, and p. C-31; and MPCA, p. C-38 and 39)

The discussion of the need for power in Chapter X was based on information available in mid-1972. Since that time there have been a number of developments which serve to reinforce the case made previously for the need for the Prairie Island units.

The Draft Statement indicated that initial fuel loading of Unit 1 was scheduled for June, 1973 and commercial service would commence in August, 1973. On this schedule it was reasonable to assume that some power might be available from Unit 1 to assist the Applicant in meeting its summer 1973 peak demand, and that a similar situation might exist in regard to Unit 2 during the summer of 1974. These possibilities are now precluded by the revised schedule provided by the Applicant (see p. C-8).

[1] Safety Evaluation by the Directorate of Licensing, U.S. Atomic Energy Commission, in the matter of the Northern States Power Company, Prairie Island Nuclear Generating Plant Units 1 and 2, September 28, 1972.

Such slippages were not totally unexpected by the Applicant, since the addition of sizeable blocks of peaking units in the springs of 1973 and 1974 were being considered (see Table X-4). These, together with a small hydroelectric unit for 1975 operation, were indicated as proposed. The Applicant's Board of Directors has since approved the addition of these units.

Some of the delay indicated by the revised schedules resulted from a general craft strike of seven weeks' duration and late delivery of major equipment (see Nuclear Industry, February 1973, p. 34 and March 1973, p. 22). It is of interest to note that the Applicant has increased his estimate of the time required between authorization and commercial operation from 76 to 84 months for a fossil plant and from 90 to 108 months for a nuclear plant (see p. C-12). In spite of these delays, the situation regarding reserve margins has not changed significantly, since the original assessment (Table X-5) assumed that Unit 1 would not be available for the 1973 summer peak, nor Unit 2 for the 1974 summer peak. Any further slippage would reduce the value of these units for assisting significantly during 1973-74 and 1974-75 winter peaks, but the reserve margins for winter peaks are more satisfactory than those for summer peaks.

The increase of only 4.6% in 1971 sales to retail customers over 1970 sales was mentioned (page X-5). While this was attributed to abnormal weather and business conditions, the Staff speculated that it might also be a result of a decreasing growth in demand and conservation efforts. However, such sales increased by 8.6% in 1972. For planning purposes, the Applicant has assumed an annual growth rate for summer demand of 9% for 1973, but reducing thereafter by 1/4% per year until 1981. The actual average growth rate for the past three years has been about 10.5% per year, so the projected peaks in Table X-5 may prove to be conservative.

The Federal Power Commission's assessment of reserves for the 1974 and 1975 summer peaks do not differ significantly from those in Chapter X, as shown by the following comparisons:

Condition	% Reserve			
	Summer, 1974		Summer, 1975	
	Chapter X	FPC	Chapter X	FPC
With Units 1 and 2	--	--	16.2	17.9
With Unit 1 only	9.7	10.9	4.9	6.1
Without either	-2.5	-1.5	-6.4	-5.7

There is agreement that Unit 1 must be available by the summer 1974 peak in order to avoid a reserve deficit, and that both units are required by the time of the summer 1975 peak in order to meet the 15% minimum reserve margin required to meet the region's reliability standard of loss-of-load probability of one occurrence in ten years. Even with Unit 1 available as scheduled, this required reserve margin will not be met in the summer of 1974.

Some perspective is provided by the FPC's evaluation of the reserves for the groups of electric utilities with which the Applicant is associated for the purpose of mutual assistance in times of localized power shortages. The Applicant is a major participant in the Upper Mississippi Valley Power Pool (UMVPP) and has over one-half of the generating resources and load. The FPC data show that the UMVPP will have only a 5.7% reserve margin for the 1974 summer peak and 4.2% for the 1975 summer peak if the Prairie Island units are not available. Thus, the reserve margin of the Applicant's immediate neighbors is only slightly better than that of the Applicant.

The Applicant is also a major member of a larger group of electric utilities, the Mid-Continent Area Reliability Coordination Agreement (MARCA). The data for MARCA during the summer peaks of 1974 and 1975 (pp. C-26 and C-27) show excess reserves, but without the Prairie Island units over half of the summer 1974 and two-thirds of the summer 1975 reserve margins of 22.2% and 17.6% respectively are provided by other new nuclear plants which are scheduled for startup within the year preceding the 1974 summer peak. In view of the delays which have plagued nuclear plants,[1] there is some doubt as to the amount of firm power that could be committed to the Applicant from MARCA if the Prairie Island units experience excessive additional delays.

The Applicant has indicated[2] that the MARCA reserve margins for the 1974 and 1975 summer peaks will not be as large as indicated by the FPC. The Applicant's numbers, based on the MARCA Report 383-2 dated 4-1-73, are compared with those of the FPC in the following table.

[1] "FPC Assesses Delays on Thirty Nuclear Units Scheduled for Operation by Summer '73," Nuclear Industry, March 1973, pp. 22-23.

[2] Letter, E. C. Ward to Gordon K. Dicker, "Applicant's Response to Comments on the Draft Environmental Statement," Northern States Power Co., April 20, 1973.

MARCA'S SUMMER PEAK LOAD - SUPPLY SITUATION

Conditions	Generating Capcity, Mw	Load Responsi-bility, Mw	Reserve Margin, Mw	Reserve Margin, %	Reserve Deficiency, Mw
1974, with P.I. Unit #1					
FPC	17,978	14,277	3,701	25.9	-
Applicant	17,797	15,215	2,582	17.0	-
1974, without Unit #1					
FPC	17,448	14,277	3,171	22.2	-
Applicant	17,267	15,215	2,052	13.4	230
1975, with Units #1 and #2					
FPC	19,019	15,266	3,753	24.6	-
Applicant	18,621	16,404	2,217	13.5	244
1975, without Unit #2					
FPC	18,489	15,266	3,223	21.1	-
Applicant	18,091	16,404	1,687	10.3	774
1975, without Units #1 and #2					
FPC	17,957	15,266	2,693	17.6	-
Applicant	17,561	16,404	1,157	7.0	1,304

The reserve deficiencies are primarily a consequence of the Applicant's higher value for the load responsibility. The FPC data were based on an updating of information in the 4-1-72 version of the MARCA Report 383-2. The Applicant's use of the 4-1-73 version presumably reflects more recent estimates of projected demands within MARCA.

In agreement with the Staff's conclusion, the FPC has found that "the electric output of the Prairie Island Nuclear Station Units No. 1 and No. 2 will be needed to meet the projected loads on the Applicant's system and those of the UMVPP and MARCA." In addition, "the units will be depended upon to supply power over a period of many years beyond the initial service needs."

16. Effect of Chlorine on Fish (COM, p. C-4; INT, pp. C-43, 45; and NSP, p. C-11)

Since an Amertap system has been installed, chlorination of the main condensers will not be necessary, according to the Applicant (Page V-10). If chlorine is used as a biocide, it must be monitored and kept within the limits of the new EPA criteria.[1] These are:

1. If the use of chlorine is continuous, the concentrations of total residual chlorine in the body of natural water will not exceed 0.01 mg/l.

2. If the use of chlorine is intermittent, the concentration of total residual chlorine will not exceed 0.2 mg/l for a period not to exceed 2 hours in a 24-hour day.

The Applicant has stated (see p. C-11) that these limits will be met at the discharge to the river when any system within the Plant is chlorinated. The 7-day median tolerance limits for chlorine of 3 fish species found in the Plant area (p. II-74) are: Largemouth bass, 0.26 mg/l; small-mouth bass, 0.13 mg/l; and walleye, 0.15 mg/l. Trout and salmon are more sensitive to chlorine[1] but none of these are present in the Plant region (Page II-74).

The chlorine level of the intake canal water in the recycle flow (P. III-10) is not expected to cause a problem, since fish will probably avoid water that contains toxic levels of residual chlorine. During once-through operation, if this is necessary during the coldest months of the winter, the re-cycle canal will not be used. There will be no chlorination of the main condensers at any time, since an Amertap system has been installed.

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[1] W. A. Brungs, "Review of Literature on the Effects of Residual Chlorine on Aquatic Life," Prepublication Copy from the U.S. EPA, Nat'l Water Qual. Lab., Duluth, Minn. (1973).

Thus, only the service water system will be chlorinated. No chlorination of the cooling towers is intended, although some residual chlorine from service water treatment may reach the towers. By the time that the water is returned from the towers to the intake, no measurable residual chlorine is anticipated. Chlorination of the service water system will be intermittent. This will further reduce the chlorine level in the intake water, in comparison with continuous chlorination.

At all times, both the barrier wall and the bubble screen will be used to discourage fish from entering the intake canal. The Applicant will be required to monitor the efficiency of these methods in preventing fish entry into the intake forebay, and to test for residual chlorine in the recycle canal during operation of the Plant.

17. <u>Blue-Green Algae</u> (COM, p. C-3; and EPA, p. C-62)

Increased plankton growth resulting from the nutrient-rich Sturgeon Lake water being warmed by the Plant condensers is not likely to be a real problem for the following reasons: First, the phytoplankton require more time to reproduce than needed for passage of cooling water through the Plant (passage estimated at less than 15 minutes). Any stimulatory effect of the warmed nutrient water on the phytoplankton in the plume will likely be balanced or reduced by mixing turbulence, which reduces the penetration of sun light for photosynthesis, as well as by the thermal and mechanical shocks resulting from passage of some phytoplankton through the plant. Second, other limiting factors such as high natural turbidity of the river and Sturgeon Lake waters will limit phytoplankton growth due to limitation of sunlight. Weather is another factor in the formation of surface blooms. If turbulent mixing by winds occurs, plankton will be mixed within the upper six feet of water. Without this mixing, during stagnant air conditions, phytoplankton will rise to the upper two feet of the water column, and are more likely to form a dense surface bloom. Third, studies at the Applicant's A. S. King fossil-fueled plant have indicated that, although the heated effluent enters the river 1/2 mile downstream of a sewage treatment plant, the combination of heated water and sewage wastes has not caused an increase in phytoplankton blooms.

These comments also apply to late spring and early fall algal blooms.

18. <u>Dry Cooling Towers</u> (MPCA, p. C-39)

A dry cooling-tower system is the only practical alternative to the use of water to dissipate the waste heat from a steam-electric generating plant. Heat is transferred from the plant's coolant system directly to air in the same way that an automobile radiator dissipates engine heat. Cooling air flow is provided by motor driven fans in the mechanical towers or by means of thermal convection in natural draft towers. Such systems are in use for relatively small (less than 200 MW) fossil-fueled and nuclear plants in this country and abroad.

The use of dry tower cooling results in a significant power loss compared with an evaporative tower since the water from the condenser approaches the dry-bulb temperature of the ambient air, rather than the lower wet-bulb temperature. Therefore, a dry tower cools the water less effectively than an evaporative tower, with resultant higher condenser temperature and thus higher turbine back-pressure and lower plant efficiency. To compensate for the lower efficiency of conversion of heat into electrical energy,[1] future use of dry towers in U. S. power plants probably will involve (a) construction of large turbines to operate with higher back-pressure and (b) the opportunity to locate the plant closer than otherwise to the load center.

Consumptive water use, ground fog, and solids deposition are non-existent with a dry tower, but the process of heat removal from the condenser is less efficient than in an evaporative system, requiring a larger and more costly heat-exchange structure. The capital cost of a dry tower is estimated to be about three times that of an evaporative tower.[2-5] Also, operating costs are greater, so that the overall energy production costs are higher for dry towers compared to evaporative towers. The overall energy cost increment compared with evaporative towers is estimated as lying in the range 0.6 to 1.0 mills/kWh.

19. <u>Consideration of Ways to Reduce Power Consumption</u> (ARM, p. C-7; and MPCA, p. C-33, 38, 39)

Comments were received suggesting that certain conservation of energy mechanisms, such as inverting the rate structure, be considered as an alternative to the plant. Such an alternative to the Prairie Island Plant is only a remote and speculative possibility in view of the basic changes required in the statutes and policies of other federal and state governmental agencies. Consequently this alternative has not been considered by the Staff.

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[1] J. P. Rossie, "Dry-Type Cooling Systems," Chemical Engineering Progress, Vol. 67, No. 7, July 1971.

[2] F. L. Parker and P. A. Krenkel, "Thermal Pollution: Status of the Art," Vanderbilt University, School of Engineering, Nashville, Tennessee, December 1969.

[3] R. W. Beck and Associates (Rossie, Cecil and Young), "Cost Comparison of Dry-Type and Conventional Cooling Systems for Representative Nuclear Generating Plants," TID-26007, March 1972.

[4] J. P. Rossie and Y. A. Cecil, "Research on Dry-Type Cooling Towers for Thermal Electric Generation," Parts 1 and 2, November 1970, EPA Water Pollution Control Research Series 16130 OEES 11/70.

[5] R. D. Woodson, "Cooling Towers," Scientific American, May 1970, p. 70-78.

20. Compliance with Federal Water Pollution Control Act Amendments of 1972 (EPA, pp. C-51, 55)

On January 29, 1973, the Commission published an interim policy statement effective on that date, implementing the FWPCA, particularly section 511 thereof (38 F.R. 2679). On the same date, a Memorandum of Understanding between EPA and the Commission for the purpose of implementing NEPA and the FWPCA in a manner consistent with both acts was published in the Federal Register (38 F.R. 2718).

In general, the interim policy statement provides that the Commission will continue to exercise its NEPA authority and responsibility in licensing proceedings subject to Appendix D of 10 CFR Part 50 so as to avoid any hiatus in Federal responsibility and authority, respecting environmental matters embraced by both NEPA and FWPCA, in the interim period before various actions are taken under the FWPCA.

Section 3 of the interim policy statement indicates one major impact of the FWPCA on the Commission's NEPA authority. It provides that if and to the extent that there are applicable limitations or other requirements imposed pursuant to the FWPCA, the Commission will not (with certain exceptions) impose different limitations or requirements pursuant to NEPA as a condition to any license or permit.

Section 4 sets out the limitation on AEC consideration of alternatives relevant to water quality in particular situations. Generally, it indicates that the Commission will not consider various alternatives where such action would constitute a review of similar consideration of alternatives under the FWPCA and upset a limitation or requirement imposed as a result thereof or where a particular alternative has been required to be adopted pursuant to the FWPCA.

Section 5 concerns the effect of the FWPCA on cost-benefit analyses in environmental impact statements. It states, in summary, that the Commission will continue to evaluate and give full consideration to environmental impact provided that, with certain exceptions, such evaluation will be conducted on the basis of activities at the level of limitations or requirements promulgated or imposed pursuant to the FWPCA. In addition, section 5 provides that the Commission will also determine, except in certain situations specified in section 5(c), whether the facility will comply with applicable limitations or other requirements promulgated or imposed pursuant to the FWPCA.

The impact of the Commission's interim policy statement is dependent on whether and to what extent there are "limitations or other requirements promulgated or imposed pursuant to the FWPCA," as defined in SEction 2.a. of the statement. In this case, to the Staff's knowledge the only such limitations or other requirements in existence are the Minnesota interstate water quality standards. These standards were approved by EPA Region V, except as noted below, in a letter to the Governor of Minnesota dated January 16, 1973 (Appendix D, p. 1).

In its cost-benefit analysis, the Staff evaluated the environmental impact of the facility on the basis of the various discharge levels indicated in the Applicant's Environmental Report for the Prairie Island Nuclear Generating Plant. The Northern States Power Company has committed itself to the principle that the discharges from Prairie Island will not exceed the levels noted in its Environmental Report for the Plant.

The EPA Region V letter to the Governor of Minnesota dated January 16, 1973 rejected as inadequate the existing Minnesota standard regarding water temperature. Since there are no applicable limitations or requirements regarding water temperature in Minnesota imposed pursuant to the FWPCA, the Commission may impose its own temperature requirements as a condition to the issuance of the operating license for the Prairie Island Plant.[1] For detailed analysis of the water temperature requirements being imposed on this Plant, see pages III-19 and V-15.

21. Alternative Radwaste (MPCA, p. C-39)

The Plant's radwaste systems and their emissions are described in Section III.D.2 and the radiological impact is evaluated in Section V.D. The principal features of the radwaste systems are shown in Figures III-12 and III-13. The treatment systems comprise state-of-the-art processes, including demineralizers and evaporators for liquid waste, and high-efficiency filters and charcoal absorbers for gaseous waste. Extensive recycle is used to reduce the quantity of effluents. The processing equipment is flexible, within limits, in that the number of treatment steps can be adjusted to various radioactive inputs and to levels of radioactivity detectable at the monitoring points. The systems as proposed thus provide alternatives as to extent of treatment to minimize

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[1] See Appendix D for text of EPA and AEC Memorandum of Understanding and AEC Interim Policy Statement.

radioactive effluents. The evaluation of acceptable radioactive releases was made on the basis of present health standards and on the principle that the Plant will not appreciably add to the exposure to radioactivity obtained from natural sources, which are principally earth minerals and cosmic rays. Assurance of acceptable performance is provided by continuing monitoring and review over the life of the Plant, so that specific modifications of the radwaste systems can be made, if needed.

22. Impact due to Transportation of Radioactive Materials (MPCA, p. C-36, 37; and INT, p. C-43)

a. Population Density

The average population density used (330 people/square mile) is a conservative number since it is an overestimate for the most populous region of the United States (Northeast--300 people/square mile[1]). This is substantiated by a review of the population density of the states through which the fuel must travel; Minnesota, Wisconsin, Illinois, Indiana, Ohio, Pennsylvania, and New York. Such a review indicates that New York has the highest average, and the only average above 300, at 380 persons per square mile. Since the cities en route, such as Chicago, have been included in these averages, it is concluded that 330 persons per square miles is a conservative estimate.

A representative table[2] of dose values due to transportation of radioactive wastes has been developed for normal cases. The shipment of radioactive wastes from Prairie Island has been reviewed and found to be in the category of a normal case. A comparison of the dose values in the referenced table and those in this statement (see section V.E) indicates that the latter are comparably small. In estimating the doses to persons along the route, no credit has been taken for shielding provided by buildings, hills, or other intervening materials in either this statement or the referenced table.

b. Height of Drop Tests for Shipping Cask

The height of the drop test considered in the environmental review is related to the impact anticipated in a severe accident during transportation.[2] Among

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[1] 1970 Census of Population, U.S. Department of Commerce, PC(1)-A1 December 1971, page 1-52.

[2] Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants, USAEC, December 1972, page 8.

other things this had led to a 90-day holding period to permit radioactive decay. The fact that the cask may drop 66 feet during use in transferring fuel has been considered in the safety review.[1]

c. Transportation Accidents for New Fuel

The fuel element separation in a criticality accident during transport referred to is in the presence of water. Because of the low enrichment of the fuel, accidental criticality in air is not possible. Submersion of a close array of several fuel elements is necessary in order to make the assembly critical. In such a case the critical reaction would cause heating of water to steam which in expanding would separate the fuel elements without dispersing substantial amounts of fuel.

d. Packaging Requirements

The standards and criteria for packaging in the regulations of the AEC (10 CFR part 71) and of DOT (49 CFR parts 170 through 179) provide assurance that packaging designed to meet such standards will withstand "the entire spectrum of physical strain" to which the package is likely to be subjected to in normal and accident conditions in transportation. Some discussion of the basis for that statement is given in a recent AEC publication.[2]

23. Herbicides (MPCA, p. C-35; and INT, p. C-42)

The intended use of the iso-octyl ester of 2, 4, 5-T for control of foliage, particularly woody vegetation under the transmission lines, was mentioned on page V-12. In addition to this compound, the Applicant will use several other defoliants, one or more of which contains 2, 4-D. The actual application of defoliants is done on a contract basis by persons licensed by the State of Minnesota to do this type of work.

The frequency of application usually varies from 1 to 3 years. The Applicant does not intend to use any broadcast spray methods. Broadcast methods of applying 2, 4-D and 2, 4, 5-T esters are drastic,[3] and are not required. However, different methods of application approved by the USDA or EPA will be utilized. Hand spraying on an individual species basis will be used to control vegetation along the 34-mile transmission line corridor. No herbicide is applied to crops, lawns, or pasture, and no private or public property is sprayed without a written permit. A three-foot-diameter circle around each transmission line pole is treated in a manner sufficient to prevent any vegetation growth.

1 Safety Evaluation Report for the Prairie Island Nuclear Generating Station, USAEC, September 28, 1972, page 9-4.

2 Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants, USAEC, December 1972.

3 W. C. Bramble and W. R. Byrnes, A long-term ecological study of game food and cover on a sprayed utility right-of-way," Purdue University Agricultural Experiment Station, Lafayette, Indiana, Research Bulletin #885, February 1972.

The Applicant uses only those defoliants approved by the USDA or EPA. Furthermore, the method or methods of application of each defoliant, including quantity per unit area and frequency of application, are ones approved by the USDA or EPA.

The Staff concludes that the impact on the environment due to the use of herbicides in the above approved manner will be minimal.

24. Turbine Building Gaseous Releases (MPCA, p. C-35; and EPA, pp. C-53, 54)

The release of radioactive gaseous effluents has been reviewed in the light of recent revisions in our program for calculating radioactive iodine doses, and the calculated radioactive iodine releases from the turbine has now been included in the source term. Thus, Table III-3, page III-35, is modified by including the additional iodine releases. The values of iodine given in Section V.D.2, page V-28, are updated as indicated in Appendix E. Revised dose calculations based on the increased iodine effluent indicate that the thyroid dose to a child drinking milk from the cow nearest to the Plant will be less than 5 mrem/yr. The calculated dose to a child drinking milk from a hypothetical cow pastured at the boundary of the Plant would be 36 mrem/yr. The Applicant will be required to maintain a surveillance program to determine whether cows are introduced into this area. The monitoring program in the Technical Specifications will require that the dose to a child drinking milk from the first real cow be less than 5 mrem/yr.

25. Cooling Water Requirements (COM, p. C-3; NSP, p. C-10; and EPA, pp. C-51, 52, 55, 58, 60 and 61)

The Plant was designed and built with a very flexible cooling system which allowed once-through cooling, once-through cooling with "helper" cooling towers or completely closed-cycle cooling. Our evaluation indicates that there is a possibility of damage to aquatic biota while on once-through cooling at certain times of the year. Consequently the Staff will require that the Plant be operated on closed-cycle to the maximum extent practicable.

The Staff has interpreted "to the maximum extent practicable" as meaning no operation with once through cooling unless the cooling towers are inoperable. This may occur, but only during the winter months of the year when biological activity is at its minimum. Once-through cooling, if necessary, will be used only in conformance with the existing temperature standards as will be delineated in the Technical Specifications. From an evaluation based on this interpretation, the impact of the Plant on the aquatic biota due to entrainment, impingement, and thermal effects is expected to be minimal.

26. Evaluation of Accidents (MPCA, p. C-35, 37; and INT, p. C-43)

a. Class 9 Accidents

A comment was made that release of radwaste should be assessed in terms of Class 9 Accidents. Radwaste releases are considered as a part of the routine operation of the Plant. Accidents are specifically addressed in a separate section of the environmental statement, and Class 9 accidents are considered in that section in accord with the proposed Annex to Appendix D, 10 CFR Part 50.

b. Accidents Referred to in an Anonymous Letter to the ACRS

A comment was made that a special section should be added to the final statement which addresses the points in an anonymous letter to the ACRS. The allegations in the anonymous letter to the ACRS, during its review of the Prairie Island Plant in October 1972, have been considered by the Regulatory Staff and the ACRS. All questions raised, except the one regarding rupture of a main steam pipe outside containment, had been considered and resolved during the Staff's regular review, and reflected in the Safety Evaluation of the Prairie Island Nuclear Generating Plant, Units 1 and 2 dated September 28, 1972. The question regarding the rupture of a main steam pipe outside containment has been considered and reported in Supplement No. 1 to the Safety Evaluation dated March 21, 1973. At the request of the ACRS subcommittee on Prairie Island, the Staff responded to each of the specific questions raised in the anonymous letter in an open meeting with the subcommittee on March 31, 1973. A transcript of the March 31, 1973 meeting may be seen in the Public Document Room, 1717 H St. NE, Washington, D.C. or in the local Public Document Room in the Environmental Library of Minnesota, 1222 S.E. 4th St., Minneapolis, Minnesota, 55414.

c. Assumptions Used in the Realistic Analysis of Postulated Radiological Accidents

A comment was made concerning the assumptions used in the realistic analysis of postulated radiological accidents. This analysis was performed using the assumptions presented in the proposed Annex to Appendix D, 10 CFR Part 50.

27. Land Use Near the Site[1] (MPCA, p. C-33)

The predominance of agriculture activities within a five mile radius of the Plant was mentioned (page II-14). Fifty-seven percent of this area is farmland. Of these 28,500 acres, about 14,500 were used for crops in 1972. The distribution was corn, 53%; hay, 20%; soybean, 10%; oats, 8%; barley, 5%; and spring wheat, 4%.

The Applicant has been conducting semiannual surveys of the milk production in the vicinity of the Monticello Plant and in April 1973 performed the first such survey for the Prairie Island Plant. In addition to the closest dairy farm located two miles east of the Plant in Wisconsin (page II-14), the survey included five other farms in the area as far as seven miles NW and five miles west. The average daily milk production for these six herds totaled 5225 pounds and ranged from 650 to 1300 pounds. This is 1/4% of the milk production in the three-county area near the Plant.

The smaller natural-gas pipelines in the vicinity of the Plant (page II-20) are part of the distribution systems which serve the towns of Red Wing, Minnesota and Hager City, Wisconsin. The former extend as close as 3-1/2 miles from the Plant, and the latter 4-1/2 miles. The one natural gas transmission line within five miles of the Plant is a 3-inch-diameter supply line for Hager City. It extends north therefrom, and its closest point to the Plant is about 4-1/2 miles away.

28. Radiological Impact (MPCA, pp. C-35, 36; EPA, pp. C-51, 53 and 69)

Recomputed airborne doses are reported and described in Appendix E. Up-to-date computational methods have been applied. ICRP values have yet to be superseded.

The dose estimates given on page V-26 are superseded by those of Table E-2. The current source term reflects the release of organic iodides and their presence is reflected in the doses of Table E-2. These doses are based on the worst possible organic-inorganic iodide mixture, worst being determined by the mixture's effect on the dose. This approach was taken as the source term contains no information as to percentage of organic iodides.

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[1] Letter, E. C. Ward to Gordon K. Dicker, "Applicant's Response to Comments on the Draft Environmental Statement," Northern States Power Co., April 19, 1973.

As indicated on page V-26, the annual radioactivity release (excepting tritium) of 10 Ci/yr (Table III-2) will be contained in the cooling tower blowdown of 150 cfs. Therefore, the concentration before dilution in the discharge canal will be 7×10^{-8} μCi/cc.

Values given for the natural radiation background are not too high; see A. Klement et al., EPA, ORP/CSD-72-1, 1972.

χ/Q is not applicable to multiple diffused source vents as is the case for this Plant. Therefore in Table E-2 we have not utilized the fiction of point sources that lead to the concept of χ/Q, but rather have presented concentration ratios, K_c values. For this reason, a comparison of χ/Q values and the dispersion values of Table E-2 are inapplicable.

29. Decommissioning (MPCA, p. C-36)

A discussion on decommissioning is included on pages VIII-1 and -2. Cost values for the various reactors decommissioned to date are given below. As indicated, a two-unit PWR (Midland) is estimated to cost $50 million. Discounting this figure for 30 years at an interest rate of 8.75% gives a present worth of about $4 million. Even if a five percent per year escalation is included in the estimated future decommissioning cost, the present worth would be in the range of $15 to $20 million, too small to materially influence any cost/benefit balance.

Decommissioning Data[a]

Facility	Type	MWt	MWe	Type of Decommissioning	Decommissioning Cost
Hallam	Na-C	250	75	entombment	3.2 million
Piqua	Organic	45	12	restricted	1.0 million
Bonus	BWR	50	15	entombment	
Elk River	BWR	58	22.5	complete restoration	5.6 million (est.)
CVTR	PWR	44	15	restricted	
Midland	PWR	4904	1380 + steam	complete restoration	50 million (est.)

[a] Midland Testimony by Hallett and Schemel, TR. p. 8226, Docket Nos. 50-329 and 50-330.

30. Radwaste System: "Low as Practicable" (MPCA, p. C-33; and EPA, pp. C-53, 68)

The radioactive effluent releases meet our guidelines for "as low as practicable." We estimate that the radwaste systems at Prairie Island should be able to process effluents to less than 5 Ci/yr/unit and resulting in a whole body or organ dose of less than 5 mrem/yr due to liquid effluents, less than 5 mrem/yr dose to the whole body or critical organ from noble gases to an individual at the site boundary, and less than 5 mrem/yr dose to the thyroid via the pasture-cow-milk chain where a real cow is located. Prairie Island radwaste releases meet these guidelines; and therefore, we conclude that the effluent releases will be "as low as practicable."

31. Failed Fuel (MPCA, p. C-34)

We estimate 0.25% of the operating power equilibrium fission product source term released to the primary coolant based on zircaloy fuel performance at the following plants:

Plant Name	Extent of Fuel Failure (%)
Ginna	0.4
NOK	0.7
KEP	0.03
Point Beach	0.003
H. B. Robinson	0
	AVG. = 0.23%

32. Thermal Impact on Fish (EPA, p. C-63 to 64)

In the Upper Mississippi River, sauger, walleye, and yellow perch are widely distributed. Sauger and walleye are found in all pools from #3 through #26.[1] The thermal plume from the Prairie Island Plant is very localized, and for this and other reasons to be mentioned below, the Plant's Thermal discharge is not likely to have an affect on the natural populations of these fish in the Mississippi River System.

In the first place, the hypothetical emergency condition discussed on page III-24 would have to be corrected within a relatively short time period. The Technical Specifications will define temperature limitations, and this will be a part of the license to operate the Plant. Thus, any unusual

[1] Robert C. Nord, "A Compendium of Fishery Information on the Upper Mississippi River." A contribution of the Upper Mississippi River Conversation Committee. (UMRCC), 1967.

emergency condition would, if it occurred, exist for only a relatively brief period of time, and would not likely have an affect on fish. Fish tend to seek their preferred temperatures, and would generally avoid a plume too warm for them.

The experiments on yellow perch that were done in the Duluth laboratory give data which do not apply to natural conditions in the area of the Mississippi River around the Prairie Island Plant. The fish in those experiments were forced to live in tanks with controlled temperatures. In the river, the fish can adjust to preferred temperatures by avoidance movements, and they can regulate their body temperatures to some extent by controlling their swimming activity.

Yellow perch spawn when the water temperature reaches 45 to 50 degrees F., usually in April in the Mississippi River. The eggs are extruded in long ribbon-like masses and deposited randomly over the bottom and on submerged vegetation and other material. Eggs hatch in about 12 to 21 days. The young travel in schools in and around weedy areas where the required minute food items are most abundant. Yellow perch are highly subject to predation while young but soon become predaceous themselves.[1]

The sauger fish (Stizostedion canadense (Smith)) spawning occurs in April. The location of the beds is not definitely known, but activity has been observed on sand bars below the dams. Eggs are deposited at random, presumably over sand and gravel, but this has not been positively verified for the river. Eggs incubate for about 12 to 18 days in a water temperature of approximately 50 degrees F.

Little is known about the young sauger in the river, but they feed extensively on insects including mayflies and midges. Young sauger sometimes are seen in the shallow mud flats along the Mississippi River. Larger sauger feed on fish, insects, and crustaceans. Sauger prefer running water, and is generally found in the main channel, side channels, and in the tail waters below the dam.

Walleye fish (Stizostedion vitreum vitreum (Mitchill)) spawn in April, when the water temperature approaches 50 degrees F., and is generally done at night.[1] The period of spawning may cover from one to two weeks. In the Mississippi River, many areas of possible spawning have been singled out,

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1 Robert C. Nord, "A Compendium of Fishery Information on the Upper Mississippi River." A contribution of the Upper Mississippi River Conversation Committee. (UMRCC), 1967.

but good evidence is not available. What appears to be spawning concentrations of fish have been discovered by electrofishing during April in the tail waters of dams.

