Final

environmental statement

related to operation of

ENRICO FERMI ATOMIC POWER PLANT UNIT 2

DETROIT EDISON COMPANY

DOCKET NO. 50-341

July 1972

RETURN TO REGULATORY CENTRAL FILES
ROOM 016

UNITED STATES ATOMIC ENERGY COMMISSION
DIRECTORATE OF LICENSING

FINAL

ENVIRONMENTAL STATEMENT

BY THE

UNITED STATES ATOMIC ENERGY COMMISSION

DIRECTORATE OF LICENSING

FOR

ENRICO FERMI ATOMIC POWER PLANT UNIT-2

OF

DETROIT EDISON COMPANY

DOCKET NO. 50-341

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SUMMARY AND CONCLUSIONS

This final environmental statement was prepared by the U. S. Atomic Energy Commission, Directorate of Licensing.

1. This action is administrative.

2. The proposed action is the issuance of a construction permit to the Detroit Edison Company for the construction of the Enrico Fermi Atomic Power Plant Unit-2 (AEC Docket No. 50-341), a 3,428 MWt (1,150 net MWe) boiling-water reactor cooled by wet, natural draft cooling towers and scheduled for startup in 1975. The plant is located in the State of Michigan, County of Monroe, near the city of Monroe.

3. Summary of environmental impact and effects:

    a. During the construction and site development, disruptions of portions of the onsite land and waters will occur, localized changes will be made in the contour of onsite and adjacent water basins, and some wildlife will be temporarily displaced.

    b. There will be respective summer and winter heated-water discharges to Lake Erie of 12,000 gpm at 12°F above ambient and 6,000 gpm at 23°F above ambient. These discharges are not expected to have any significant environmental effects.

    c. Approximately 50,000 curies of noble gases and 0.5 curie of iodine per year will be released in gaseous effluents and less than 5 curies per year will be released in liquid effluents in addition to about 20 curies per year of tritium. These quantities will produce no detectable adverse effects.

    d. A maximum of about 19,500 gallons per minute of Lake Erie water will be evaporated from the cooling tower and the residual heat removal pond.

    e. Some minute organisms will pass through the water intake and be killed, but the total effect of plant operation on aquatic biota will be very localized and inconsequential in terms of Lake Erie ecology.

    f. Dewatering and quarrying operations have lowered groundwater levels and adversely affected some water wells in the vicinity of the plant site. Actions have been taken to restore groundwater supplies and alleviate problems in nearby wells.

g. Ground fog and local icing may develop very infrequently as a result of the cooling-tower discharge.

h. The visual impact of the cooling towers and to a lesser extent the new transmission lines may be objectionable to some of the public in their vicinity.

i. Small amounts of chemicals will be released in liquid effluent from the plant; but expected maximum concentrations to be discharged will be sufficiently low so as not to pose a hazard to aquatic or human life.

j. A very low probability of risk of accidental radiation exposure to the public will be created.

k. Electrical power will be supplied for residents, industries, and communities within the applicant's system.

l. A benefit to the local economy will result from operation of the plant, through payment of taxes, employment of personnel, and local purchase of goods and services.

4. Principal alternatives considered were:

   a. Select an alternative site;

   b. Do not produce the power;

   c. Purchase the power from other utilities;

   d. Install 1150 MWe of base-load fossil-fueled capability, with interim purchase of power;

   e. Install 1150 MWe of diesel generator peaking capacity;

   f. Renovate the 950 MWe of obsolete generating capacity now scheduled for retirement, and add 200 MWe of peaking capacity;

   g. Use once-through cooling;

   h. Use mechanical-draft towers;

   i. Use a spray pond;

   j. Use a cooling pond; and

   k. Use dry towers.

5. Comments on the draft environmental statement were requested from the following Federal, State and local agencies. Comments received were forwarded to the applicant for reply, are included as Appendices D through K of this final environmental statement, and are discussed in Section X. In addition, separate discussions were held in April 1972 between the staff and interested members of the public and with the applicant on environmental problems related to quarrying operations at the plant site.

<u>U. S. Federal</u>:

Council on Environmental Quality
Department of Transportation
Department of Commerce
Department of Health, Education and Welfare
Department of the Army (Office of the Chief of Engineers)
Department of Agriculture
Federal Power Commission
Department of the Interior
Department of Housing and Urban Development
Environmental Protection Agency

<u>Michigan State and Local</u>:

Governor
Department of Natural Resources, Water Resources Commission
Supervisor, Frenchtown Township

6. This final statement is being made available to the public, to the Council on Environmental Quality, and to the other agencies noted in item 5., above, in July 1972.

7. On the basis of the evaluations and analysis set forth in this statement, and after weighing the environmental, economic, technical, and other benefits against environmental costs and considering available alternatives, it is concluded that the action called for is the issuance of a construction permit for the Enrico Fermi Atomic Power Plant Unit 2 subject to the following conditions for the protection of the environment:

   a. The applicant will, prior to the issuance of a construction permit, provide a program, acceptable to the staff, for the control of the site of present quarrying operations, including, but not limited to, plans for the present and future use of the site, appropriate monitoring of the environment, and positive actions to be taken to enhance beneficial environmental effects and to avoid, mitigate or alleviate adverse environmental effects which have occurred or which might occur in the future. Activities and effects associated with blasting onsite shall be included, whether or not related to quarrying.

b. The applicant will perform preoperational measurements of the distributions of aquatic species to establish base-line data adequate for determining adverse effects the plant might have on the environment. An analysis of the results of this program will be reported to the staff semiannually.

c. The applicant will take measures to assure that construction of transmission lines and their future maintenance will be carried out so as to minimize disruption of vegetation and wildlife and use of recreational lands, and so as to minimize visual impact.

d. The applicant will establish, prior to operation of the plant, a monitoring program for liquid effluents to measure parameters such as temperature, dissolved solids concentrations, and chlorine concentrations. The applicant will take positive actions, such as modification of equipment or operating procedures, as necessary to assure that these parameters are kept as low as practicable and within limits considered by the regulatory staff to be adequate to protect against unacceptable environmental effects.

e. The applicant will define an environmental monitoring program to disclose changes which may occur in land and water ecosystems as a result of plant operation, and considered by the regulatory staff to be adequate for inclusion in the Technical Specifications for the plant.

f. The applicant will define a radiological monitoring program to determine radiological effects on the environment from operation of the plant, and considered by the regulatory staff to be adequate for inclusion in the Technical Specifications for the plant.

g. If harmful effects or evidence of irreversible damage are detected by the monitoring programs, the applicant will provide an analysis of the problem and will provide a course of action to be taken immediately to alleviate the problem.

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FOREWORD

This final environmental statement associated with the issuance of a construction permit to the Detroit Edison Company (the applicant) for its 1150 MWe boiling water reactor, the Enrico Fermi Atomic Power Plant Unit-2 (the plant) (AEC Docket No. 50-341) scheduled for startup in 1975, has been prepared by the U. S. Atomic Energy Commission's (AEC) Directorate of Licensing (the 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).

As required by the AEC's implementation of the NEPA outlined in AEC 10 CFR Part 50, Appendix D (Federal Register, June 3, 1970), an Environmental Report for the plant was submitted by the applicant in September 1970. This Report, titled "Applicant's Environmental Report - Construction Permit Stage," was sent by the AEC to various Federal and State agencies for comment. A supplementary document responding to the comments received from the various agencies was submitted by the applicant to the AEC on March 22, 1971. In addition to the AEC, the agencies providing comments were the:

1. Department of Health, Education, and Welfare;
2. Department of Housing and Urban Development;
3. Department of Defense;
4. Department of Agriculture;
5. Department of the Interior;
6. Federal Power Commission; and
7. State of Michigan, Department of Natural Resources.

The staff issued a "Final Detailed Statement on the Environmental Considerations" for the proposed construction of the plant on June 18, 1971. That statement took into consideration the Applicant's Environmental Report; the comments received from Federal and State Agencies regarding the applicant's report; additional information furnished to the AEC by the applicant responding to those items in the Federal and State Agency comments requiring further clarification; and information contained in the Preliminary Safety Analysis Report (PSAR) as amended.

A revised Environmental Report was prepared by the applicant in accordance with the revised Appendix D of Part 50 of the Commission's regulation, effective when published in the Federal Register on September 9, 1971. As permitted by Paragraph D of that Appendix, the applicant chose to submit a revised, i.e., "new" Environmental Report rather than supplement the original report dated September 1970. The revised Environmental Report was received by the AEC on October 22, 1971.

A draft environmental statement was issued in March 1972 and sent to Federal, State, and local agencies and officials for comment.

This final environmental statement is based on the literature tabulated in Appendix C. Major documents used in the preparation of this statement were the applicant's revised Environmental Report; the Preliminary Safety Analysis Report and the 19 amendments to the Application for Licenses; the Safety Evaluation of May 17, 1971, by the Division of Reactor Licensing, and its Supplement of August 19, 1971, and comments on the draft environmental statement and the applicant's responses thereto. All of these documents are available for inspection by members of the public in the AEC Public Document Room, 1717 H Street, N. W., Washington, D. C. and in the Monroe County Library System, 3700 South Custer Road, Monroe, Michigan.

Independent calculations and sources of information were also utilized as a basis for the Commission's assessment of environmental impact. In addition, some of the information was gained by visits by the staff to the plant site and surrounding areas in 1971 and 1972.

The AEC is publishing in the Federal Register a summary notice of the availability of the final environmental statement.

The applicant is required to comply with Section 21(b) of the Federal Water Pollution Control Act, as amended by the Water Quality Improvement Act of 1970.

A public hearing on environmental issues related to the granting of a construction permit for the plant will be held, and notice of this hearing will be published in the Federal Register.

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I. INTRODUCTION

On April 29, 1969, the Detroit Edison Company applied to the U. S. Atomic Energy Commission for a construction permit and facility license for a nuclear power plant to be called the Enrico Fermi Atomic Power Plant Unit-2, an 1150-megawatt electrical (MWe) boiling water reactor, to be located at Lagoona Beach, Frenchtown Township, in Monroe County, Michigan. The application (Docket No. 50-341), available for public inspection at the AEC's Public Document Room at 1717 H Street, N. W., Washington, D. C., also has been forwarded to Michigan State and local officials. Material submitted in support of the application for a construction permit was reviewed and evaluated by the regulatory staff and by the Commission's independent Advisory Committee on Reactor Safeguards (ACRS) prior to convening a public hearing. A Notice of Hearing concerning the issuance of a construction permit was published in the Federal Register on March 26, 1971. The public hearing was initiated by an Atomic Safety and Licensing Board in Monroe, Michigan, on October 26, 1971.

A. NEED FOR POWER

The latest projections made by the applicant, in April 1971, indicate that the demand for power on its system will continue to double every 10 years over the next 3 decades. Estimates for the current decade, shown in Table I-1, indicate an average annual summer peak-load increase of 7.9%. The applicant, together with Consumers Power Company, forms the Michigan Power Pool. The applicant has a summer peak load; Consumers a winter peak load.

The applicant's generation expansion plan is based on the forecast of peak demands for its system and that of the Michigan Power Pool. The latter is expected during the 1970's to have an average annual summer peak load increase of 7.7%.

The size of the plant conforms with the general trend in the electric utility industry to construct and operate larger capacity units. The plant is now scheduled for operation in October 1975. It will supply about 14% of the 1976 summer peak load and over 20% of the total system kilowatt-hour requirements. The moderately increasing trend in reserve margins in the current decade, shown in Table I-1, reflects the fact that most of the new generating capacity will be in relatively large units whose schedules and availability can be uncertain.