The walleye eggs incubate for 12 to 18 days, depending upon water temperatures. The fry begin to feed on minute organisms as soon as the yolk sac is absorbed, or before. They feed on larger organisms after they are able to capture and engulf them; these eventually include other fish. Cannibalism is common, and appetites voracious.

In the river, the walleye frequents the main channel and the deeper side channels and river lakes.

33. Halogen Releases (EPA, p. C-68)

We estimate the halogen releases from the component cooling system and the auxiliary feedwater pump turbine to be negligible.

34. Basis for Combustion Efflents (INT, p. C-45)

The source of the discharge rates of combustion products for the alternative of fossil-fueled generation (page XI-16) was page 8 of the Applicant's Environmental Report Supplement 2. These effluents were specific for the NSP system in which 1) Prairie Island would not be operative, and 2) substitute power would be obtained from fossil-fired units of the NSP system and from purchase of power generated by fossil-fired units of other utilities. The relatively high levels of combustion products are due to the fact that the fossil plants considered were older and obsolescent types.

35. Geologic and Seismologic Environment (INT, pp. C-41 and 42)

The inclusion of a more thorough analysis of the geology and seismology of the region would needlessly duplicate the evaluation performed by other branches of the USAEC. The Staff has provided only a general discussion of the area's geology and seismology. For the reader who wishes additional, detailed information, reference should be made to the Applicant's Final Safety Analysis Report. Pages 2.9-1 through 2.9-5 and Appendix A therein consider geological aspects, and pp. 2.10-1 through 2.10-4 and Appendix A describe the seismic history of the area. The Staff's analysis of these aspects of the region, as they affect Plant safety, is contained in safety evaluations performed by the Directorate of Licensing during the construction permit and operating license stages (see 1968 and 1972 reports listed as items #18 and 19 in the Bibliography, page R-2). Comments by the Department of Interior on geology and the Department of Commerce on seismicity are appended to those safety evaluations.

36. Non-radioactive Gaseous Wastes (EPA, p. C-69)

The Minnesota Pollution Control Agency has issued operating permits for the Plant's heating boiler and five emergency diesel generators. The permits are contingent upon future effective performance of the equipment within air pollution emission standards. The boiler will be used for space heating on a year-round basis, as needed, with peak load during the winter months. The estimated use for the diesels is 72 hours per year. Both use #2 fuel oil, having a sulfur content of 0.4%. The estimated annual consumption for the heating boiler is 325,000 gallons, resulting in an emission of 9.3 tons of SO_2 per year from a 130-foot-high stack. Corresponding values for the diesels are 40,000 gallons, 1.2 tons, and 40 feet.

37. Intake System Design (EPA, p. C-63)

The Staff believes that the proposed Plant is within the present state of the art, that environmental impacts will be local and minimal, and that impacts of the present proposed operation and of practical alternatives will be defined and/or demonstrated in the proposed study and monitoring programs so that appropriate modification can be made, if needed, early in the operating life of the Plant.

38. Cooling Tower Drift (INT, p. C-43)

The Staff concluded that no significant ecological damage was likely from fallout of minerals from the tower plumes (p. V-6), and noted that the Applicant's monitoring program would include observations to determine any consequences of the deposition of these chemicals from tower drift (p. V-12). The expectation of a negligible effect was based on a consideration of the quantities involved.

The guaranteed maximum drift loss from the Plant's cooling tower is 0.19% of the circulating water flow, or a total of 2.5 cfs. Since the towers are equipped with modern drift eliminators, the Applicant believes that 0.05% or 0.7 cfs, is a more realistic estimate.[1] On the basis of experience at other cooling towers, the Staff is of the opinion that the drift will be even lower, of the order of 0.02%.[2]

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[1] Northern States Power Company, "Environmental Report Supplement Number 1, Prairie Island Nuclear Generating Plant," Minneapolis, Minnesota, June 7, 1972, p. III.D.4-3.

[2] F. M. Shofner and C. O. Thomas, "Development and Demonstration of Low Level Drift Instrumentation," EPA Report 16130 GNK 10/71, Water Poll. Cont. Research Series, October 1971.

The Staff estimates an upper limit of 190 tons per year from the amount of solids deposited at ground level by the drift from the towers. This is based on a drift of 0.05%, an average total solids of 286 mg/l in the intake water (see Table II-19 on page II-43), a concentration factor of 1.25 in the circulating (closed-cycle) cooling water (see Section XII.A.41), an 80% Plant factor, and an assumption that all drift evaporates before it reaches ground level.

The larger droplets are not likely to evaporate completely before they reach the ground, and most will return to ground level upwind and close[1] to the tower. The dissolved solids which they carry will soak into the earth so that these solids will not appear on the surface. A portion of the droplets and residual solids therefrom will fall on the numerous water surfaces in the vicinity of the site and hence will be immediately returned to their origin. The salts deposited on the soil near the towers due to drift therefrom will be added to that from other sources such as rainfall, windblown deposits and fertilization. Surface drainage and the porous nature of the soil, in combination with rainfall, will serve to redisolve and disperse the low concentrations of salts deposited by drift from the cooling tower.

39. Evaporation in Open Cycle Cooling (EPA, p. C-66)

In discussing the open-cycle cooling mode, it was stated that 1360 cfs would be discharged to the river without evaporative loss (p. III-8). This statement requires clarification. It was based on the very limited area of open on-site water associated with the flow system compared with the large area covered by the thermal plume as discharged water passes into the discharge canal and flows into the main channel of the river. Certainly there is a significant evaporative loss from the heated water after it leaves the on-site flow system. The Staff has estimated that 30 cfs of water will be evaporated from the cooling towers when both units are operating with the closed-cycle cooling mode. For operation in the open-cycle mode, the evaporative loss is estimated as 20 cfs. This evaporation occurs over a much larger area than that for closed-cycle operation.

40. Treatment of Chemical and Sanitary Discharges (EPA. pp. C-65 to 67 and 70)

The nonradioactive chemicals discharged routinely from the Plant in lb/day are summarized in Table III-5 (p. III-38). The Plant processes requiring the use of these chemicals and the justification of the specific amounts

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1. Waselkow, Charles, "Design and Operation of Cooling Towers," in Engineering Aspects of Thermal Pollution, Edited by Frank L. Parker and Peter A. Krenkel, Vanderbilt University Press, 1969, pp. 249-281.

are described in Section III.D.2 (pp. III-34 to 41). A discussion of alternatives in relation to the state of the art is given in Section XI.A.6 (p. XI-23). Impacts on the river are discussed principally in Section V.C.4 (p. V-20 to 23). An overall balance of benefits and environmental costs is given in Section XI.B. The Staff's assessment of the effect of these chemical releases is that no definite or detectable effect is likely, except in a small localized region, and the purpose of Table III-5 is to illustrate the low potential for impact in terms of the incremental change these releases would make in the river. The largest chemical release, sodium sulfate, increases the average sulfate concentration of the river by less than 0.02% of the range of natural variation in sulfate concentration in the river.

Additional information on the treatment of chemical and sanitary wastes discharged routinely and under special circumstances is provided below.

a. Blowdown and Demineralization

The blowdown of the cooling tower system is not treated, although it is monitored. The cooling-tower system alters the river water only by concentrating the normal dissolved solids content of the river by a factor of 1.25 (See XII.A.41). The other principal effluents discharged to the river via the blowdown and their treatment are discussed separately below.

The steam generator blowdown is monitored for radioactivity and, if found radioactive, is treated in the liquid radwaste system to remove radioactive constituents. Chemical content of the steam generator blowdown consists of very small amounts of phosphate and morpholine, which has been discussed (pp. III-39 and 40, and Section XII.A.6). Removal of this small chemical content does not appear necessary or practical.

Regeneration chemicals of the makeup water demineralizers are neutralized before release to the river. The addition is principally sodium sulfate. The resulting incremental concentration in the river was stated above.

b. Pre-Operational Cleaning

Pre-operational chemical cleaning has been performed on Prairie Island Unit 1, and a similar operation is proposed for Unit 2. Pre-operational chemical cleaning was performed only on the secondary water system. The primary system was not cleaned chemically, but individual components were pre-cleaned or hand-wiped. The cleaning solution used in Unit 1 contained 1400 lb disodium phosphate, 3500 lb trisodium phosphate, 2 gallons of an antifoaming agent (Dow E), and 110 gallons of a wetting agent (Dow Trident X-2) in 100,000 gallons of water. A rinse solution consisted of about 300,000 gallons of water. These chemical-cleaning operations were carried out on major parts of the secondary water system (but bypassing the steam generator which was cleaned by the vendor).

A "wet-layup" fill of the equipment with about 100,000 gallons of demineralized water was used, containing 385 gallons of a 40% morpholine solution (NALCO #352). This wet layup solution was discharged at the commencement of testing operations.

The spent cleaning solution and rinses were dumped into a special temporary holding basin of about 700,000 gallons capacity. The cleaning solution and the rinse (400,000 gallons) were collected together. The total non-water content of the combined solution was about 0.2% by weight. The phosphorus content was only a fraction of this total. The layup solution of about 100,000 gallons contained about the same concentration of total chemicals.

Pre-operational cleaning wastes were retained in the skimmer pond before being discharged to the river. The release of these cleaning agents is for one time only (per unit). The skimmer pond allows separation of any extraneous material, and the pond effluent as described above meets applicable standards for discharge to the river.

Solutions from Unit 1 were discharged to the river under a temporary discharge permit issued by the Minnesota Pollution Control Agency, and conformed to the following conditions:

1. The discharge was monitored chemically;

2. State Water Quality Standards were observed (this includes neutralization); and

3. Phosphate concentration was less than 1 mg/1.

c. Septic System

The adequacy of the single septic system to be retained during the life of the Plant is based on the anticipated sanitary load and the intended use of the system.

The Applicant has clarified the method of treatment of laundry wastes in the Plant (see Section XII.A.7). Laundry wastes will not be sent to the septic tank system, but will be sent to the radwaste system after being given a coagulation treatment and filtered, whereby detergent and extraneous material from the bulk of the liquid effluent are removed from the main volume of waste. The extent of treatment in the radwaste system depends on radioactive contents. Also, water from showers required for Plant personnel because of possible exposure to radioactive contamination will not drain into the septic tank system, but will be directed tto the radwaste system.

The expected sanitary load is provided by about 150 operating personnel at the Plant, principally during daytime hours. No visitors' program is anticipated. Considering the small expected sanitary load and the large site, the proposed 3830-gallon tank and tile field appear within the range of standard practice. This system, with the 3050-gallon tank in parallel, was used satisfactorily for the construction phase, which served a peak of 1300 persons.

Approval for the permanent septic tank system has been given by the Minnesota Department of Health. It should be noted that the effluent of the sanitary system is dispersed into the local ground water of the site and does not enter the river. The Applicant will engage the services of a commercial operator licensed in the State of Minnesota for removal and disposal of the sludge from the septic tank.

Based on the above considerations, the Staff believes that the Applicant's proposed system will provide sanitary treatment adequate for environmental protection.

d. Oily Waste Disposal

Routine oil replacement is performed for the transformer system, for the turbine oil system, and for miscellaneous maintenance of mechanical components. Oily waste is collected in barrels and disposed of through a commercial service. For emergency dumping, a special containment basin is provided for transformer oil and a separate sump for turbine oil.

e. Miscellaneous Chemical Spills

Present plans for miscellaneous chemical spills at the Prairie Island Plant are concerned with personnel safety rather than environmental consequences. However, all chemical storage and uses are within the Plant buildings and spills will be controlled by Plant systems, including manual cleaning of floors and collection in floor drains.

41. Blowdown Rate (EPA, p. C-59)

The discharge from the closed-cycle circulating water system ("blowdown") has the functions of (1) limiting the buildup of concentrations of nonvolatile solute due to evaporation of water and (2) affording a vehicle for the discharge of disposable waste effluents. The selection of the volumetric flow rate of this blowdown is determined by the desired concentration of solutes ("dissolved solids") in the circulating-water system.

If V_E is the volumetric rate of evaporation, V_B the rate of blowdown, and V_M the rate of makeup supply, then, by material balance on the water: $V_M = V_E + V_B$. The concentration of dissolved solids in the blowdown, C_B, is the same as that in the circulating water system, and the concentration in the makeup stream, C_M, is the same as that in river. A material balance on total nonvolatile solutes entering and leaving is as follows: $C_M V_M = C_B V_B$. The ratio of concentration in the circulating water system to that in the river, R, is:

$$R = \frac{C_B}{C_M} = \frac{V_E}{V_B} + 1.$$

The anticipated values of V_E = 38 cfs and V_B = 150 cfs result in a concentration factor R = 1.25. Some plants have used higher concentration factors, about R = 3.0; however, low factors are desirable if water supply is adequate and there are no critical intake or discharge effects. The blowdown rate corresponding to R = 3 is about 19 cfs, or about 130 cfs less than the 150 cfs proposed by the Applicant. The makeup water requirement would be lower by this amount. However, the higher concentration of dissolved solids in the circulating water system might require extra efforts to maintain clean conditions in the various components of the cooling system, including the condenser, heat exchangers, and cooling towers. With the proposed blowdown rate, the Applicant does not anticipate a need for chemical additives.

The Staff believes that the proposed 150 cfs blowdown does not constitute an excessive demand on the Mississippi River for supply of this amount of water. Quantitative data on entrainment and impingement of biota in the intake waters will be obtained from the monitoring program. If the adverse effect is greater than expected, a reduction in the blowdown may be advantageous, on balance.

42. Year-round Use of Cooling Towers (EPA, p. C-58)

There are two reasons why the operation of mechanical draft cooling towers may be either impossible or undesirable during periods of very cold (subzero) weather. These are: (1) icing on the towers; and (2) fogging and icing problems created by the plumes.

Icing on the towers themselves can be eliminated or at least controlled to acceptable levels by proper design. Such design features include multiple speed, reversible fans; heaters for motors and gear boxes; ice retainers in the louvers; enclosed stairways; fill and supports designed to carry a small ice load; and provision of valves, etc., to permit dumping an excess of water on the outside faces of fill. Operating procedures which can serve to reduce icing problems include variable fan speeds, reverse direction air flow, visual observation of icing conditions, and use of fewer tower cells. It is the Staff's understanding that the Prairie Island Plant towers have these construction features and operational flexibility. Therefore, on the basis of this understanding and operational experience with mechanical draft towers in cold climates,[1-4] the Staff believes that the towers can be successfully operated at any temperature at the Plant.

During periods of extreme cold, the plume from the towers will extend for long distances and be quite dense. Thick deposits of light rime ice will form on elevated surfaces near the Plant. The plume could possibly interfere with other land and water uses, such as highway traffic and river traffic, trees, power lines and houses in the area, etc. Thus, an absolute ban on once-through cooling at the Prairie Island Plant could result in adverse environmental impacts on land use in the area.

As previously indicated, it is the Staff's opinion that it is possible to run the towers at all times, but that such operation could create a fogging problem on rare occasions. Furthermore, improper operating procedures could lead to potentially damaging icing of the towers' structure. Therefore, the Staff does not propose an absolute ban on the use of once-through cooling. The conditions under which once-through cooling can be used will be defined in the Technical Specifications.

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[1] G. E. McVehil and D. A. Peckham, "Comparison of Cooling Tower Plume Model Predictions to Observations," Report by Sierra Research Corporation (Boulder, Colorado) to Commonwealth Edison Company and Northern States Power Company, October 1971, 19 pp.

[2] G. E. McVehil, "Environmental Effects of Cooling Towers at Prairie Island Generating Station," Northern States Power Company, May 23, 1972, 6 pp.

[3] Waselkow, Charles, "Design and Operation of Cooling Towers," in Engineering Aspects of Thermal Pollution, Edited by Park, Frank L., and Peter A. Krenkel, Vanderbilt University Press, 1969, pp. 249-281.

[4] Cooling Tower Operates at Temperatures Down to -60°F, Power Engineering, March, 1972, p. 83.

43. Disposal of Material Caught by Intake Screens (ARM, p. C-6, EPA, pp. C-64 and 65, and SPA, p. C-47)

The Applicant will be required to meet applicable regulations for disposal of material caught on the cooling-water intake screens. In the present system, the material trapped on the traveling screens is sluiced off and collected in a large wire basket. Survival of many of the viable aquatic organisms collected in the basket could be achieved by promptly returning the collected material to the river. Alternatively, the contents of the basket could be treated in the same manner as the debris removed from the vertical bars of the trash rack, that is, removed for State-approved off-site land burial. Final selection of the method for treatment has not yet been made, pending observations of the type and quantity of materials collected in the initial tests of the cooling system.

The Staff concludes that the monitoring program (See Section XII.A.3) along with consultation with appropriate State officials[1] will result in the appropriate treatment of the materials caught on the intake screens.

44. Recirculation of Discharge Water (EPA, p. C-59)

The possibility that the warm effluent from the Plant might recirculate upstream through Truttman's Slough to the plant intake, when the Plant is operated in the open-cycle cooling mode, has been examined. Recirculation could occur if, because of limited mixing with cooler river waters, a warm water layer of depth greater than 5-6 ft were to extend upstream to the intake skimmer wall. The skimmer wall extends about 7.5 ft below the water surface at the intake. Therefore, the flow of the waters at ambient river temperatures beneath the wall at about 0.9 fps when the Plant is operated in open-cycle cooling mode might be sufficient, if the depth of warm water were to exceed 5-6 ft, to induct warm water from the lower region of the warm water layer.

Lower river flowrates and higher temperature differences between the Plant effluent and river temperatures will favor formation of a warm water layer of greater depth, and extension to greater distances upstream from the outfall. An analysis employing densimetric Prouda numbers of upper (warm) and lower (cold) layers[2,3] indicates that the warm water layer over the entire width of the slough channel will be

[1] Letter to Mr. Robert L. Herbert, Commissioner, Minnesota Department of Natural Resources from Mr. G. V. Welk, Northern States Power Co., March 5, 1973.

[2] Parker, P. L. and Krephel, Peter A. (Editors), Engineering Aspects of Thermal Pollution, Vanderbilt University Press, Nashville, Tennessee, 1969.

[3] Benedict, Barry A., Anderson, Jerry L. and Yandell, Edgar L., Jr., "Analytical Modeling of Thermal Discharges: A Review of the State of the Art" (draft), Vanderbilt University, Environmental and Water Resources Engineering, Nashville, Tennessee, August 1972.

not more than 3.3 ft deep for the Plant operated at full power in open-cycle mode, when the river flowrate at 32°F is 4430 cfs. The warm water layer will terminate rather sharply at a distance of 1300-1400 ft upstream of the effluent outfall, or about 100-200 ft upstream from the intake centerline. Therefore, even though the warm water layer might extend past the actual intake, the Staff expects that the 7.5 ft skimmer wall will effectively control recirculation from this source. Also, the warm water layer is unlikely to extend upstream beyond the intake channel to the Sturgeon Lake outlet.

Another path for recirculation could occur for homogeneously mixed warm and cold waters at the effluent outfall if, with open-cycle mode of Plant cooling at river lowflow conditions, a negative surface energy gradient were to develop along the shoreline between the outfall and intake locations. The slough is composed of a rather deep channel (250 ft width and 12.5 ft average depth) near the river, and a shallow channel (350 ft width and 4 ft average depth) along the shore. Flow velocities in the shallow shoreline channel are estimated to be about 2/3 those in the deep channel. The negative gradient could develop if the difference between the higher surface level at the outfall due to swelling by discharged waters, and the lower surface level at the intake due to drawdown at the intake, were to be greater than the natural positive surface level gradient associated with normal flow in the shallow channel. Because the warmer and colder waters would be homogeneously mixed when they reach the intake, they may not float, but be drawn beneath the skimmer wall.

Using a coefficient for the Chezy formula that was estimated from the information from the study undertaken for the Applicant[1], the calculated surface drawdown at the shoreline position of the intake is about 0.057 inches at a river flow rate of 4430 cfs, and a plant intake rate of 1360 cfs. At the Plant discharge rate of 1360 cfs to Truttman's Slough (equal to the intake rate for open-cycle operation), the surface level swelling near the shoreline is 0.048 inches. For the 760 cfs net flow rate of slough waters between the intake and effluent outfall locations (see Section XII.A.3), the change of surface elevation over this distance of 1150 feet is estimated as 0.038 inches. Based on these calculated values, a negative surface gradient of 0.067 inches could develop along the shoreline between the intake and the effluent outlet locations.

The calculated negative gradient is for the water surface. The gradient of the shallow channel bottom is probably positive. Therefore, rather than unidirectional flow from outfall to intake throughout the wide,

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[1] Letter to G. K. Dicker, "Applicant's Response to Comments on the Draft Environmental Statement," E. C. Ward, Northern States Power Company, April 19, 1973.

shallow channel, a major convective flow pattern could develop. A density difference between outfall effluent and Sturgeon Lake waters could induce a rolling motion with the warmer surface waters moving toward the intake and waters beneath them moving toward the outfall. Natural heat losses from the slow-moving surface waters, and dilution by cooler waters with which the warmer waters are in contact, might cause them to sink as they approach the intake canal. The lower, cooler waters would return toward the outfall; thus, some or all of the effluent waters might recirculate within the channel without being drawn into the Plant.

The calculated maximum recirculation of effluents to the Plant via Truttman's Slough is 200 cfs. However, in view of the tendency for a rolling recirculation pattern to be established within the channel itself, rates in excess of 100 cfs are unlikely. For this rate, the maximum velocity of warm waters flowing toward the intake would be less than 0.1 fps. The velocity of cold undercurrent waters toward the effluent outfall will be no higher than 0.12 fps irrespective of whether recirculation is or is not occurring.

The rate of flow of warm water from the outfall to the intake due to development of a negative surface energy gradient would be accelerated by southerly winds, and retarded by northerly winds.

The effect of recirculation is unlikely to have a noticeable effect on the Plant. The estimated maximum rate of warm-water induction to the Plant will elevate the temperature of mixed waters to the Plant by less than 2°F, and the effluent outfall temperature by the same amount. At a short distance from the Plant, in the mixed waters flowing toward the downstream temperature sensors, the effect will be perceptible. However, reduction of Plant power to meet the 50°F temperature limitation will not be required unless the stagnant layer of warm water at the mouth of the slough, and within the slough above the deep channel, impedes influx of natural (cold) river waters.

If a gradient reversal of this type does occur, or if a warm water layer over the slough develops, no important effects on the biota are anticipated. In the first place, the entire phenomenon is very localized. Secondly, the benthos may not be in contact with the warmed water since the latter will tend to float, or cool as it mixes. Thirdly, the fish will tend to avoid the part of the warmed plume that is not preferred by them. Fourthly, the plankton will move with the currents, but no detrimental or augmentative effects on their populations are likely to occur, largely because of 1) relatively brief exposure time to warmed water on the part of some organisms, and 2) no exposure to warmed water for most plankton in the river system which passes the Plant.

Arrival at the intake of warm waters from the outfall, either by development of flow by a negative surface energy gradient, or development over the surface of the slough of the stagnant layer of unmixed warm water, will be detected at the Plant by the temperature sensor grid located at the intake ahead of the skimmer wall. The Technical Specifications will require that the Applicant will monitor the intake waters and report evidence of arrival of the intake of warm waters from the outfall, even though they may be restricted from entry by the skimmer wall.

45. Reserve Margin During Cooling Tower Emergency (EPA, p. C-61)

The effect of low river flow on allowed power level for the Plant has been questioned, in terms of Applicant's reserve margin. A contributing factor would be the possibility of a concurrent need to reduce output at the Monticello plant which also uses Mississippi River water for cooling.

The Applicant is committed to operate with closed-cycle cooling to the greatest extent practicable, and the Staff believes that the temperature increase in the river water will be within the allowed limit at all times. Even with some of the cooling tower cells inoperative, e.g., for maintenance or repair, the temperature limits will be met for full power operation. However, if icing problems in the towers require bypassing a major fraction or all of the cells, power reduction is likely to be required.

Calculations have shown, for the extreme conditions of once-through cooling and no dilution in Truttman's Slough (the discharge canal), that a power reduction will be necessary to meet the current temperature limits. For example, data included in Section XII.A.2 indicate that, in order to meet the current limit of 50°F at the outfall temperature sensors, a reduction to about 2/3 of normal power would be required for intake water at 32°F. The Staff believes that year-round operation of the cooling towers is feasible, so such a situation is not expected to occur.

It is difficult to imagine a situation (other than extensive damage due to an improbable tornado or earthquake) in which a major fraction of the cooling tower cells would be inoperable except during a period of severely cold weather. Thus, in all likelihood, circumstances requiring a reduction in power level because of water quality (temperature limits) would occur only in the winter. The capability-demand-reserve data presented in Table X-3 (page X-6) show that the Applicant's system will have a large reserve margin for the winter peak demand after the Prairie Island units are operable. Thus, it will be more feasible to accommodate any forced reduction in power output from the Plant during the winter months than would be the case during the summer peak. Of course, a simultaneous restriction at the Monticello plant would make the situation more difficult. Similarly, if more restrictive temperature limits are adopted in the future, the postulated situation would become more serious.

46. Annual Average Release of Gaseous Radwaste (COM, p. C-1)

The Staff computation indicates that about 90% of the total body dose due to gaseous releases is caused by gaseous radionuclides that are emitted continuously. On this basis the use of annual average meteorology is valid.

B. LOCATION OF PRINCIPAL CHANGES IN THE STATEMENT IN RESPONSE TO COMMENTS

	Topic	Page
1.	Current Schedule (NSP, p. C-8)	I-2, IV-2
2.	Endangered Species of Clam (NSP, p. C-9)	II-60
3.	Pool 3 Biota (COM, p. C-2; NSP, p. C-15)	II-22, XI-33
4.	Fish Spawning Grounds (NSP, p. C-9 and INT, p. C-42)	II-22, XI-33
5.	Fish Observed Near the Plant (COM, p. C-2; NSP, p. C-9, C-12 and INT, p. C-42)	II-22, II-73
6.	Gizzard Shad (COM, p. C-4)	V-19
7.	Planktonic Growth (COM, p. C-3)	V-19
8.	Impact on Sturgeon Lake Biota (COM, p. C-3 and INT, p. C-45)	V-14 and -15; see XII.A.3 also
9.	Effect of Chlorine on Fish (COM. p. C-4; NSP, p. C-11 and INT, p. C-43, 45)	V-20 and -21; see XII.A.16 also
10.	Phytoplankton (COM, p. C-3)	V-16
11.	Radiological Monitoring Program, Table V-5 revised (COM, p. C-4; NSP, p. C-8; ARM, p. C-6)	V-36
12.	Laundry Water to Septic Tank, Figure III-12 corrected (MPCA, p. C-34; and EPA, p. C-66)	III-26
13.	Gaseous Doses (Table V-4, p. V-31 recalculated)	E-1, also XII.A.28
14.	Direct Doses (additional calculation)	E-1, also XII.A.28
15.	Summary of Population Dose, Gaseous Effluents (Table V-3, p. V-30 modified by items 13 and 14)	E-1, also XII.A.28
16.	Decommissioning (MPCA, p. C-36)	VIII-1 and -2, also XII.A.29
17.	Nonradioactive Gaseous Wastes (EPA, p. C-69)	III-41; also see XII.A.36
18.	Number of Auxiliary Feedwater Pumps (EPA, p. C-69)	III-7

BIBLIOGRAPHY

1. Northern States Power Company, "Prairie Island Nuclear Generating Plant Units 1 and 2 Environmental Report-Operating License Stage," Docket Nos. 50-282 and 50-306, Minneapolis, Minnesota, May 12, 1971. (Supplement and updated pages November 5, 1971).

2. Northern States Power Company, "Prairie Island Nuclear Generating Plant, Units 1 and 2, Environmental Report-Supplement No. 1," Docket Nos. 50-282 and 50-306, Minneapolis, Minnesota, June 7, 1972.

3. Northern States Power Company, "Prairie Island Nuclear Generating Plant, Units 1 and 2 Environmental Report-Supplement No. 2," Docket Nos. 50-282 and 50-306, Minneapolis, Minnesota, July 14, 1972.

4. Northern States Power Company, Monticello Nuclear Generating Plant, Environmental Report, 1971. (Errata sheets dated October 23, 1972).

5. USAEC Directorate of Licensing, "Draft Environmental Statement, Monticello Nuclear Generating Plant, N.S.P. Co.," Docket No. 50-263, May 1972.

6. Final Environmental Statement, Monticello Nuclear Generating Plant, Northern States Power Co., Docket No. 50-263, November, 1972.

7. Letter, Mr. Richard C. DeYoung to Mr. A. V. Dienhart, N.S.P. dated March 31, 1972, confirming dates for site visit and agenda.

8. Letter, Mr. D. R. Muller to Mr. A. V. Dienhart, N.S.P. dated May 16, 1972 requesting additional information.

9. Letter, Mr. D. R. Muller to Mr. A. V. Dienhart, N.S.P. dated July 11, 1972, requesting proposed Non-Radiological Technical Specifications.

10. Letter, Mr. D. R. Muller to Mr. A. V. Dienhart, N.S.P. dated October 13, 1972 requesting additional information.

11. Letter, Mr. A. V. Dienhart, N.S.P. to Mr. Harold L. Price dated October 15, 1971 containing "show cause" information.

12. Letter, Mr. A. V. Dienhart, N.S.P. to Mr. L. Manning Muntzing dated November 9, 1971 containing additional "show cause" information.

13. Letter, Mr. E. C. Ward, N.S.P. to Mr. R. C. DeYoung dated May 1, 1972, containing "source term" information.

14. U.S. District Court, District of Minnesota, Fourth Division, Minnesota Environmental Control Citizens Association; Russell J. Hatling and E. Taylor Hare v U.S. Atomic Energy Commission, James R. Schlesinger, Chairman et al and Northern States Power Co. Memorandum and Order No. 4-72 civ 109, July 28, 1972.

15. Letter, Mr. E. C. Ward, N.S.P. to Mr. D. R. Muller dated September 15, 1972 containing non-radiological technical specifications.

16. Letter, Mr. E. C. Ward, N.S.P. to Mr. D. R. Muller dated November 15, 1972 containing supplemental information.

17. Northern States Power Co., "Final Safety Analysis Report: Prairie Island Nuclear Generating Plant," Docket Nos. 50-282 and 50-306, Minneapolis, Minnesota, January 28, 1971 (amendments 1 through 25).

18. Directorate of Licensing, "Safety Evaluation in the Matter of Northern States Power Company Prairie Island Nuclear Generating Plant Units 1 and 2, Goodhue County Minnesota," Docket Nos. 50-282 and 50-306, U.S. Atomic Energy Commission, Washington, D. C., April 19, 1968.

19. "Safety Evaluation by the Directorate of Licensing, U.S. Atomic Energy Commission, in the Matter of Northern States Power Company Prairie Island Nuclear Generating Plant Units 1 and 2, Goodhue County Minnesota," Docket Nos. 50-282 and 50-306, Washington, D. C., September 28, 1972, Supplement #1, March 21, 1973, Supplement #2, April 30, 1973.

20. Directorate of Licensing, U. S. Atomic Energy Commission, "Discussion and Findings Relating to Consideration of Suspension Pending NEPA Environmental Review of the Provisional Construction Permits for the Prairie Island Nuclear Generating Plant Units 1 and 2," AEC Docket Nos. 50-282 and 50-306, November 23, 1971.

21. Northern States Power Company, "System Growth," testimony on February 2, 1970 to Minnesota Governor LeVander's Environmental Cabinet (copies available from NSP Information Department).

22. Northern States Power Company, "Annual Report, 1970," Minneapolis, Minnesota, April 1971.

23. Northern States Power Company, "This is how it was in 1971...," Minneapolis, Minnesota, April 1972.

24. A. J. Brook, "NSP Environmental Monitoring Program Annual Reports for the Allan S. King Plant," (1969, 1970, 1971).

25. E. F. Miller and A. J. Brook, "Environmental Monitoring and Ecological Studies Program, 1970 Annual Report on the Prairie Island Nuclear Generating Plant for Northern States Power Company," 1971.

26. Minnesota Department of Agriculture -- U. S. Department of Agriculture, Crop and Livestock Reporting Service, "Minnesota Agricultural Statistics 1971."

27. Wisconsin Statistical Reporting Service, "1971 Wisconsin Agricultural Statistics," U. S. Department of Agriculture and Wisconsin Department of Agriculture, Madison, Wisconsin, August 1971.

28. "Red Wing, Minnesota Community Profile," Minnesota Dept. of Economic Development, St. Paul, Minnesota, March 1971.

29. "Hastings, Minnesota Community Profile," ibid.

30. Northern States Power Co., "Prairie Island - From Antiquity to Atoms," Minneapolis, Minnesota, 1970.

31. Engineering Vice Presidential Staff, "Environmental Monitoring and Ecological Studies Program: 1970 Annual Report for the Prairie Island Nuclear Generating Plant, Units 1 and 2," Northern States Power Company, Minneapolis, Minn., 30 August 1971.

32. The Engineering Vice Presidential Staff, "The Environmental Monitoring and Ecological Studies Program: 1971 Annual Report for the Prairie Island Nuclear Generating Plant," Northern States Power Company, Minneapolis, Minn., July 1971.

REFERENCES

Foreword References

1. Directorate of Licensing, "Safety Evaluation in the Matter of Northern States Power Company Prairie Island Nuclear Generating Plant Units 1 and 2, Goodhue County Minnesota," Docket Nos. 50-282 and 50-306, U. S. Atomic Energy Commission, Washington, D. C., April 19, 1968.

2. "Safety Evaluation by the Directorate of Licensing U.S. Atomic Energy Commission, in the Matter of Northern States Power Company Prairie Island Nuclear Generating Plant Units 1 and 2, Goodhue County Minnesota," Docket Nos. 50-282 and 50-306, September 28, 1972.

Chapter I Reference

1. Northern States Power Company, "System Growth," Testimony on February 2, 1970 to Minnesota Governor LeVander's Environmental Cabinet (copies available from NSP Information Department).

Chapter II References

1. Bureau of the Census, U. S. Dept. of Commerce, "1970 Census of Population: Number of Inhabitants, PC (1)-A25 Minnesota," U. S. Government Printing Office, Washington, D. C., June 1971.

2. Ibid., PC (1)-A51 Wisconsin.

3. Minnesota, Statistical Reporting Service, "1971 Minnesota Agricultural Statistics," U. S. Dept. of Agriculture and Wisconsin Department of Agriculture, Madison, Wisconsin, August 1971.

4. Wisconsin Statistical Reporting Service, "1971 Wisconsin Agricultural Statistics," U. S. Dept. of Agriculture and Wisconsin Department of Agriculture, Madison, Wisconsin, August 1971.

5. U. S. Bureau of the Census, "County Business Patterns, 1970," Minnesota CBP-70-25 and Wisconsin CBP-70-25, U. S. Government Printing Office, Washington, D. C., 1971.

6. Northern States Power Company, "Prairie Island Nuclear Generating Plant Environmental Report, Supplement," Minneapolis, Minnesota, November 1971.

REFERENCES (Contd.)

7. "International Petroleum Encyclopedia," Petroleum Publishing Co., Tulsa, Oklahoma, 1970, pp. 126-127.

8. "Atlas of Major Gas Transmission Lines of the United States and Canada," The Oil and Gas Journal, Tulsa, Oklahoma, 1969.

9. Corps of Engineers, Dept. of the Army, "Waterborne Commerce of the United States 1970: Part 2, Waterways and Harbors, Gulf Coast, Mississippi River System and Antilles," New Orleans District, Corps of Engineers, New Orleans, Louisiana, 1971.

10. "Official Guide to Hiawathaland, Southeastern Minnesota's Land of Five Seasons," Hiawathaland, Inc., Rochester, Minnesota, 1972.

11. Division of Parks and Recreation, State of Minnesota, personal communication, April 14, 1972.

12. Floyd A. Hennagir and Richard B. Sternberg, Division of Game and Fish, Minnesota Dept. of Natural Resources, personal communications, 1972.

13. Edward F. Miller, "Ecological Studies Fish," in 1970 Annual Report: Environmental Monitoring and Ecological Studies Program, Engineering Via Presidential Staff Dept., Northern States Power Co., Minneapolis, Minnesota, August 30, 1971, pp. 56-57.

14. Division of Game and Fish, "Interstate Operations of Commercial Fishing-Annual Report," Dept. of Natural Resources, Minneapolis, Minnesota, 1964-1971.

15. Richard B. Sternberg, "Angler Creel Census of Pools 4 and 5 of the Mississippi River, Goodhue and Wabasha Counties, Minnesota in 1967-1968," Investigational Report No. 306, Minnesota Dept. of Conservation, Minneapolis, Minnesota, May 1969.

16. Richard B. Sternberg, "Mississippi River Spring Creel Census in the Tailwaters of Pools 4 and 5, 1968-1970," Investigational Report No. 311, Minnesota Dept. of Natural Resources, Minneapolis, Minnesota, January 1971.

REFERENCES (Contd.)

17. "Red Wing, Minnesota Community Profile," Minnesota Dept. of Economic Development, St. Paul, Minnesota, March 1971.

18. "Hastings, Minnesota Community Profile," ibid.

19. Harza Engineering Company, "Probable Maximum Flood: Mississippi River at Prairie Island, Minnesota," Appendix A-2 of Appendix A, Final Safety Analysis Report: Prairie Island Nuclear Generating Plant, Minneapolis, Minnesota, 1971.

20. H. C. S. Thom, "New Distribution of Extreme Winds in the United States," ASCE Environmental Engineering Conference, Dallas, Texas, 1961.

21. H. C. S. Thom, "Tornado Probabilities," Monthly Weather Review 91, No. 10-12, 730-736 (1963).

22. National Park Service, U. S. Dept. of the Interior, "National Register of Historic Places," Federal Register 36, No. 35 (February 2, 1971), p. 3323.

23. Northern States Power Co., "Prairie Island - From Antiquity to Atoms," Minneapolis, Minnesota, 1970.

24. Letter, Mr. C. W. Nelson, Minnesota Historical Society to Dr. W. C. Redman, Argonne National Laboratory, dated May 4, 1972.

25. Elden Johnson, M. Q. Peterson, and J. E. Streiff, "Birch Lake Burial Mound Group," J. Minn. Acd. Sci. 36, No. 1, 3-8 (1969) (ER Appendix D).

26. J. E. McKee and H. W. Wolf, ed., "Water Quality Criteria, Second Edition," Publication A-3, California State Water Resources Control Board, Sacramento, California, 95814, (1963; Reprinted 1971).

27. U. S. Army Corps of Engineers, "Upper Mississippi River Charts, Numbers 148-153, of River Miles 785 to 819."

28. Engineering Vice Presidential Staff, "Environmental Monitoring and Ecological Studies Program: 1970 Annual Report for the Prairie Island Nuclear Generating Plant, Units 1 and 2," Northern States Power Company, Minneapolis, Minn., 30 Aug. 1971.

REFERENCES (Contd.)

29. U. S. Dept. of the Interior, "Endangered Species of the United States," Official List, revised October 1970.

30. Northern States Power Company, "Environmental Report Supplement No. 1 for the Prairie Island Nuclear Generating Plant, Units 1 and 2, Red Wing, Minnesota," June 7, 1972.

31. A. J. Brook, "NSP Environmental Monitoring Program Annual Reports for the Allen S. King Plant," (1969, 1970, 1971).

32. USAEC Directorate of Licensing, "Draft Environmental Statement, Monticello Nuclear Generating Plant, N.S.P. Co.," Docket No. 50-263, May 1972.

33. The Engineering Vice Presidential Staff, "The Environmental Monitoring and Ecological Studies Program: 1971 Annual Report for the Prairie Island Nuclear Generating Plant," Northern States Power Company, Minneapolis, Minn., July 1971.

34. R. R. Kudo, "Protozoology," Fifth Edition, C. C. Thomas Publishing Co., Springfield, Ill., February 1966.

Chapter III References

1. J. G. Asbury and A. A. Frigo, "A Phenomenological Relationship for Predicting the Surface Areas of Thermal Plumes in Lakes, ANL/ES-5, (April 1971).

2. Northern States Power Co., "Final Safety Analysis Report: Prairie Island Nuclear Generating Plant," Docket Nos. 50-282 and 50-306, Minneapolis, Minnesota, January 28, 1971.

3. Ibid, "Amendment 12 to the Final Safety Analysis Report," November 15, 1971.

4. Northern States Power Co., "Environmental Report: Prairie Island Nuclear Generating Plant," Docket Nos. 50-282 and 50-306, Minneapolis, Minnesota, May 12, 1971.

5. Northern States Power Co., "Environmental Report: Prairie Island Nuclear Generating Plant," Docket Nos. 50-282 and 50-306, Minneapolis, Minnesota, November 5, 1971.

6. Letter Mr. E. C. Ward, Northern States Power Co., to Mr. D. R. Muller dated November 15, 1972.

REFERENCES (Contd.)

7. Northern States Power Company, "Environmental Report Supplement No. 2," July 14, 1972.

8. Northern States Power Co., "Environmental Report, Supplement Number 1," Minneapolis, Minnesota, June 7, 1972.

Chapter IV References

1. Directorate of Licensing, U.S. Atomic Energy Commission, Discussion and Findings Relating to Consideration of Suspension Pending NEPA Environmental Review of the Provisional Construction Permits for the Prairie Island Nuclear Generating Plant Units 1 and 2," AEC Docket Nos. 50-282 and 50-306, November 23, 1971.

2. Northern States Power Co., "Environmental Report, Supplement Number 1," Minneapolis, Minnesota, June 7, 1972.

3. Federal Power Commission, "Guidelines for the Protection of National, Historic, Scenic, and Recreational Values in the Design and Location of Rights-of-Way and Transmission Facilities," FPC Order No. 414, Washington, D. C., November 27, 1970.

4. U. S. Departments of the Interior and Agriculture, "Environmental Criteria for Electric Transmission Systems," U. S. Government Printing Office, Washington, D. C., October 1970.

5. Northern States Power Company, "1970 Annual Report," Minneapolis, Minnesota, March, 1971.

6. Northern States Power Co., "Environmental Report: Prairie Island Nuclear Generating Plant," Docket Nos. 50-282 and 50-306, Minneapolis, Minnesota, November 5, 1971.

Chapter V References

1. Northern States Power Company, "Environmental Report, Supplement No. 1 for the Prairie Island Nuclear Generating Plant, Units 1 and 2, Red Wing, Minnesota," June 7, 1972.

2. Northern States Power Company, "Prairie Island Nuclear Generating Plant Environmental Report," Minneapolis, Minnesota, May 12, 1971.

3. Fish and Wildlife Service, "Chemical Vegetation Control Manual for Fish and Wildlife Management," U. S. Dept. of the Interior, 1968.

REFERENCES (Contd.)

4. Directorate of Licensing, U. S. Atomic Energy Commission, "Discussion and Findings Relating to Consideration of Suspension Pending NEPA Environmental Review of the Provisional Construction Permits for the Prairie Island Nuclear Generating Plant Units 1 and 2," AEC Docket Nos. 50-282 and 50-306, November 23, 1971.

5. Div. of Reactor Development and Technology, USAEC, "Thermal Effects and U. S. Nuclear Power Stations," WASH-1169, January 1971.

6. C. C. Coutant, "Thermal Pollution - Biological Effects," J. Water Poll. Control Federation 43, 1292 (1971).

7. John F. Storr, "Ecological Studies of Cooling Water Discharge (at the Ginna Nuclear Power Plant) Part 1: Summary of Ecological Effects and Changes Resulting from Introduction of Thermal Discharge," Report to Rochester Gas and Electric.

8. C. C. Coutant, "Consequences of Effluent Release, Effects on Organisms of Entrainment in Cooling Water: Steps Toward Predictability," Nuclear Safety 12, No. 6, 600-607 (1971).

9. E. C. Raney, "Heated Discharge and Fishes in Lake Michigan in the Vicinity of the Donald C. Cook Nuclear Plant," Testimony at a meeting of the Michigan Water Resources Commission, June 24, 1971, Lansing, Michigan.

10. D. P. Currie, Testimony before the Thermal Standards for Lake Michigan hearings, January 15, 1971.

11. A. J. Brook, "NSP Environmental Monitoring Program Annual Reports for the Allan S. King Plant," 1969-71.

12. J. Cairns, Jr., "Effects of Increased Temperature on Aquatic Organisms," Ind. Wastes 1, 4, 150-152 (1956).

13. C. B. Wurtz, and C. E. Renn, "Water Temperature and Aquatic Life," Edison Electric Institute Research Project, RP-49, 1965.

14. Directorate of Regulatory Standards, U. S. Atomic Energy Commission, "Draft Detailed Statement of Environmental Considerations Related to the Proposed Issuance of an Operating License to the Wisconsin Electric Power Company and the Wisconsin Mighigan Power Company for the Point Beach Nuclear Plant, Unit No. 2," Docket No. 50-301.

15. J. E. Draley, "The Treatment of Cooling Waters with Chlorine," ANL/ES-12, Environmental Statement Project, Argonne National Laboratory, Argonne, Illinois, 1972.

REFERENCES (Contd.)

16. M. M. Ellis, B. A. Westfall, and M. D. Ellis, "Determination of Water Quality," Dept. of the Interior Res. Report 9 (1946).

17. M. M. Ellis, "Detection and Measurement of Steam Pollution (Related Principally to Fish Life)," U. S. Dept. of Commerce, Bur. of Fisheries Bull. 22 (1937).

18. E. R. Hewitt, "Aeration of Waters for Trout," Prog. Fish Culturist 35, 23 (1938); Water Pollution Abs. 12 (March 1939).

19. E. F. Miller and A. J. Brook, "Environmental Monitoring and Ecological Studies Program, 1970 Annual Report on the Prairie Island Nuclear Generating Plant for Northern States Power Company," 1971.

20. "Summary of Recent Technical Information Concerning Thermal Discharges Into Lake Michigan," Contract Report 72-1 to EPA Region 5 Enforcement Division Center For Environmental Studies and Environmental Statement Project, Argonne National Laboratory, Argonne, Illinois, August 1972.

21. International Committee on Radiological Protection, "Report of ICRP Committee II on Permissible Dose for Internal Radiation (1959) with Bibliography for Biological, Mathematical and Physical Data," Health Physics, Vol. 3, June 1960.

22. Minnesota Department of Agriculture -- U. S. Department of Agriculture, Crop and Livestock Reporting Service, "Minnesota Agricultural Statistics 1971."

23. Wisconsin Statistical Reporting Service, "1971 Wisconsin Agricultural Statistics," U. S. Department of Agriculture and Wisconsin Department of Agriculture, Madison, Wisconsin, August 1971.

24. Floyd A. Hennagir, Division of Game and Fish, "Minnesota Department of Natural Resources, personal communication, 1972.

25. Richard B. Sternberg, "Mississippi River Spring Creel Census in the Tailwaters of Pools 4 and 5, 1968-1970." Investigational Report No. 311, Minnesota Department of Natural Resources, Minneapolis, Minnesota, January 1971.

REFERENCES (Contd.)

26. S. I. Auerbach, "Ecological Considerations in Siting Nuclear Power Plants: The Long-Term Biota Effects Problems," Nuclear Safety, 12, 25, 1971.

27. W. L. Templeton, et al., "Radiation Effects," in Radioactivity in the Marine Environment, National Acedemy of Science, Washington, 1971.

28. S. I. Auerbach, et al., "Ecological Considerations in Reactor Power Plant Siting," in Environmental Aspects of Nuclear Power Stations, IAEA-SM-146/53, Vienna, 1971, pp. 805-820.

29. W. H. Chapman, H. L. Fisher, and M. W. Pratt, "Concentration Factors of Chemical Elements in Edible Aquatic Organisms," UCRL-50564.

30. J. N. Gitlin and P. S. Lawrence, "Population Exposure to X-rays U. S. 1964," Public Health Service Publication No. 1519.

31. R. P. Minx, B. Schleien, A. W. Klement, Jr., and C. R. Miller, "Estimate of Ionizing Radiation Doses in the United States 1960-2000," Environmental Protection Agency EPA ORD/CSD 72-1 August 1972.

32. 10 CFR Part 71; 49 CFR Parts 171, 173, and 178.

33. 49 CFR § 397.1 (d).

34. J. E. Carson, "The Atmospheric Effects of Thermal Discharges into a Large Lake," J. Air Poll. Cont. Assoc., 22, 523-528 (1972).

35. R. W. Zeller, H. E. Simison, E. J. Weathersbee, H. Patterson, G. Hansen, and P. Hildebrant, "Report on Trip to Seven Thermal Power Plants," prepared for the Pollution Control Council, Pacific Northwest Area, 1969.

36. F. W. Decker, "Probabilities of Cooling System Fogging," in Proc. AIChE Symposium, Houston, Texas, March 1971, pp. 91-93.

37. E. Wendell Hewson, "Moisture Pollution of the Atmosphere by Cooling Towers and Cooling Ponds," Bull. Amer. Meteor. Soc., 51, 21-22 (1970).

38. F. A. Huff, R. C. Beebe, D. M. A. Jones, G. M. Morgan, and R. G. Semonin, "Effect of Cooling Tower Effluents on Atmospheric Conditions in Northeastern Illinois," Illinois State Water Survey, Urbana, Illinois, Circ. 100, 1971.

REFERENCES (Contd.)

39. W. A. Hall, "Elimination of Cooling Tower Fog from a Highway," J. Air Poll. Cont. Assoc., 12, 379-383 (1962).

40. D. M. Nester, "Salt Water Cooling Tower," in Proc. AIChE Symposium, Houston, Texas, March 1971, pp. 115-117.

41. W. C. Ackermann, "Research Needs on Waste Heat Transfer from Large Sources in the Environment," Illinois State Water Survey Report to the National Science Foundation, December 1971.

42. G. E. McVehil and D. A. Peckham, "Comparison of Cooling Tower Plume Model Predictions to Observations," Report by Sierra Research Corporation (Boulder, Colorado) to Commonwealth Edison Company and Northern States Power Company, October 1971, 19 pp.

43. G. E. McVehil, "Environmental Effects of Cooling Towers at Prairie Island Generating Station," Northern States Power Company, May 23, 1972, 6 pp.

44. G. E. McVehil, "Evaluation of Cooling Tower Effects at Zion Nuclear Generating Station," Final Report, prepared by Sierra Research Corporation for Commonwealth Edison Company, Chicago, Illinois 1970, 50 pp.

45. R. S. McGinnis, Prepared Testimony in Public Hearing by the Minnesota Department of Natural Resources on Prairie Island Nuclear Generating Plant Permit Application".

Chapter VI References

1. Federal Highway Administration, "1969 Accidents of Large Motor Carriers of Property," December 1970; Federal Railroad Administration Accident Bulletin No. 138, "Summary and Analysis of Accidents on Railroads in the U. S.," 1969; U. S. Coast Guard, "Statistical Summary of Casualties to Commercial Vessels," December 1970.

2. 49 CFR §§ 171.15, 174.566, 177.861.

3. Federal Radiation Council Report No. 7, "Background Material for the Development of Radiation Protection Standards; Protective Action Guides for Strontium 89, Strontium 90, and Cesium 137," May 1965.

REFERENCES (Contd.)

Chapter VII References

1. Argonne National Laboratory, "Summary of Recent Technical Information Concerning Thermal Discharges Into Lake Michigan," EPA Contract Report 72-1 (1972).

2. The Engineering Vice Presidential Staff "The Environmental Monitoring and Ecological Studies Program: 1971 Annual Report for the Prairie Island Nuclear Generating Plant," Northern States Power Company, Minneapolis, Minn., July 1971.

Chapter X References

1. Northern States Power Company, "This is how it was in 1971...," Minneapolis, Minnesota, April, 1972.

2. R. H. Krause, ed., "Public Utility Manual - 1971," Moody's Investors Service, Inc., New York, N. Y., April, 1971.

3. Northern States Power Company, "Prairie Island Nuclear Generating Plant Environmental Report," Minneapolis, Minnesota, May 12, 1971.

4. Northern States Power Company, "Supplement 1 to the Environmental Report for the Monticello Nuclear Generating Plant, Minneapolis, Minnesota, April 4, 1972.

5. Northern States Power Company, "System Growth," testimony on February 2, 1970 to Minnesota Governor LeVander's Environmental Cabinet (copies available from NSP Information Department).

6. Northern States Power Company, "Annual Report, 1970," Minneapolis, Minnesota, April 1971.

Chapter XI References

1. "A Report by MARCA to the Federal Power Commission, Pursuant to FPC Docket R-362, Appendix A," April 1, 1972.

2. "MAIN's 1972 Reply to Appendix A of Order No. 383," April 1, 1972.

REFERENCES (Contd.)

3. Northern States Power Company, "Annual Report: This is how it was in 1971...," Minneapolis, Minnesota, March 1972.

4. R. W. Beck & Associates, "Cost Comparison of Dry-Type and Conventional Cooling Systems for Representative Nuclear Generation Plants," USAEC Report TID-26007 (March 1972).

5. Northern States Power Company, "Forever Yours, A Corporation's Contribution to its Environment," Minneapolis, Minnesota, 1972.

6. National Academy of Engineering, "Engineering for the Resolution of the Energy-Environment Dilemma," 1972, Appendix C.

7. Northern States Power Company, "Monticello Environmental Report Supplement 1," Minneapolis, Minnesota, April 4, 1972.

8. Northern States Power Company, "Supplement to the Prairie Island Environmental Report and Supplements 1 and 2," Minneapolis, Minnesota, November 5, 1971; June 7, 1972, and July 14, 1972.

9. Northern States Power Company, "System Growth," testimony on February 2, 1970 to Minnesota Governor LeVander's Environmental Cabinet (copies available from NSP Information Department).

10. Northern States Power Company, "Power for Progress from NSP's Allen S. King Steam-Electric Generating Plant on Lake St. Croix," Minneapolis, Minnesota, 1969.

11. Environmental Protection Agency, "Regulation in Standards of Performance for New Stationary Sources," 40 CFR 60, and 36 FR 24876, December 23, 1971.

12. Federal Power Commission, "The 1970 National Power Survey" (see Table 19.3, p. I-19-4 for plant costs: Table 4.2, p. I-4-3, and Fig. 4.9, p. I-4-28 for coal costs).

13. Atomic Energy Commission, "Final Environmental Statement on Fort Calhoun Plant" (Docket No. 50-285) Appendix: Comments of the Federal Power Commission.

14. K. A. Roe and W. H. Young, "Trends in Capital Costs of Generating Plants," Power Engineering, June 1972, pp. 40-43.

REFERENCES (Contd.)

15. Duane Arnold Energy Center, Environmental Report, Docket 50-331, April 1971, pp. 8.1-6 and 8.1-7.

16. P. W. Spaite, "SO_2 Control; Status, Cost and Outlook," Power Engineering, October 1972, pp. 34-37.

17. U. S. Environmental Protection Agency, "Compilation of Air Pollutant Emission Factors (Revised)" February 1972, Table 1-2.

18. National Academy of Engineering, "Engineering for the Resolution of the Energy-Environment Dilemma," 1972, p. 117.

19. Atomic Energy Commission, "Draft Environmental Statement on Monticello Nuclear Generating Plant," Docket No. 50-263, May, 1972, p. XI-3.

20. F. L. Parker and P. A. Krenkel, "Thermal Pollution: Status of the Art," Vanderbilt University, School of Engineering, Nashville, Tennessee, December 1969.

21. Westinghouse Electric Company, "Dry Cooling Affects More Than Costs," Electrical World, July 1, 1972, pp. 50-54.

22. Northern States Power Company, "Information Pertaining to the Environmental Review," November 15, 1972, Docket Nos. 50-282, 50-306.

23. U. S. Atomic Energy Commission, Hearings in the Matter of Portland General Electric Company et al (Trojan Nuclear Plant), Docket No. 50-344, pp. 226-232, May 2, 1972, including Exhibit No. 7.

24. Iowa Electric Light and Power Co., "Duane Arnold Energy Center Environmental Report: Amendment 1, Section F," July 1972, USAEC Docket No. 50-331.

25. Federal Power Commission, "1970 National Power Survey," Part III, West Central Region.

26. Green, H. P., "The National Environmental Policy Act in the Courts," ALI-ABA, "Course of Study on Atomic Energy Licensing and Regulation," III, September 21-23, 1972, Washington, D.C.

Appendix A References

1. Northern States Power Company, "Environmental Report Supplement for the Prairie Island Nuclear Generating Plant, Units 1 and 2, Red Wing, Minnesota," June 7, 1972.

REFERENCES (Contd.)

2. Northern States Power Company, "Prairie Island Nuclear Generating Plant Environmental Report," Minneapolis, Minnesota, November 1971.

3. U. S. Dept. of the Interior, "Endangered Species of the United States," Official List, revised October 1970.

APPENDIX A: BIOTA OF THE REGION

TABLE A-1 Prairie Island Area Trees[1]

1) The major tree species of the floodplain areas of the site are:

Silver Maple
(*Acer saccharinum*)

Cottonwood
(*Populus deltoides*)

Green Ash
(*Fraxinus pennsylvanica*)

American Elm
(*Ulmus americana*)

Willows
(*Salix spp.*)

Box Elder
(*Acer negundo*)

River Birch
(*Betula nigra*)

2) The dryer flat upland areas have the following species:

Burr Oak
(*Quercus macrocarpa*)

Pin Oak
(*Quercus ellipsaidalis*)

Eastern Redcedar
(*Juniperus virginiana*)

3) The north-facing slopes of the valleys in the vicinity of the site have:

Sugar Maple
(*Acer saccharum*)

American Basswod
(*Tilia americana*)

Paper Birch
(*Betula paprifera*)

Ironwood
(*Carpinus caroliniana*)

Black Walnut
(*Juglans nigra*)

Butternut
(*Juglans cinerea*)

4) The dryer south-facing slopes are characterized by:

Burr Oak
(*Quercus macrocarpa*)

Red Oak
(*Quercus rubra*)

Northern Pin Oak
(*Quercus ellipsoidalis*)

White Oak
(*Quercus alba*)

Trembling Aspen
(*Populus tremuloides*)

Bitternut Hickory
(*Carya cordiformis*)

Eastern Redcedar
(*Juniperus virginiana*)

TABLE A-2 Insects of the Prairie Island Region[a]

Species	Remarks
Springtails	Arthropods of the order Collembola; common in the lower areas in the early spring.
Red-legged grasshopper	Melanopus fermur-rubrum, M. differentialis and other grasshopper species are common in the prairie regions in summer.
House flies and stable flies	Musca domestica and Stomoxys calcitrans are two common dipterans that live in the area and breed in the river shore debris.
Saw flies	American saw-fly (Cimbex americanus), cherry "slug" (Eriocampoides limacina) and other species. These are hymenopterans of the Tenthredinidae family. The larvae eat foliage or bore in stems, etc. Saw flies are not major pests at Prairie Island.
Ground beetles	Several species are common.
Elm bark beetles	(Hylurgopinus rufipes, the native species, and Scolytus multistriatus, the small European species.) The carriers of the fungus that causes Dutch Elm disease; they may be the most important forest insects.
European corn borer	(Pyrausta nubilalis, an old world moth.) A threat to untreated corn and potato crops; may be damaging if conditions are right.
Box-elder bugs	(Leptocoris trivittatus of the family Coreidae.) Abundant but not a major problem. A red and black sap-sucking bug that prefers box elder trees, but also feeds on fruit, hibernates in buildings.
Tent caterpillar	(Malocosoma americana.) Common in areas growing choke cherry; may defoliate trees.

[a]Mosquitoes excluded; see Section II.E.2.

TABLE A-3 Migratory Birds, Predominantly Terrestrial, Characteristic of the Prairie Island Plant Area

Common Names of Bird Families	Common Names of Bird Species
Herons	Black-crowned night
Hawks	Goshawk, sharp-skinned, broad-winged, red-shouldered, rough-legged, osprey, perigrine falcon, pigeon, bald eagle
Plovers	Semipalmated, golden, black-bellied, ruddy turnstone
Sandpipers	Solitary, greater yellowlegs, lesser yellowlegs, pectoral, white-rumped, least, dunlin, short-billed dowicher, long-billed dowicher, semi-palmated, sanderling
Phalaropes	Wilson's
Terns	Forester's, Caspian
Cuckoos	Yellow-billed, black-billed
Owls	Long-eared, short-eared
Flycatchers	Yellow-billed, traill's, olive-sided
Titmouse	Tufted
Nuthatches	Red-breasted
Creepers	Brown
Wren	Winter
Thrushes	Hermit, Swainson's, gray-cheeked, veery
Kinglets	Golden-crowned, ruby-crowned
Shrikes	Northern
Vireos	Solitary, Philadelphia
Warblers	Black and white, golden-winged, Tennessee, orange-crowned, Nashville, parula, magnolia, Cape May, myrtle, black-throated green, blackburnian, chestnut-sided, bay-breasted, blackpoll, pine, palm, northern waterthrush, Connecticut, mourning, Wilson's

TABLE A-3 (Contd.)

Common Names of Bird Families	Common Names of Bird Species
Blackbirds	Rusty, Brewer's
Finches	Evening grosbeak, purple finch, common redpoll, pine siskin
Sparrows	LeConte's, Henslow's, slate-colored junco, Tree
Longspur	Lapland

TABLE A-4 Nesting Birds Living within 10 Miles of the Plant

Common Names of Bird Families	Common Names of Bird Species
Herons	Great blue, green
Egret	Common, American
Bittern	Least
Vulture	Turkey
Hawks	Coopers, red-tailed, marsh, sparrow
Grouse	Ruffed
Pheasant	Ring-necked
Rails	Virginia, sora
Plovers	Killdeer
Sandpipers	Woodcock, spotted
Terns	Black
Doves	Rock, mourning
Owls	Great horned, barred
Swift	Chimney
Hummingbird	Ruby-throated
Kingfisher	Belted
Woodpeckers	Flicker, pileated, red-bellied, red-headed, yellow-bellied sapsucker, hairy downy
Flycatcher	Eastern kingbird crested, phoebe, least, wood pewee
Lark	Horned
Swallows	Tree, bank, rough-winged, barn, purple martin
Whip-poor-will.	

TABLE A-4 (Contd.)