Table I-1 also shows the annual net capacity additions to the applicant's system. By the time the plant has achieved full power operation, about 950 MWe of older fossil-fueled generating equipment will have been retired. These are the coal-fired Marysville and Trenton plants and the oil-fired Conner Creek and Delray plants. A comparable situation exists for Consumers Power Company.

TABLE I-1

APPLICANT'S PROJECTIONS OF DEPENDABLE CAPACITY AND PEAK DEMAND FOR THE YEARS 1970 - 1980[4]

	Megawatts Electric										
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1. Peak Demand	5,465	5,986	6,485	6,985	7,515	8,080	8,685	9,345	10,055	10,825	11,650
2. Owned Capacity	5,807	5,889	6,670	7,579	8,402	9,341	9,982	9,982	10,782	10,782	11,932
3. Net Capacity Additions	82	781	709	823	939	641	0	800	0	1,150	1,150
4. Total Owned Capacity	5,889	6,670	7,579	8,402	9,341	9,982	9,982	10,782	10,782	11,932	13,082
5. Net Purchases (Sales)	391	354	274	54	(321)	238	666	605	1,125	739	1,080
6. Total Dependable Capacity	6,280	7,024	7,853	8,456	9,020	10,220	10,698	11,387	11,907	12,671	14,162
7. Reserve Margin(%)	14.9	17.3	21.1	21.1	20.0	26.5	23.2	21.9	18.4	17.1	21.6

Through 1975, Consumers has scheduled the retirement of 158 MWe of older, fossil-fueled, plants as new units in the Pool become operational.[7] Since the applicant must purchase power from the Consumers system to achieve the total dependable capacity indicated in Table I-1, the applicant's system is influenced by developments within Consumers' system, such as any delay in full-power operation of its Palisades plant.

The Federal Power Commission (Appendix A) provided comments on the environmental impact in its area of expertise based on an operating date of August 1974 for the plant and on other information available from the applicant at that time. Subsequently, on March 22, 1971, in Amendment 18 to the Preliminary Safety Analysis Report and in the Revised Environmental Report of September 1971, the applicant has provided updated information. The data of Table I-1 indicate the status in September 1971. They do not reflect the most recent estimate of a delay in startup until after the 1975 summer peak. Updated estimates by the Federal Power Commission, reflecting the additional delay, are presented in Appendix H, the concluding paragraph of which states:

"... In view of the delays already experienced in bringing many large new generating units of all types into commercial operation on schedule, with the consequence that less than optimum economic or adequate and reliable operations results, the staff of the Bureau of Power concludes that it would be prudent to avoid further delay in the schedule for bringing the Enrico Fermi unit into commercial operation."

In arriving at its estimate of the availability date for the plant, the applicant made reasonable allowances for the many delays that might occur. If these allowances prove insufficient, or if unanticipated delays occur in the schedules for other large plants currently under construction within the applicant's system and the Michigan Power Pool, the system's reserve margin would be reduced and peak demand might even exceed available capacity. On the assumption that only the Fermi-2 plant is delayed until after the 1975 summer peak, the reserve margin will be reduced to 12.6% during the 1975 summer peak. This is considered to be below a satisfactory level for maintaining system reliability, in view of the dependence on a relatively few large units to provide the bulk of the power demand at that time. Short-term arrangements possible to assure that the system is able to meet demands of its customers would include a delay in shutting down the obsolete fossil-fired plants and, if sufficient lead time exists, the construction of additional gas turbine and/or oil-fired peaking units. Neither of these alternatives is desirable on either environmental or economic grounds. Continued operation of the obsolete units would in fact violate agreements made with local air pollution authorities, require locating an adequate supply of fuel, and affect the plans of the Michigan Public Service Commission. (See Appendix B). Furthermore, significant amounts of power probably cannot be purchased on a short-term basis during Summer 1975.

Projections of capability, demand and reserve depend on many factors which vary with time, such as capacity addition schedules and delays, recent history of actual demand, availability of purchased power and similar conditions in neighboring utility systems. The differences among such data in Table I-1 and Appendices A, B and H are explainable in terms of the changing situation over the period from September 1970 to April 1972 during which they were developed. For example, the estimated date for commercial operation of Fermi-2 has ranged from the summer of 1974 to the fall of 1975 during this period. Thus such tabulations of capability-demand-reserve should be considered as indicative of the status at a particular time, rather than invariant.

B. SITE SELECTION

The company's Monroe site, the location for one coal-fired 800 MWe unit now in operation, a second now undergoing final testing and two similar units scheduled for completion in 1973 and 1974, was considered briefly for a nuclear power plant site. However, because of the high population density, it was rejected in preference to the Fermi-1 site.

The applicant has owned the Fermi-1 site since 1956 and has used it for generation of electricity intermittently since 1963. In connection with the construction and operation of the Fermi-1 nuclear unit, the site's characteristics have been investigated extensively, beginning in the late 1950s. Comparison of the current site boundaries with those existing when Fermi-1 was constructed shows that approximately 170 acres have been added along the northern boundary. (See Section II.A.) In addition to having favorable geological, seismological, hydrological, and meteorological characteristics, the Fermi-1 site is relatively isolated from population and industrial centers, is large enough for additional generating units, and is connected to the power transmission system by right-of-way. The land is already dedicated to use for power production in the regional land use plan of the Southeastern Michigan Council of Governments.

C. APPLICATIONS AND APPROVALS

Prior to construction and operation of the plant, the applicant must apply to a number of Federal, State, and local agencies for licenses, permits, and other approvals. The status of the applications is discussed below.

1. Federal Agencies

a. U. S. Atomic Energy Commission

(1) A construction permit, applied for in April 1969, is now pending. A public hearing must be held by the Atomic Safety and Licensing Board of the AEC before the permit can be issued. Hearings were initiated on October 26, 1971. The AEC and the Advisory Committee on Reactor Safeguards have conducted a comprehensive review of the application for a construction permit. The Staff Safety Analysis Report was issued May 17, 1971 and supplemented by information concerning the Emergency Core Cooling System on August 19, 1971.

(2) The AEC granted Exemption Authorizations for construction prior to receipt of the construction permit as follows: for 1.) reactor building foundations and walls below grade on October 15, 1970; and 2.) for steel sections below grade in March 1971.

(3) The AEC and the Advisory Committee on Reactor Safeguards will conduct an intensive review of the Applicant's Final Safety Analysis Report prior to issuance of an operating license.

(4) The AEC requires that the applicant have a license for receipt and storage of nuclear fuel prior to the shipment of the fuel to the site.

b. Federal Aviation Agency

	Approval	Applied For	Obtained
(1)	Cooling Towers	April 16, 1971	May 21, 1971
(2)	Meteorological Tower	May 10, 1971	June 1, 1971

c. U. S. Army Corps of Engineers

(1) For discharge of liquid effluents into Lake Erie. - Not yet applied for.

The Corps regulations require that the State of Michigan and the Environmental Protection Agency (EPA) must review these discharges from the standpoint of water quality prior to issuance of a permit. The Michigan Water Resources Commission (MWRC) has certified (see 2.a. below), in accordance with Section 21(b) of the Federal Water Pollution Control Act, that these discharges will not violate applicable water quality standards. EPA concurrence has not yet been obtained.

A similar application for Fermi-1 was made on July 1, 1971, but a permit has not as yet been obtained.

(2) For dredging in Lake Erie for a barge canal for delivery of the reactor pressure vessel. - Applied for March 1, 1972.

(3) For periodic dredging of the joint intake canal.

Permits for such operations have been obtained in the past, at one or two year intervals (most recently September 14, 1971). Because the maximum incremental flow associated with Fermi-2 is only 24%, the frequency of such dredging should not increase markedly.

(4) For river crossing by 345 kV transmission lines (Huron River). Applied for October 25, 1971; permit not yet obtained.

2. State Agencies

a. Michigan Water Resources Council

	Approval	Applied For	Obtained
(1)	Water use	November 23, 1970	February 18, 1971
(2)	Temporary sewage treatment plant use	(Not Available)	February 18, 1971
(3)	Sewage treatment facilities for onsite science center	May 27, 1971	July 23, 1971

b. Michigan Public Service Commission

A building permit for one of the two 345 kV transmission lines was applied for on January 22, 1971 and was obtained February 5, 1971. At an appropriate time, a building permit will be requested for the second line.

c. Michigan Highway Department

Five highway crossing permits for one of two 345 kV transmission lines were applied for on December 29, 1971 but have not as yet been obtained.

3. Local Agencies

a. Frenchtown Township

	Approval	Applied For	Obtained
(1)	Building Permit (plant)	April 7, 1970	November 23, 197(
(2)	Building Permit (Cooling Tower)	May 13, 1971	June 14, 1971
(3)	Notification of building one of two 345 kV transmission lines.	September 24, 1971	*

*Notification of township supervisor is only requirement.

b. Monroe County Health Department

Approvals for use of the temporary sewage treatment plant during construction and for the science center sewage treatment facilities were obtained upon notification to the Health Department by the Michigan Water Resources Council of approval. (See 2.a. above.)

c. Local permits for construction of one of two of the 345 kV transmission lines (similar permits to be requested for the second line later), as follows:

(1) Berlin Township

Construction permit applied for July 23, 1971 and obtained July 23, 1971.

(2) City of Rockwood

Construction permit applied for April 21, 1971 and obtained April 21, 1971.

(3) City of South Rockwood

Notification of Village Clerk was the only requirement. Notification given on April 5, 1971.

(4) City of Woodhaven

Construction permit was applied for (date not available) and permit obtained November 14, 1971.

4. Consultations with Other Organizations

A complete record of the applicant's contacts with other agencies, organizations, and individuals is not available. However numerous presentations about plans for the plant were made to local civic and business groups, township and county boards, and school systems.

II. THE SITE

A. LOCATION OF PLANT

The plant is located in a rural and recreational area in the southernmost region of the applicant's service area at Lagoona Beach, Frenchtown Township, Monroe County, Michigan, midway between Detroit and Toledo on the western shore of Lake Erie about 1.5 miles northwest of Stony Point, a summer resort with a population of 1,370, and 8 miles east-northeast of Monroe, Michigan, whose population in 1970 was 23,894. The populations of communities within a 10-mile radius of the site are presented in Section 2.1 of the applicant's revised Environmental Report. As shown in Figure II-1, Detroit, Michigan, with a 1970 population of 1,511,482, is centered about 30 miles north-northeast, and Toledo, Ohio, with a 1970 population of 383,818, is about 25 miles to the southwest. Figure II-2 provides a more detailed indication of significant land and water use in the immediate vicinity of the plant.

The site, a 1,088-acre property owned by the applicant, was not previously developed except for Unit 1. The area is flat land, except for the western portion, which displays meager relief in which lowland forest predominates. The north and south lagoons and their adjoining marsh areas accounted for almost half the site, excluding Lake Erie and Swan Creek. Figure II-3 shows the nature of the site at the time that Unit 1 was placed in operation. The extension of the original 915-acre tract to its current size by the addition of land and adjacent water at the northern boundary is also shown in this figure.

Table II-1 shows the site characteristics for use prior to construction of the Fermi-2 plant. The major modifications made since the site was acquired were the construction of the Fermi-1 plant and related facilities such as an access road, a railroad spur and a quarry, peaking units and associated facilities, power transmission lines, and a Public Information Center.