Common Names of Bird Families	Common Names of Bird Species
Jays	Blue
Chickadee	Black-capped
Nuthatches	White-breasted
Wren	House, long-billed marsh, short-billed marsh
Thrasher	Brown
Thrushes	Robin, wood, bluebird
Gnatcatcher	Blue-gray
Waxwings	Cedar
Vireos	Yellow-throated, red-eyed, warbling
Warblers	Blue-winged, yellow ovenbird, yellowthroat, redstart
Starling	Starling
Blackbirds	Bobolink, eastern meadowlark, western meadowlark, red-winged, baltimore oriole, grackle, cowbird
Tanager	Scarlet
Finches	Cardinal, rose-breasted grosbeak, indigo bunting, dickcissel, goldfinch, ruffous-sided towhee
Sparrows	Savannah, grasshopper, vesper, lark, chipping clay-colored, field swamp, song, house
Crow	Common
Catbird	Grey
Night Hawk	Brown

TABLE A-5 Reptiles Identified within 10 Miles of the Plant

Sauria (lizards)

Cnemidophorus sexlineatus - Six-lined racerunner

Eumeces septentrionalis - Banded skink

Serpentes (Snakes)

Diadophis punctatus - Ring-necked snake

Heterodon contortrix - Eastern hognose snake

Opheodrys vernalis - Smooth green snake

Coluber constrictor - Blue racer

Elaphe volpina - Fox snake

Pituophis melanoleneus sayi - Bull snake

Lampropeltis getulus - Milk snake

Natrix Sipedon - Banded water snake

Storeria dekayi - Brown snake

Thamnophis radix - Plains garter snake

Sistrurus catenatus - Swamp rattle snake

Crotalus horridus - Timber rattle snake (rare)

Testudinata (Turtles)

Chelydra serpentina - Snapping turtle

Cremmys insculpta - Wood turtle

Emys blandingii - Blandings turtle

Graptemys geographica - Map turtle

Chrysemys pilta belli - Painted turtle

Trionyx mutila - Smooth soft-shelled turtle

Trionyx spinifer - Spiny soft-shelled turtle

Graptemys pseudogeographica - False map turtle

TABLE A-6 Algae in the Plankton of the Mississippi River[1]

Cyanophyta

Chroococcaceae

Aphanocapsa delicatssimia
Aphanocapsa elachista var. conferta
Chroococcus dispersus var. minor
Merismopedia tennuissima
Microcystis aeruginosa f. aeruginosa
M. incerta
M. wesenbergii
Gomphosphaeria naegeliana
G. compacta
Marssoniella elegans

Oscillatoriaceae

Oscillatoria agardhii
O. geminata
O. tenuis
O. limnetica
O. redekii
Lyngbya contorta
Lyngbya limnetica
Aphanizomenon flos aquae
A. elenkinii
Anabaena flos aquae
A. circinalis
A. circinalis forma affinis
A. planctonica
A. spiroides
Anabaenopsis raciborskii
Anabaenopsis sp.
Raphidiopsis curvata
R. mediterraneana

Chlorophyta

Volvocales

Chlamydomonas spp.
Eudorina elegans
Sphaerocystis schroeteri
Gemellicystis neglecta
Elaktothrix gelatinosa

TABLE A-6 (Contd.)

Chlorococcales

Ankistrodesmus falcatus
A. falcatus var. mirabile
var. spirilliformis
var. acicularis
Dictyosphaerium ehrenbergianum
D. pulchellum
Oocystis spp.
Scenedesmus abundans
S. arcuatus
S. brasiliense
S. bernardii
S. perforatus
S. dimorphus
S. quadricauda
S. opoliensis
S. armatus
S. bijuga
Pediastrum simplex
P. simplex var. clathratum
P. boryanum
P. tetras
P. duplex
P. duplex var. clathratum
Coelastrum cambricum
C. microporum
Tetrastrum staurogeniaeforme
Actinastrum hantzschii
Closteriopsis longissima
Tetraedron muticum
T. caudatum
T. hastatum
T. trigonum
Chodatella genevensis
C. wratislawiensis
C. ciliensis
Crucigenia tetrapedia
C. apiculata
C. quadrata

Desmidiales

Closterium aciculare var. variabile
C. acutum
Cosmarium spp.
Staurastrum chaetoceras
S. pingue

TABLE A-6 (Contd.)

Euglenophyta

- Euglena acus
- E. gracilis
- Euglena spp.
- Phacus sp.
- Trachelomonas volvocina
- T. spp.

Cryptophyta

- Chroomonas acuta
- Cryptomonas erosa
- Cryptomonas spp.
- Katablepharis ovalis

Chrysophyta

- Chrysophyceae
    - Chrysococcus sp.
    - Bioeca planctonica
    - Stichogloeoa doederleini
    - Mallomonas spp.
    - Synura sp (petersenii)
- Bacillariophyceae
    - Melosira granulata
    - M. granulata var. angustissima
    - Melosira cf. ambigua
    - Melosira cf. islandica
    - Cyclotella spp.
    - Stephanodiscus spp.
    - Stephanodiscus astraea
    - S. astraea var. minutula
    - S. niagarae
    - Asterionella formosa
    - Synedra acus
    - S. acus var. angustissima
    - Synedra spp.
    - Fragilaria crotonensis
    - Nitzschia acicularis
    - Nitzschia spp.

TABLE A-7 Macroinvertebrates Collected in the Mississippi River Study Area near the Plant Site

Common Name	Genus/Species	Common Name	Genus/Species
Bryozoans		Isopod crustaceans	
	Plumatella repens		Asellus militaris
Worms		Crayfish	
	Limnodrilus (sp.)		(immature)
	Tubifex tubifex		
		Stoneflies	
Flatworms			Isoperla (sp.)
	Dugesia tigrinum		Perlodes (sp.)
	Helobdella stagnalis		
	Placobdella parasitica	Mayflies	
			Stenonema (sp. -1)
Snails			Stenonema (sp. -2)
	Goniobasis (sp.)		Caenis (sp.)
	Physa heterostropha		Baetis (sp.)
	Pseudosuccinea (sp.)		Pseudocleon (sp.)
	Ferrissia cf. laeviplex		Ephemerella (sp.)
		Dragonflies	
Clams			Gomphus (sp.)
	Amblema rariplicata		
	Quadrula pustulosa	Damselflies	
	Pleurobema coccineum		Ischnura (sp.)
	Lampsilis siliquoidea		Hyponeura (sp.)
	Proptera alata		Argia (sp.)
	Fusconia undata		
	Lampsilis ovata ventricosa	Caddis-flies	Hydropsyche simulans
	Musculium (sp.)		Hydropsyche orris
	Psidium (sp.)		Cheumatopsyche (sp.)
			Neuroclipsis (sp.)
Amphipod crustaceans			Polycentropus (sp.)
	Hyalella azteca		Athripsodes (sp. -1)
	Gammarus gammarus		Athripsodes (sp. -2)
	Gammarus fasciata		Oecetis (sp.)
			Pycnopsyche (sp.)
Adult Beetles			Agraylea multipunctata
	Rhizelmis (sp.)		
Larval Beetles		Dipterans	
	Rhizelmis (sp.)	(Midges)	Tanytarsus (sp.)
			Stictochironomus (sp.)
Dipterans			Cryptochironomus (sp.)
(Midges)	Parachironomus (sp.)		Dicrotendipes (sp.)
	Glyptotendipes (sp.)		Coryneura (sp.)
	Thienemaniella (sp.)		Cricotopus (sp.)
	Eukiefferiella (sp.)		Psectrocladius (sp.)
	Pentaneura (sp.)		

TABLE A-8 Common and Scientific Names of Adult Fish Found in the Mississippi River near Prairie Island in 1970[2]

Scientific Name	Common Name
Amia calva	Dogfish (Bowfin)
Lepisosteus platostomus	Shortnose Gar
Dorosoma cepedianum	Gizzard Shad
Hiodon tergisus	Mooneye
Esox lucius	Northern Pike
Ictiobus cyprinellus	Largemouth Buffalo
Ictiobus bubalus	Smallmouth Buffalo
Moxostoma anisurum	Silver Redhorse
Moxostoma macrolepidotum	Shorthead Redhorse
Moxostoma valenciennsei	Greater Redhorse
Cyprinus carpio	European Carp
Ictalurus punctatus	Channel Catfish
Pylodictis olivaris	Flathead Catfish
Ictalurus natalis	Yellow Bullhead
Roccus chrysops	White Bass
Micropterus salmonoides	Largemouth Bass
Micropterus dolomieui	Smallmouth Bass
Promoxis nigromaculatus	Black Crappie
Promoxis annularis	White Crappie
Ambloplites rupestris	Rock Bass
Lepomis macrochirus	Bluegill
Stizostedon vitreum	Walleye
Stizostedon canadense	Sauger
Aplodinotus grunniens	Freshwater Drum

TABLE A-9 Minnows and Forage Fish in Vicinity of Lock and Dam No. 3[2]

Sturgeon Lake Fish	Mississippi River Main Channel
Minnows:	Minnows:
Cyprinus carpio	*Cyprinus carpio*
Notemigonus	*Notemigonus crysoleucas*
Notropis blennius	*Notropis blennius*
Notropis hudsonius	*Notropis hudsonius*
Notropis spilopterus	*Notropis spilopterus*
Pimephales promelas	*Notropis dorsalis*
	Notropis atherinoides
	Percina caprodes semifasciata
Young Forage Fish:	Young Forage Fish:
Dorosoma cepedianum	*Dorosoma cepedianum*
Moxostoma spp.	*Hiodon tergisus*
Pomoxis spp.	*Moxostoma* spp.
Roccus crysops	*Roccus crysops*
Ictaluridae	*Promoxis* spp.
Lepomis spp.	*Amia calva*[a]
	Lepisosteus spp.[a]
	Acipenseridae[b]

[a]Fish not captured, yet identifiable and under six inches.

[b]Family containing sturgeon, an endangered species.[3]

UNITED STATES DISTRICT COURT
DISTRICT OF MINNESOTA
FOURTH DIVISION

Minnesota Environmental Control Citizen's Association, a non-profit Minnesota corporation; Russell J. Hatling; and E. Taylor Hare, Plaintiffs,	)	
v.	)	MEMORANDUM AND ORDER
The United States Atomic Energy Commission; James R. Schlesinger, Chairman, James T. Ramey, Wilfrid E. Johnson, William O. Doub, and Clarence E. Larson, as Members of the United States Atomic Energy Commission; Peter A. Morris, Director, Division of Reactor Licensing, United States Atomic Energy Commission; and Northern States Power Company, a Minnesota Corporation, Defendants.	)	No. 4-72 Civ.109

This is an action brought by plaintiffs under the National Environmental Policy Act, 42 U.S.C. 4321 et seq. to enjoin further development and operation of two nuclear generating plants operated by defendant Northern States Power Company because of the alleged failure of the Atomic Energy Commission defendants to follow the requirements of the Act.

The Atomic Energy Commission issued a construction permit for the Monticello generating plant in June, 1967. A provisional operating permit was issued in September, 1970, following public hearings held from April through August of 1970. In January, 1971 full-power operation of the Monticello plant was authorized under the provisional operating permit.

Plaintiffs assert that the aforementioned activity, which is said to constitute "major federal action" under NEPA, took place without the full scale environmental review mandated by NEPA. The defendants, while apparently acknowledging that NEPA has been violated, maintain that they have taken cognizance of environmental effects and thus have complied with the "spirit" of the Act.1/

1/ A contention to which this Court can attach no legal significance

Filed July 31 1972
Harry A. Sieben, Clerk
By [signature]

The National Environmental Policy Act was signed into law on January 1, 1970. Since that time, it has been apparent that the AEC has complied with the Act only grudgingly; see Calvert Cliffs Coordinating Committee v. AEC, 449 F.2d 1109 (D.C. Cir. 1971).2/ After the first set of AEC regulations promulgated under the National Environmental Policy Act were disapproved in the Calvert Cliffs decision, the AEC issued new regulations in Appendix D to 10 C.F.R. Part 50 setting forth guidelines to be followed by the AEC for achieving compliance with NEPA. Pursuant to these regulations, the AEC on November 18, 1971, made a determination not to suspend operation of the Monticello facility pending completion of the environmental review required by NEPA. On December 23, 1971, plaintiff Minnesota Environmental Control Citizens Association (MECCA) filed a timely objection to the AEC decision not to suspend and requested a public hearing on this issue. On May 3, 1972, nearly four and one-half months later, the AEC responded to the MECCA petition by granting a hearing on an interim shutdown. However, no date has been set for such hearing, and it appears that the issue will be consolidated for hearing on the full-power 40-year license and hearing on the full environmental review. Thus, the delay in hearing MECCA's petition has resulted in a denial of the interim relief MECCA requested and has rendered meaningless any hearing on the issue raised by MECCA, that is whether the plant should be shut down pending the environmental review.

In early June, when this case was heard on plaintiffs' motion for summary judgment and defendants' motions to dismiss, the AEC produced a first draft of the proposed environmental statement required by NEPA. This is the first step in the production of the

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2/ In Calvert Cliffs, supra, the Court of Appeals for the District of Columbia said: We believe that the Commission's crabbed interpretation of NEPA makes a mockery of the Act. 449 F.2d at p.1117.

full environmental statement; the first draft is to be revised after comments are received from the public and other governmental agencies and interested parties, and after any hearings the AEC may hold on the environmental statement.

The other nuclear generating plant that is the subject of this lawsuit is the NSP facility at Prairie Island, Minnesota. A construction permit was issued for Prairie Island in June, 1968, and construction was commenced shortly thereafter. Defendant NSP filed a request for operating licenses for Prairie Island in February, 1971. Notice of a hearing on this application has not been given to date. On November 26, 1971, the AEC, pursuant to its Appendix D regulations cited above, determined that construction activities need not be suspended pending completion of the NEPA environmental review. This determination was published in the Federal Register on December 3, 1971 (36 F.R. 23086). However, no request by MECCA or others was made for a hearing on this determination.

Environmental review on the Prairie Island facility is currently in process. However, no first draft environmental statement has been published nor have any hearings been scheduled on this matter.

I.

Before examining the merits of plaintiffs' claims under NEPA, the Court first turns to defendants' motions to dismiss.

Jurisdiction is established pursuant to 28 U.S.C. 1361 and 28 U.S.C. 1331. Izaak Walton League v. Schlesinger, 337 F.Supp.287 (D.D.C. 1971). Plaintiffs' basic contention is that, in failing to comply with the terms of NEPA, the AEC defendants have acted outside their statutory authority. In such situation, mandamus is clearly appropriate, Peoples v. Department of Agriculture, 427 F.2d 561 (D.C. Cir. 1970), and thus the District Court has jurisdiction to review such contentions. This action does not seek review of final agency action, but only a determination of whether the defendants have complied with the law. See Kalur v. Resor, 335 F.Supp. 1 (D.D.C. 1971); Murray v. Vaughn, 300 F.Supp. 688 (D. R.I. 1969). Nor do plaintiffs seek a determination of the validity of the AEC regulations, Appendix D. to 10 C.F.R. Part 50; thus 28 U.S.C. 2342 is inapplicable here. See Izaak Walton League v. Schlesinger, supra.

This Court concludes, as did the court in Kalur, supra, that jurisdiction is established as to all defendants by virtue of the general federal question jurisdictional statute, 28 U.S.C. 1331. Further it appears that plaintiffs' good faith allegation of amount in controversy exceeding $10,000 is sufficient to sustain such jurisdiction. St. Paul Mercury Indemnity Co. v. Red Cab Co., 303 U.S. 283 (1937). Illinois v. City of Milwaukee ____U.S.____, 92 S.Ct. 1385 (1972).

The Court also concludes that plaintiffs need not exhaust administrative remedies on two grounds. First, as noted above, it was apparent in plaintiff MECCA's attempt to seek review of the AEC determination that such attempt was futile, and as a practical matter, plaintiffs have no administrative remedies. And second, this clearly is a situation where plaintiffs need not exhaust administrative remedies because their contention is that the agency acted outside its statutory authority. In Skinner & Eddy v. United States, 249 U.S. 557 (1919) a shipper sued to enjoin a rate increase ordered by the Interstate Commerce Commission claiming that the order violated the Interstate Commerce Act. The court held that in such a situation the shipper did not need to exhaust administrative remedies even though they were available. The rationale is that where administrative agency action and procedure exceeds statutory authority, and the issues do not involve agency discretion or expertise, the plaintiff need not exhaust administrative remedies. See also: Allen v. Grand Central Aircraft Co., 347 U.S. 535 (1954); McKart v. United States, 395 U.S. 185 (1969).

As to the AEC defendants, the action is not barred by the sovereign immunity doctrine. The allegation that defendants' acts are contrary to law brings this action within the exception to the doctrine of sovereign immunity recognized by the Supreme Court in Dugan v. Rank, 372 U.S. 609 at 621 (1963). See also, Kalur v. Resor, supra.

Finally, there is no question that plaintiffs have the requisite interest in the subject matter of this litigation to confer upon them standing to sue. Sierra Club v. Morton, ____ U.S. ____, 92 S.Ct. 1361 (1972).

II.

The National Environmental Policy Act, 42 U.S.C. 4321, et seq requires that a detailed statement of environmental impact be prepared prior to any major federal action. The key section of the Act, which the Court is here called upon to interpret, provides that all agencies of the federal government, including the Atomic Energy Commission, shall:

> (A) utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and the social sciences and the environmental design arts in planning and in decisionmaking which may have an impact on man's environment;
> (B) identify and develop methods and procedures, in consultation with the Council on Environmental Quality established by Title II of this Act, which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision-making along with economic and technical considerations;
> (C) include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on -
> (i) the environmental impact of the proposed action,
> (ii) any adverse environmental effects which cannot be avoided should the proposal be implemented,
> (iii) alternatives to the proposed action,
> (iv) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and
> (v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.
> Prior to making any detailed statement, the responsible Federal official shall consult with and obtain the comments of any Federal agency which has jurisdiction by law or

> special expertise with respect to any environmental impact involved. Copies of such statement and the comments and views of the appropriate Federal, State and local agencies, which are authorized to develop and enforce environmental standards, shall be made available to the President, the Council on Environmental Quality and to the public as provided by Section 552 of Title 5, United States Code, and shall accompany the proposal through the existing agency review processes;
> (D) study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources; . . . . Section 102(2).

It is clear that the Monticello and Prairie Island facilities were on-going projects at the time NEPA took effect. With respect to Monticello, however, there were permits issued after the enactment of NEPA that clearly constitute major federal action. As for Prairie Island, the continued construction, under the supervision of the Atomic Energy Commission, must be deemed to be major federal action within the meaning of the Act. And further, a permit for an operation has been applied for, and that will constitute major federal action. The Council on Environmental Quality has set forth guidelines for ensuring compliance with NEPA with respect to on-going projects. Section 11 of the Council's Guidelines provides:

> Application of Section 102(2)(C) procedure to existing projects and programs. To the maximum extent practicable. the section 102(C)(2) procedure should be applied to further major Federal actions having a significant effect on the environment even though they arise from projects or programs initiated prior to the enactment of the Act on January 1, 1970. Where it is not practicable to reassess the basic course of action, it is still important that further incremental major actions be shaped so as to minimize adverse environmental consequences. It is also important in further action that account be taken of environmental consequences not fully evaluated at the onset of the program.

While NEPA by its terms has been held not to apply retroactively to projects begun before January 1, 1970, federal involvement after that date must be preceded by the scrutiny of an environmental impact statement. Texas Committee on Natural Resources v. United States, ___F.Supp.____ (W.D. Tex. 1971), 1 Environment Reporter 1303, San Antonio Conservation Society v. Texas, 446 F.2d 1013 (5th Cir. 1971), Environmental Defense Fund v. Corps of

Engineers, 325 F.Supp. 749 (E.D. Ark. 1971). It is abundantly clear that plaintiffs and the general public were entitled to a full environmental review "forthwith" following the enactment of NEPA, Calvert Cliffs, supra at p. 1120, in order to ensure that the Monticello and Prairie Island projects would not become developed to the point that the environmental review would be meaningless or developed to the point that alternative technology for the protection of the environment would be impracticable to install.

More than two and one-half years have passed since the enactment of NEPA and plaintiffs are only now getting the environmental review they have all along been entitled to. This Court believes that plaintiffs are entitled to have the Atomic Energy Commission consider the alternatives to the Monticello and Prairie Island projects as they existed immediately after the enactment of NEPA. Section 2 of the Council on Environmental Quality Guidelines requires that the NEPA environmental review take place "as early as possible . . . in order to avoid to the fullest extent practicable undesirable consequences for the environment. . . ." Because defendants have delayed this environmental review, they must now consider all environmental options that existed just after January 1, 1970, in addition to the options now available that are under review. The defendants cannot take the position that time and further development of these projects has foreclosed some options that would have been available when NEPA was enacted. As the Court of Appeals for the District of Columbia stated in the Calvert Cliffs decision, supra:

> (T)he section 102 duties are not inherently flexible. They must be complied with to the fullest extent, unless there is clear conflict of statutory authority. Considerations of administrative difficulty, delay or economic cost will not suffice to strip the section of its fundamental importance. 449 F.2d at p.1115.

See also Ely v. Velde, 451 F.2d 1130 (4th Cir. 1971). This Court takes no position on whether these two nuclear projects had reached the stage of development in early 1970 that it was not practicable to reassess the basic course of action. This decision would best be made after completion of the NEPA environmental review. It is quite clear, however, that expeditious completion of the environmental review is required. If the basic course of action must be altered or abandoned, it is most feasible to do so at an early date in order to minimize economic costs. The past history of the AEC's handling of the environmental review of these nuclear facilities, particularly Monticello, indicates that the AEC's methods threaten to delay completion of the NEPA review to a point when reconsideration of the basic course of action may no longer be feasible and the so-called "energy crisis" will have led to a "blackout of environmental consideration." See Calvert Cliffs, supra, at p.1122.

The procedures described in NEPA are "nothing less than a mandate," National Helium Corp. v. Morton, 326 F.Supp. 151 (D. Kans. 1971) which establish a "strict standard of compliance" and "judicially enforceable duties;" Calvert Cliffs, supra, at p.1115. Thus this Court will continue jurisdiction of this case to ensure that full environmental review will be made in accordance with NEPA, as explicated above.

This Court disagrees with plaintiffs that NEPA mandates an injunction closing down the two projects pending final NEPA review, although such relief was granted in other circumstances in Izaak Walton League v. Schlesinger, supra. See also, Arlington Coaltion v. Volpe, ____F.2d ____, (4th Cir. 1972). Nothing in the Act or the Council on Environmental Quality Guidelines requires that all ongoing projects be stopped pending environmental review. To the contrary, the Council on Environmental Quality Guidelines, in Section 11 quoted above, states that for ongoing projects the section 102(C)(2) procedures should be applied "to the maximum extent practicable." In this case, the guidelines do not require suspension of these projects to protect the plaintiffs' interests. However, to ensure that plaintiffs' right to a full and meaningful review will not be irretrievably lost, the Court will retain jurisdiction of this matter. Defendants have proceeded at their own peril with these projects since early 1970 without a full environmental review. If these delays make backfitting of technological changes more expensive now than they would have been in 1970, such additional expense will not justify their omission.[3] The Court's jurisdiction will continue in order to ensure that plaintiffs are not foreclosed from any rights they have to a full and meaningful environmental review under NEPA.

In accordance with the foregoing memorandum,

IT IS ORDERED that defendants' motions to dismiss are denied.

IT IS FURTHER ORDERED that plaintiffs' motion for summary judgment is denied.

The Court will continue jurisdiction of the matter for the purposes set forth above.

Milton W. Lord [signature]
United States District Judge

Dated: July 28, 1972.

3/ As stated by the court in Calvert Cliffs, supra:

> The procedural duties, the duties to give full consideration to environmental protection, are subject to a . . . strict standard of compliance . . . . If 'irreversible and irretrievable commitment(s) of resources' have already been made, the license hearing (and any public intervention therein) may become a hollow exercise. This hardly amounts to consideration of environmental values 'to the fullest extent possible.' 449 F.2d at p.1128.

THE ASSISTANT SECRETARY OF COMMERCE
Washington, D.C. 20230

50-282
50-306

March 7, 1973

RECEIVED MAR 9 1973 U.S. ATOMIC ENERGY COMMISSION Regulatory Mail Section

Mr. Daniel R. Muller
Assistant Director
for Environmental Projects
Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Muller:

The draft environmental impact statement for Prairie Island Nuclear Generating Plant, Units 1 and 2, which accompanied your letter of January 22, 1973, has been received by the Department of Commerce for review and comment.

The Department of Commerce has reviewed the draft environmental statement and has the following comments to offer for your consideration.

The description of the operational release of radioactive effluents to the atmosphere on pages III-31 to III-35 leaves unanswered the question of the period of release involved in the gas processing system. It is stated that before decay is completed in the hold-up tanks, "an occasional discharge may be required" and that "it was assumed that all gases will be released after 60 days." If, for example, 3 tanks are available, each collecting for a month period, held for decay for another 2 months, and then released to the atmosphere over a 24-hour period, the total annual release time would be 12 days. This, according to table III-3, is about 1/3 of the total annual release from all sources. An annual average dilution factor is not appropriate for such a release condition.

Although the question of steam and ice fogging is addressed in several sections, the draft environmental impact statement does not model these phenomena with respect to the Prairie Island facility. An analogy is made with a Sioux Falls, South Dakota facility which has disparate topographical features. Since the study was made at approximately 20°F ambient temperatures, we recommend that the ice fog question be modeled quantitatively using the upper Mississippi Valley's winter ambient conditions in order to determine mean and extreme plume heights and critical (or worst case) transport and dispersion characteristics of the plume effluents. Empirical, but still valid algorithms for these parameters and the input data is available.1/

Page II-22, second paragraph

The comparison of "game and rough fish proportions" summarized in Table II-10 appears to be biased, inasmuch as the samples were taken in two different type of habitat, thus tending to reflect the difference between lenthic and lotic habitats rather than the poor quality of Pool 3.

Page II-22, third paragraph

The figures given for commercial production in Table II-11 do not necessarily confirm the validity of the assertion that "the variation in annual yields indicates that the amount of effort devoted to it varies markedly." The magnitude of the commercial catch varies with fishing effort, availability of stocks, and market value. In addition, it should be noted that Pool 3 has an area of only 17,900 acres, whereas the area of Pool 4 is 38,820 acres.

1/ Workbook of atmospheric dispersion estimates, B. Turner, Air Res. Lab., Public Health Service, 99-AP-26, 3rd Printing-1970

- o Plume Rise, G.A. Briggs, NTIS Pub. #TID-25075 (NBS Pulication)
- o National Climatic Center, Ashville, N. C.

Page III-19, second paragraph

Although the flexibility of cooling-system operation and the variability of the discharge make it difficult to describe the thermal plume, diagrams for full once-through and closed-cycled cooling should be included to provide an approximation of the area affected by the heated discharge under extreme conditions.

Page III-22, third paragraph

Despite the fact that it is limited, the available information on the distribution of flow between Sturgeon Lake and the main channel of the river and the flow pattern within the lake itself should be presented so as to provide a basis for a more accurate estimate of the magnitude of the problem of entrainment of aquatic organisms.

Page IV-5, fifth paragraph

If the information requested in the comment for page III-22, third paragraph, were included, the actual percentage of water from each source could be determined. Moreover, it should be noted that the slough that has been sealed is now a slack water area rather than a flowing section.

Page V-14, second paragraph and V-15, second paragraph

Because the exact flow pattern from Sturgeon Lake is not known, and because this area is highly productive of microorganisms and larval fishes, we feel that the conclusion that the adverse effects on planktonic organisms will be insignificant may be premature, in view of the fact that the drifting organisms in the Sturgeon Lake flow must pass directly across the intake canal.

Page V-16, fourth paragraph

Even though blue-green algae may grow better at temperatures in excess of those expected in the river, the possibility that the combination of the heated effluent and the nutrient-rich Sturgeon Lake water may cause increased planktonic growth should be discussed. In addition, the possibility that the mid- and late-summer phytoplankton populations dominated by eutrophic species such as those referred to on Page II-63 would extend their period of dominance into the cooler portions of the year should be addressed.

Page V-19, second paragraph

It is stated that "the increased spring hatch of gizzard shad, due to lower winter mortality, provides an excellent food source for young piscivorous game fish." On the other hand, it is stated that "A shut down shad kill, if this were to occur, would not be a serious loss." It would seem that if young shad provide an excellent food source for young piscivorous game fish, then the role of shad as forage might be important enough to contradict the conclusion reached in the latter sentence.

Page V-20, sixth paragraph

The effects of chlorine on fish in the intake canal (inside the skimmer wall) during closed-cycle operation should be discussed.

Page V-23, section 5

This section should include a detailed description of the monitoring program, including sampling methods, equipment to be used, and frequency of sampling.

Page VII-4, fourth paragraph

Inasmuch as "Sturgeon Lake functions as a nursery area for young fish," it is important to provide an estimate of the fraction of Sturgeon Lake water that will pass through the condenser cooling system.

We hope these comments will be of assistance to you in the preparation of the final environmental impact statement.

Sincerely,

Sidney R. Galler

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

50-282
50-306

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT. CORPS OF ENGINEERS
1210 U. S. POST OFFICE & CUSTOM HOUSE
ST. PAUL. MINNESOTA 55101

IN REPLY REFER TO
NCSED-E

9 March 1973

RECEIVED MAR 12 1973

Mr. Daniel R. Muller
Assistant Director for
Environmental Projects
Directorate of Licensing
U.S. Atomic Energy Commission
Washington, D.C. 20545

Dear Mr. Muller:

This is in reply to your letter dated 22 January 1973, subject: Draft Environmental Statement for Prairie Island Nuclear Generating Plant Units 1 and 2, dated January 1973.

We have reviewed your environmental statement and found it to be generally complete and adequate. You may want to consider the attached suggested additions of the ecological specialist in our Environmental Resources Branch.

Thank you for the opportunity to review and comment upon the proposed general siting criteria.

Sincerely yours,

Rodney E. Cox

RODNEY E. COX
Colonel, Corps of Engineers
District Engineer

1 Incl.
As stated

COMMENTS ON PROPOSED NUCLEAR POWER PLANT AT PRAIRIE ISLAND

This is in reply to your letter of 22 January 1973, subject: Environmental Statement for Prairie Island Nuclear Generating Plant Units 1 and 2.

III. THE PLANT

a. Is the distribution of flow between Sturgeon Lake and the main channel being studied to better assess impacts (Page III-22, paragraph 3)?

b. What is the location of the offsite Solid Waste Disposal Area, and what will be the impact of radioactive waste disposal on the site (Page III-34)?

c. There is a considerable difference between your estimates and the applicant's estimates of tritium (Page III-31).

IV. ENVIRONMENTAL IMPACT OF SITE PREPARATION AND PLANT CONSTRUCTION

a. Discuss more fully the effects of prior site preparation (Page IV-3).

b. How was cleared vegetation disposed of (Page IV-5)?

c. Have studies on previous dredging shown that the benthic community will regenerate itself?

IV. ENVIRONMENTAL IMPACTS OF PLANT OPERATION

a. How will trash from trash racks be disposed of (Page V-13)?

b. Reproductive cycles of invertebrates should also be studied (Page V-23).

c. The degree to which a 40-year or longer exposure to low levels of radiation will impair function and cause mutations in man, plants, and aquatic and terrestrial animals should be determined (Page V-12, 23). Some scientists, such as Peter Alexander (1965, Atomic Radiation and Life), feel that every dose of radiation, even if quite small, increases to some extent the incidence of cancer. If such is the case, then even 21.7 man-rem/year is significant.

d. Estimate the total exposure to persons living downstream from nuclear power plants on the Mississippi River and its tributaries.

VI. ENVIRONMENTAL IMPACT OF POSTULATED ACCIDENTS

How would a flood like that of 1965, or one of greater magnitude, affect operation of the plant?

IX. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

a. What will be the impacts on source areas of obtaining fuel and materials for the power plant?

b. What will be the environmental impact of zirconium on the storage site?

X. NEED FOR POWER

Should not the Monticello and Black Dog plants be included on Table X4?

IX. ALTERNATIVES

The "Alternatives" section should discuss the various ways of reducing power consumption.

NSP

NORTHERN STATES POWER COMPANY

MINNEAPOLIS, MINNESOTA 55401

March 12, 1973

RECEIVED
MAR 15 1973
U.S. ATOMIC ENERGY COMMISSION

Deputy Director for Reactor Projects
Directorate of Licensing
U S Atomic Energy Commission
Washington, DC 20545

Gentlemen:

PRAIRIE ISLAND NUCLEAR GENERATING PLANT E-6197
Docket Nos. 50-282 and 50-306
Comments on Draft Environmental Statement

The recently issued Draft Environmental Statement for the Prairie Island Plant has been reviewed by appropriate NSP personnel. We find the statement's tone favorable and believe it places the environmental impacts in good perspective. However, pursuant to the comment opportunity afforded in the Notice of Availability published in the FEDERAL REGISTER of January 24, 1973, we are conveying these comments which we feel will clarify or expand specific areas within the statement.

Comment 1

Page iv/Sections a. & b.

These sections imply that NSP has not defined adequate radiological, chemical, biological or thermal monitoring programs to determine the effects on the environment from plant operation. The radiological monitoring program has been defined in the FSAR and Technical Specifications and this definition has been accepted by the AEC. This program has been underway for approximately two years. Proposed Non-Radiological Technical Specifications were submitted to the AEC on September 15, 1972. These specifications define an environmental chemical, biological, and thermal monitoring program. As a result of recent meetings, these Technical Specifications are now being revised to meet current AEC guidelines.

Comment 2

Page I-1/Section I./3rd paragraph - and Page IV-2/Table IV-1

Our current schedule for plant operations is:

	Unit 1	Unit 2
Fuel Loading	7-1-73	7-1-74
Power Operation	Late 1973	Late 1974

Comment 3
Page II-60/4th paragraph

The clam Lampsilis higginsii is an endangered species which has part of its natural range occurring within the Prairie Island stretch of the Mississippi River. The clam has been found in the St Croix River downstream from Stillwater, Minnesota, in the vicinity of NSP's Allen S King Generating Plant.

Comment 4
Page II-73/Section g/2nd paragraph

The Department of Natural Resources' regional fisheries manager has found that the area below Lock and Dam No. 3 is the major spawning and rearing area for game fish (sauger and walleye) when compared to the lower end of pool 3 where Prairie Island is located. This fact is important in evaluating entrainment of the game species in the plant's intake.

Comment 5
Page II-74/Table 2-26

In analyzing this table care should be taken in interpreting the percentages of rough and game fish. Although there is a substantial game fish population in the tail waters area as shown by a creel census, the data that shows 84% predators and approximately 16% prey would indicate a very low grazing population for the predators. This type of situation would mean that the predators would feed heavily upon themselves, thus lowering their own populations; therefore the data probably shows that the change from slack water habitat to fast water habitat may be the controlling factor in what fish species are sampled above and below the dam.

Comment 6
Page III-9/Section 3.b.

Even though NSP questions whether or not a fish loss will occur, we are concerned over a possibility that one may occur within the intake system. Such a loss could result from fish entering the system from under the barrier wall and becoming either entrapped within the intake canal or impinged on the intake screens. NSP has investigated possible design modifications to the intake system which will avoid such a problem should it occur.

On the basis of this investigation NSP is installing a bubbler system at the mouth of the intake canal in the vicinity of the barrier wall. This system will create a bubble curtain across the canal. Prior to plant startup testing of the system will

Comment 6

Page III-9/Section 3.b. - continued

be conducted. We feel such a curtain will be effective in reducing the number of fish entering the canal. If the bubbler system proves ineffective, an additional control device will be installed. Such devices as fixed or traveling screens at the barrier wall, or methods of returning trapped fish from the canal or impinged fish from the intake screens to the river will be considered.

Comment 7

Page III-15/Section C./1st paragraph - and Page V-15/Section 3.2./1st paragraph

The Prairie Island plant will be operated to meet the discharge temperature limits stated in the Technical Specifications and the permit issued by the Minnesota Pollution Control Agency. NSP will operate the condenser cooling system with cooling towers in service to the maximum degree practicable. Cold weather operating equipment has been installed on the cooling towers as an attempt to permit their use year-round; however, their operation in extreme cold conditions may cause severe icing and therefore may not be practicable. When the cooling towers are out of service due to repair or maintenance their operation is not possible, however, the temperature limitation will nonetheless be met. When only one unit is running, efficient facility operation dictates the use of two cooling towers.

Comment 8

Page III-39 and 40/Section c.

Water treatment specifications for the steam-generator system are currently being revised by the vendor. Indications are that phosphate levels, in the range of 15 ppm to 80 ppm as PO_4, will be required within the secondary system. In addition, a continuous steam-generator blowdown rate of 5 gpm (7200 gallons/day) may also be required. Hydrazine, and morpholine-cyclohexylamine treatment levels will probably remain the same, but naturally their discharge rates will increase in proportion to the increased blowdown rate. The demineralized water requirements, and associated chemical wastes, will also be increased due to the additional steam-generator system makeup requirements. Though the plant's chemical discharges will be increased significantly by this revision, these discharges will still be well below current regulation and permit requirements.

Comment 9

Page V-20 and 21/Section 4./3rd and 4th paragraphs

The Duluth Freshwater Quality Laboratory of the Environmental Protection Agency has given us data suggesting that chlorine residuals of 0.002 mg/l for continuous discharges, 0.05 mg/l for discharges which do not exceed two hours in any 24-hour period, and 0.1 mg/l for discharges not exceeding one hour in any 24-hour period are necessary to protect the receiving water biota. These limits will be met at the discharge to the river when chlorinating any system within the plant.

Comment 10

Page V-21/2nd paragraph

Though data concerning the effects of residual chlorine on fish and other organisms in natural water systems are not well documented, data are available which are applicable to the types of fish more characteristic to the Upper Midwest than salmon. The selection of salmon as an example is significant in that they, along with trout, appear to be the most sensitive fish species to chlorine. Seven-day TL50 dose concentrations for several species of fish found in the Upper Midwest are reported by J W Arthur of the National Water Quality Laboratory in Duluth, Minnesota. These are summarized as follows:

Walleye	0.15 mg/l
White sucker	0.13 mg/l
Yellow perch	0.20 mg/l
Largemouth bass	0.26 mg/l
Fathead minnow	0.05-0.16 mg/l

To put these levels into perspective the same investigations found TL50 dose concentrations from 0.015 to 0.083 for salmon and trout. These data indicate that the sensitivity of fish to residual chlorine is species specific; and as such, the above data are more applicable to Prairie Island.

Comment 11

Page VII-3/2nd paragraph

The wording implies that the release of very low levels of radioactivity, small quantities of chemicals, and heated water resulting from normal plant operation is potentially detrimental. NSP does not feel this inference is valid. The waste treatment and handling at Prairie Island is such that all operational releases will be well within applicable regulations which we feel are designed to protect the environment.

Comment 12
Page X-2/Section B.

The lead times of 76 months for fossil plants and 90 months for nuclear plants are too optimistic. Present-day numbers are in the order of 84 months for fossil units and 108 months for nuclear units, and indications are that these lead times are growing even longer.

Comment 13
Page X-5/Section B./2nd paragraph

NSP feels it is premature to make statements that the growth rate is declining, and that the public's reaction to our energy conservation program had already taken effect to the extent that daily demands would already have been reduced. Kilowatt hour sales to retail customers in 1972 were 8.6% higher than in 1971. The total System Integrated Hour Maximum Demand in 1972 was approximately 12.0% higher than in 1971. NSP's maximum demand growth trend has been at a rate of about 9% per year in recent years. The average growth rate for the period 1969 through 1972 was actually about 10.5%.

Comment 14
Page XI-7/2nd paragraph

A seventh site has recently been selected for a new coal fired baseload generating plant. This site, referred to as the Henderson site, is in Sibley County, Minnesota, near the Minnesota River, 55 miles southwest of the Twin Cities. The site was selected by the Minnesota Environmental Quality Council based on a recommendation of their Task Force on plant siting, and siting studies by NSP.

Comment 15
Page XI-33/Section c./2nd paragraph

The last sentence in this paragraph implies that the reduced diversity found in the fish population in pool 3 is due to the increased pollution of that area over the Monticello and Allen S King plant areas. This may not be the case. First, pool 3 includes a stretch of the St Croix River from which the Allen S King data were taken. Secondly, the diversity of the species in the Mississippi River adjacent to the upstream and downstream of the Prairie Island Nuclear Generating Plant is probably much greater than the diversity found at the Monticello plant. This is due to the fact that fish have migrated up the Mississippi River to the St Anthony Falls which was a physical barrier for fish migration further upstream. If all the species would be counted, it may be that the Mississippi River at Prairie Island has a greater diversity than that found at Monticello. Furthermore,

Comment 15

Page XI-33/Section c./2nd paragraph - continued

the data at Monticello represents a time span of approximately four more years of sampling than the Prairie Island data.

We trust the above comments can be reflected in the production of the Final Environmencal Statement.

Yours very truly,

E C Ward

E C Ward, Director
Engineering Vice Presidential Staff

Cc: Gerald Charnoff
Donald E Nelson
Minnesota Pollution Control Agency - Attn: K Dzugan

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

MAILING ADDRESS:
U.S. COAST GUARD (GWS/83)
400 SEVENTH STREET SW.
WASHINGTON, D.C. 20590
PHONE: 202 426-2262

50-282
50-306

1 5 MAR 1973

Mr. Daniel R. Muller
Assistant Director for
Environmental Projects
Directorate of Licensing
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Muller:

This is in response to your letter of 22 January 1973 addressed to Mr. John E. Hirten, Assistant Secretary for Environment and Urban Systems, concerning the draft environmental impact statement on the Prairie Island Nuclear Generating Plant, Goodhue County, Minnesota.

The concerned operating administrations and staff of the Department of Transportation have reviewed the material submitted. We have no comments to offer on the draft statement nor do we have any objection to the project.

The opportunity to review the draft statement is appreciated.

Sincerely,

J. D. McCANN
Captain, U. S. Coast Guard
Acting Chief, Office of Marine
Environment and Systems

DEPARTMENT OF AGRICULTURE
OFFICE OF THE SECRETARY
WASHINGTON, D. C. 20250

50-282
50-306

RECEIVED
MAR 22 1973
U.S. ATOMIC ENERGY COMMISSION
Regulatory
Mail Section

MAR 21 1973

Mr. Daniel R. Muller
Assistant Director for
Environmental Projects
Directorate of Licensing
Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Muller:

We have had the draft environmental statement for the Prairie Island Nuclear Generating Plant, Northern States Power Company, reviewed in the relevant agencies of the Department of Agriculture, and comments from Soil Conservation Service and Forest Service, both agencies of the Department, are enclosed.

Sincerely,

T. C. Byerly

T. C. BYERLY
Coordinator, Environmental
Quality Activities

Enclosures

February 16, 1973

Soil Conservation Service, USDA

Comments on Draft Environmental Statement prepared for the Prairie Island Nuclear Generating Plant by the Northern States Power Company (Docket Nos. 50-282 and 50-306) located in Goodhue County, Minnesota:

1. The statement could be strengthened by the addition of more detailed information on provisions for the control of erosion and management of water during and after construction. A project with such a long construction period should take into consideration the need for temporary seedings for wind erosion control and improving the appearance of the disturbed areas until permanent seedings can be made. The cost would be minimal as compared to the improved looks of the project. The statement indicated native plants would be used as much as possible on the surrounding area, but we failed to note how this was to be accomplished. The disposal of the surface water from the plant and parking areas, etc., will create a problem even though the soil is sandy. More clarification on how this additional water will be disposed of without causing erosion would be helpful.

2. The area selected for the site is marginal cropland as was indicated. The location selected is about as isolated as could have been found adjacent to the Mississippi River and reasonably close to the Twin Cities. Even though it will take over 500 acres out of agricultural production, we wouldn't consider it prime agricultural land.

3. The addition of some shrub and tree plantings on the border areas would be quite beneficial to wildlife.

4. Due to the limited time available for the reply, we did not have as much time as we would have liked to provide us an opportunity to visit the site. However, we believe the above comments cover our major areas of concern and expertise.

U. S. DEPARTMENT OF AGRICULTURE

Forest Service

Re: PRAIRIE ISLAND NUCLEAR GENERATING PLANT

The "proposal" is already largely in place - construction was well underway before NEPA, Consequently, the obvious impacts on forest land have already occurred.

The draft states that "prior to purchase of the site, the land area within the 560 acres acquired by the Applicant (for the plant site) was used solely for farming". But it appears from Figures II-6 and III-3 that some wooded areas were cleared. The draft states that approximately "240 acres have been disturbed"; it does not indicate how much of this area was wooded.

The draft (pages ii and III-1) states that new corridors for transmission lines, already cleared, total 33 or 34 miles, with an average width of 244 feet, and a total area of 973 acres. On page V-4 it states that 6% of the right-of-way was cleared of trees. This would amount to 58 acres. But Northern States Power Company's Environmental Report, page II-27 states that the 33.3 mile corridor totals 6041 acres, that it was .6 percent wooded, and that 34 acres of trees will be removed. Using the average width of 244 feet, we figure a total area of about 9770 acres, so we believe the NSP figure is more accurate than the figures in the draft.

The draft recognizes no impact of the clearing of forest land other than the impact on wildlife habitat. Aesthetic loss, and possibly loss of recreation use must also occur. The draft indicates by reference (page IV-4) that the USDI-USDA and FPC criteria and guidelines for transmission systems were conformed to.

ADVISORY COUNCIL
ON
HISTORIC PRESERVATION

WASHINGTON, D.C. 20240

50-282
50-306

March 21, 1973

Daniel R. Muller
Assistant Director for Environmental Projects
Directorate of Licensing
Atomic Energy Commission
Washington, D.C. 20545

Dear Mr. Muller:

This is in response to your request of January 22, 1973, for comments on the environmental statement for the Prairie Island Nuclear Generating Plant, Goodhue County, Minnesota. Pursuant to its responsibilities under Section 102(2)(C) of the National Environmental Policy Act of 1969, the Advisory Council on Historic Preservation has determined your draft environmental statement inadequate regarding our area of expertise as it does not contain sufficient information to enable the Council to comment substantively.

According to your statement, three major historic sites associated with Indian tribes of the region are located within 6 miles of the Plant. One of these sites, the Bartron Site, a property listed on the National Register of Historic Places, is on the Plant site. Your statement does not, however, give any indication of what effect the proposed undertaking will have on these sites.

To enable the Council to comment, please furnish additional data indicating:

a. Compliance with Section 106 of the National Historic Preservation Act of 1966 (16 U.S.C. 470(f)).

   1. If no National Register property is affected by the project, a section detailing this determination must appear in the environmental statement.

   2. If a National Register property is affected by the project, the environmental statement must contain an account of steps taken in compliance with Section 106 and a comprehensive discussion of the contemplated effects on the National Register property. (Procedures for compliance with Section 106 are enclosed).

b. Compliance with Executive Order 11593 of May 13, 1971.

   1. In the case of land under the control or jurisdiction of the Federal Government, a statement should be made as to whether or not the proposed undertaking will

result in the transfer, sale, demolition, or substantial alteration of potential National Register properties. If such is the case, the nature of the effect should be clearly indicated.

2. In the case of lands not under the control or jurisdiction of the Federal Government, a statement should be made as to whether or not the proposed undertaking will contribute to the preservation and enhancement of non-federally owned districts, sites, buildings, structures, and objects of historical, archeological, architectural, or cultural significance.

To insure a comprehensive review of historical, cultural, archeological, and architectural resources, the Advisory Council suggests that the environmental statement contain evidence of contact with the appropriate State Liaison Officer for Historic Preservation, and that a copy of his comments concerning the effects of the undertaking upon these resources be included in the environmental statement. The State Liaison Officer for Minnesota is Dr. Russell W. Fridley, Director, Minnesota Historical Society, 690 Cedar Street, St. Paul, Minnesota 55101.

Should you have any questions on these comments or require any additional assistance, please contact James Cardwell, of the Advisory Council staff.

Sincerely yours,

Ken Tapman
Compliance Officer

Enclosure

federal register

TUESDAY, NOVEMBER 14, 1972
WASHINGTON, D.C.

Volume 37 ■ Number 220

PART II

ADVISORY COUNCIL ON HISTORIC PRESERVATION

■

NATIONAL REGISTER OF HISTORIC PLACES

Protection of Properties; Procedures for Compliance

C-20

ADVISORY COUNCIL ON HISTORIC PRESERVATION

NATIONAL REGISTER OF HISTORIC PLACES

Protection of Properties; Procedures for Compliance

Pursuant to the National Historic Preservation Act of 1966 (80 Stat. 915, 16 U.S.C. 470), the Advisory Council on Historic Preservation has undertaken steps to implement the purposes of that Act through the revision of Procedures for Compliance previously set forth in paragraphs II A through C (37 F.R. 5430) of the FEDERAL REGISTER of March 15, 1972. In addition, the role and functions of the Advisory Council on Historic Preservation have been more clearly defined. Proposed revisions and clarifications were published in the FEDERAL REGISTER of July 15, 1972 (37 F.R. 14007) and 30 days were allowed for comment.

It is the purpose of this notice, through publication of the revised procedures, to apprise the public as well as governmental agencies, associations, and all other organizations and individuals interested in historic preservation, that the following procedures are hereby adopted as set forth below and will take effect 30 days after publication of this notice in the FEDERAL REGISTER. Inquiries regarding the substance of, and compliance with, the procedures should be directed to the Executive Secretary, Advisory Council on Historic Preservation, Suite 430, 1522 K Street NW., Washington, DC 20005.

THOMAS FLYNN,
Executive Director, Advisory Council on Historic Preservation.

PROTECTION OF PROPERTIES IN THE NATIONAL REGISTER OF HISTORIC PLACES

Introduction. The National Historic Preservation Act of 1966 created the Advisory Council on Historic Preservation, an independent agency of the Executive branch of the Federal Government, to advise the President and Congress on matters involving historic preservation. Its members are the Secretary of the Interior, the Secretary of Housing and Urban Development, the Secretary of Treasury, the Secretary of Commerce, the Attorney General, the Secretary of Transportation, the Secretary of Agriculture, the Administrator of the General Services Administration, the Secretary of the Smithsonian Institution, the Chairman of the National Trust for Historic Preservation, and 10 citizen members selected on the basis of their outstanding service in the field of historic preservation.

The Council is authorized to review and comment upon undertakings carried out, licensed, or financially assisted by the Federal Government which have an effect upon properties listed on the National Register; to recommend measures to coordinate activities of Federal, State, and local agencies and private institutions and individuals relating to historic preservation; and to secure from the appropriate Federal agencies certain information necessary to the performance of these duties.

I. PROCEDURES FOR COMPLIANCE WITH SECTION 106

The Council exercises an important function by reviewing and commenting upon undertakings carried out, licensed, or financially assisted by the Federal Government when the undertaking will affect a property listed on the National Register. This authority derives from section 106 of the National Historic Preservation Act, which provides that:

> The head of any Federal agency having direct or indirect jurisdiction over a proposed Federal or federally assisted undertaking in any State and the head of any Federal department or independent agency having authority to license any undertaking shall, prior to the approval of the expenditure of any Federal funds on the undertaking or prior to the issuance of any license, as the case may be, take into account the effect of the undertaking on any district, site, building, structure, or object that is included in the National Register. The head of any such Federal agency shall afford the Advisory Council on Historic Preservation established under Title II of this Act a reasonable opportunity to comment with regard to such undertaking.

The Advisory Council desires to provide maximum assistance to Federal agencies in connection with section 106. Normally the Council anticipates that its comments will be required in only the most complex situations, and it requests that Federal agencies fulfill their obligations under section 106 by the use of the following procedures:

PROCEDURES FOR COMPLIANCE WITH SECTION 106 NATIONAL HISTORIC PRESERVATION ACT OF 1966

The Advisory Council on Historic Preservation hereby establishes the following procedures for agencies of the Federal Government having direct or indirect jurisdiction or authority over a Federal or federally financed or licensed undertaking for compliance with section 106 of the National Historic Preservation Act of 1966.

A. *Definitions.* As used in these procedures:

1. "National Historic Preservation Act" means Public Law 89-665, approved October 15, 1966, an "Act to establish a program for the preservation of additional historic properties throughout the Nation and for other purposes," 80 Stat. 915, 16 U.S.C. 470, hereinafter referred to as "the Act."

2. "Undertaking" means any Federal action, activity, or program, or the approval, sanction, assistance, or support of any other action, activity, or program, such as the issuance of a license or permit, the granting of funds, or the development or funding of master or regional plans.

3. "National Register" means the National Register of Historic Places, which is a register of districts, sites, buildings, structures, and objects, significant in American history, architecture, archeology, and culture, maintained by the Secretary of the Interior under authority of section 2(b) of the Historic Sites Act of 1935 (49 Stat. 666, 16 U.S.C. 461) and section 101(a)(1) of the National Historic Preservation Act. The National Register is published in its entirety in the FEDERAL REGISTER each year in February. Addenda are published monthly.

4. "National Register Property" means a district, site, building, structure, or object, listed in the National Register.

5. "National Register Criteria" means the following criteria established by the Secretary of the Interior for use in evaluating and determining the eligibility of properties for listing in the National Register:

The quality of significance in American history, architecture, archeology, and culture, is present in districts, sites, buildings, structures, and objects of State and local importance that possess integrity of location, design, setting, materials, workmanship, feeling and association and:

a. That are associated with events that have made a significant contribution to the broad patterns of our history; or

b. That are associated with the lives of persons significant in our past; or

c. That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

d. That have yielded, or may be likely to yield, information important in prehistory or history.

Criteria considerations. Ordinarily cemeteries, birthplaces, or graves of historical figures, properties owned by religious institutions or used for religious purposes, structures that have been moved from their original locations, reconstructed historic buildings, properties primarily commemorative in nature, and properties that have achieved significance within the past 50 years shall not be considered eligible for the National Register. However, such properties will qualify if they are integral parts of districts that do meet the criteria or if they fall within the following categories:

(1) A religious property deriving primary significance from architectural or artistic distinction or historical importance.

(2) A building or structure removed from its original location but which is significant primarily for architectural value, or which is the surviving structure most importantly associated with a historic person or event.

(3) A birthplace or grave of a historical figure of outstanding importance if there is no appropriate site or building directly associated with his productive life.

(4) A cemetery which derives its primary significance from graves of persons of transcendent importance, from age,

from distinctive design features, or from association with historic events.

(5) A reconstructed building when accurately executed in a suitable environment and presented in a dignified manner as part of a restoration master plan, and when no other building or structure with the same association has survived.

(6) A property primarily commemorative in intent if design, age, tradition, or symbolic value has invested it with its own historical significance.

(7) A property achieving significance within the past 50 years if it is of exceptional importance.

6. "Criteria for Effect" means the following criteria established by the Advisory Council on Historic Preservation for use in determining the effect of an undertaking upon a National Register property:

A federally financed or licensed undertaking shall be considered to have an effect on a National Register listing (districts, sites, buildings, structures, and objects, including their settings) when any condition of the undertaking causes or may cause any change in the quality of the historical, architectural, archeological, or cultural character that qualified the property under the National Register criteria for listing in the National Register.

Generally, adverse effects occur under conditions which include but are not limited to:

a. Destruction or alteration of all or part of a property;

b. Isolation from or alteration of its surrounding environment;

c. Introduction of visual, audible, or atmospheric elements that are out of character with the property and its setting.

7. "Agency Official" means the head of the Federal Agency having responsibility for the undertaking or a subordinate employee of the Federal Agency to whom authority with respect to the evaluation of the effect of the proposed undertaking has been delegated.

8. "Executive Director" means the Executive Director of the Advisory Council on Historic Preservation established by Section 205 of the Act, or his designated representative.

9. "State Liaison Officer" means the official within each State, authorized by the State at the request of the Secretary of the Interior, to act as liaison for purposes of implementing the Act, or his designated representative.

B. *Agency procedures*—1. *Consideration of effect.* At the earliest stage of planning or consideration of a proposed undertaking, including master and regional planning, the Agency Official shall: (a) Consult the National Register to determine if a National Register property is invoved in the undertaking; and (b) upon finding involvement, apply the "Criteria for Effect." Upon applying the criteria and finding no effect, the undertaking may proceed.

2. *Effect established.* Upon finding that the undertaking will have an effect upon a National Register property, the Agency Official shall: (a) Notify the State Liaison Officer and the Executive Director; and (b) in joint consultation with them, determine whether or not the effect will be adverse.

3. *Finding of no adversity.* Upon finding the effect not to be adverse, the Agency Official, the State Liaison Officer and the Executive Director shall execute a joint memorandum acknowledging no adversity and forward the document to the Chairman of the Advisory Council for review pursuant to section C(1).

4. *Finding of adversity.* If any of the consulting parties find the effect to be adverse, the Agency Official shall consult further with the State Liaison Officer and the Executive Director to determine whether there is a feasible and prudent alternative to remove or satisfactorily mitigate the adverse effect.

5. *Removal of adversity.* If the Agency Official, the State Liaison Officer, and the Executive Director select and unanimously agree upon a feasible and prudent alternative to remove the adverse effect of the undertaking, they shall execute a joint memorandum acknowledging no adversity. This document shall be forwarded to the Chairman of the Advisory Council for review pursuant to section C(1).

6. *Mitigation of adversity.* If the consulting parties are unable to unanimously agree upon a feasible and prudent alternative to remove the adversity, the Agency Official shall consult with the State Liaison Officer and the Executive Director to determine whether there is a feasible and prudent alternative to satisfactorily mitigate the adverse effect of the undertaking. Upon finding and unanimously agreeing to such an alternative, they shall execute a joint memorandum acknowledging satisfactory mitigation of effect. This document shall be forwarded to the Chairman of the Advisory Council for review pursuant to section C(1).

7. *Failure to remove or mitigate adversity.* Upon the failure of the consulting parties to find and unanimously agree upon a feasible and prudent alternative to remove or satisfactorily mitigate the adverse effect, the Agency Official shall delay further processing of the undertaking and provide written notice affording the Advisory Council an opportunity to comment upon the proposed undertaking. Such notice shall include a record of the status of the proposal in the planning and funding sequence and an account of actions taken in accordance with the Procedures for Compliance. Upon request, the Agency Official shall submit a report of the undertaking to the Advisory Council.

C. *Council procedures*—1. *Review of joint memorandum.* Upon receipt from the Agency Official of a joint memorandum acknowledging either no adversity or satisfactory mitigation of effect, the Chairman of the Council shall review the content of the document. Unless the Chairman, or in his absence a citizen member of the Council appointed by the membership for this purpose, shall notify the Agency Official that the matter has been placed on the agenda of the Council for final review and comment, the joint memorandum shall become final in 30 days and the undertaking may proceed. The Chairman, or in his absence the Council's appointee, may waive all or part of the 30-day review period by notice to the Agency Official, at which time the joint memorandum shall become final and the undertaking may proceed.

2. *Preliminary action on notice affording opportunity for comment.* Upon receipt of a written notice from an agency affording the Advisory Council an opportunity to comment pursuant to section B(7) of these procedures, the notice shall be acknowledged and a 30-day review period instituted during which:

a. It shall be determined whether the Procedures for Compliance have been observed;

b. The Federal Agency, the State Liaison Officer and the Executive Director shall provide such information as may be requested by the Council; and

c. The Chairman, or in his absence the Council's appointee under section C(1), shall determine whether or not the Council will comment. If the Council decides not to comment, the undertaking may proceed.

3. *Decision to comment.* Upon determination to comment upon an undertaking, the Council shall:

a. Schedule the matter for consideration at a regular meeting no less than 60 days from the date the notice was received; or in exceptional cases, schedule the matter for consideration in an unassembled or special meeting;

b. Notify the Federal Agency of the date on which comments will be considered; and

c. Authorize preparation of a section 106 report.

4. *Content of section 106 report.* For purposes of arriving at comments under section 106 of the Act, the Advisory Council prescribes that certain reports be made available to it and accepts reports and statements from other interested parties. Specific informational requirements are enumerated below. Generally, the requirements represent an explication or elaboration of principles contained in the "Criteria for Effect." The Council notes, however, the Act recognizes that historical and cultural resources should be preserved "as a living part of our community life and development." Consequently, in arriving at final comments, the Council considers those elements in an undertaking that have revelance beyond historical and cultural concerns. To assist it in weighing the public interest, the Council welcomes information not only bearing upon physical, sensory, or esthetic effects but information concerning economic, social, and other benefits or detriments that will result from the undertaking.

5. *Elements of the section 106 report.* The report on which the Council relies for comment shall consist of:

a. A report from the Executive Director to include a verification of the legal and historical status of the National Register property; an assessment of the historical, architectural, archeological, or cultural significance of the National Register property; a statement indicating the special value of features to be most affected by the undertaking; an evaluation of the total effect of the undertaking upon the National Register property; and a critical review of any known feasible and prudent alternatives.

b. A report from the Federal Agency requesting comment to include a general discussion of the proposed undertaking; when appropriate, an account of the steps taken to comply with section 102(2)(A) of the National Environmental Policy Act of 1969 (83 Stat. 852, 42 U.S.C. 4332); an evaluation of the effect of the undertaking upon the National Register property, with particular reference to the impact on the historic scene; steps taken or proposed by the agency to take into account or minimize the effect of the undertaking; a discussion of alternatives, and, if applicable and available, a copy of the draft of the preliminary environmental impact statement prepared in compliance with section 102(2)(C) of the National Environmental Policy Act of 1969.

c. A report from any other Federal Agency having under consideration a plan or undertaking that will concurrently or ultimately affect the National Register property, including a general description of the plan or undertaking and a discussion of the effect the undertaking under consideration by the Council will have upon such proposals.

d. A report from the State Liaison Officer to include an assessment of the significance of the National Register property; an identification of features of special value; an evaluation of the effect of the undertaking upon the National Register property and its specific components; a consideration of known alternatives; a discussion of present or proposed participation of State and local agencies or organizations in preserving or assisting in preserving the National Register property; an indication of the support or opposition of units of government and public and private agencies and organizations within the State; and the recommendations of his office.

e. Other pertinent reports, statements, correspondence, transcripts, minutes, and documents, received by the Council from any and all parties, public or private.

6. *Report by recipient or potential recipient.* When the Federal Agency requests comment upon an application for funds, a grant, or license or some other form of Federal approval, sanction, assistance, or support, the Council will welcome the submission and presentation of a report by the applicant or potential recipient. Arrangements for the submission and presentation of reports by applicants or potential recipients should be made through the Federal Agency having jurisdiction in the matter.

7. *Coordination of section 106 reports and statements.*

a. In considerations involving, either directly or indirectly, more than one Federal department, the agency requesting comment shall act as a coordinator in arranging for a full assessment and discussion of all interdepartmental facets of the problem and prepare a record of such coordination to be made available to the Council.

b. The Council may request the State Liaison Officer or other State officials to accept the responsibility for notifying appropriate governmental units and public and private organizations within the State of the pending comments of the Council, and to coordinate the presentation of written statements to the Council.

8. *Council meetings.* The Council will not hold formal hearings on section 106 matters. All meetings will be open except as otherwise ordered by the Chairman. Reports and statements will be presented to the Council in open session in accordance with a prearranged agenda and considered by the Council in executive session for the purpose of preparing comments. Regular meetings of the Council occur on the first Wednesday and Thursday of February, May, August, and November.

9. *Oral statements to the Council.* A schedule shall provide for oral statements from the Executive Director; the referring Federal Agency presently or potentially involved; the recipient or potential recipient; the State Liaison Officer; and representatives of national, State, or local units of government and public and private organizations. The Council requests that parties wishing to make oral remarks submit written statements of position in advance to the Council staff.

10. *Comments by the Council.* The comments of the Council shall take the form of a three-part statement, including an introduction, findings, and a conclusion. The statement shall include notice to the Federal Agency of the report required under section C(11) of these procedures. Comments shall be made to the head of the Federal Agency requesting comment or having responsibility in the matter. Immediately thereafter, the comments of the Council will be forwarded to the President and the Congress as a special report under authority of section 202(b) of the Act and published as soon as possible in the FEDERAL REGISTER.