B. REGIONAL DEMOGRAPHY AND LAND USE

Other than a few small beach communities, which are of decreasing attractiveness due to pollution of Lake Erie, the area in the immediate vicinity of the site is primarily agricultural. State Highway 56 runs approximately north-south 2 miles west of the plant and Interstate Highway 75 (Detroit-Toledo Expressway) is approximately 4 miles west. Traffic on the former is light, but it is estimated that 30,000 vehicles per day use the latter. The main line of the Detroit and Toledo Shore Line Railroad and a branch of the Penn-Central system run parallel to Interstate 75 in the vicinity of the site.

The lake side of the tract is unpopulated except for transient water craft that normally pass at substantial distances because of the shallowness of the lake near shore. One and 2-fathom depths are reached at approximately 1,250

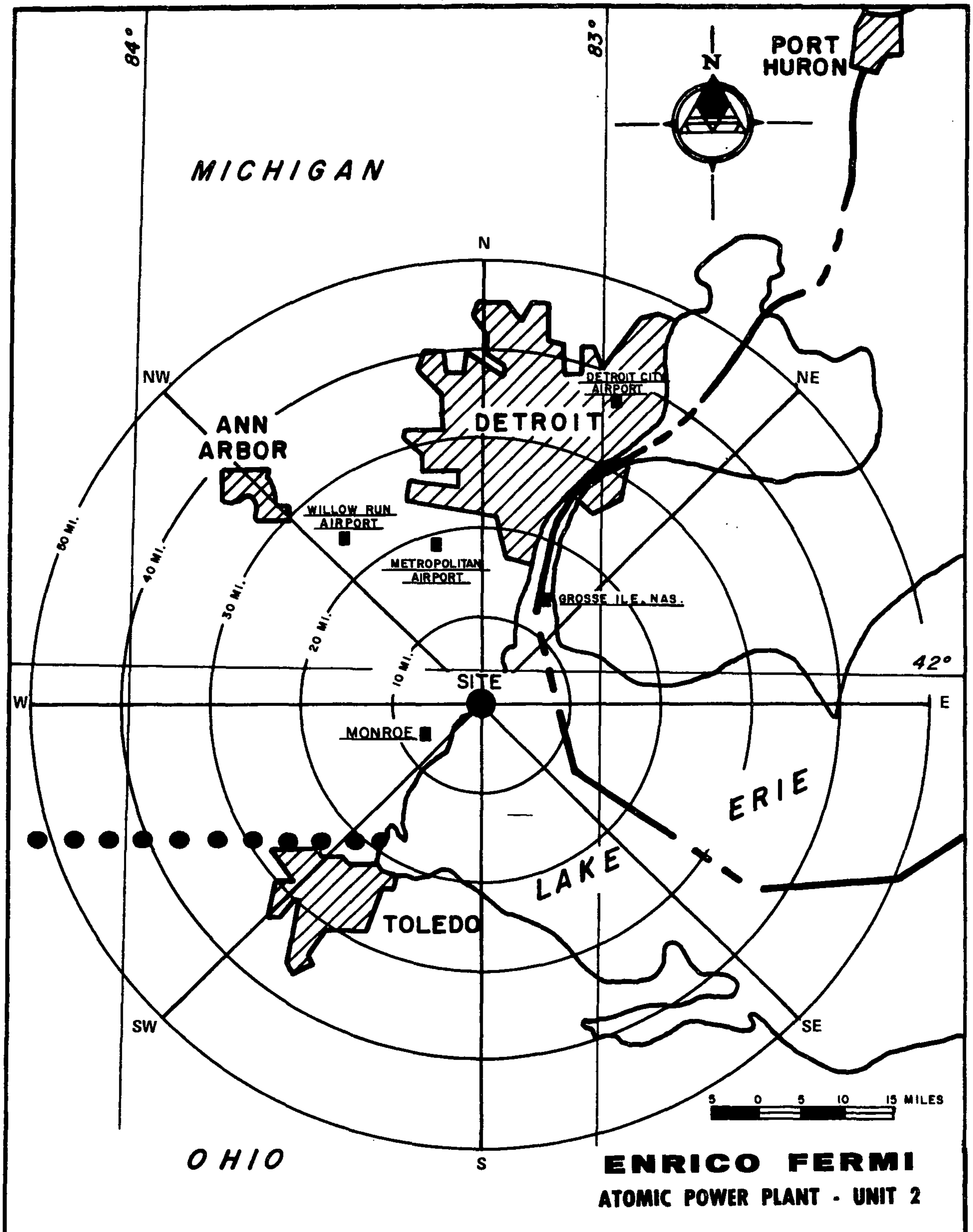


FIGURE II-1. MAJOR POPULATION CENTERS WITHIN 50 MILES OF THE FERMI SITE

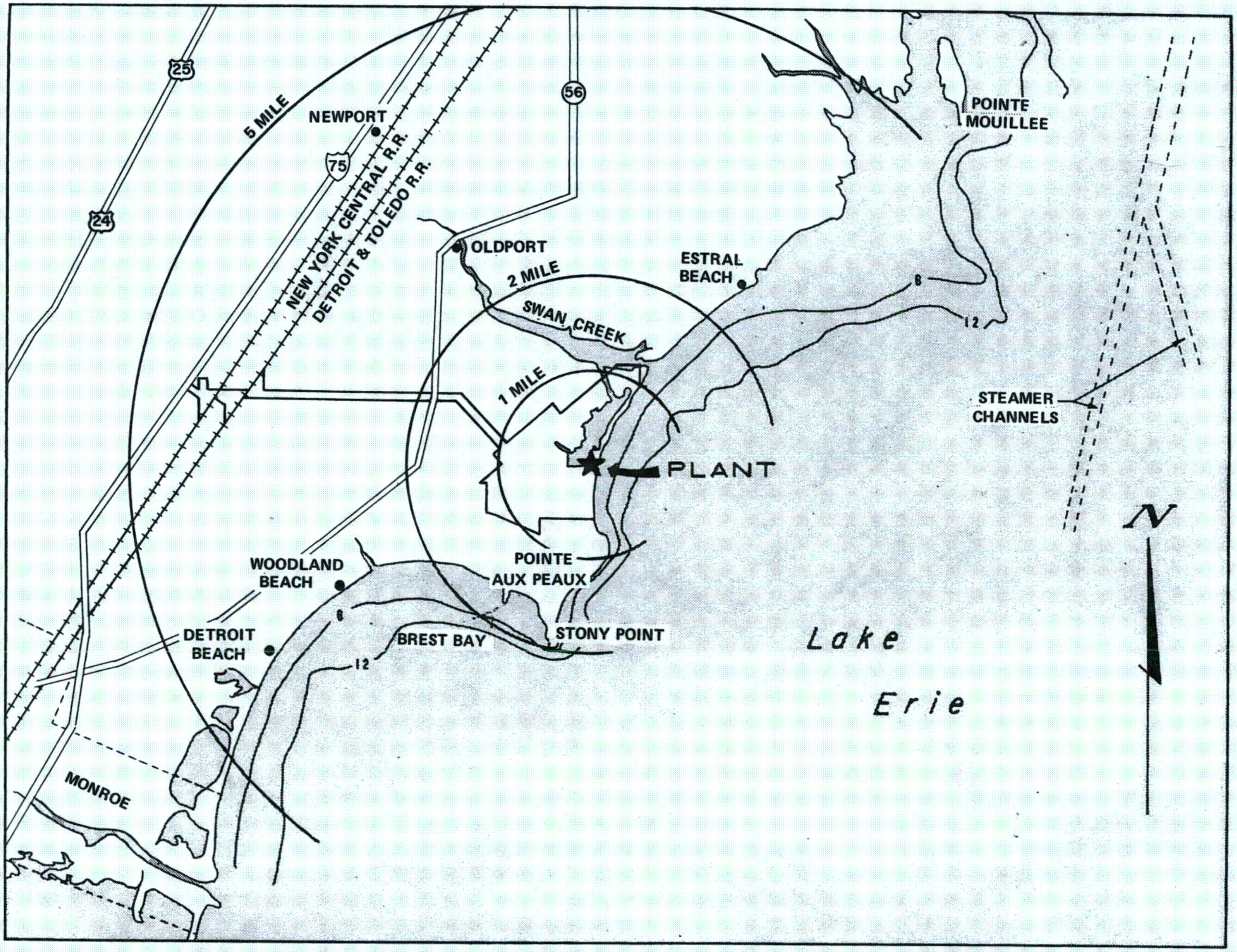


FIGURE II-2. SIGNIFICANT LAND AND WATER USE IN THE VICINITY OF THE FERMI SITE

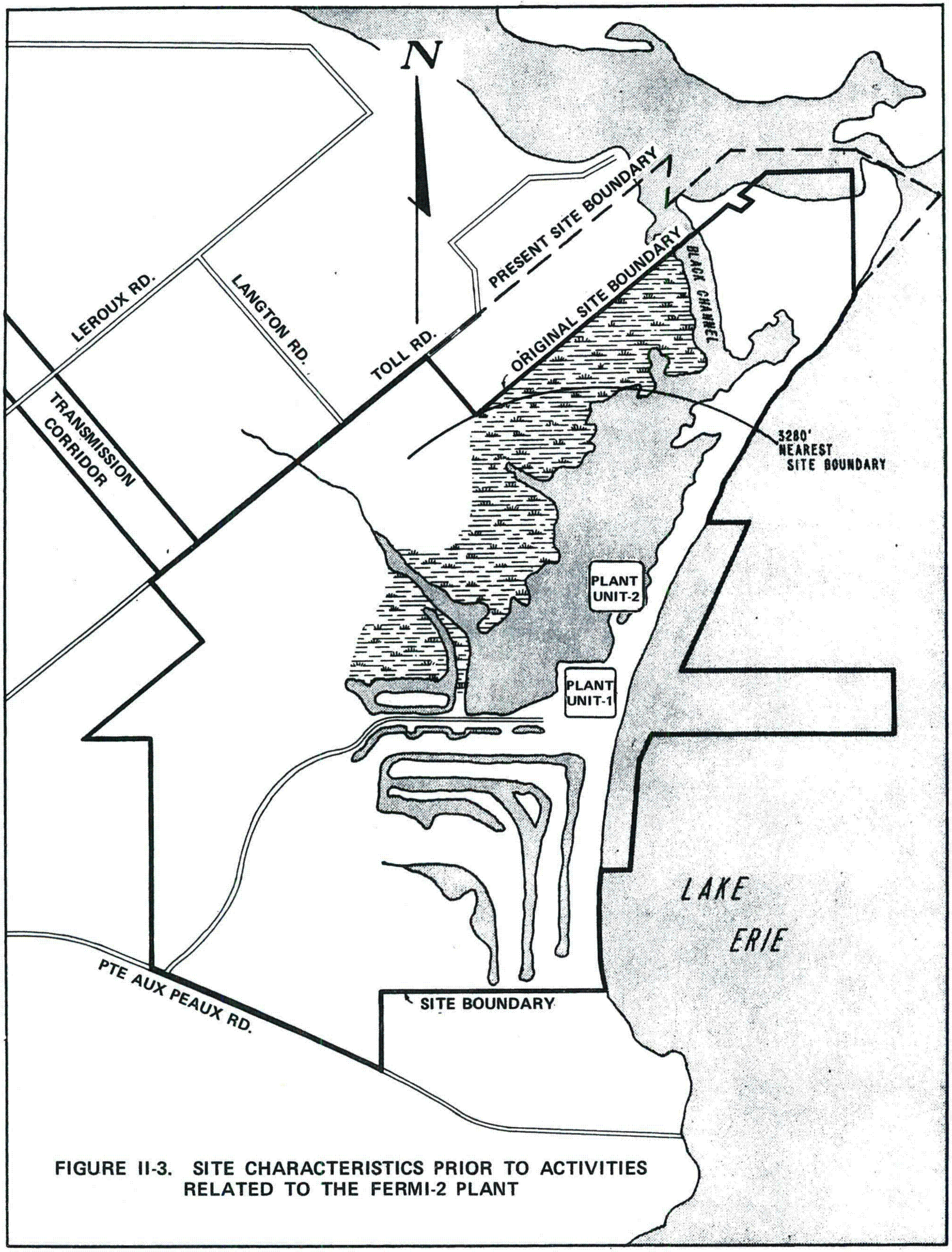


FIGURE II-3. SITE CHARACTERISTICS PRIOR TO ACTIVITIES RELATED TO THE FERMI-2 PLANT

TABLE II-1. LAND USE PRIOR TO FERMI-2 CONSTRUCTION

	Acres	Percent
Plant Area	26	2.4
Inland Water Bodies	262	24.1
Woodland	175	16.1
Scrub Growth	245	22.5
Reeds and Marsh	274	25.1
Access Road	3	0.3
Railroad	2	0.2
Beach Area	9	0.8
Lake Erie and Swan Creek	92	8.5
	1,088	100.0