11. *Report of agency action in response to Council comments.* When a final decision on the undertaking is reached by the Federal Agency, the Agency Official shall submit a written report to the Council containing: (a) A description of actions taken by the Federal Agency subsequent to the Council's comments; (b) a description of actions taken by other parties pursuant to the actions of the Federal Agency; and (c) the ultimate effect of such actions on the National Register property involved. The Council may request supplementary reports if the nature of the undertaking requires them.

12. *Records of the Council.* The records of the Council shall consist of an oral transcript of the proceedings at each meeting, the section 106 report prepared by the Executive Director, and all other reports, statements, transcripts, correspondence, and documents received. Records shall be maintained in the office of the Council.

13. *Continuing review jurisdiction.* When the Council has formally commented pursuant to sections C(2) through C(10) or has approved a joint memorandum pursuant to section C(1) concerning an undertaking, such as a master plan, which by its nature requires subsequent action by the Federal Agency, the Council will consider its comments or approval to extend only to the undertaking as reviewed. The Agency Official shall insure that subsequent action related to the undertaking is submitted to the Council for review in accordance with these procedures when that action is found to have an effect on a National Register property.

II. OTHER POWERS OF THE COUNCIL

A. *Comment or report upon non-Federal undertaking.* The Council will exercise the broader advisory powers, vested by section 202(a)(1) of the Act, to comment or report upon a non-Federal undertaking that will adversely affect a National Register property or any other property determined by the Secretary of the Interior to meet the National Register criteria: (1) Upon request from the President of the United States, the President of the U.S. Senate, or the Speaker of the House of Representatives, or (2) when agreed upon by a unanimous vote of the members of the Council.

B. *Comment or report upon Federal undertaking in special circumstances.* The Council will exercise its broader advisory powers by commenting to Federal agencies in certain special situations even though written notice that an undertaking will have an effect has not been received. For example, the Council may choose to comment in situations where an objection is made to a Federal Agency finding of "no effect."

[FR Doc.72-19384 Filed 11-13-72;8:45 am]

FEDERAL POWER COMMISSION
WASHINGTON, D.C. 20426

MAR 2 . 1973

50-282
50-306

IN REPLY REFER TO:

RECEIVED
MAR 28 1973
U.S. ATOMIC ENERGY COMMISSION
Regulatory
Mail Section

Mr. Daniel R. Muller
Assistant Director for
Environmental Projects
Directorate of Licensing
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Muller:

This is in response to your letter dated January 22, 1973, requesting comments on the AEC Draft Environmental Statement related to the proposed issuance of operating licenses to the Northern States Power Company for the Prairie Island Nuclear Generating Plant (Docket Nos. 50-282 and 50-306).

Pursuant to the National Environmental Policy Act of 1969 and the April 23, 1971, Guidelines of the Council on Environmental Quality, these comments review the need for the facilities as concerns the adequacy and reliability of the affected bulk power systems and related matters. In preparing these comments, the Federal Power Commission's Bureau of Power staff has considered the AEC Draft Environmental Statement; the Applicant's Environmental Report and Supplements thereto; related reports made in response to the Commission's Statement of Policy on Reliability and Adequacy of Electric Service (Order No. 383-2); and the staff's analysis of these documents together with related information from other reports submitted to this Commission by the Applicant. The staff generally bases its evaluation as to the need for a specific bulk power facility on long term considerations as well as on the load-supply situation for the next peak load period following the availability of the facility for service on the Applicant's system and that of the pool or regional coordinating area with which the Applicant is associated.

Need for the Facility

The Prairie Island station, consisting of two 530-megawatt nuclear units, is located on the west bank of the Mississippi River approximately 35 miles southeast of Minneapolis-St. Paul and six miles northwest of Red Wing, Minnesota (population 10,441) in Goodhue County. The facility is wholly owned by the Northern States Power Company which will hereinafter be referred to as "the Applicant." Recently, Unit No. 1 was reported as 95 percent complete and Unit No. 2 as 40 percent complete with commercial service scheduled for October 1973 and October 1974, respectively. Availability on these dates would have a significant influence

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on the capability of the summer-peaking Applicant's system for meeting the anticipated summer peak loads of 1974 and 1975 and the winter peak load of 1974; however, the life of the units is expected to be some 30 years or more, and this capacity will represent a significant portion of the Applicant's total capacity throughout its lifetime. Therefore, the units will be depended upon to supply power to meet future demands over a period of many years beyond the initial service needs discussed in this report.

The following tabulations show the projected loads for the 1974 and 1975 summer peak load periods which must be served by the Applicant, the Upper Mississippi Valley Power Pool (UMVPP), and the members of the Mid-Continent Area Reliability Coordination Agreement (MARCA). The UMVPP is a planning and operating pool organized in 1961 which now includes eleven utilities,[1/] both investor-owned and cooperatives, serving Minnesota, northwestern Wisconsin, North Dakota and the northeastern corner of Iowa. The Applicant is a major participant in this pool representing over one-half of the generating resources as well as load. The Applicant is also a major member of the MARCA Reliability Region which covers the states of North and South Dakota, Minnesota, Iowa, western Wisconsin and the greater part of Nebraska. While the Applicant has a responsibility to its own customers to provide adequate generating facilities, it also has a responsibility in the Region to insure its own reliability and mutually share this responsibility with its neighbors in providing for the greatest overall reliability through adequate power supply under adverse conditions which may occur due to the unscheduled outage of a large generating source or sources, extreme climatic conditions that affect heat sensitive loads, or other contingencies.

1/ The members of the UMVPP other than the Applicant are:

Cooperative Power Association
Dairyland Power Cooperative
Interstate Power Company
Lake Superior District Power Company
Minnesota Power and Light Company
Minnkota Power Cooperative, Inc.
Montana-Dakota Utilities Company
Northwestern Public Service Company
Otter Tail Power Company
United Power Association

Mr. Daniel R. Muller

1974 SUMMER PEAK LOAD-SUPPLY SITUATION 1/

	Applicant's System	UMVPP	MARCA
Conditions with Prairie Island Unit 1 (530 Megawatts)			
Generating Capacity - Megawatts	4,747	8,169	17,978
Load Responsibility - Megawatts	4,280 2/	7,229 3/	14,277 4/
Reserve Margin - Megawatts	467	940	3,701
Reserve Margin - Percent of Peak Load	10.9	13.0	25.9
Minimum Reserve Needs - Based on 15 Percent of Peak Load - Megawatts	642	1,084	2,142
Reserve Deficiency - Megawatts	175	144	-
Conditions without Prairie Island Unit 1			
Generating Capacity - Megawatts	4,217	7,639	17,448
Load Responsibility - Megawatts	4,280	7,229	14,277
Reserve Margin - Megawatts	-63	410	3,171
Reserve Margin - Percent of Peak Load	-	5.7	22.2
Reserve Deficiency - Megawatts	705	674	-

1/ Source: MARCA Report 383-2 dated 4-1-72 updated for subsequent information.
2/ Load reduced for net purchases of 50 megawatts.
3/ Load reduced for net purchases of 69 megawatts and USBR allocation of 140 megawatts.
4/ Load increased for net sales of 5 megawatts.

Mr. Daniel R. Muller

1975 SUMMER PEAK LOAD-SUPPLY SITUATION 1/

	Applicant's System	UMVPP	MARCA
Conditions with Prairie Island Units 1 and 2 (1,060 Megawatts)			
Generating Capacity - Megawatts	5,307	9,191	19,019
Load Responsibility - Megawatts	4,503 2/	7,797 3/	15,266 4/
Reserve Margin - Megawatts	804	1,394	3,753
Reserve Margin - Percent of Peak Load	17.8	17.9	24.6
Minimum Reserve Needs - Based on 15 Percent of Peak Load - Megawatts	675	1,170	2,290
Conditions without Prairie Island Unit 2			
Generating Capacity - Megawatts	4,777	8,661	18,489
Load Responsibility - Megawatts	4,503	7,797	15,266
Reserve Margin - Megawatts	274	864	3,223
Reserve Margin - Percent of Peak Load	6.1	11.1	21.1
Reserve Deficiency - Megawatts	401	306	-
Conditions without Prairie Island Units 1 and 2			
Generating Capacity - Megawatts	4,247	8,131	17,957
Load Responsibility - Megawatts	4,503	7,797	15,266
Reserve Margin - Megawatts	-256	334	2,693
Reserve Margin - Percent of Peak Load	-	4.2	17.6
Reserve Deficiency - Megawatts	931	836	-

1/ Source: MARCA Report 383-2 dated 4-1-72 updated for subsequent information.

2/ Load reduced for net purchase of 195 megawatts.

3/ Load reduced for net purchase of 70 megawatts and USBR allocation of 142 megawatts.

4/ Load reduced for net purchases of 98 megawatts.

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Although the reliability standards for the MARCA Region have been met in the past by a minimum reserve margin of 12 percent, MARCA has stated that this minimum reserve margin will be increased to 15 percent in 1974 to meet the reliability standard of loss-of-load probability of one occurrence in ten years. The increased reserve margin is made necessary by the large capacity of new thermal generating units coming in service in the MARCA members' systems. These reserve margins are gross; in addition to providing for scheduled outages for maintenance, the reserve margin must provide an excess of generating capacity over the peak system demands to provide for errors in load forecasts, forced outages of generating equipment, slippage of scheduled availability of new units, and for spinning reserves. Minimum reserve margins of 15 percent have been used for purposes of this report.

The availability of Unit No. 1 of the Prairie Island Plant for the 1974 summer peak load period would provide a reserve margin of 467 megawatts or 10.9 percent of the peak load responsibility on the Applicant's system. If delays for any reason should make this unit unavailable for this peak period, the reserve margin would be reduced to a negative 63 megawatts and a deficiency of 705 megawatts from the MARCA criterion would occur on the Applicant's system. Based on the Applicant's 1974 peak load responsibility of 4,280 megawatts, a minimum reserve margin of 642 megawatts is needed to meet the 15 percent reserve criterion. Similarly, the UMVPP will have a reserve margin of 940 megawatts, or 13.0 percent of the peak load responsibility with the unit available; without the unit, the reserve margin is reduced to 410 megawatts or 5.7 percent of the peak load responsibility of 7,229 megawatts. The deficiency of 674 megawatts for the UMVPP systems would require the Applicant to purchase power from other sources, if available, in order to maintain the needed reserve position. While the data for MARCA would indicate excess reserves, there is some doubt as to the amount of firm power that could be committed for regional service since the capability includes three new nuclear plants besides Prairie Island scheduled for startup within a year prior to the 1974 summer peak. These plants are as follows:

Plant	Utility	Capacity (MW)	Scheduled Service
Fort Calhoun	Omaha Public Power Dist	455	August 1973
Cooper	Nebraska Public Power Dist.	800	November 1973
Duane Arnold	Iowa Electric Light & Power Co.	550	December 1973
	Total	1805	

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The 2,335 megawatts of new capacity (including Prairie Island No. 1) in large units comprises a very significant portion of the total MARCA capacity and thus there must be concern not only for potential delays due to the licensing procedures for this capacity but delays during start-up of large new units. The probable lack of available power for purchase from other sources appears to be confirmed by the Applicant's action in committing an additional 400 megawatts of gas turbine capacity as an interim measure to compensate for slippage in availability dates for Prairie Island Units Nos. 1 and 2 of ten months and six months, respectively.

In any event, purchased power cannot be considered as an adequate solution to the Applicant's capacity requirements except for the short term and, further, gas turbine capacity employed for other than peaking purposes or emergency use is uneconomical.

Analysis of the 1975 summer peak load supply situation for conditions with Prairie Island Units Nos. 1 and 2 indicates a reserve deficiency of 931 megawatts for the Applicant's system and 836 megawatts for the UMVPP if Prairie Island is not available. This cannot be considered acceptable in terms of adequacy and reliability of power supply.

Transmission Facilities

The proximity of the Prairie Island Station site to the heavily populated Twin Cities load center requires relatively short transmission lines for delivery of the plant's output to the Applicant's transmission system. It is planned to tie the Prairie Island Station into an existing 345 kV transmission line between Red Rock Substation in southwest St. Paul and Adams Substation in southern Minnesota. A 345 kV circuit is to be constructed between Prairie Island and the Red Rock Substation. A 345 kV overhead line will run in a westerly direction to the Applicant's Inver Hills Station and thence to their Black Dog and Blue Lake Stations. New transmission line right-of-way consists only of a 33-mile segment between Prairie Island and the Inver Grove Station.

The transmission line planning appears to be judicious in accomplishing the objectives of delivering the Station output to the load and providing for interties with other stations in the Applicant's system as well as to major centers in the Region for reliability purposes. The design, routing and construction of the transmission lines were planned in accordance with the guidelines issued by the U. S. Department of the Interior and Agriculture in their joint publication, "Environmental Criteria for Electric Transmission Lines." The lines are routed mainly through cultivated fields, railroad right-of-way, and other transmission line corridors with very little woodland involved, with due consideration being given to minimize the environmental impact.

Mr. Daniel R. Muller

Alternatives to the Proposed Facilities and Costs

The need for the plant was established in the Applicant's planning program relying on forecasts of expanding energy demands that could reasonably be expected at the time of commercial operation. The estimated lead time has grown beyond the control of the Applicant which is a common experience for all utilities scheduling nuclear projects at this time. Interim action to accommodate the demand while base load capacity is delayed has been to install combustion turbine capacity, which can be placed in service in a relatively short time. Such capacity may serve as peaking capacity in the system, but it cannot be considered to be suitable as an alternative to the baseload performance expected of nuclear units. The inherent high operating and maintenance costs of the combustion turbine units make them unsuitable for this service and in addition, with oil as a fuel, place a further strain on the Nation's dwindling oil supply. The potential undeveloped hydroelectric capacity in the region is estimated to be less than 225 megawatts with an associated annual energy output of 975,000 megawatt-hours. These hydro projects are distributed over a wide area, and would account for less than one-fourth of the anticipated production of one unit of the Prairie Island Station. Hydroelectric power, including pumped storage, would not provide a reasonable alternative. The Applicant has stated that the alternative of purchasing power would not eliminate the environmental impact of the capacity required but only transfer it to another location. Imported power would also require provision of transmission facilities to move this power adding further to the environmental impact. A reliable source of power for purchase, of the magnitude needed, does not exist. The Applicant has been engaged in a study of importing power from the Manitoba Hydroelectric Board's Nelson River project via a 500-mile high voltage transmission line. The feasibility of this project involves international negotiations and it is not possible that they could be completed in time for use in 1974 or 1975. In addition, power from this source would only be for an interim period since the total output of the Nelson River project will eventually be utilized in Canada. The only other alternative would be a coal-fueled plant since oil and gas are in very critical supply. At the time the Prairie Island Plant was contracted for, the economic break-down point for fuel costs in a comparison of nuclear and coal-fired plants was considered to be in the range where coal costs were from 25 to 27 cents per million Btu. The Applicant's typical fuel costs in 1967 were 27.9 cents per million Btu. The Applicant indicates that a major consideration in their selection of the nuclear power alternative was their concern over stack emissions with a coal-fired plant. There was apprehension as to whether the more stringent future air pollution control regulations anticipated could be satisfied with available technology.

Mr. Daniel R. Muller

Conclusions

The staff of the Bureau of Power concludes that the electric output of the Prairie Island Nuclear Station Units No. 1 and No. 2 will be needed to meet the projected loads on the Applicant's system and those of the Upper Mississippi Valley Power Pool and MARCA Region and to provide them with reserve margins in accordance with the regional coordination council's stated system reliability criterion. These units will be necessary to provide the required reserve margin on the Applicant's system in the summer of 1975 and Prairie Island No. 1 is necessary to prevent a negative reserve margin in the summer of 1974.

Very truly yours,

T. A. Phillips
Chief, Bureau of Power

50-282
50-306

MINNESOTA POLLUTION CONTROL AGENCY

717 Delaware Street S.E./ Minneapolis, Minnesota 55440
Telephone: (612) 378-1320

APR 2 1973

March 30, 1973

Deputy Director for Reactor Projects
Directorate of Licensing
U.S. Atomic Energy Commission
Washington, D.C. 20545

Dear Sir:

Enclosed are our comments on the Draft Environmental Impact Statement for Prairie Island.

We had indicated in February to counsel for the AEC that our comments would be late. With such prior notification, we expect that our comments will be addressed in the final impact statement.

Sincerely yours,

Grant J. Merritt
Executive Director

GJM/KD:sa
Enclosure

2164

MINNESOTA POLLUTION CONTROL AGENCY

Staff Comments on the Draft Impact Statement
on Prairie Island

Ken Dzugan
Research Scientist

pg. i) It states on page i that in the closed cycle cooling mode, the plant will withdraw 85,000 gpm from the river. This is about 190 cfs. This figure is higher than anticipated, and should be corrected to a lower figure of about 150 cfs.

pg. ii) The scope of alternatives is far too narrow. Alternatives such as a change in rate structure, and additional radwaste treatment should be considered.

pg. II-5) Since much of the area near the site is under cultivation, (II-5), there should be a map provided which gives an overlay of the agricultural products that are produced. There should also be a milk production overlay including information as to whether the milk goes into a general market or is used by a single family.

pg. II-20) With respect to the discussion on page II-20, what size and distance are the natural gas pipelines located within the five miles of the site?

pg. II-30) The diagramming of the dike on page II-30 is incorrec This dike is no longer required nor proposed by the applicant since the acceptance of the closed cycle cooling mode for the plant.

pg. III-25) In Section 2, "Radioactive Waste," the statement is made, "The radioactivity that may be released during operation of the plant will be 'as low as practicable' and in accordance with the Commission's regulations." There is no basis in fact for this statement. Beginning on page III-25, there is a section on the waste disposal system. The basis for the assumptions on flows and discharges should be given for each system. In addition, there should be prepared for each potential release from the plant a chart containing the concentration of various radioactive nuclides for each type of waste. This should include the maximum expected concentrations prior to any dilution. Also indicate the concentrations expected after treatment. This will provide a bette basis for looking at the question of whether or not the waste releases are "as low as practicable." For all air and liquid releases, concentrations should be given before and after treatment prior to any dilution. In addition, if failed fuel is expected to be .25%, some justification for this figure should be provided.

pg. III-41) It indicates on page III-41 that there will be no radioactive wastes going into the sanitary waste system of the plant. This should be a specification within the license.

pg. IV-5) On page IV-5 it says that no radioactive waste (as defined by 10 cfr 20.303) will be processed in the sanitary sewage disposal system. Earlier it says there will be no sanitary wastes put in the sewage system. There should be a clarification as to whether or not there is any intent to release any radioactive waste into the sanitary sewer system as a result of plant operation. (See also pg. V-11.)

pg. V-2) On page V-2, what studies have been done to show that the visual impact of the plant will be such as to "afford a view pleasant to many people."

pg. V-4) Discuss how the transmission right-of-way was prepared by the applicant, how much land was cleared, how it was cleared, and what the disposition was of the cleared material.

pg. V-5) Total appropriation should be closer to 150 cfs with discharge the order of 100 cfs.

pg. V-12) It says on page V-12 "there is expected to be very little radwaste in any form that is available to interact with the terrestrial plants and animals. Consequently, the radiation impact of plant operation on wildlife and other biota in the area should be slight." This should clearly be assessed in terms of the Class 9 accident, which could hardly be described as releasing very little radwaste in any form.

It indicates that to keep the area below the transmission lines clear, 2,4,5-T will be used. The environmental effect of this compound should be clearly stated.

pg. V-25) On page V-25 the conclusion that the releases of the plant will be "as low as practicable" are not justifiable. Page V-25, in section D-1, it indicates that the calculations were made using an ICRP report which dates back 13 or 14 years. Since that time there have been changes in calculational methods utilized. We believe that more up-to-date methods should be used for the present calculations.

The calculations on iodine dose to the thyroid of a child, page V-26 should be done for the worst case estimate, i.e., at the plant boundary. In any case, it is noted that the 32 millirem per year possibility is completely unacceptable and that further restrictions will have to be placed on iodine release from the plant.

pg. V-26) In Section 3, "Radioactivity Release to Receiving Waters" indicates what the concentration of nuclides is expected to be in the canal. In addition to this, the concentration of nuclides before any dilution within the canal should be given for all potential releases.

pg. V-29) Section 5, "Evaluation of Radiological Impact." This section is misleading. Although there is a natural radiation dose to people, with various components as indicated in this section, the values provided are too high. See Donalt T. Oakley, Natural Radiation Exposure in the U.S., EPA, ORP/SID 72-1. Natural background is for the most part uncontrollable. Plant releases can be controlled. Consequently, the AEC attempt to put this matter "in perspective" is merely an attempt to hide their non-compliance with minimizing release of radioactive waste.

pg. V-37) In discussing the shipment of spent fuel, the following should be addressed: Do the height from which drop tests have to be made for shipping fuel cask include the maximum height from which a fuel cask can fall during use?

pg. V-42) The assumption that the population density would average 330 persons per square mile along the route should be justified. Along the routes which are considered to be practicable, the maximum population densities should be listed.

pg. V-43) It discusses costs for plant dismantling based upon experience at the Hallam nuclear power facility. This section should be modified to include the cost for decommissioning Prairie Island in a fashion similar to the decommissioning of the Elk River nuclear facility in which all radioactive material produced as a result of plant operation will be removed from the site and the site will be returned to use such that no restrictions are placed upon the site due to radioactive contamination. The AEC litany on defense and depth is repeated. In view of the great number of difficulties which have shown up at nuclear power plants over the last several years, including fuel densification, fuel cladding failure, the possibility of fracture of the main vessel, main steam line placement, as well as other problems more specific to Prairie Island, the use of such a litany on defense and depth is naive at best. The failure to consider Class 9 accidents in the environmental impact statenent, must be rectified in the final statement. Indeed a special section should be added to the final statement which addresses on a point by point basis the accidents that can be caused as a result of the points addressed in an anonymous letter recently received by the ACRS concerning the Prairie Island nuclear plant.

pg. VI-6) It states, "It is concluded from the results of the realistic analysis that the environmental risks due to postulated radiological accidents are exceedingly small." The analysis which has been done has not been documented, calculations have not been provided, and we have no way of knowing whether or not the analysis of the accidents considered has been realistic. Certainly the consideration of the spectrum of accidents has been totally unrealistic in view of the information which has been made available on Prairie Island.

pg. VI-7) Under "Discussion of Transportation Accidents for New Fuel," it indicates that a criticality accident, although not generating a nuclear explosion, would generate enough heat to physically separate the fuel elements. It then indicates that there would be very little dispersion of radioactive material. It is very difficult to imagine the circumstances in which enough heat is generated to physically separate the fuel elements, yet not lead to rupture and dispersal of substantial amounts of the fuel.

pg. VI-5-9) Under the "Severity of Postulated Transportation Accidents," it says that accidents more severe than those analyzed have not been considered because of the quality assurance, etc., of the packaging and the transport conditions. For each accident it should be shown that the packaging requirements are such as to cover the entire spectrum of physical strain to which the packaging can be expected to be subject during its lifetime including accident conditions.

pg. IX-9) In Section C "Other Materials," the estimate for the kilowatt hours electricity used should be provided to show that it is enough to cover the electric power required for the gaseous diffusion plants and the production of the nuclear fuel.

Section X, the use of past rapid power growth and the use of what the applicant believes to be necessary reserves in no way constitutes an acceptable discussion of the need for power concerning the Prairie Island nuclear plant.

pg. XI-1 (A.1), "Basis" It notes that the need for power expressed in Section 10 has been assumed for this discussion. This is incomplete. The potential for changing the demand rate increase should be considered through a change in the rate structure or energy conservatio programs. Consideration for the following two concepts of rate structure should be explored. First a flat rate structure, with the rate determined such that the revenues generated over the past year are to be divided by t amount of power produced to reach a necessary flat rate charge to produce revenues required; secondly, a rate structure which increases the cost per kilowatt as more and more kilowatts are used, rather than decreasing the cost per kilowatt, as is presently done. For consideration of this alternative, the following should be done. In the present structure the difference in rates among various classes of users should be considered to find the maximum and minimum cost per kilowatt hour. This will give a range of prices per kilowatt hour and a factor should be calculated giving a ratio between the highest and lowest cost per kilowatt hour. This same factor should be applied to a new system in which the cost per kilowatt hour moves through the same factor in going from a low cost per kilowatt hour to a high cost per kilowatt hour with the rate structure becoming progressive rather than regressive. Some ost using this range should be established to generate the necessary evenues based on last year's costs and power production. Then the ffect of a flat rate structure and a progressive rate structure should e made on the projected growth throughout the next 10-15 years.

pg. XI-5) It indicates that the construction cost of $200,000 er mile for transmission lines may be expected. An adequate reference or such costs should be provided. The referenced study on cooling towers ould not seem to be adequate.

pg. XI-21) The concept of dry cooling towers is rejected almost ut-of-hand. The additional difficulties encountered and alluded to by he AEC staff should be addressed in much greater detail in the final npact statement.

pg. XI-23) The discussion of alternative radwaste systems is ithout merit. The National Environmental Policy Act requires the dis- ussion of alternatives. The fact that it is feasible to reduce effluents elow presently expected levels indicates that not only is this required y NEPA but such a discussion and requirement for plant operation must be ncluded pursuant to the regulations of the Atomic Energy Commission. lso, it is almost unbelievable that the alternatives section or a draft impact statement for a nuclear power facility does not ddress waste treatment beyond that contemplated by the applicant.

pg. XI-28) Table 11-10, item A. Increasing future demand has ot been documented.

pg. XI-29) Table 11-10, item C. Under the reference radwaste ystem, there are practical alternatives for reducing the radioactivity urther.

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

50-282
50-306

ER-73/155

APR 23 1973

Dear Mr. Muller:

This is in response to your letter of January 22, 1973, requesting our comments on the Atomic Energy Commission's draft statement, dated January 1973, on environmental considerations for Prairie Island Nuclear Generating Plant, Goodhue County, Minnesota.

General

Environmental concern is evidenced by the applicant's efforts toward ongoing monitoring studies and the cooperative attitude in working with this Department to solve environmental problems associated with the project. Based on this past experience, we are confident that through continuing joint efforts unforeseen problems also will be resolved.

Our specific comments on the draft environmental statement are presented in the following paragraphs according to the format of the statement or according to specific subjects.

Commercial and Sports Fishing in the Mississippi River

We suggest that the second paragraph on page II-22 be modified to show that the upper reaches of Pool #3 are a recovery pool for degraded water conditions from Pool #2 since the same paragraph also indicates that the area just below Lock and Dam #3 provides some of the best spring fishing on the Mississippi River.

Water Supplies

The statement identifies 58 domestic and livestock wells within close proximity of the plant. We suggest that the final environmental statement include additional information on these wells as to aquifer tapped, depth of well, hydraulic gradients in the area, and schedules of future groundwater monitoring.

Historical Significance

It does not appear that the plant will adversely affect existing or proposed units of the National Park System.

The applicant's consultation with the Minnesota Historical Society, whose Director is the State Liaison Officer for Historic Preservation, has revealed the presence of important archeological resources within the plant area and resulted in the addition of the Barton site to the National Register of Historic Places. Although it is indicated on page V-1 that the operation of the plant is not expected to adversely affect historic sites, the statement does not disclose the impacts that the project construction has had on these cultural resources or what provisions have been made to assure their preservation.

The statement should reflect the applicant's consultation with the National Register of Historic Places to determine if such properties will be affected by the proposed action. The "Criteria for Effect" should be applied for this determination. If National Register properties will be affected, the statement should include a listing of the properties to be affected, an analysis of the nature of the effects, a discussion of the ways in which the effects were taken into account, and an account of steps taken to assume compliance with Section 106 of the National Historic Preservation Act of 1966 (80 Stat. 915) in accordance with procedures of the Advisory Council on Historic Preservation as they appear in the Federal Register, November 14, 1972, pages 24146-8.

Geology

As a result of procedures previously established between this Department and the Atomic Energy Commission, the Geological Survey has reviewed the geologic aspects of the site that are included in the applicant's environmental reports and supplements. Their comments were transmitted to the AEC Director of Regulation on March 12, 1968, for inclusion in the public record. However, we believe that the environmental statement should include a more thorough analysis of the geologic and seismologic environment in which the Prairie Island Nuclear Generating Plant is sited to provide a basis for independent judgments by others that these important aspects of the environment have been appropriately considered.

Effects on Fish

The effects on the fishery in Sturgeon Lake and the cutoff backwater areas are only briefly discussed on page II-73 and Table II-26. The fish resources, fishery, fish food-chain and nursery aspects of Sturgeon and North Lakes, and the backwater area between the project and Lock and Dam #3 should be discussed in more detail.

Impacts on Land, Water, and Human Resources

We are pleased that the application of herbicides, pesticides, and related chemicals will be done in a manner "consistent" with the Department's Bureau of Sport Fisheries & Wildlife's recommendations. In view of the prevalent use of chemicals in the environment, the rapid development of new ones, and discoveries that some commonly used chemicals are harmful and are banned or restricted, we conclude that the applicant should consult with the Director of the State Conservation Agency, the County agent, or the nearest office of the Bureau of Sport Fisheries & Wildlife for information which may be more recent than the Bureau of Sport Fisheries & Wildlife's Resource Publication 48, Chemical Vegetation Control Manual for Fish and Wildlife Management Programs. Such contact should be made early in planning so that acceptable chemicals and methods of application known to be most effective can be used.

Water Use

Since hunting and fishing pressures within the vicinity of the plant are expected to increase as a result of the plant's operation, we urge the applicant to consult with the Minnesota Department of Natural Resources to comprehensively evaluate the expected increase. It would also appear desirable to negotiate provisions for developing a public fishing pier and boat launching facilities with attendant sanitary facilities to meet the anticipated public use.

A large portion of the 560-acre plant site and 973 acres of transmission corridors will not be occupied by structures. Possible uses of these lands are indicated on pages II-21, V-1, and VIII-1; however, an overall plan for multiple uses of these lands is not shown.

We urge that the applicant be encouraged by AEC to consult with the Minnesota Department of Natural Resources and the Bureau of Sport Fisheries & Wildlife, and the Bureau of Outdoor Recreation (both of this Department) to develop an overall land use plan for the above-mentioned lands. Such a plan could incorporate the above-mentioned uses as well as evaluate the feasibility of utilizing transmission line corridors for recreational uses.

It may not be possible to develop such plans in time to be included in the final environmental statement. However, we think that the final statement should include, as a minimum, an indication that such plans would be forthcoming.

Cooling Tower Effluent

The statement does not include a discussion of the dissolved solids contained in the draft from the cooling tower. An estimate of the amount of solids involved and means and measures that could be employed to minimize their environmental effects should be discussed.

Consequences of Chemical Release to the River

The possible adverse effects resulting from the release of chlorine in the cooling water are discussed on pages V-20 and V-21; however, an assessment of the effects of chlorine releases from this plant are not given. In view of the recognized possible environmental impacts, we think that an effort should be made to eliminate chlorine if feasible. We understand that ozone, a powerful oxidizing agent, can be used to eliminate chlorine from the effluent. The feasibility of the recent developments in ozonolysis for the purpose of reducing or eliminating chlorine from such discharges should be discussed in the final environmental statement.

Transport of Solid Radioactive Wastes

It is stated on page V-40 that spent resins, waste evaporator bottoms, and some process liquids will be dewatered and concentrated and, with other solid wastes, loaded into containers for shipment and disposal. The estimated 16 truckloads of wastes each year "may be shipped" to the Nuclear Fuel Services Reprocessing Plant at West Valley, New York. We believe that the environmental statement should provide specific information concerning the radionuclides that will be present, their physical-chemical states, and their estimated concentrations in the solid wastes. The final statement should contain a discussion of the licensing provisions and specify the AEC criteria and responsibilities related to (1) determination of the suitability of the disposal site to isolate the specific radioactive components of the Prairie Island Plant wastes from the biosphere for specific periods of time; (2) current and continuing surveillance and monitoring at the disposal site; and (3) any remedial or regulatory actions that may be necessary at the site through a specific period of time during which the radioactive components may remain hazardous. It appears that most of these impacts could either be covered in the impact statement for Prairie Island or in a separate environmental statement on the disposal site.

Plant Accidents

This section contains an adequate evaluation of impacts resulting from plant accidents through Class 8 for airbourne emissions. However, the environmental effects of releases to water is lacking. Many of these postulated accidents listed in Tables VI-1 and VI-2 could result in releases to the Mississippi River and should be evaluated.

We also think that Class 9 accidents resulting from releases to both air and water should be described and the impacts on human life and the remaining environment discussed as long as there is any possibility of occurrence. The consequences of an accident of this severity could have far-reaching effects on land and in the Mississippi River, which could persist for centuries.

Irreversible and Irretrievable Commitments of Resources

Section IX should describe the fish and wildlife resources lost annually because of project construction and operation. Resources foregone are irretrievable for all practical purposes.

Alternative Means of Power Generation

We suggest that the final environmental statement include the basis for the estimates of dust, SO_2 and NO_x emissions given on page XI-16. Dust and SO_2 emissions will vary with the ash and sulfur content of the coal, and NO_x emissions will vary with the type of firing employed.

We hope these comments will be useful to you in the preparation of the final environmental statement.

Sincerely yours,

Assistant Secretary of the Interior

Mr. Daniel R. Muller
Assistant Director for
Environmental Projects
Directorate of Licensing
U.S. Atomic Energy Commission
Washington, D. C. 20545

STATE OF MINNESOTA

STATE PLANNING AGENCY
802 CAPITOL SQUARE BUILDING
550 CEDAR STREET
ST. PAUL, 55101

RECEIVED APR 24 1973

April 19, 1973

U.S. Atomic Energy Commission
Directorate of Licensing
Washington, D.C. 20545

50-282
50-306

SUBJECT: Draft Environmental Statement - The Prairie Island Nuclear Generating Plant

Gentlemen:

This letter is to certify that the Minnesota State Planning Agency has in accordance with the procedures established by OMB Circular A-95 reviewed the above mentioned draft environmental statement. State agencies that may be interested or affected by the project have been notified. Attached are comments we received from the Minnesota Department of Natural Resources.

This letter represents the final action of the State Planning Agency's review of the draft environmental statement in its performance of the function as State Clearinghouse under A-95 procedures.

Sincerely,

Thomas N. Harren

Thomas N. Harren
State Clearinghouse

DMIN 1000

DEPARTMENT Natural Resources - Planning

STATE OF MINNESOTA

Office Memorandum

TO : Mr. Tom Harren
State Planning Agency
Clearinghouse

DATE: March 12, 1973

FROM : Mr. Jerome H. Kuehn
Administrator

SUBJECT: Draft Environmental Impact Statement for the NSP Prairie Island Nuclear Generating Plant.

The Minnesota Department of Natural Resources has reviewed the above referenced Draft E.I.S. and submits the following comments:

A letter dated February 20, 1973 from DNR Commissioner Robert L. Herbst to NSP Vice President Arthur V. Dienhart expressed concerns regarding fishery losses related to a functional operation of the plant. Representatives from your office should meet with Department of Natural Resources fishery personnel to discuss the problems and investigate the possible correction of the situation.

Our Department also feels that efforts should be extended to repair construction work that has scarred the natural landscape during the building of the plant. All of the artificial development done on the river banks, intake structure and dike areas should be graded and planted in as near a natural condition as possible. Aesthetics in viewing the plant from the highway user and river users level should receive attention by planting vegetation which will screen eyesores and frame views.

Assistance in reviewing types of plans devoted to aesthetic treatment of plant site will be available from our Division of Parks and Recreation.

This concludes our comments on the Prairie Island Nuclear Generating Plant at this time.

BPH:dat

cc: Milt Krona
Larry Seymour
Art Peterson
Howard Krosch
Bob Story
Earl Lhotka

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
REGION 5
18209 DIXIE HIGHWAY
HOMEWOOD, ILLINOIS 60430

50-282
50-306

April 11, 1973

IN REPLY REFER TO:
5-00.5

Mr. A. Giambusso
Deputy Director for Reactor Projects
Atomic Energy Commission
Directorate of Licensing
Washington, D. C. 20545

Dear Mr. Giambusso:

Our February 15, 1973 letter requested the opportunity to review and comment upon your agency's draft environmental statement relative to the proposed issuance of an operating license for the Prairie Island Nuclear Generating Plant in Goodhue County, Minnesota (Docket Nos. 50-282 and 50-306). A copy of your draft EIS was subsequently sent to us through our Washington office arriving here on March 15, 1973.

Review by our Minnesota Division indicates the proposed AEC action will probably not adversely affect existing or proposed Federal-aid highways. The draft statement recognizes that the plant's cooling towers will produce some localized fogging and icing particularly during the winter months. Since prevailing winds in the area are predominantly northwest to southeast, the possibility of fog or icing problems is considered rather remote on the only major Federal-aid highway in the area which is marked as US 61 and located more than two miles southeast of the plant. Their informal contacts with the Goodhue County Engineer also suggest a similar lack of any anticipated problems on other lesser Federal-aid highways in the area.

We appreciate the opportunity to review and comment on your draft environmental statement and look forward to providing similar review of future AEC draft statements for nuclear plant actions within this region involving matters within our areas of expertise or special knowledge.

APR 16 1973

Sincerely yours,

G. D. Love
Regional Administrator

By: W. G. Emrich

W. G. Emrich
Director, Office of Design

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

MAY 4 1973

Mr. L. Manning Muntzing
Director of Regulation
U.S. Atomic Energy Commission
Washington, D.C. 20545

Dear Mr. Muntzing:

The Environmental Protection Agency has reviewed the draft environmental impact statement for the Prairie Island Nuclear Generating Plant and our detailed comments are enclosed.

The waste management systems described in the draft statement appear to be capable of limiting the radioactive releases from Prairie Island to levels that are "as low as practicable." We are concerned, however, about the chemical form of the radioiodine to be released through the gaseous waste treatment system. If a significant amount of released radioiodine is in volatile form, a reevaluation of the potential thyroid dose via the inhalation pathway will be warranted.

In light of our review of this draft statement and in accordance with EPA procedure, we have classified the project as ER (Environmental Reservations) and rated the draft statement as "Category 2" (Insufficient Information). We have enclosed a detailed explanation of our classification system for your information. In addition, we would be pleased to discuss our classification or comments with you or members of your staff.

Sincerely,

/s/

Sheldon Meyers
Director
Office of Federal Activities

Enclosure

ENVIRONMENTAL PROTECTION AGENCY

Washington, D. C. 20460

April 1973

ENVIRONMENTAL IMPACT STATEMENT COMMENTS

Prairie Island Nuclear Generating Plant

TABLE OF CONTENTS

INTRODUCTION AND CONCLUSIONS

The Environmental Protection Agency (EPA) has reviewed the draft environmental statement for the Prairie Island Nuclear Generating Plant prepared by the Atomic Energy Commission (AEC) and issued on January 22, 1973. Following are our major conclusions:

1. Although the radioactive waste management systems for the Prairie Island Nuclear Generating Plant appear to be able to limit environmental releases of radioactivity to "as low as practicable" levels, we are concerned about the possibility of the facility iodine releases being in the form of methyl iodide or other volatile specie. If such is the case, a reevaluation of the thyroid doses via the inhalation exposure mode appears warranted.

2. The draft statement is deficient since thermal plume analyses, duration of each cooling period, and effects upon aquatic organisms with regard to the three proposed operational cooling modes are not provided. The final statement should include this information.

3. While it appears that the Prairie Island Nuclear Generating Plant, as now designed, will meet the present Minnesota water quality standards, it should be noted that the plant may meet the proposed revisions to the standards only by year-round closed-cycle cooling.

3. The AEC has conditioned the licensing of this facility by the requirement for "...closed-cycle mode unless icing or other

operational difficulties arise, but always within the required temperature limits," however, the draft statement does not clearly specify the applicant's intention for projected utilization of each proposed cooling mode.

4. Since the plant is located in a fish nursery area, adequate information should be presented to assure protection of juvenile fish against entrainment and entrapment in the plant intake system.

RADIOLOGICAL ASPECTS

Radioactive Waste Management

The radioactive waste management systems for the Prairie Island Nuclear Generating Plant, appear to be capable of limiting the environmental releases of radioactivity to levels that are "as low as practicable," if utilized in a manner consistent with the provisions of 10 CFR Part 50.36a. It is anticipated that the indicated utilization of this equipment, as presented in the proposed technical specifications, will be changed to reflect the requirements of 10 CFR Part 50 and the proposed Appendix I guidelines.

The draft statement, although referring to the turbine building releases of radioactive gaseous effluent, did not quantify the expected releases under conditions of primary-to-secondary steam generator leakage in combination with reactor fuel failures. This source of potential radioiodine releases has been indicated by the AEC staff in the draft statement for the proposed Appendix I, to be about equivalent to that estimated from the auxiliary building ventilation exhaust. The final statement should address this source of iodine discharge in its evaluation of the environmental effects of this plant.

Dose Assessment

The draft statement realistically calculates the dose to a child's thyroid through the cow-milk pathway (2.3 mrem/year) by utilizing meteorological parameters applicable to the nearest dairy herd (2 miles east of the plant). A similar dose calculated at the site boundary or the nearest residence would be larger by a factor of 20. The final statement should discuss the requirement which will be made of the applicant to document, on a periodic basis, the location of the critical receptor relative to the point of maximum potential dose. If no surveillance program is to be required, the guidelines of Appendix I should be applied at the site boundary. In addition, the AEC should verify that the milk surveillance program and analytical techniques to be used by the applicant will be adequate to document compliance with the Appendix I guidelines.

Of more significance is the possibility that the radioiodine release may be in the form of methyl iodide (CH_3I) or another volatile compound. In this case, the calculated iodine-131 released from the plant vents could be increased by a factor ranging from 60 to greater than 300, depending on compound partition factors. If the release should be in the form of methyl iodide, for example, the inhalation thyroid exposures at the site boundary would be comparable to presently calculated hypothetical ingestion exposures (30 mrem). The final statement should therefore, discuss the effluent monitoring program relative to its capability to indicate the chemical nature of the iodine source term. This is important so that the critical pathway may be properly identified and adequately monitored. Furthermore, if a significant release of CH_3I or other volatile species is suspected, a reevaluation of the dose assessment calculation is warranted.

Transportation and Reactor Accidents

In its review of nuclear power plants, EPA has identified a need for additional information on two types of accidents which could result in radiation exposure to the public: (1) those involving transportation of spent fuel and radioactive wastes and (2) in-plant accidents. Since these accidents are common to all nuclear power plants, the environmental risk for each type of accident is amenable to a general analysis. Although the AEC has done considerable work for a number of years on the safety aspects of such accidents, we believe that a thorough analysis of the probabilities of occurrence and the expected consequences of such accidents would result in a better understanding of the environmental risks than a less-detailed examination of the questions on a case-by-case basis. For this reason we have reached an understanding with the AEC that they will conduct such analyses with EPA participation concurrent with review of impact statements for individual facilities and will make the results available in the near future. We are taking this approach primarily because we believe that any changes in equipment or operating procedures for individual plants required as a result of the investigations could be included without appreciable change in the overall plant design. If major redesign of the plants to include engineering changes were expected or if an immediate public or environmental risk were being taken while these two issues were being resolved, we would, of course, make our concerns known.

The statement concludes "...that the environmental risks due to postulated radiological accidents are exceedingly small." This conclusion is based on the standard accident assumptions and guidance issued by the AEC for light-water-cooled reactors as a proposed amendment to Appendix D of 10 CFR Part 50 on December 1, 1971. EPA commented on this proposed amendment in a letter to the Commission on January 13, 1972. These comments essentially raised the necessity for a detailed discussion of the technical bases of the assumptions involved in determining the various classes of accidents and expected consequences. We believe that the general analysis mentioned above will be adequate to resolve these points and that the AEC will apply the results to all licensed facilities.

NON-RADIOLOGICAL ASPECTS

Thermal

The applicant has designed the condenser cooling system for operation with three alternating cooling modes: once-through; helper; and closed-cycle mechanical draft cooling towers. However, the draft statement does not present a clear or consistent plan for the utilization of the three cooling modes. In several places in the text, year-round use of the mechanical draft towers in a closed-cycle system is indicated (p. III-6, V-15). However, in other instances, the variability of using helper and once-through modes is cited for economic advantage of power production (pp. III-17, III-19). This position on cooling modes would appear to be in conflict with the condition for licensing set forth by the AEC in item "d" on page iv of the draft statement.

In addition, the estimates of the duration of the use of each cooling mode with seasonal correlations are not provided. Also, thermal plume analyses for each cooling scheme are not presented. Specific effects on aquatic organisms caused by alternative cooling modes and operational changes are not discussed.

Public Law 92-500, the Federal Water Pollution Control Act Amendments of 1972, defines the thermal component of any discharge as a pollutant. EPA is required by this law to set effluent guidelines for pollutants discharged from steam-electric power plants by the fall of 1973. All effluent discharges from the

Prairie Island Nuclear Power Plant will have to be in accordance with the requirements of Public Law 92-500.

Another provision of this law calls for review and revision of State water quality standards. The proposed revision of the State's thermal discharge criteria are specified in a letter and addendum from Mr. Mayo, EPA Regional Administrator, to Governor Anderson of Minnesota, dated January 16, 1973 (attached).

Although it appears that the Prairie Island Nuclear Power Plant, as now designed, will meet the present Minnesota water quality standards, it should be noted that the Prairie Island Plant seems to have the capability to meet the proposed revisions to the water quality standards provided it is operated in a closed cooling cycle mode throughout the year. Further, a commitment by the applicant for year-round closed-cycle operations should not include exceptions during cold weather. In this regard, the applicant cites its own successful experience with small plants in South Dakota. The successful cold weather cooling tower operation for large plants such as Cherokee and Arapahoe in Colorado has established that cooling tower operation under severe weather conditions is feasible and recognized as the current state-of-the-art.

The National Technical Advisory Committee has recommended that the zone of passage available to fish and other aquatic organisms "...should contain preferably 75 percent of the cross-sectional area and/or volume of flow of the stream or estuary." The diversion and discharge at an elevated temperature of an estimated 31 percent of the river flow, during the 7-day, once-in-10-year low flow, under the once-through cooling mode, would exceed this recommendation.

The final statement would be enhanced if the observed 7-day, once-in-10-year low flow value and recorded temperature at the site were presented in a single table for convenient reference. All plant water uses (intake and consumption values) in the final statement should also be expressed as percentages of such low flow values in addition to the absolute gallons per minute (gpm) or cubic feet per second (cfs) values usually supplied.

Present plans for closed-cycle operation include a blowdown discharge of 150 cfs. The blowdown rate is about 11 percent of the circulating water flow which is almost 10 times the normal rate resulting from 3 to 5 cycles of concentration. We suggest the applicant investigate raising its proposed 1.25 cycles of concentration to higher levels, thereby reducing blowdown. Reduced makeup requirements would also result with an associated reduction in entrained loss of organisms through entrainment.

The once-through cooling mode will require 611,000 gpm, or 1,360 cfs, of Mississippi River water for cooling purposes. Up to 1,200 cfs of cooling water may be recycled. The final statement should discuss the effects caused by the warmer discharge water from once-through cooling being recirculated to the intake. If recycle of heated water might occur, the applicant should consider the use of spray modules in the discharge canal to lower the discharge temperature.

The draft statement indicates on page III-19 that no simple description of a thermal plume is practical because of the flexibility of cooling system operation. It would be appropriate, however, for the statement to adequately address the worst condition i.e., 7-day, once-in-10-year low flow at peak power with once-through cooling. Similarly, examples of less than worse case conditions would be useful in estimating potential environmental impact. The final statement should include analyses of proposed thermal discharge plumes, discharge temperatures, mixing zone areas, and other computations needed to show compliance with current State and/or Federal regulations under varied operational cooling modes.

The potential adverse impact of once-through cooling during winter months is not discussed. Substantial damage to aquatic organisms may occur during the winter months if once-through (open-cycle) cooling is allowed. No estimates are given for the length of time for which it might be necessary to employ once-through cooling, nor is there sufficient information to evaluate potential adverse environmental impact. The 7-day, once-in-10-year low flow occurs in February; December and January also experience very low flows. During these periods the approximate temperature rise with once-through cooling, as indicated on page III-19, is 8°F, mixed river temperature. This rise substantially exceeds the 5°F rise above natural which will be permitted under the revised State water quality standards.

While the draft statement indicates that, if necessary, power will be reduced to meet the temperature standards, no specific plan is outlined to accomplish this reduction nor is there an indication that the applicant has sufficient reserves at other stations to accomplish this reduction. The question arises as to whether, under severe low flow conditions, other stations, such as the Monticello Nuclear Power Plant, would also be required to reduce power to meet water quality standards. State and Federal laws regarding power generation may preclude such reductions if power demands are high. The final statement should address this problem.

Biological

A detailed evaluation of biological effects that may occur as a result of the operation of the Prairie Island Nuclear Plant is not possible because no estimate of the expected time of operation under helper or once-through (open-cycle) conditions was presented in the draft statement and no attempt to quantitatively estimate environmental damage during those times was made.

If once-through cooling or helper mode is allowed during the winter, the pool behind Lock and Dam #3 may warm significantly and attract large numbers of fish. If a shutdown occurs, these fish would be trapped as the colder river water moves in toward the dam resulting in a kill. During helper mode operation, all entrained organisms and phytoplankton will be killed. This kill exceeds that of once-through operation. Should once-through or even helper mode cooling occur during the winter low flow period, it is estimated up to 27 percent of the plankton passing the plant would be killed (7-day, once-in-10-year low flow). The median winter flow would result in up to a 16 percent loss of aquatic organisms.

The final statement should further address the impact of the added heat from the plant on the already highly eutrophic conditions in the river above Lock and Dam #3. Both once-through and closed-cycle operation may add sufficient heat to lower dissolved oxygen levels and enhance algal blooms in the local area.

More attention should be given to the fact that Sturgeon Lake is a nursery area for young fish. This fact is merely mentioned on page VII-4 of the draft statement. The potential blockage of fish migration into and out of Sturgeon Lake by the intake and discharge structures and flows, particularly during once-through cooling, should be discussed in detail in the final statement since Sturgeon Lake is a rearing area for juvenile fish. Further, the intake and discharge structures are located at the end of Sturgeon Lake (p. II-73). Much, and probably all at times, the river flow through Sturgeon Lake would enter the plant during all cooling modes other than closed-cycle operation.

While the intake velocity at the trash racks is expected to be 0.9 fps and is within the range recommended by EPA, the proximity of the intake to the fish nursery area may suggest reducing the intake velocity to approach 0.5 fps to avoid entrapment of juvenile fish in the intake system. Ideally, the intake structure should be located away from important aquatic habitats.

Specific and detailed information on the proposed intake system snould be provided in the final statement, including an evaluation of those periods when low flow conditions exist. Further, since Section 316(b) of Public Law 92-500 states "... location, design, construction and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impact", the final statement should also discuss how the present design will meet these requirements.

On page 108 of the Prairie Island Environmental Monitoring Annual Report for 1971, Dr. Edward Miller of St. Mary's College in Winona remarked that his on-going studies on Sturgeon Lake indicated its continuing value as a nursery area for game fish, particularly walleye and sauger. If these juvenile fish were entrained in the plant's intake, their destruction could have a significant impact on sport fishing downstream.

The blowdown discharge during closed-cycle operation also appears to have some potential for blocking fish migration into and out of Sturgeon Lake. The final statement should address these issues.

The winter chill period requirements for successful spawning of walleye and sauger and the effects of the thermal plume on the fish have not been presented. As indicated on page III-24, during abnormal conditions, temperatures 2 to 4°F higher than natural may occur below Lock and Dam #3 where these fish are known to occur in abundance. Studies at the National Water Quality Laboratory, Duluth, Minnesota on yellow perch have indicated the following:

> "The level of reproductive success among perch held at 39°F for about 6 months (70% fertile eggs, 53% normal larvae) was approximately twice as great as for fish held at 43°F for about 6 months (16 and 21% fertile eggs, 13 and 7% normal larvae). Exposure to the above temperatures for periods less than 6 months lowered reproductive success at each temperature. The data indicate substantial impairment of yellow perch reproduction by an increase in winter temperature of approximately 4°F above 39°F, the lowest temperature tested. It is expected that reproduction of closely related species such as sauger and walleye, may be impaired by similar increases in winter temperature."

The final statement should include an assessment of aquatic organisms likely to be affected by all modes of plant operation. The possibility of detrimental effects to aquatic organisms caused by varying the modes of operation should be included in the discussion. In addition, the site should be described with reference to fish spawning, nursery and migratory areas, as applicable.

Disposal methods for materials caught on the intake screens are not discussed in the draft statement. The return of such materials to public water is not acceptable, except for the return of viable aquatic organisms. A commitment by the applicant to provide adequate off site disposal, meeting applicable regulations, should be presented in the final statement.

Chemical

The chemical wastes result from: (1) regeneration of demineralizers used to purify plant water supplies, (2) control of fouling of service heat exchangers (the main heat exchangers are cleaned mechanically), (3) maintenance of in-plant water quality, (4) corrosion inhibition, and (5) preoperational and operational equipment cleaning. Sanitary wastes are generated by operating personnel, visitors, and construction workers.

Blowdown from the cooling towers and steam generator, and regenerant chemicals from the makeup water demineralizers are released untreated via the circulating water system to the Mississippi River. Treatment of preoperational cleaning wastes will be carried out to meet applicable water quality standards, but the treatment processes and waste constituents are not described. More information is required in the final statement on the treatment and nature of the preoperational cleaning wastes.

Sanitary wastes will be treated in a 3,830 gallon capacity septic tank and associated tile drainage field. The size of the septic tank is smaller than desirable for 200 operating personnel, potential visitors, and possible introduction of laundry water (p. III-26, Fig. III-12). Since a parallel 3,050 gallon capacity septic tank and tile drain field has been in use with the 3,830 gallon system during plant construction for workers, it should not be abandoned when operation is begun, but should be continued in service.

Table III-5 includes "natural dilution" flows to calculate the concentration of waste discharges. Dilution of discharges is not considered adequate treatment by EPA. The final statement would be enhanced if the various waste treatment explanations were keyed to the schematic diagram. The final statement, therefore, should describe the treatment of all effluent streams prior to disposal into the circulating water discharge and indicate how the discharges will meet the effluent guideline requirements to be established under Public Law 92-500 and take into consideration the fact that dilution of effluents is not likely to be considered the best practicable treatment.

Figure III-12, Page III-26, shows radwaste laundry water directed to the septic tanks. This water may contain radioactive material, but is not monitored since it is withdrawn downstream from the radiation monitor. Also, the text indicates that no radwastes are directed to the septic tanks. This apparent discrepancy should be resolved in the final statement. Further, the discharge of nutrients into a eutrophic area should be discouraged.

Residues from the makeup water demineralization system will be indirectly discharged to the Mississippi River. The septic tank will produce a sludge. Its disposal should be discussed in the final statement.

A discussion of oily wastes disposal and a contingency plan for non radioactive spills should be included in the final statement. The use of morpholine should be carefully evaluated.

As a minimum, treatment should be provided for laundry wastes and all other wastes containing significant concentrations of BOD, detergents, oils, or nutrients (phosphates, nitrates, ammonia, etc.).

The effects of plant operation upon groundwater should be described and evaluated in the final statement. A program to guard against intrusion into wells should be considered.

ADDITIONAL COMMENTS

During the review we noted in certain instances that the statement did not present sufficient information to substantiate the conclusion presented. We recognize that much of this information is not of major importance in evaluating the environmental impact of the Prairie Island Nuclear Generating Plant. The cumulative effects, however could be significant. It would, therefore, be helpful in determining the impact of the plant if the following topics were addressed in the final statement:

1. The final statement should include clarification of the bases to be used in establishing technical specifications which will limit the dose consequences of atmospheric steam dumps and the effluent release limits which will be applicable; e.g., the 2, 4, 8, time Appendix I levels or the 10 CFR Part 20 limits. It is noted that, historically, the AEC has established secondary coolant concentration limits based on a calculated 1.5 mrem inhalation dose from iodine-131 following a "loss-of-load" incident.

2. If the component cooling surge tank is vented to the atmosphere, the statement should discuss the significance of potential halogen releases from this source. The maximum detectable leak rate from the primary system to the component cooling water and the maximum allowable radioactivity level in the component cooling water should be stated.

3. An evaluation should be included in the final statement regarding the significant, if any, of the exhaust from the biannual startup and annual fuel flow tests of auxiliary feedwater pump turbine.

4. The iodine inhalation dose on page V-26 appears low by two orders of magnitude.

5. There appears to be an inconsistancy between the FSAR and the draft statement (page III-7) regarding the number of steam driven auxiliary feedwater pumps.

6. A discussion is warranted regarding the differences in annual average site boundary X/Q values presented in the Safety Evaluation Report and the draft statement.

7. Several comments regarding air quality considerations are as follows: (1) boiler size and the sulphur content and BTU rating of fuel oil should be presented, (2) a statement regarding emission rates compliance with the local source performance standard should be included, and (3) estimates of peak offsite SO_2 and NO_2 concentrations should be provided. Reference to material presented in the review of the Rancho Seco draft statement is suggested.

8. The draft statement mentions that the maximum recorded flood height is 688 feet, the maximum probable flood height is 704 feet, the plant grade elevation is 695 feet and the flood wall is 705 feet. The final statement should further discuss the conditions under which flooding could surpass the 695 feet

elevation and inundate the plant site despite the flood wall due to groundwater surcharge and upwelling and describe the environmental consequences of water surpassing the 695 feet elevation during operation, and in the future when the power plant has been decommissioned.

9. The final statement should describe any proposed plans to maintain accessability to the Barton and Silvernale historical sites.

10. The final statement should explain the discrepancy in tritium discharge estimates as calculated by the staff and applicant.

11. On page III-8 it is stated that when the cooling towers are bypassed there is no evaporative loss. This statement is incorrect as evaporation occurs in the stream itself and the final statement should compare those evaporative losses from once-through cooling to those from cooling tower operation.

12. Design criteria to be used in the discharge system to ensure that water quality in the Mississippi River is not adversely affected and should be discussed in the final statement.

13. The quality of the waste treatment plant effluents from the Twin Cities will inevitably improve and effect a concurrent improvement in the quality of the fisheries in the area of the plant with a resultant increase in use and value. The final statement should consider effects of plant operation upon an increased aquatic resource.

APPENDIX D

1. Letter, F. T. Mayo, EPA, to Governor W. R. Anderson, Minnesota, dated January 16, 1973, regarding Status of Minnesota Water Quality Standards under the Federal Water Pollution Control Act Amendment of 1972 (PL-92-500), p. D-1.

2. Memorandum of Understanding Regarding Implementations of Certain Complementary Responsibilities, 38 Fed. Reg. 2718, Monday, January 29, 1973, p. D-7.

3. Interim Policy Statement on Implementations, Federal Water Quality Pollution Control Act Amendment of 1972, 38 Fed. Reg. 2679, Monday, January 29, 1973, p. D-8.

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION V
1 NORTH WACKER DRIVE
CHICAGO, ILLINOIS 60606

MAR 2 1973

M. GROTENHUIS

JAN 16 1973
JAN 16, 1973

Honorable Wendell R. Anderson
Governor's Office
State Capitol
St. Paul, Minnesota 55155

Dear Governor Anderson:

As provided by Section 303(a)(1) of the Federal Water Pollution Control Act Amendments of 1972(PL 92-500). "any water quality standard applicable to interstate waters which was adopted by any State and submitted to, and approved by, or is awaiting approval by, the Administrator pursuant to this Act as in effect immediately prior to the date of enactment of the Federal Water Pollution Control Act Amendments of 1972, shall remain in effect unless the Administrator determines that such standard is not consistent with the applicable requirements of this Act as in effect immediately prior to the date of enactment of the Federal Water Pollution Control Act Amendments of 1972. If the Administrator makes such a determination, he shall, within three months after the date of enactment of the Federal Water Pollution Control Act Amendments of 1972, notify the State and specify the changes needed to meet such requirements." This letter and attachments shall serve as your official notification of any changes required under 303(a)(1).

A basic policy of the Act immediately prior to the enactment of the 1972 Amendments is to enhance the quality and value of the Nation's waters. It is consistent with the letter and spirit of that Act that all waters be capable of supporting recreational uses and desirable aquatic biota. The basic policy of the above Act was further defined and reinforced in Section 101(a)(1) and (2) of the 1972 Amendments which provide for the protection and propagation of fish, shellfish, wildlife, and recreation in and on the water wherever attainable by 1983, and the total elimination of pollutant discharges into navigable waters by 1985.

To satisfy the requirements of the law, I am taking this opportunity to inform you that pursuant to Section 303(a)(1) of the 1972 Amendments, all Minnesota interstate water quality standards are approved except for the changes specifically noted in the attachments to this letter. It is my determination that to meet the requirements of the 1972 Amendments, the noted changes to Minnesota water quality standards must be adopted as shown. The required modifications have been discussed with the Minnesota Pollution Control Agency staff in several meetings since December 1, 1972, and our two Agencies have been actively cooperating in developing legally adequate water quality standards for Minnesota.

JAN 18 1973

The requirements as listed in the attached Standards Revisions Requirements - State of Minnesota must be adopted by the State within 90 days following the date of this letter (Section 303(a)(1). Should the State fail to do so, it is the Administrator's obligation under the law to publish the necessary standards in the Federal Register as a preliminary step toward Federal promulgation. The published standards would be promulgated as Federal standards 190 days after publication, unless prior to that date Minnesota adopts water quality standards which are determined by me to be in accordance with the requirements of the Act as in effect immediately prior to the enactment of the Amendments of 1972, or unless requests for exceptions are supported by adequate analysis as provided for in <u>Guidelines for Developing or Revising Water Quality Standards</u> attached with this letter. For the sake of uniformity and consistency between State standards, and for ease of evaluation, it is suggested that the water quality standards format embodied in the attached guideline be adopted. You may anticipate that the requirements for intrastate waters will be consistent with those outlined in the attachment for interstate waters. Our official evaluation of intrastate waters will be forwarded to you by March 18, 1973 as required by the new law.

We have every confidence that Minnesota will adopt the necessary standards revisions required to satisfy the provisions of the new legislation. The cooperative attitude which the Minnesota Pollution Control Agency has displayed in past revisions is a tribute to the Agency and staff. It will be our pleasure to work together in the continuing effort to enhance and protect the waters of Minnesota.

Sincerely yours,

Francis T. Mayo
Francis T. Mayo
Regional Administrator

Attachments:

(1) Standards Revisions Requirements - State of Minnesota
(2) Guidelines for Developing or Revising Water Quality Standards

cc: Region VIII, Region VII, Mount, Pemberton, BPI (Polikoff), Sansom Sabock, Schneider, McDonald, Zeller Adamkus, Potos, WQS Staff, Kovalik D.O.D., MPCA

STANDARDS REVISIONS REQUIREMENTS

STATE OF MINNESOTA *

Classification (General) -

All waters must be designated to support desirable aquatic biota and recreational uses. Use and value of water for public water supplies, agriculture, industrial, and other purposes can be considered in setting standards, but in no case except as provided for in Guidelines for Developing or Revising Water Quality Standards (Guidelines) shall the criteria supporting these uses interfere with recreational uses and the preservation of desirable species of aquatic biota. Where appropriate streams and lakes should be classified as 2A for the protection of salmonids rather than the present 2B or 2C classification.