TABLE II-2. PAST AND PROJECTED POPULATIONS IN THE FERMI-2 VICINITY

Distance (miles)	Population		
	1960	1980	2000
0 - 5	6,850	30,432	71,839
5 - 10	44,057	138,962	253,679
10 - 50	4,208,665	6,332,472	9,111,873
Totals:	4,259,572	6,501,866	9,437,391

and 2,100 feet from shore, respectively. A small number of pleasure boats operate from the mouth of Swan Creek but, in general, the waters inshore have no significant recreational usage. In order to assure clear access to Lake Erie water for use in the plant, the applicant leased from the State of Michigan approximately 8 acres of underwater land immediately adjacent to the plant. The deep-water channel used by commercial shipping is approximately 5-1/4 miles offshore from the site. The channel is used mainly in the commercial shipping season which ordinarily extends from about April 1 to December 15.

Past and projected populations in selected regions around the site are given in Table II-2. Because of Lake Erie, more than 99% of the population within a 10-mile radius of the plant is in the 180° sector extending from northeast through northwest to southwest. The 1970 population within a 10-mile radius of the plant was about 58,000. The projected population data were provided by the Developing Detroit Area Research Project, a combined effort involving personnel from a firm of urban planners and landscape architects, Wayne State University and the applicant. The indicated increase from 1960 to 1980 for the population within ten miles of the plant is equivalent to an annual growth rate of 6.2%, while the corresponding rate for the following two decades is 3.3%. This predicts a future slowing in the growth rate in the vicinity of the plant.

The site is located at the eastern edge of Monroe County which in turn is at the southeast corner of the State of Michigan. The county extends about 10 miles north, 25 miles west, and 25 miles southwest of the site. Agriculture is dominant in the county.[9] In 1964, 73.4% of its area was devoted to farming, through 2,268 farms averaging 116.4 acres. In 1968, Monroe County ranked first among Michigan counties in production of soybeans and second in corn. In 1959, the feed crops included 45,000 acres of soybeans, 100,000 acres of corn, and 30,000 acres of wheat. Principal vegetable crops were 30,000 acres of tomatoes, 2,400 acres of sugar beets, and 1,200 acres of potatoes. Approximately 10% of the farms were dairy farms, with herds ranging from 20 to 70 head.

In 1963, there were only 128 manufacturing establishments in Monroe County. Only 5 employed more than 250 people, while 89 had less than 20 employees. Industrial activity is concentrated in the city of Monroe. Mining and forestry operations were insignificant.

It is unlikely that the principal activities in Monroe County will change significantly in the near future. It is noteworthy that the "Comprehensive 1990 Plan for the Detroit Region," prepared in 1969 under an urban planning grant from the U. S. Departments of Transportation and Housing and Urban Development, indicates a dominance of agricultural, low-density (1.1 to 4 housing units per acre) housing, and recreational land use within a 5-mile radius of the site. Other than the Fermi site itself, the only land available for industrial activities within this radius is a narrow strip, bounded by Interstate Highway 75 and the Detroit and Toledo Shore Line Railroad and extending northeast from a point about 4-1/2 miles from the plant.

The communities of Estral Beach, Stony Point, Detroit Beach, and Woodland Beach lie along the lake shore within 5 miles of the site. These communities are in part summer resorts and in part permanent residential areas.

The nearest of them is Stony Point, 1 to 2 miles south along the shore from the plant. Except for these communities and the small Newport-Oldport residential area to the northwest, the land within 5 miles of the plant is devoted primarily to agricultural uses. The dwellings nearest the plant are private cottages lying about 3,500 feet south. The nearest habitations to the north lie on the banks of Swan Creek about 7,000 feet from the plant. To the west the nearest habitations are farm houses, the closest about 4,500 feet from the plant. Any substantial future increase in the summer resort population near the site seems unlikely, since much of the shore land is marshy, the existing beach is of rather low quality, and few good building sites remain.

A recreational area is located at Sterling State Park on the lake shore about 5 miles southwest of the plant. During July and August, when the park has by far its greatest popularity, there are about 1,500 visitors per day. The Pointe Moullie State Game Area adjoins the lake shore about 6 miles northeast of the plant.

The sector approximately east through southeast from the plant corresponds to the nearby axis of Lake Erie, and the first land in that direction consists of islands over 30 miles away from the site. The land nearest to the plant in other lakeward directions is a sparsely populated agricultural area of Essex County, Province of Ontario, about 10 miles east-northeast of the site. Essex County as a whole has an area of 700 square miles, of which about 83% is agricultural. It includes Windsor, Ontario, situated across the river from Detroit and about 30 miles northeast of the site.

C. HISTORICAL SIGNIFICANCE

The U. S. Department of the Interior's National Register of Historic Places has no listings for Monroe County, Michigan. In the contiguous counties of Wayne, Washtenaw, and Lenawee in Michigan, and Lucas in Ohio, the nearest are about 35 miles away, in Ann Arbor, Michigan (University of Michigan President's House), and in Maumee, Ohio (Hull-Wolcott House and Fallen Timbers Battlefield).

No significant fossil deposits or archaeological materials are known to exist on the site. Quarrying operations have revealed some fossil remnants, and they have been examined by student groups on field trips, but they are considered to be of pedagogical value only.

The State Liaison Officer for Historic Preservation has indicated[39] that the plant will not affect any known historical resources of the State.

A university anthropologist has stated there are no known archaeological resources at the site although they might have been covered or disturbed by the site preparation activities.[39] The applicant is not aware of any such burial or disturbance.

D. ENVIRONMENTAL FEATURES

1. Surface Waters

Prior to site development for the plant, approximately one-quarter of the site was covered by water, principally in the north and south lagoons. In many places, the water was less than 2 feet deep. These places are separated from the western shoreline of Lake Erie by a barrier beach which forms the eastern site boundary. The lagoons are connected to the lake by Swan Creek, a perennial stream bounding the site on the north. The south lagoon still shows the alterations made as a part of an unsuccessful real estate development of a 200-acre summer lake community in the 1930s.

The divide between the Lake Michigan and Lake Erie watersheds is about 50 miles west of the site. Perennial streams in the region generally flow southeast and drain into Lake Erie. The annual average runoff is 10 to 16 inches, with the higher values characteristic of the eastern portion of the watershed because of relatively impermeable soils. In the immediate vicinity of the site the land is relatively flat and the watershed limited, so flooding is highly improbable. The surface area drainage pattern does not permit water flow toward inland areas.

2. Ground Water

The rock surface in the vicinity of the site ranges from 0 to 30 feet below relatively impervious deposits of sands, silts, and clays of the Pleistocene epoch. Ground water in the bedrock occurs under confined conditions and is recharged primarily from precipitation. Regionally, the ground water moves toward discharge areas located at relatively low elevations near Lake Erie.

Non-potable water occurs at relatively shallow depths throughout much of the region. Potable water wells rarely exceed 100 feet in depth and are of limited capacity. There are approximately 350 private wells within 1 mile of the site, primarily for residences in the Stony Point area, and there are over 4,300 wells within 10 miles. The closest is about 4,000 feet south of the plant location.

3. Weather[16]

The weather in the site region is generally continental. The site's location on the lake shore subjects it to some local perturbations such as lake-breeze effects and moderated temperature fluctuations. Onsite weather observations are recent, so general characteristics are based on observations during the past decade at the Detroit Metropolitan Airport located 22 miles north-northwest of the plant location, unless otherwise specified.

Temperatures range from 98 to -13°F, with a mean annual temperature of 49°F. Subzero temperatures average 7 days per year. The mean annual precipitation is 30.8 inches. The average annual snowfall is 36 inches.

There are about 40 thunderstorms per year in the vicinity of the site. Eight tornadoes were observed during a 10-year period (1953-1962) within a single latitude-longitude square (∿3,500 sq. miles) near the site. The probability of a tornado's striking a specific point is 6.4×10^{-4}, corresponding to a recurrence frequency of once in 1,560 years. For a 93-year period (1871-1963), only five storms of tropical origin passed within 250 miles of the site. Four of these were of hurricane force, having wind speeds in excess of 73 miles per hour.

The prevailing wind direction is from the west-southwest (toward Lake Erie), with a frequency of 11.4%. All sectors with a westerly component have frequencies greater than 5%. The average wind speed at the site is 12.4 miles per hour. Fog sufficiently heavy to reduce visibility to 1/4 mile or less is observed on the average at one or more hourly intervals on 3 days in January, March, October, and December; on 2 days in February, August, September, and November; and on 1 day in April, May, June, and July. A wind rose diagram is shown in Figure II-4.

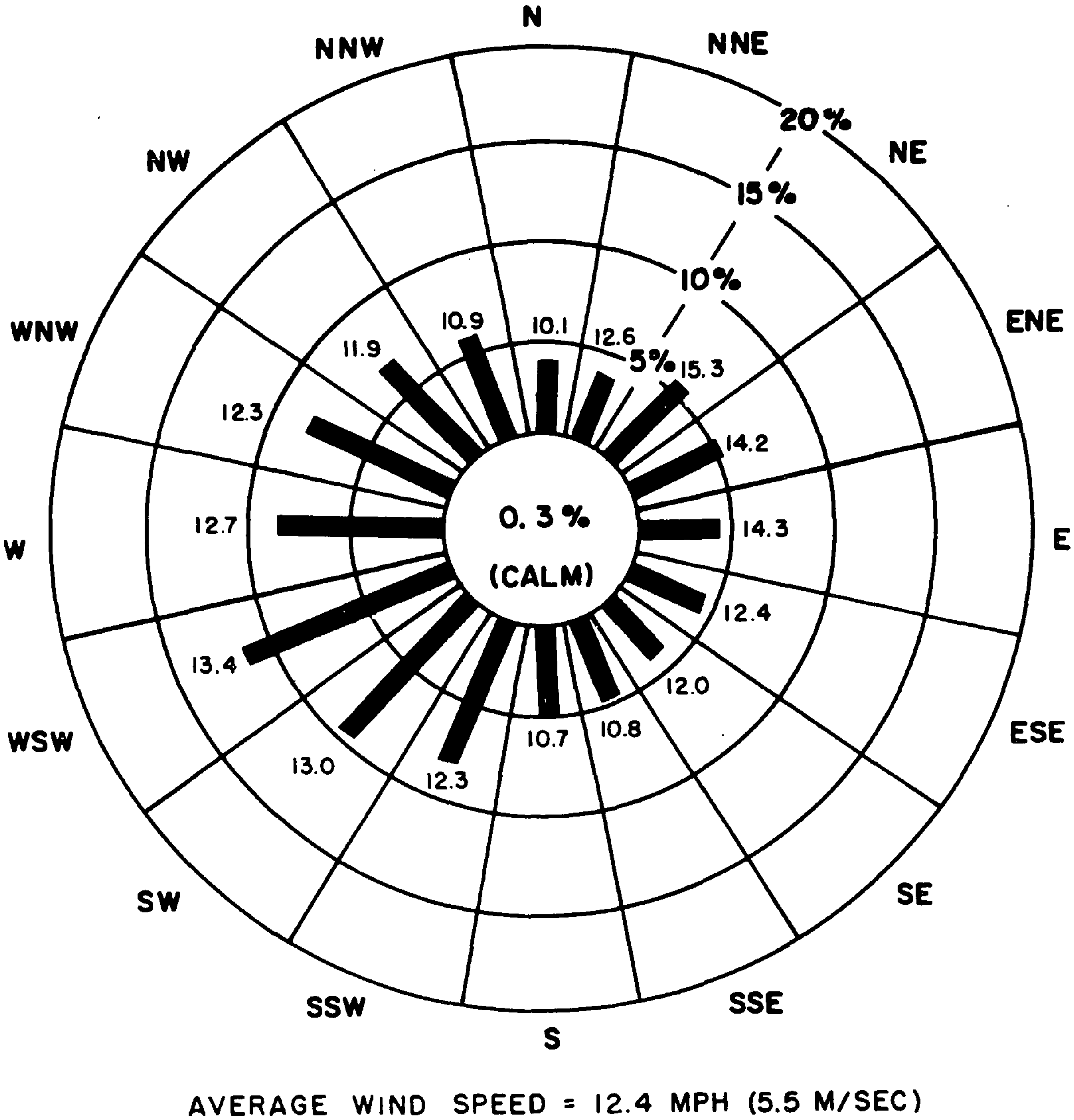
4. General Terrain

The site is essentially low-lying and flat, with about 50% occupied by the lagoons and their adjoining marshes. To the west of the lagoons the land rises about 25 feet above the highest mean monthly level of Lake Erie. About one-third of the site is an old, abandoned field environment, about one-sixth a wet woodland. An expanding quarrying operation near the western edge will result in a small lake.

5. Geology

Comprehensive geologic studies performed for the site supplemented earlier localized studies of the subsurface structure geology undertaken prior to the construction of Fermi-1. Highlights of the findings follow.

The site is located within the Central Stable Region of North America, an area in which the geologic structure is relatively simple. The region is characterized by a system of broad, circular-to-oblong, sedimentary basins, which include the Michigan, Appalachian, and Illinois Basins. Stable regions, including the Cincinnati-Findlay-Algonquin and Kankakee Arches, separate the basins. Numerous secondary features are superimposed on these broad structures. The site lies within the Findlay Arch between the Michigan and Appalachian Basins.



KEY:
RADIALS INDICATE WIND SECTOR FREQUENCY-(PERCENT)
NUMBERS INDICATE AVERAGE WIND SPEED PER SECTOR-(MILES PER HOUR)

NOTE:
3-YEAR SUMMARY:
DECEMBER 1956 - NOVEMBER 1959;

FIGURE II-4. ANNUAL WIND ROSE (102 FEET ABOVE GROUND LEVEL)

Precambrian crystalline basement rock lies some 3,100 feet below the ground surface in the vicinity of the site. The crystalline basement complex is mantled by sedimentary Paleozoic rocks. The bedrock surface at the site ranges in depth from approximately 0 to 30 feet below the existing ground surface. The overburden materials consist of Pleistocene sands, silts, and clays. Topography in the region is relatively flat and smoothly contoured as a result of glacial processes.

Bedrock at the site consists of the Bass Islands dolomite of the Upper Silurian epoch. Prior to glaciation, the Bass Islands Group was covered by deeply weathered and jointed rocks which experienced solution activity. Glacial advance and retreat scoured the younger rocks and exposed the hard and relatively unweathered Bass Islands Group. The Bass Islands dolomite is about 80 feet thick in the site area. The Salina Group underlies the Bass Islands and is about 590 feet thick near the site. This material consists of interbedded shales, limestone, and dolomites and is underlain by the Niagara dolomite.

No faults have been identified within the basement rocks or overlying sedimentary strata in the vicinity of the site. The closest fault is postulated approximately 25 miles west of the site. The vertical displacement of this fault, where it is known, is estimated to be several hundred feet. Other known faults in the area are more distant from the site. Most faults in the region are believed to have been dormant since late Paleozoic time, at least 200 million years ago. Folding is known throughout southeastern Michigan. The most prominent secondary feature is the Howell anticline located on the south flank of the Michigan Basin.

Accidental gas blowouts, associated with oil and gas exploration, have occurred in the region. In blowouts, gas has been known to travel several miles along permeable horizons from the source well and cause damage in the outcrop area of the permeable stratum. However, there is no danger of gas blowouts at the site since the highest relatively permeable stratum in the area is the Salina E formation, which outcrops beyond the shore line in Lake Erie.

There are no geologic features at the site or in the surrounding area that preclude the use of the site for a nuclear facility. The bedrock in the construction area is competent and will provide satisfactory foundation support for all major structures.

6. Soils

The land lying near shore north of Fermi-2 to the mouth of Swan Creek (about 1 mile) is marshland. The land lying about 2 miles north by northwest of Fermi-2 but south of Swan Creek primarily has Del Rey and Fulton silty clay loams with considerable areas of Toledo silty clay loam.[12] This latter land has many cultivated fields and most of it (offsite) is farmed.

The power-plant structures are built on man-made land and are surrounded by marshland. Beyond this area, but within a mile radius of the reactor buildings, except to the southwest, is Lenawee silty clay loam. West of this soil type are mottled areas of Fulton and Del Rey silty clay loams, Blount loam, and well-to-moderately-well-drained clay loam 20 to 40 inches thick, overlying limestone bedrock. Pewamo and Toledo loams are also present in some areas. The land is farmed beyond about a mile of the reactor buildings except for the marshes to the south and southwest. Specific analyses of the soils were presented in the applicant's revised Environmental Report.

7. Biota of the Region

a. Flora

Grassland Floras: The grassland floras of the Fermi-2 site consist of various grasses, legumes, and forbs (herbs other than grasses). The grasses are composed of foxtail, timothy, switch, and bluegrass. Bromegrass is dominant among these, but *Panicum* and needle grass also occur.

Legumes: The legumes are mainly clover and alfalfa. The forbs are somewhat more diversified and include goldenrod, Queen Ann's Lace, plantain, hawkweed, milkweed, and various thistles. Ragweed, mullein, common dock, and mustard are found. Also present are black-eyed Susan, blue aster, fleabane, strawberry, and mint.

Marsh Flora: There are a number of marsh flora, which include arrowhead, waterlily, water shield, and water milfoil. American pondweed and Sago pondweed are present as well as duckweek although cattail is the dominant species. Bur-reed and sedges are also present in addition to rushes, loosestrife and *Ceratophyllum*.

Woodland Floras: The woodland floras consist of the herbaceous species, shrub plants, and trees. Virginia creeper, mayapple, grape vines, briars, and brambles make up the bulk of the undergrowth; poison ivy is present throughout the woodland area and is the dominant member of the herbaceous species. Viburnum and mint are present to a limited extent.

Shrubs: The shrub plants are made up of juneberry, sumac, hackberry, and some serviceberries. The dominant shrubs are hawthorn and dogwood, but crabapple is also present. Other shrubs are buttonbush, alder, and shadbush.

Trees: There are about a dozen different species of trees. The typical wet woodland species occur including willow, green ash, and cottonwood. Aspen, black locust, and box elder occur, but the dominant species are American elm, basswood, white ash, and swamp oak. Red maple is fairly abundant and could be considered subdominant. Other species observed are sycamore, pin oak, and shagbark hickory. Various mosses and lichens occur.

b. Fauna

Vertebrates: The largest wild vertebrates are occasional deer and fox. The more abundant cottontail rabbit, raccoon, and woodchuck make up the bulk of the warm-blooded vertebrates exclusive of the birds. Squirrels have been observed, as well as smaller rodents including rats and mice. Muskrats are frequently seen in the south lagoon.

The most abundant species of birds are seagulls (about 2,000 or more on the site); most of these are herring gulls although other species, such as bonaparte gull (Larus philadelphia) are present. Some egrets and herons are in the area. Hawks and owls occur, as do thrushes and vireos. Ringnecked pheasants are the most numerous game birds on the site. Some ducks, predominantly mallards and blue-winged teal, have been seen in the marsh and open-water areas.

Cold-blooded vertebrates include frogs, salamanders, and fish (carp). Amphibians are not abundant. Reptiles are represented mainly by a fair abundance of painted or "mud" turtles.

Invertebrates: Mosquitoes, Mayflies, and midges are prevalent, as well as dragonflies, which prey upon these smaller flying insects. Various species of beetles are present in the old field and woodland habitats. Grasshoppers are present, and arachnids (spiders) are ubiquitous. Roundworms of numerous species occur in the soil and marsh areas.

8. Special Features

a. Lake Erie

Lake Erie is approximately 240 miles long and has a mean width of 40 miles. The lake is divided into three principal subbasins: a small, shallow basin at the west end which borders the site and is partially restricted by a chain of reefs and islands; a flat, unrestricted, and rather shallow basin in the center; and a small, relatively deep eastern basin. The average depth of the lake is 61 feet and the maximum depth is 210 feet. Its volume is 110 cubic miles. The longitudinal axis of the lake trends northeast-southwest, a direction coincident with strong and persistent winds which predominate under normal meteorological conditions. Wind stresses acting on the lake surface over a sustained period can have a considerable effect on the instantaneous level of the lake.

The most significant lake-level variations are observed mainly at the western and eastern ends of the lake and are caused by transport of water as a result of sustained wind action. Historical records show that, in about 96% of all extreme cases, high water occurred at the eastern end of the lake and low water occurred at the western end owing to prevailing westerly winds which cause the lake to set up at the eastern end.

The lake bottom in the vicinity of the site slopes very gently toward the east and reaches a depth of 12 feet approximately 0.4 mile offshore. The soil deposits below the west end of the lake consist primarily of sand with intermittent layers of gravel and/or clay.

The only existing municipal water intake in the vicinity of the site is the Monroe intake near Pointe aux Peaux, approximately 2 miles southeast of the site. This intake provides water from Lake Erie for about 25,000 people in the Monroe area.

A multiple industrial intake, which serves six companies, is located in Lake Erie south of Stony Point, about 4 miles from the site. The existing nuclear generating station (Fermi-1) also uses water from Lake Erie.

b. Foundation Structure

Foundations for the major plant facilities are installed within the dense, resistant upper Bass Islands dolomite. The geologic boring program and an inspection of an old quarry in the site area revealed that dense, sound dolomite extends to depths considerably below foundation level. In addition, limited laboratory testing of representative rock cores indicated that allowable bearing capacities of the foundation strata are far in excess of pressures that will be imposed by the structures under anticipated static and dynamic loading conditions. From a foundation standpoint the site is considered satisfactory for the construction of the proposed plant facilities.

Although no solution cavities were encountered in the vicinity of the site, there is a history of cavitation in the area. Sink holes were reported in the Bass Islands dolomite in one old quarry near the city of Monroe. Careful inspection of all excavations were made to assure that no cavities of detrimental size underlie the plant structures. Fill materials required to raise the site to required final grade are being obtained from an onsite quarry.