Mixing Zones (General) -

The National Technical Advisory Committee (NTAC) recommendation regarding zones of passage must be adopted as a minimum. The following mixing zone definition is recommended:

> Mixing zones in rivers must permit an acceptable passageway for movement of aquatic organisms. The total mixing zone or zones, at any transect of the stream should contain no more than 25% of the cross-sectional area and/or volume of flow of a stream and should not extend over more than 50% of the width. Mixing zone characteristics must not be lethal to aquatic organisms. The 96 hr. TLm for indigenous fish or fish food organisms, whichever is more stringent, should not be exceeded at any point in the mixing zone.
>
> Mixing zones must be as small as possible, should not intersect spawning or nursery areas, migratory routes, water intakes, nor mouths of rivers. Mixing zones should not overlap, but where they do, measures shall be taken to prevent adverse synergistic effects.

Radioactivity -

The NTAC recommendation concerning acceptable levels of radioactivity in public water supplies must be specified in the criteria presented in Section d 1.

Total Phosphorus as P -

A maximum single value of 0.1 mg/l must be applied to all streams. A maximum single value of 0.05 must be applied to all reservoirs and lakes.

*Where numerical values are adopted the minimum approvable criteria for specified water use classifications are the minimum recommended levels set by the National Technical Advisory Committee in its report to the Secretary of Interior on Water Quality Criteria April 1, 1968.

Class 2A Fish and Recreation Must Contain the Following:

Dissolved Oxygen - Concentrations shall not be less than 6.0 mg/l at any time. During the spawning season, spawning areas shall be protected by a minimum concentration of 7.0 mg/l.

Bacteria - Whole Body Contact-- The fecal coliform content (either MPN or MF) must not exceed 200 per 100 ml as a monthly geometric mean based on not less than 5 samples per month, nor exceed 400 per 100 ml in more than 10 percent of all samples during any month.

Class 2B Fish and Recreation Must Contain the Following:

Temperature - An allowable 3°F increase above natural temperature for lakes and 5°F increase above natural temperature for rivers and streams must be included.

The temperature criteria must be revised to read as follows:

Not to exceed -

86°F in July and Aug. 80°F in June and Sept. 67°F in May and Oct. 55°F in April and Nov. 43°F in Mar. and Dec. and 37°F in Jan. and Feb.	or	5°F above natural in streams and 3°F above natural in lakes, whichever is lesser

Whole Body Contact - the fecal coliform content (either MPN or MF) must not exceed 200 per 100 ml as a monthly geometric mean based on not less than 5 samples per month, nor exceed 400 per 100 ml in more than 10 percent of all samples during any month.

Class 2C Fish and Recreation Must Contain the following:

Dissolved Oxygen - Concentrations shall not be less than 5 mg/l D.O. as a daily average and a minimum of 4 mg/l D.O. at all times. (A minimum of 5 mg/l D.O. at all times would be more desirable).

Temperature - An allowable 3°F increase above natural temperatures for lakes and a 5°F increase above natural temperatures for rivers and streams must be included.

The temperature criteria must be revised to read as follows:

Not to exceed -

90°F in July and Aug. 87°F in June and Sept. 75°F in May and Oct. 63°F in Apr. and Nov. 51°F in Mar. and Dec. 45°F in Jan. and Feb.	or	5°F above natural in streams and 3°F above natural in lakes, whichever is lesser

Hydrogen Ion Concentration (pH) - A pH range of from 6.0 to 9.0 must be included and made applicable to all waters.

Bacteria - The following criteria must be adopted:

Partial Body Contact - the fecal coliform content (either MPN or MF) must not exceed 1000 per 100 ml as a geometric mean nor equal or exceed 2000 per 100 ml in more than 10 percent of the samples.

Mississippi River

The recommended temperature standards for the Mississippi River which were developed at the joint meeting of Federal and State Agencies on Mississippi River Temperature Standards in St. Louis on March 3, 1971 must be adopted.

Zone I Monthly Maximum Temperatures (°F)

Jan	37°F	July	80°F
Feb	37	Aug	80
Mar	43	Sept	80
Apr	55	Oct	67
May	67	Nov	55
June	80	Dec	43

Zone II Monthly Maximum Temperatures (°F)

Jan	40°F	July	84°F
Feb	40	Aug	84
Mar	54	Sept	82
Apr	65	Oct	73
May	75	Nov	58
June	84	Dec	48

FEDERAL WATER POLLUTION CONTROL ACT AMENDMENTS OF 1972

Memorandum of Understanding Regarding Implementation of Certain Complementary Responsibilities

The Environmental Protection Agency (EPA) has authority under the Federal Water Pollution Control Act Amendments of 1972, Public Law 92-500 (FWPCA), over, among other things, certain discharges into navigable waters of pollutants from nuclear facilities and other activities requiring a license or permit from the Atomic Energy Commission (AEC). The AEC, under the National Environmental Policy Act of 1969 (NEPA), also has certain responsibility and authority to consider and take action with respect to environmental impact of discharges of pollutants. This responsibility and authority of AEC under NEPA is in turn affected by section 511 of the FWPCA. For the purpose of implementing NEPA and the FWPCA in a manner consistent with both acts and the public interest, EPA and AEC agree pursuant to their respective statutory authorities as follows:

1. AEC will exercise its responsibility and authority under NEPA as modified by section 511 of the FWPCA in accordance with the Interim Policy Statement appearing under 10 CFR Part 50 at 38 FR 2679 *supra*. This Statement of Policy requires, among other things, that AEC in its licensing actions accept decisions under specified sections of the FWPCA with respect to compliance with limitations or other requirements promulgated or imposed pursuant to the FWPCA. Where no decisions under these sections have been made, AEC will give due regard to EPA's views as expressed in comments on AEC draft environmental statements.

2. EPA will to the maximum extent practicable expedite the issuance of effluent limitations and the processing of applications for permits under section 402 of the FWPCA for nuclear facilities and other activities requiring an AEC license or permit which are subject to the requirements of 10 CFR Part 50, appendix D.

3. It seems certain that many licensing decisions by AEC will have to be made prior to the time that effluent limitations or other requirements have been established or discharge permits have been issued, as prescribed by the recent amendments to the FWPCA and that, conversely, many decisions with respect to establishment of effluent limitations or other requirements or issuance of discharge permits will be made after licenses for affected nuclear facilities or other activities have been issued by AEC. It is clear from the recent amendments to the FWPCA (section 304(b) and 306(b)) that Congress intended that EPA, in establishing effluent limitations and other requirements, give consideration not only to water quality, but also to such other factors as cost, the age of equipment and facilities involved, control techniques, process changes, nonwater quality environmental impact and energy requirements. These factors are also appropriate for consideration, to the extent authorized by the FWPCA and consistent with any applicable effluent limitations, in regard to issuance of discharge permits pursuant to section 402 of the FWPCA for facilities and activities previously licensed by AEC, as contemplated hereinabove.

4. Nothing in this memorandum is intended to restrict the statutory authority of either agency.

5. This Memorandum of Understanding shall take effect upon the signing by authorized representatives of the respective agencies and approval by the Council on Environmental Quality. The Memorandum of Understanding shall thereafter by published in the FEDERAL REGISTER.

For the United States Atomic Energy Commission.

L. MANNING MUNTZING,
Director of Regulation.

JANUARY 15, 1973.

For the United States Environmental Protection Agency.

JOHN R. QUARLES, Jr.,
Assistant Administrator for Enforcement and General Counsel.

JANUARY 19, 1973.

Approved by the Council on Environmental Quality for the Council.

TIMOTHY ATKESON,
General Counsel.

JANUARY 22, 1973.

[FR Doc.73-1634 Filed 1-26-73;8:45 am]

Rules and Regulations

Title 10—Atomic Energy

CHAPTER 1—ATOMIC ENERGY COMMISSION

PART 50—LICENSING OF PRODUCTION AND UTILIZATION FACILITIES

Interim Policy Statement on Implementation, Federal Water Pollution Control Act Amendments of 1972

On October 18, 1972, the Federal Water Pollution Control Act Amendments of 1972, Public Law 92-500, 86 Stat. 816 (hereinafter FWPCA), became law. These amendments completely restructured the Federal Water Pollution Control Act previously in effect and also modified Federal agencies' responsibilities and authorities under the National Environmental Policy Act of 1969 (hereinafter NEPA). Section 511 of the Federal Water Pollution Control Act as restructured provides in pertinent part as follows:

SEC. 511. (a) This Act shall not be construed as (1) limiting the authority or functions of any officer or agency of the United States under any other law or regulation not inconsistent with this Act * * *

* * * * *

SEC. 511. (c)

(2) Nothing in the National Environmental Policy Act of 1969 (83 Stat. 852) shall be deemed to—

(A) Authorize any Federal agency authorized to license or permit the conduct of any activity which may result in the discharge of a pollutant into the navigable waters to review any effluent limitation or other requirement established pursuant to this Act or the adequacy of any certification under section 401 of this Act; or

(B) Authorize any such agency to impose, as a condition precedent to the issuance of any license or permit, any effluent limitation other than any such limitation established pursuant to this Act.

Set forth below is a Commission interim statement of policy concerning the effect of section 511 of the FWPCA upon the Commission's regulatory responsibility and authority under NEPA in licensing actions covered by 10 CFR Part 50, Appendix D. In developing this interim statement of policy the Commission has viewed the provisions of the FWPCA in conjunction with the mandate of NEPA, as construed in Calvert Cliffs' Coordinating Committee v. AEC, 449 F. 2d 1109 (D.C. Cir. 1971), and embodied in 10 CFR Part 50, Appendix D, i. e., that in regard to major Federal actions having a significant effect on the environment, environmental costs be evaluated and balanced along with benefits and that alternatives be considered that could affect this balancing. The Commission has paid particular attention to the interrelationship between sections 511(a)(1) and 511(c)(2) and the interim statement of policy has as its central premise that AEC's authority and responsibility under NEPA (as implemented by Appendix D to 10 CFR Part 50) remain unaffected except to the extent that there is a conflict with implementing actions taken under the FWPCA. In general, the Commission would continue to exercise its NEPA authority and responsibility in the interim period before various implementing actions are taken under the FWPCA, so that there would be no hiatus in Federal responsibility and authority respecting environmental matters embraced by both NEPA and FWPCA. In addition, the Commission has been mindful of section 101(f) of the FWPCA and has endeavored to avoid to the maximum extent possible needless duplication of regulatory effort.

In summary, the interim statement of policy provides as follows:

(1) If and to the extent that there are applicable limitations or other requirements imposed pursuant to the FWPCA, the Commission will not (with certain exceptions relating to matters of State law) impose different limitations or requirements pursuant to NEPA as a condition to any license or permit. The Commission will itself determine compliance with limitations or requirements promulgated pursuant to FWPCA where no prior compliance determination has been made under FWPCA or where a certain type of interim certification under section 401 of FWPCA has been provided.

(2) The Commission will not consider various alternatives where such action would constitute a review of similar consideration of alternatives under FWPCA and upset a limitation or requirement imposed as a result thereof or where a particular alternative has been required to be adopted pursuant to FWPCA.

(3) In considering the costs and benefits of a proposed action pursuant to NEPA, the Commission will continue to evaluate and give full consideration to environmental impact: *Provided* That, with certain exceptions relating to matters of State law, such evaluation and consideration will be conducted on the basis of discharges or other activities which are at the level of limitations or

requirements promulgated or imposed pursuant to FWPCA.

To the extent that there is a conflict between any of the provisions of the interim statement of policy and the provisions of 10 CFR Part 50, Appendix D, the provisions of the statement will govern.

Because these modifications to the Commission's regulations implementing NEPA are necessary to comply with the FWPCA, the Commission has found that good cause exists for omitting notice of proposed rule making and public procedure thereon as unnecessary and impracticable and for making the interim statement of policy effective upon publication in the FEDERAL REGISTER without the customary 30-day notice.

Accordingly, pursuant to NEPA, FWPCA, the Atomic Energy Act of 1954, as amended, and sections 552 and 553 of Title 5 of the United States Code, the following interim statement of policy is published as a document subject to codification, to be effective on January 29, 1973.

The Commission invites all interested persons who desire to submit written comments or suggestions for consideration in connection with the statement to send them to the Secretary of the Commission, U.S. Atomic Energy Commission, Washington, D.C. 20545, Attention: Chief, Public Proceedings Staff, on or before March 15, 1973. Consideration will be given to such submissions with the view to possible further amendments. The Commission expects in any event to make conforming changes to the language in 10 CFR Part 50, Appendix D, in the near future after March 15, 1973. Copies of comments received by the Commission may be examined at the Commission's Public Document Room, 1717 H Street NW., Washington, DC.

INTERIM POLICY STATEMENT ON IMPLEMENTATION OF SECTION 511 OF THE FEDERAL WATER POLLUTION CONTROL ACT AMENDMENTS OF 1972 (FWPCA)

1. *Applicability.* This statement is effective immediately and shall apply to all licensing proceedings subject to 10 CFR Part 50, Appendix D, involving facilities or activities which may result in the discharge of a pollutant into the navigable waters, as defined in section 502(12)(A) of the FWPCA, and as to which no final Commission action had been taken prior to enactment of the FWPCA.

2. *Definition of terms.* As used in this statement:

a. Limitations or other requirements promulgated or imposed pursuant to the FWPCA means effluent limitations or other requirements promulgated or imposed pursuant to sections 208(e), 301, 302, 303(e), 304(b), 306, 307, 316, 318, 401, 402, 403, or 404 of the FWPCA. It also includes (i) Water quality standards continued in effect or promulgated pursuant to sections 303(a), 303(b), or 303(c) of the FWPCA; (ii) maximum daily loads for pollutants and maximum daily thermal loads, promulgated pursuant to section 303(d) of the FWPCA; and (iii) limitations or other requirements of State law under authority preserved by section 510 of the FWPCA, but only if and to the extent that such limitations or other requirements covered by this subpart (iii) are imposed and set forth in a certification pursuant to section 401(d) of the FWPCA or are imposed and set forth as a condition in a permit issued pursuant to section 402 of the FWPCA. It does not include (1) effluent limitations or other requirements regarding source, byproduct or special nuclear materials, which are subject to regulation by the Commission pursuant to the Atomic Energy Act of 1954, as amended, or (ii) limitations or other requirements promulgated or imposed pursuant to any other Federal law.

b. Pollutant discharge system means equipment or a mode of operation or procedure designed or intended for the control of discharge of pollutants, as that last phrase is defined in section 502(12) of the FWPCA. It does not include equipment or mode of operation or procedure designed or intended for the control of source, byproduct or special nuclear materials, which are subject to regulation by the Commission pursuant to the Atomic Energy Act of 1954, as amended.

c. Cooling water intake structure location, design, construction, and capacity means cooling water intake structure location, design, construction, and capacity within the meaning of section 316(b) of the FWPCA.

3. *Authority to impose requirements or limitations pursuant to National Environmental Policy Act of 1969 (NEPA).* If and to the extent that there are applicable limitations or other requirements promulgated or imposed pursuant to the FWPCA, different limitations or requirements will not be imposed by the Commission pursuant to NEPA as a condition to any permit or license, provided however, that limitations or other requirements of State law under authority preserved by section 510 of the FWPCA which are imposed and set forth in a certification pursuant to section 401(d) of the FWPCA or imposed and set forth as a condition in a permit issued pursuant to section 402 of the FWPCA, shall be regarded as only minimum limitations or requirements and the Commission shall retain any authority under NEPA to impose more stringent limitations or requirements.

4. *Alternatives.* a. Neither alternative cooling water intake structure location, design, construction, and capacity, nor alternative pollutant discharge systems will be considered by the Commission pursuant to NEPA (i) if a permit has been received for the facility or activity pursuant to section 402 of the FWPCA and a detailed statement with respect to issuance of that permit has been prepared pursuant to section 102(2)(C) of NEPA, or (ii) if and to the extent that conditions imposed as a part of the license or permit for the facility or activity pursuant to section 401(d) of the FWPCA require that a particular alternative be adopted, or (iii) if and to the extent that a permit or determination with a condition requiring the adoption of a particular alternative has been issued for the facility or activity pursuant to sections 208(b)(2)(C)(ii) and 303(e)(3)(B), 316, 402 or 404 of the FWPCA.

b. Alternative pollutant discharge systems will not be considered by the Commission pursuant to NEPA where effluent limitations have been imposed on the facility or activity under sections 301(c) or 302 of the FWPCA.

c. Neither alternative sites, facilities, or activities, nor alternative systems will be considered by the Commission pursuant to NEPA if and to the extent that a determination made with respect to the facility or activity under sections 208(b)(2)(C)(ii) and 303(e)(3)(B) of the FWPCA requires as a condition that a particular site, facility, or activity, or system be adopted.

d. To the maximum extent practicable any alternatives considered by the Commission pursuant to NEPA shall be considered by following procedures similar to those described in paragraph 5.

5. *Cost-benefit balances.* a. Except as provided in paragraphs b. and c., if and to the extent that there are applicable limitations or other requirements promulgated or imposed pursuant to the FWPCA, in considering the costs and benefits of a proposed action pursuant to NEPA, the Commission will determine whether the facility or activity that is the subject of the licensing action will comply with such limitations or other requirements.

(1) If it is determined that the facility or activity, or any part thereof, will not comply with such limitations or other requirements, then the facility or activity, or particular part in question, shall not be approved in the AEC license or permit.

(2) If it is determined that the facility or activity will comply with such limitations or other requirements, then the Commission will evaluate environmental impact on the basis of discharges or other activities associated with the facility or activity to be licensed which are at the level of such limitations or other requirements.

In making a determination in regard to compliance, as provided hereinabove, AEC will give due regard to the views on this matter of the Environmental Protection Agency and, where appropriate, of cognizant State and interstate agencies which exercise authority derived from the FWPCA.

b. Where limitations or other requirements of State law under authority preserved by section 510 of the FWPCA are imposed and set forth in a certification under section 401 (d) of the FWPCA or are imposed and set forth as a condition in a permit issued pursuant to section 402 of the FWPCA, the Commission will, in considering costs and benefits of a proposed action pursuant to NEPA, evaluate environmental impact on the basis of discharges or other activities associated with the facility or activity which are in compliance with said limitations or other requirements. In considering the costs and benefits of a proposed action pursuant to NEPA the Commission will accord due consideration to the fact that the facility or activity, or part thereof, will meet limitations or other requirements more stringent than such limitations or other requirements of State law by evaluating and giving consideration to environmental impact of the facility or activity accordingly.

c. (1) The Commission will not determine whether applicable limitations or other requirements promulgated or imposed pursuant to the FWPCA will be complied with if and to the extent that such a determination has been made (i) under sections 208(b)(2)(C)(ii) and 303(e)(3)(B), or (ii) sections 301(c), 302, 318, 401, or 402, or (iii) section 404 of the FWPCA. In such cases, the Commission will accept the determination made under these provisions, *Provided, however,* That the Commission will determine whether applicable limitations or other requirements promulgated or imposed pursuant to the FWPCA will be complied with notwithstanding that a determination has been made under section 401 of the FWPCA where there has been provided a certification that there is not an applicable limitation under sections 301(b) and 302 of the FWPCA and there is not an applicable standard under sections 306 and 307 of the FWPCA.

6. *Effect on Appendix D.* To the extent that there is a conflict between any of the provisions of this interim statement of policy and

the provisions of 10 CFR Part 50, Appendix D, the provisions of this statement shall govern.

(Sec. 102, 83 Stat. 853; secs. 101, 401, 511, 86 Stat. 817, 877, 893; sec. 161, 68 Stat. 948, as amended; 42 U.S.C. 2013, 2201)

Dated at Germantown, Md., this 12th day of January 1973.

For the Atomic Energy Commission.

PAUL C. BENDER,
Secretary of the Commission.

[FR Doc.73-1635 Filed 1-26-73;8:45 am]

APPENDIX E

Gaseous and Direct Doses

The airborne doses have been recomputed on the basis of: (a) an addition to Table III-3, page III-35 of 0.036 Ci/yr of I-131 and 0.025 Ci/yr of I-133 released from the turbine building vent; (b) additional engineering information on vent sizes, flow rates, and temperatures.*

Table E-2 gives direct doses to the human population via atmospheric dispersion of Plant releases at the Plant boundary, and for the population within the 160 sectors extending to 50 miles. These are subdivided into the critical organ doses attendant on releases of halogens and particulates (e.g., I-131), and of noble gases (e.g., Kr-85). The critical organ doses are given because they represent the limiting cases of human hazard (e.g., carcinogenesis). The corresponding genetically-significant doses (gonads), for example, are one or two orders of magnitude lower. Cumulated population doses and average individual doses versus distance from the Plant are given in Tables E-1 and E-2.

Airborne doses in all sectors are dominated by the noble gas component. The maximum airborne doses are found in the NW sector between zero and one mile. This sector is inhabited, so that the maximum dose (0.26 mrem/yr) represents an actual dose commitment. The annual population integrated dose commitment over the 50-mile radius will be 19 man-rem. The nearest dairy herd is pastured about two miles east of the site. Annual dose to a child's thyroid via the air-cow-milk pathway will be less than 5 mrem/yr. Were there to be a cow in the NW sector, at the boundary, the corresponding child's thyroid dose would be about 36 mrem/yr.

Direct dose rates from the Plant will be less than one mrem/yr at the closest approach to the Plant. This dose drops off very rapidly with distance, however, so that the total annual population dose from this source will be less than 0.1 man-rem. This source is essentially independent of Plant releases.

*Letter, "Applicant's Response to Comments on the Draft Environmental Statement," Northern States Power Company, E. C. Ward to G. K. Dicker, April 19, 1973.

TABLE E-1.* Cumulative Population, Cumulative Annual Dose, and Average Dose Due to Airborne Releases from the Prairie Island

Radial Distance from Plant, miles	Cumulative Population	Cumulative Population Dose, man-rem/yr	Average Individual Dose, mrem/yr
0-1	86	0.018	0.21
1-2	374	0.026	0.068
2-3	654	0.029	0.044
3-4	1670	0.039	0.023
4-5	3267	0.051	0.016
5-10	19400	0.13	0.0068
10-20	68920	0.23	0.0033
20-30	245900	0.46	0.0019
30-40	1248000	1.5	0.0012
40-50	1831000	1.9	0.0010

*This table replaces Table V-4, p. V-31.

TABLE E-2. Population Doses Due to Airborne Releases from the Prairie Island Plant

Direction		Boundary	0-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50
N	a	18.0	28.0	7.3	3.5	2.1	1.4	0.71	0.31	0.17	0.12	0.087
	b	81.0	130	33.0	16.0	9.7	6.8	3.4	1.5	0.86	0.59	0.44
	c	0.0	0.0	0.80	1.3	0.17	0.16	1.3	13.0	2.6	5.3	2.4
	d	54.0	85.0	22.0	11.0	6.5	4.5	2.3	1.0	0.58	0.40	0.30
	e	0.0	0.0	0.024	0.079	0.017	0.024	0.40	8.9	3.1	9.0	5.5
NNE	a	9.0	14.0	3.7	1.7	1.0	0.72	0.36	0.16	0.087	0.059	0.044
	b	41.0	64.0	17.0	8.1	4.9	3.4	1.7	0.76	0.43	0.30	0.22
	c	0.0	0.0	2.0	0.081	0.083	0.17	0.82	1.0	1.8	0.76	1.3
	d	27.0	43.0	11.0	5.5	3.3	2.3	1.1	0.51	0.29	0.20	0.15
	e	0.0	0.0	0.12	0.010	0.017	0.051	0.48	1.4	4.2	2.5	5.8
NE	a	7.5	12.0	3.0	1.5	0.87	0.60	0.30	0.13	0.073	0.049	0.036
	b	34.0	53.0	14.0	6.8	4.1	2.8	1.4	0.63	0.36	0.25	0.19
	c	0.0	0.0	0.29	0.11	0.086	0.096	0.68	0.90	1.2	1.0	0.66
	d	23.0	36.0	9.4	4.5	2.7	1.9	0.95	0.42	0.24	0.17	0.12
	e	0.0	0.0	0.021	0.017	0.021	0.034	0.48	1.4	3.4	4.1	3.5
ENE	a	9.1	14.0	3.7	1.8	1.1	0.73	0.36	0.16	0.080	0.059	0.044
	b	41.0	64.0	17.0	8.2	4.9	3.4	1.7	0.77	0.43	0.30	0.23
	c	0.0	0.0	0.12	0.14	0.035	0.14	0.97	1.0	1.1	2.5	2.1
	d	28.0	43.0	11.0	5.5	3.3	2.3	1.2	0.51	0.29	0.20	0.15
	e	0.0	0.0	0.007	0.017	0.007	0.041	0.56	1.3	2.5	8.3	9.5

TABLE E-2. (Contd.)

Direction		Boundary	0-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50
E	a	20.0	32.0	8.2	3.9	2.3	1.6	0.80	0.35	0.20	0.13	0.098
	b	91.0	140	38.0	18.0	11.0	7.6	3.8	1.7	0.97	0.66	0.50
	c	0.0	0.0	0.26	0.75	0.23	0.21	2.0	1.8	2.4	2.8	2.5
	d	61.0	96.0	25.0	12.0	7.4	5.1	2.6	1.1	0.65	0.44	0.34
	e	0.0	0.0	0.007	0.041	0.021	0.028	0.52	1.1	2.5	4.3	4.9
ESE	a	28.0	43.0	11.0	5.4	3.2	2.2	1.1	0.48	0.27	0.18	0.13
	b	130	200	52.0	25.0	15.0	10.0	5.2	2.3	1.3	0.90	0.69
	c	0.0	0.0	0.0	0.0	1.5	1.8	8.8	3.0	3.7	3.9	1.8
	d	84.0	130	35.0	17.0	10.0	7.0	3.5	1.6	0.89	0.61	0.46
	e	0.0	0.0	0.0	0.0	0.10	0.17	1.7	1.3	2.8	4.2	2.6
SE	a	34.0	53.0	14.0	6.5	3.9	2.7	1.3	0.59	0.33	0.22	0.16
	b	150	240	63.0	30.0	18.0	13.0	6.4	2.8	1.6	1.1	0.84
	c	0.0	0.0	0.63	0.0	0.0	3.2	54.0	2.7	5.5	3.9	2.6
	d	100	160	42.0	20.0	12.0	8.5	4.3	1.9	1.1	0.74	0.56
	e	0.0	0.0	0.010	0.0	0.0	0.25	8.5	0.96	3.4	3.6	3.1
SSE	a	18.0	28.0	7.3	3.5	2.1	1.4	0.72	0.32	0.17	0.12	0.087
	b	82.0	130	34.0	16.0	9.8	6.8	3.4	1.5	0.86	0.59	0.45
	c	0.0	0.38	0.10	0.11	6.6	4.4	3.3	1.7	1.6	3.5	17.0
	d	55.0	86.0	23.0	11.0	6.6	4.6	2.3	1.0	0.58	0.40	0.30
	e	0.0	0.003	0.003	0.007	0.67	0.65	0.96	1.1	1.9	6.0	38.0

TABLE E-2. (Contd.)

Direction	Boundary		0-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50
S	a	13.0	20	5.3	2.5	1.5	1.0	0.52	0.23	0.13	0.85	0.063
	b	59.0	92.0	24.0	12.0	7.1	4.9	2.5	1.1	0.62	0.43	0.32
	c	0.0	0.0	0.073	0.12	0.24	1.3	0.86	1.7	3.2	4.0	9.5
	d	39.0	62.0	16.0	7.9	4.7	3.3	1.6	0.74	0.42	0.29	0.22
	e	0.0	0.0	0.003	0.010	0.034	0.26	0.35	1.6	5.2	9.3	29.0
SSW	a	7.0	11.0	2.8	1.4	0.82	0.56	0.28	0.12	0.068	0.046	0.034
	b	32.0	50.0	13.0	6.3	3.8	2.6	1.3	0.59	0.34	0.23	0.17
	c	0.0	0.0	0.13	0.22	0.16	0.037	0.48	0.65	0.62	0.70	0.77
	d	21.0	33.0	8.8	4.2	2.6	1.8	0.89	0.40	0.23	0.16	0.12
	e	0.0	0.0	0.010	0.034	0.041	0.014	0.36	1.1	1.8	3.0	4.4
SW	a	6.1	9.5	2.5	1.2	0.71	0.49	0.24	0.11	0.059	0.040	0.030
	b	28.0	43.0	11.0	5.5	3.3	2.3	1.2	0.52	0.29	0.20	0.15
	c	0.0	0.0	0.0	0.17	0.46	0.048	0.027	0.71	0.85	2.9	3.5
	d	19.0	29.0	7.6	3.7	2.2	1.5	0.77	0.35	0.20	0.13	0.10
	e	0.0	0.0	0.0	0.031	0.014	0.021	0.23	1.4	2.9	15.0	23.0
WSW	a	6.0	9.4	2.4	1.2	0.70	0.48	0.24	0.11	0.058	0.039	0.029
	b	27.0	43.0	11.0	5.4	3.3	2.3	1.1	0.51	0.29	0.20	0.15
	c	0.0	0.0	0.0	0.054	0.13	0.039	0.14	1.8	3.6	0.52	1.1
	d	18.0	29.0	7.5	3.6	2.2	1.5	0.76	0.34	0.19	0.13	0.10
	e	0.0	0.0	0.0	0.010	0.041	0.017	0.12	3.6	12.0	2.6	7.1

TABLE E-2. (Contd.)

Direction		Boundary	0-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50
W	a	15.0	24.0	6.2	3.0	1.8	1.2	0.61	0.27	0.15	0.10	0.74
	b	70.0	110	29.0	14.0	8.4	5.8	2.9	1.3	0.74	0.51	0.38
	c	0.0	0.0	1.4	0.097	0.059	0.12	1.3	2.1	5.0	5.1	3.7
	d	47.0	73.0	19.0	9.3	5.6	3.9	1.9	0.87	0.49	0.34	0.26
	e	0.0	0.0	0.048	0.007	0.007	0.021	0.46	1.6	6.8	10.0	9.8
WNW	a	29.0	46.0	12.0	5.7	3.4	2.3	1.2	0.51	0.28	0.19	0.14
	b	130	210	54.0	26.0	16.0	11.0	5.5	2.5	1.4	0.96	0.72
	c	0.0	11.0	1.5	0.37	0.16	0.077	2.3	24.0	18.0	270	930
	d	88.0	140	36.0	18.0	11.0	7.4	3.7	1.7	0.94	0.64	0.49
	e	0.0	0.052	0.028	0.014	0.010	0.007	0.41	9.6	13.0	280	130
NW	a	36.0	56.2	15.0	7.0	4.2	2.9	1.4	0.63	0.35	0.23	0.17
	b	160	260	67.0	32.0	20.0	14.0	6.8	3.0	1.7	1.2	0.89
	c	0.0	4.3	0.47	0.0	0.14	0.14	2.1	35.0	160	690	260
	d	110	170	45.0	22.0	13.0	9.1	4.6	2.0	1.2	0.79	0.60
	e	0.0	0.017	0.007	0.0	0.007	0.010	0.30	11.0	94.0	580	300
NNW	a	22.0	34.0	8.9	4.3	2.6	1.8	0.88	0.38	0.21	0.14	0.11
	b	99.0	160	41.0	20.0	12.0	8.3	4.2	1.9	1.1	0.72	0.55
	c	0.0	2.2	0.12	0.059	0.084	0.0	1.2	3.2	18.0	43.0	8.2
	d	67.0	100	27.0	13.0	8.0	5.5	2.8	1.2	0.71	0.48	0.37
	e	0.0	0.014	0.003	0.003	0.007	0.0	0.28	1.7	17.0	60.0	15.0

Total = 1.9 man-rem/yr; (a) Dose from halogens + particulates, mrem/yr$\times 10^3$; (b) Dose from noble gases, mrem/yr$\times 10^3$; (c) man-rem/yr$\times 10^3$; (d) Dispersion factor $(K_c) \times 10^6$; (e) Sector population, in thousands.