E. ECOLOGY OF SITE AND ENVIRONS

1. Major Terrestrial Habitats

The terrain of the plant site and the surrounding area on the western shore of Lake Erie is low and level, with occasional small elevations. The site environment is composed of four habitats. These are wet woodland, the adjacent old abandoned field, marsh (including the new quarry lake), and Western Lake Erie. Each of these habitats has characteristic fauna and flora. The numerous microorganisms (bacteria, protozoa, and fungi), except for coliforms and streptococci in the lake, have not been included in studies made to date.

a. Wet Woodland

Approximately one-sixth of the 1,088 acre plant site is a wet woodland environment.[3-5] The dominant trees in this area are white ash, swamp oak, elm, and basswood. The rather dense undergrowth is composed mainly of dogwood and crab apple trees. The ground cover includes large patches of poison ivy and virginia creeper with scattered occurrence of mosses, may-apples, lilies, and brambles. The fauna is typical of woodland with mammals such as deer, woodchucks, raccoons, and foxes and with birds such as owls, hawks, thrushes, and vireos.

b. Old Abandoned Field

Approximately one-third of the 1,088 acre plant site is an old field environment that has not been farmed for about 2 decades. The primary invading trees are elm, ash, dogwood, and crab apple. The ground cover is composed of several grasses including bluegrass, switchgrass, timothy, broomgrass, and needlegrass. Herbaceous species such as goldenrod, thistle, milkweed, strawberry, and ground plantain also occur. The fauna includes ring-necked pheasants and cottontail rabbits and those species that invade from the surrounding woodlands such as raccoons, foxes, woodchucks, and a few deer.

c. Marsh

Approximately 25% of the site is a marsh environment, a portion of which has been prepared and filled for industrial area and buildings. The cattail is the dominant plant in the marsh. Additional emergent plant species include arrowhead (Sagittaria), reeds, sedges, and various grasses. In addition to insects such as Mayflies, dragonflies, and many mosquitoes, the fauna of the marsh includes frogs, salamanders, snakes, turtles, muskrats, and raccoons. Ducks (mainly mallards and blue-winged teal), egrets, and herons inhabit the marsh areas; various migrating waterfowl are seasonally present. Seagulls are the dominant birds.

2. Aquatic Habitats

a. Lagoon Onsite

Fish life in onsite water bodies is limited primarily to carp. The bottom fauna consists mainly of midge larvae and Mayfly nymphs, along with tubificid worms, although some snails and small clams are present. Onsite marsh animals, especially muskrats, are often seen in the lagoon area.

b. Western Lake Erie

Fish: In a 1970 study at the nearby Monroe Site (Parkhurst, 1971),[17] nine species of fish comprised 98% of the numbers and 90% of the fish biomass. These species, as listed in Table II-3, can be divided into three categories based on habitat preferences: (1) yellow perch, white bass, emerald shiners, spottail shiners, and alewives were found in greatest numbers in the open lake areas; (2) carp, goldfish, and sheepshead preferred areas sheltered from wave action; (3) gizzard shad had the widest habitat preference and was abundant at some time of the year in all areas sampled. The seasonal growth and abundance of young fish indicated that western Lake Erie was an important growth environment for at least five species.

Yellow perch and several other fish species (Table II-3) normally use the shallow inshore areas of lakes, the backwaters of rivers, etc., for spawning; they are broadcast spawners, and often utilize aquatic plants and brush to anchor their eggs. However, from the data available at present, the inshore areas near the Fermi site are apparently unsuitable for such spawning.[4,17] This may be partly the result of polluted waters from the Detroit and Raisin Rivers. The Lake Erie zone within 1,500 feet of the Fermi-2 shore is a highly unstable and harsh environment for fish. Frequent turbulent wave action causes high turbidity and compacted sediments that offer marginal habitat for bottom organisms. Turbulence in the shallows (<6 feet at 1,500 feet) essentially excludes rooted aquatic plants. Fish use the shallows when the zone is calm, but the disturbances mentioned are frequent and might partially explain the lack of evidence of fish spawning in this area. The water used by the plant will come from this unstable zone.

The applicant is sponsoring a long-range study program in the vicinity of the site by the Institute of Water Research and Department of Fisheries and Wildlife, Michigan State University. Information on the densities and distribution of zooplankton and phytoplankton will be obtained. The study will also determine what species of fish inhabit the plant site areas. Any significant effect of the plant on these organisms can then be determined.

At present, there are no commercial activities in the area which involve the aquatic organisms on the site, or in the Western Lake Erie habitat near the site. Carp is the only fish existing in any quantity in the onsite waters. Nearby Lake Erie waters provide sport fishermen principally with yellow perch and walleye pike. Occasionally other fish are caught. (See Table II-3.)

Waterfowl: Distribution, abundance, and activity of waterfowl have been studied recently along the western shore at Lake Erie by Reed (1970).[18] Waterfowl intensively use western Lake Erie during migrations and some waterfowl are present throughout the year. Seven species commonly use the area during fall and spring migrations. These species are: common merganser (*Mergus merganser*), lesser scaup (*Aythya affinis*), common goldeneye (*Bucephala clangula*), black duck (*Anas rubripes*), American widgeon (*Anas americana*), ruddy duck (*Oxyura jamicensis*), and the mallard (*Anas platyrhynehos*). The migratory birds use the area from late September until freezing weather in mid-December and from early March thaws to early May. Most birds use the lake during early mornings, but the mallards and black ducks (the two wintering or permanent resident species) are on the lake mostly during midday. Populations of the ruddy duck are most concentrated in northern Brest Bay (the portion of Lake Erie immediately southwest of the site). The distribution of waterfowl was disturbed by hunting. In the winter, the population of these species within a 15-mile radius of Fermi 2 is estimated to be 6,000 to 8,000 birds.

TABLE II-3

FISH SPECIES CAPTURED ALONG THE WESTERN SHORE OF LAKE ERIE FROM JUNE TO NOVEMBER, 1970[17]

Perca flavescens (yellow perch)
Dorosoma cepedianum (gizzard shad)
Roccus chrysops (white bass)
Notropis atheneroides (emerald shiner)
Notropis hudsonius (spottail shiner)
Crassius auratus (goldfish)
Alosa pseudoharengus (alewife)
Aplodinotus grunniens (sheepshead)
Cyprinus carpio (carp)
carp goldfish hybrid
Poxomis annularis (white crappie)
Ictalurus punctatus (channel catfish)
Ictalurus natalis (yellow bullhead)
Stizostedion vitreum (walleye)
Hybopsis storeriana (silver chub)
Osmerus mordax (smelt)
Percina caprodes (log perch)
Carpiodes cyprinus (quillback carpsucker)
Lepomis gibbossus (pumpkinseed sunfish)
Moxostoma sp. (redhorse)
Percopsis omiscomaycus (troutperch)
Ambloplites rupestris (rock bass)
Ictalurus nebulosus (brown bullhead)

Two species of gulls are frequently seen on the site. The most numerous is the herring gull. A few boneparte gulls are also present. The number of gulls varies, but as many as 2,000 have been estimated to be present at certain times. Wading birds (herons and egrets) feed extensively in these areas.

Benthic (bottom) organisms: The major benthic species in Lake Erie within 10 miles of the site are primarily pollution tolerant sludgeworms (Tubificidae), bloodworms (Chironomidae), fingernail clams (Sphaeriidae), and nematodes (Nematoda). The numbers per square meter vary greatly, depending upon the quality of the substrate. In general, the offshore areas average about 2,000 sludgeworms/m^2, 50 to 1,000 bloodworms/m^2, and 10 to 500 fingernail clams/m^2. Bloodworms and sludgeworms have been identified living within 1 mile of the Fermi 2 site. However, the shallow inshore areas near the site have high scouring due to wave action and therefore support only small benthic populations.

Zooplankton: The zooplankton forms identified so far in Brest Bay just south of the plant and near Monroe belong in three groups: the rotifers, the copepods, and the cladocerans, as listed in Table II-4.[13] The dominant rotifer seems to be Keratella cochlearis. None of the nine species of copepods has been singled out as dominant. Among the cladocerans, Daphnia retrocurva appears to be co-dominant with Bosmina sp. The cladoceran C. sphaericus reached a peak population density of 300 organisms per liter in September 1970. There is a predominance of rotifers in spring, followed by cyclopoid copepods in early summer, cladocerans in late summer, and then, again, rotifers in fall. Total numbers of zooplankton ranged between 100 and 1400 per liter, depending upon location and season. As noted earlier in this section, new studies are being made on the plankton near the plant.

Phytoplankton: There is a considerable number (68) of phytoplankton species (Table II-5).[13] The most numerous phytoplankton are the diatoms, green colonial algae, green filamentous algae, and green unicellular algae. Other groups are the blue-green colonial algae, blue-green filamentous algae, and golden algae. The dominant diatoms belong to the genus Melosira sp.; this dominance may be shared by the salt-water diatom Coscinidiscus sp. (Michigan State University study).

Among the green colonials the dominant species is Scenedesmus abundans. There are five species of blue-green filamentous algae, two of which are co-dominant, namely Oscillatoria sp. and Anabaena flos-aquae. Other algae found in the area are shown in Table II-5. Total counts for all these species are usually in a range from 10^5 to 10^6 cells/liter. The abundance of each species depends upon the season. Quantitative data for each species will be available early in 1972. The filamentous green algae Cladophora is present in the lake near Fermi 2, but is not present in nuisance quantities.

TABLE II-4

ZOOPLANKTON SPECIES IDENTIFIED IN WESTERN LAKE ERIE IN 1970[13]

ROTIFERS	COPEPODS	CLADOCERANS
Keratella cochlearis	*Cyclops vernalis*	*Bosmina* sp.
Keratella quadrata	*Cyclops bicuspitus thomasi*	*Daphnia retrocurva*
Kellocottia longispina	*Tropocyclops prasinus*	*Daphnia galeata mendotae*
Asplanchna sp.	*Diaptomus minutus*	*Chydorus sphaaericus*
Brachionus calyciflorus	*Diaptomus oregonensis*	*Leptodora kindtii*
Branchionus angularis	*Diaptomus ashlandi*	*Diaphanosoma* sp.
Filinia sp.	*Diaptomus sicilis*	*Ceriodaphnia* sp.
Synchaeta stylata	*Diaptomus siciloide*	
Trichocerca sp.	*Eurytremora affinis*	
Polyarthia vulgaris		
Conochilus sp.		

TABLE II-5

PHYTOPLANKTON POPULATION IDENTIFIED IN WESTERN LAKE ERIE DURING 1970[13]

GREEN UNICELLULARS

Andistrodesmus
A. Convolus
Colsterium sp.
Cosmarium sp.
Golenkinia radiata
Lagerheima quadriserta
Schroederia setigera

GREEN FILAMENTS

Microspora stagnorum
Mougeotia

GREEN COLONIALS

Actinastrum hantzschii
Coelastrum sp.
Dictyosphaerium sp.
D. Pulchellum
Kirchneriella sp.
K. obesa
Micractinum sp.
Oocystis sp.
Oocystis borgei
Pediastrum biradiatum
P. boryahum
P. duplex
P. duplex var. reticulatum
P. simplex
P. simplex var. duodenarium
Scenedesmus abundans var. longicauda
S. acuminatus
S. bijuga
S. denticuatus
S. dimorphus
S. opoliensis
S. quadricauda
Straurastrum sp.
Tetraspora sp.

BLUE-GREEN COLONIALS

Anacystis aeruginosa
Gloeocapsa sp.
Merismopedia sp.
M. tenuissima

GOLDEN ALGAE

Ceratium dinoflagellates sp.
Dinobryon sp.
Peridinium sp.

DIATOMS

Amphora sp.
Asterionella formosa
Coscinodiscus sp.
Cyclotella sp.
C. bodanica
C. comta
C. meneghiniana
Diatoma sp.
D. tenue
D. anceps
Fragilaria sp.
Melosira sp.
M. ambigua
M. islandica
Navicula sp.
Stephanodiscus sp.
S. alpinus
S. astrea
S. hantzschii
S. invisitatus
Surirella angustata
Synedra sp.
Tabellaria fenestrata

BLUE-GREEN FILAMENTS

Anabaena sp.
A. flow-aquae
Aphanizomenon flos-aquae
Oscillatoria sp.
O. tenuis

Bacteria: Coliform and streptococcus counts were made at lake stations in Brest Bay from May 3 to November 10, 1970.[13] Coliform counts usually ranged from 40 to 500 per 100 milliliters (ml). There were sporadic increases to much higher levels. In north Brest Bay on July 10, 1970, there were 1,650 coliforms per 100 ml. Streptococcus populations were much lower at all stations, usually less than 100 per 100 ml. However, streptococcus counts in samples taken nearest to the plant (in north Brest Bay) were recorded as high as 2,100 per 100 ml during the summer. Apparently, the abundance of bacteria at any one time is related to variations in sewage plant and industrial effluents rather than to the seasons. For example, the coliform and streptococcus counts rise after storms because of inadequately treated sewage due to overload of treatment plants from storm runoff.

III. THE PLANT

A. EXTERNAL APPEARANCE

The appearance of the site is governed basically by the flat terrain, and the major onsite water bodies and marsh areas.

The physical appearance of the major structures on the site, as presented in an artist's conception in the 1970 Detroit Edison Annual Report, is reproduced here as Figure III-1. The existing Fermi-1 plant and the proposed plant, including its cooling towers, are depicted. Lake Erie and the 50-acre residual-heat-removal (RHR) pond are shown partially in the foreground. The general design of plant buildings uses unbroken rectangular exterior surfaces typical of nuclear plants. The natural draft cooling towers have the usual hyperbolic shape. The layout of major structures and the site utilization and landscaping are indicated in the exhibits of Appendix A of the Applicant's Revised Environmental Report, particularly Exhibit 2, "Existing Land Utilization"; Exhibit 4, "General Layout Plan"; Exhibit 5, "Circulation Plan" (public access); Exhibit 6, "Site Improvements Plan"; Exhibit 10, "Proposed Soil Improvements"; and Exhibit 11, "Primary Planting Zones."

The applicant had a comprehensive site-development plan prepared. This plan considered not only Fermi-2, but also the installation of two additional units at some time in the future, with a view toward minimizing any future disruption of the site environment when these units are constructed. The eight major design areas of the site, which have been identified for purposes of site development, are shown in the general layout plan in Appendix A of the Applicant's Revised Environmental Report.

Area 1 will include all plant facilities, cooling towers, construction lay-down sites, and parking areas. The dominant structures in this area will be the two concrete natural-draft cooling towers. These hyperbolic structures will be approximately 400 feet high with a base diameter of approximately 450 feet.

Area 2 (a wildlife reserve) will be maintained as much as possible in its natural state. Observation posts and walking trails will be added to the area; crops will be planted to provide necessary food for wildlife.

Area 3 (the Fermi Science Center) will be an educational structure designed for public use. The general public and student groups, for example, will receive instruction in nuclear- and fossil-fueled power generation and transmission concepts, as well as information on the site environment and the applicant's activities in the area of environmental sciences. Facilities will be provided for students to perform their own experiments.

Area 4 has been set aside for construction of an Ecological Interpretive and Research Center at some future date. The purpose of this Center would

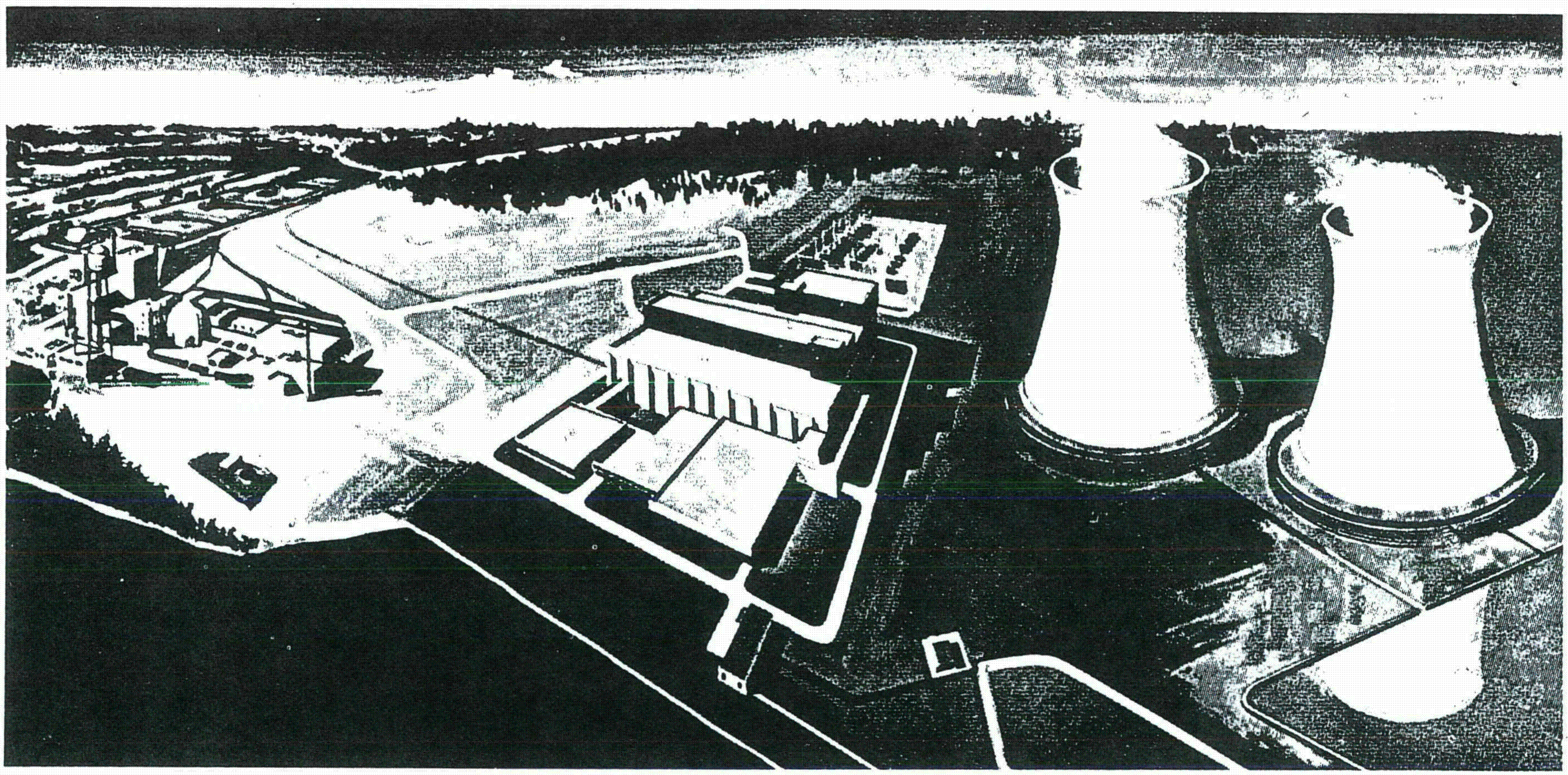


FIGURE III-1. ARTIST'S CONCEPT OF FERMI SITE'S APPEARANCE AFTER CONSTRUCTION OF THE FERMI-2 PLANT.

be to conduct studies of the ecological effects of producing electricity. It is anticipated that such studies would be performed in conjunction with area schools and universities.

Area 5 (the south lagoon) will be maintained in its natural state with the addition of food plots for wildlife.

Area 6 is a quarry lake that will be created as a result of the quarry operations; in this area, visitors' amenities such as picnic areas will be provided. The quarry itself could be developed for recreational purposes.

Area 7 (picnic and day-camp sites) is a wooded area and will be available for public and employee use. The eastern edge of this area forms a terrace overlooking the lagoon. South of the wooded area and up to the property line, a series of earth mounds will be created with material removed from the construction site.

Area 8 is the approach road area.

B. TRANSMISSION LINES

Power now generated at the site is fed into the applicant's system by means of three 120-kV lines. These lines run together for about 5 miles from the Fermi site to a point just west of Interstate Highway I-75. At this point they divide and run to three separate high-voltage stations. A map of transmission-line routes is shown in Appendix A of the Applicant's Revised Environmental Report.

Two additional 345-kV double-circuit tower lines will be installed to carry the power from the plant. This expansion of the transmission system is a part of the applicant's overall system expansion and not required specifically for the plant. These lines will run from the plant to a point near I-75 in the same corridor now used for the 120-kV lines. At this point, the new 345-kV lines will diverge, one running approximately 17 miles northeast to the Brownstown Station located northeast of Flat Rock near I-75, the other running north and west approximately 25 miles to the Milan Station. With the exception of a 10-mile section east of the Milan Station, all the new 345-kV lines will parallel existing 345-kV lines. The 345-kV lines traverse 576 acres in 37 miles of existing corridors. The new 10-mile corridor will require 180 acres. An estimated 15 to 20% of the new corridor east of the Milan Station consists of woodlots.

The new 345-kV lines from the site to I-75 will be installed on modern, slender steel poles. These poles have a more pleasing appearance than do the conventional latticework towers when viewed along with other close-by structures. Similar poles will be used in the new 10-mile section east of the Milan Station. The balance of the new lines will be installed on lattice-type towers similar to those now in use for the existing 345-kV lines.

C. REACTOR AND STEAM ELECTRIC SYSTEM

Fermi-2 will be a single-cycle, forced-circulation boiling water reactor (BWR) designed to provide initially 3,293 megawatts thermal (MWt) or approximately 1,150 megawatts net electrical power (MWe). The applicant is responsible for the design, construction, and operation of Fermi-2 and is the architect-engineer for Fermi-2. The General Electric Company is designing the nuclear-steam-supply system; the firm of Sargent and Lundy Engineers is responsible for the design of the reactor building; and The Ralph M. Parsons Company is the general contractor for the plant. Fermi-2 is scheduled to begin operation in 1975.

The reactor will be similar to other large boiling-water reactors currently in operation or under construction. The nuclear core will use slightly enriched uranium dioxide (UO_2) fuel clad with Zircaloy-2 tubes. The fuel and cladding ar designed to prevent the escape of radioactive material during normal modes of reactor operation. Site parameters, principal structures, and engineered safety features are being designed for an ultimate core output of 3,428-MWt capacity.

The uranium dioxide in the tubes within the reactor core will produce heat during the fission process. This heat will be removed from the core by water that enters the lower portion of the core and boils as it flows upward around the fuel rods. Steam leaving the core will be dried by steam separators and dryers located in the upper portion of the reactor vessel. This steam, at a turbine inlet pressure of 980 pounds per square inch, gauge (psig), will drive the turbine-generator to produce electrical energy. After leaving the turbine, the low-pressure, low-temperature steam will be condensed and returned to the core.

The core, its supporting structures, and a part of the reactor coolant system will be contained in the reactor vessel. A steel primary containment structure will surround the reactor vessel, water recirculating system, and other components. The reactor building will form a secondary containment that will enclose the primary containment, the refueling facilities, spent-fuel and equipment-storage pools, and other components of the nuclear system.

The turbine building will house the turbine-generator, the condenser and feedwater systems, and associated auxiliary power-plant equipment. A roof vent will serve as an elevated release point about 180 feet above the ground level for discharging gases to the atmosphere from portions of the turbine-generator, reactor, and radwaste buildings, including the standby gas treatment and off-gas systems. The radwaste building will house components of the radwaste system and the control center for this system. Administrative, clerical, and operating and maintenance personnel will have offices in the service building. The Fermi-2 screen house, separate from the Fermi-1 screen house, will be located on the shore of Lake Erie within the existing Fermi-1 intake canal. It will contain trash racks, traveling water screens, stop logs, and general-service water pumps

D. EFFLUENT SYSTEMS

Figure III-1A indicates the locations of all thermal, liquid and gaseous effluents from both Units 1 and 2 on the site. In addition, the common intake channel for condenser cooling water is shown, as is the branching at the end of the channel to serve the separate requirements of the two units.

1. Thermal

In the current state of technological development in nuclear plants, approximately two-thirds of the heat produced in the reactor is released to the environment. To meet the cooling requirement of the plant with minimal environmental impact on Lake Erie, closed-cycle cooling of the main condenser is planned with two natural-draft cooling towers. Waste heat will be dissipated to the atmosphere by evaporation of condenser-cooling water in the stream of ambient air drawn through the towers. The make-up water withdrawn from Lake Erie will be about 3.5% of the total amount of water being recirculated through the condenser.

Of the total amount of lake water withdrawn for make-up, about two-thirds will be evaporated. The remaining third (the "blowdown") will be returned to the lake in order to provide sufficient flushing of the recirculated water system to maintain constant water quality. This flushing prevents excessive accumulation of nonvolatile dissolved solids in the cooling-water system.

The closed-cycle cooling system will consist of a 50-acre residual heat removal pond, motor-driven pumps, the main condenser, two natural-draft cooling towers, and the connecting piping. Approximately 900,000 gallons per minute (2000 cubic feet per second) of cool water will be pumped from the pond to the condenser, where it will be heated about 18°F in condensing the steam leaving the turbine. This cooling duty will be about 135 million Btu per minute. The heated water will then flow to the two cooling towers for cooling by naturally circulating air, after which the water will be discharged to the pond and again circulated to the condenser. As a maximum, 31,500 gpm of make-up water will be drawn from Lake Erie through the existing Fermi-1 intake canal to balance the evaporation and drift losses of 19,500 gpm and the 12,000 gpm return of pond water to the lake in the flushing operation. Expected average values are about 2/3 of the above maximum values. The drift loss will be in the form of droplets entrained in the air and will be in addition to the evaporation loss.

The pond holdup will be 230 million gallons, and the holdup time about 4.5 hours. Chemical treatment of the recirculating cooling water is described in Section III.D.3. and its impact in Section V.B.2. The circulating-water reservoir blowdown will be pumped by decanting pumps in the circulating-water pump house, which is located at the south end of the reservoir and near the Lake Erie shoreline. The blowdown pipeline will be run from the pump house to the shore, then underground approximately 500 feet into the lake to the discharge point, which will be beyond the low-water-datum shoreline to prevent

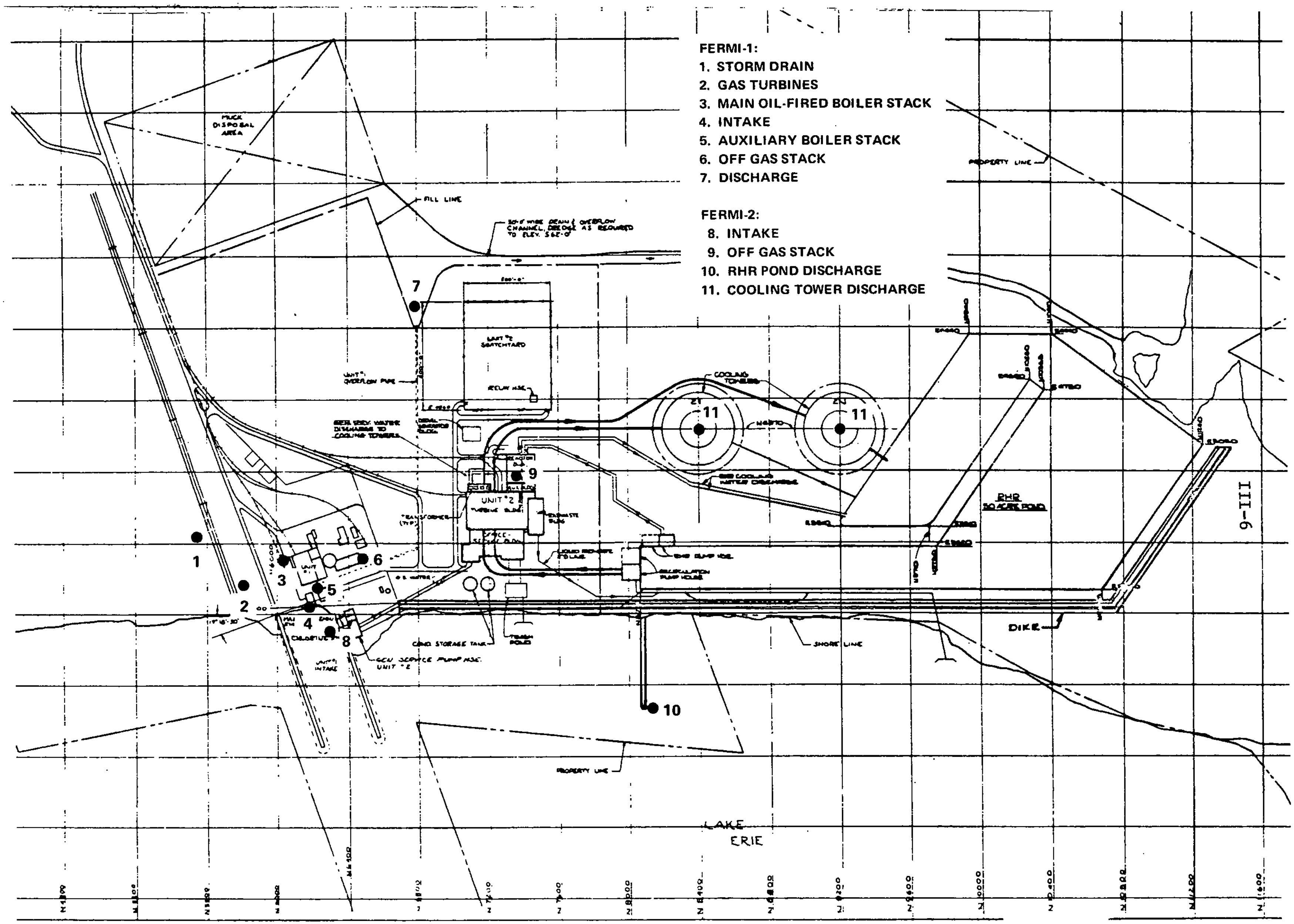


FIGURE III-1A. WATER INTAKES AND LIQUID AND GAS DISCHARGES AT THE ENRICO FERMI SITE shore erosion. The discharge structure will be basically a submerged open pipe end, with a suitable structure to protect the pipe from ice damage or silting. No special diffuser is used and a natural mixing zone will prevail near the lake shore. More elaborate means for effluent dispersion were not deemed necessary in the light of the small quantities of effluents and the appreciable natural dilution which occurs within the short distances (about 1500 ft) of the discharge; effluent dispersion and impact are described in subsequent sections.

Air will enter each cooling tower at its base and flow upward through a cement-asbestos fill material located in the bottom 50 feet of the tower. The fill provides a large surface for the downward flowing cooling water to contact the upward flowing air. The water will enter the tower near the top of the fill section. The towers will be essentially empty chimneys to provide draft for moving large amounts of air. In this way, the water will be cooled partly by evaporation of some of the water and partly by heating of the cooler air. The moist, heated air will rise inside the tower and be released to the atmosphere. The released air will be replaced by cool air entering the tower at its base. The moist, heated air will rise inside the 400-foot high tower because it will be less dense than the cooler air entering at the base. The result will be a column of moist, heated air rising several hundred feet above the top of the tower, after which it will be dissipated into the atmosphere. The tower design provides for a low exit air velocity to minimize the possibility of large water droplets being carried up inside and out of the tower.

2. Radioactive Waste

The design objective of the radwaste system will be to process and control the release of radioactive effluents from the plant, so that radiation doses in unrestricted areas will be as low as practicable as stated in 10 CFR 20, Paragraph 20.1(c), and 10 CFR 50. The performance of the radwaste system is expected to meet these criteria. Technical specifications limiting radioactivity discharges will be set prior to the issuance of an operating license and will be compatible with the "as low as practicable" requirement.

The descriptions of the radwaste systems presented here are based upon the applicant's stated designs and projected operational characteristics. The releases of radioactive materials upon which the radiological impact described in Section V.D. of this statement is based are listed in Tables III-2 and III-3.

a. Gaseous-Radwaste System:

The gaseous-radwaste system will process and control the release of gaseous radioactive wastes generated within the plant. These wastes will come principally from fission gases[27] carried over in the steam phase from the reactor core, along with activated air constituents and radiolytic decomposition gases. These noncondensable gases will be removed before the condensate is returned as reactor feedwater. Gaseous atmospheres within the primary containment subject to neutron irradiation will also contribute slightly to the gaseous radwaste as may off-gases from the chemical laboratory and liquid-radwaste system.

Gases processed by the system will be released through the reactor building roof at a height of about 160 feet after mixing with the general ventilation air flow of about 225,000 cubic feet per minute (cfm). Total activity and volume passing through the vent will be continuously monitored. Particulate and iodine concentrations will be determined by sampling.

The feasibility of releasing gaseous effluents at the top of a cooling tower (∿400 feet) is currently being studied by the applicant in case additional atmospheric dilution is needed to meet the numerical criteria of "as low as practicable." If used, this elevated release would be an addition to the engineered controls and equipment described here.

The gaseous-radwaste system will be composed of three subsystems: (1) the main-condenser off-gas system; (2) the gland-seal exhaust system, and (3) standby gas-treatment system. Each of these is described in turn below.

(1) Main-Condenser Off-Gas System:

Greater than 90% of the gaseous radioactivity carried over with the steam from the reactor will be treated by this subsystem. It will be included with the gases taken from the second-stage air ejectors following the main condenser. This continuous flow of approximately 320 cfm will pass through moisture separators and preheaters ahead of a catalytic recombiner where free hydrogen and oxygen will be recombined to form water vapor. The free hydrogen remaining in the non-condensable gases will be 0.1% or less. The gas mixture will then pass through condensers and coolers where the condensed water vapor will be removed and sent to the liquid-radwaste system. The remaining gases, now reduced in volume by about 85%, will be further dehumidified by passing through chillers and demisters before entering charcoal-bed adsorbers. After passing through a high-efficiency filter (removal efficiency about 99.95% for particles larger than 0.3-micron), the gases will be mixed with the general reactor building exhaust (225,000 cfm) before being released through the roof-top vent. A simplified diagram of this system is shown in Figure III-2.

The recombiner-charcoal bed system will be similar to that which has been in successful operation at the Gundremmingen Nuclear Power Station (KRB) in West Germany since 1967. Favorable experience with its operation was a key factor in the choice of the system for Fermi-2. The design holdup characteristics of the Fermi-2 system, shown in Table III-1, are based on measurements made on the KRB system. The design capability of

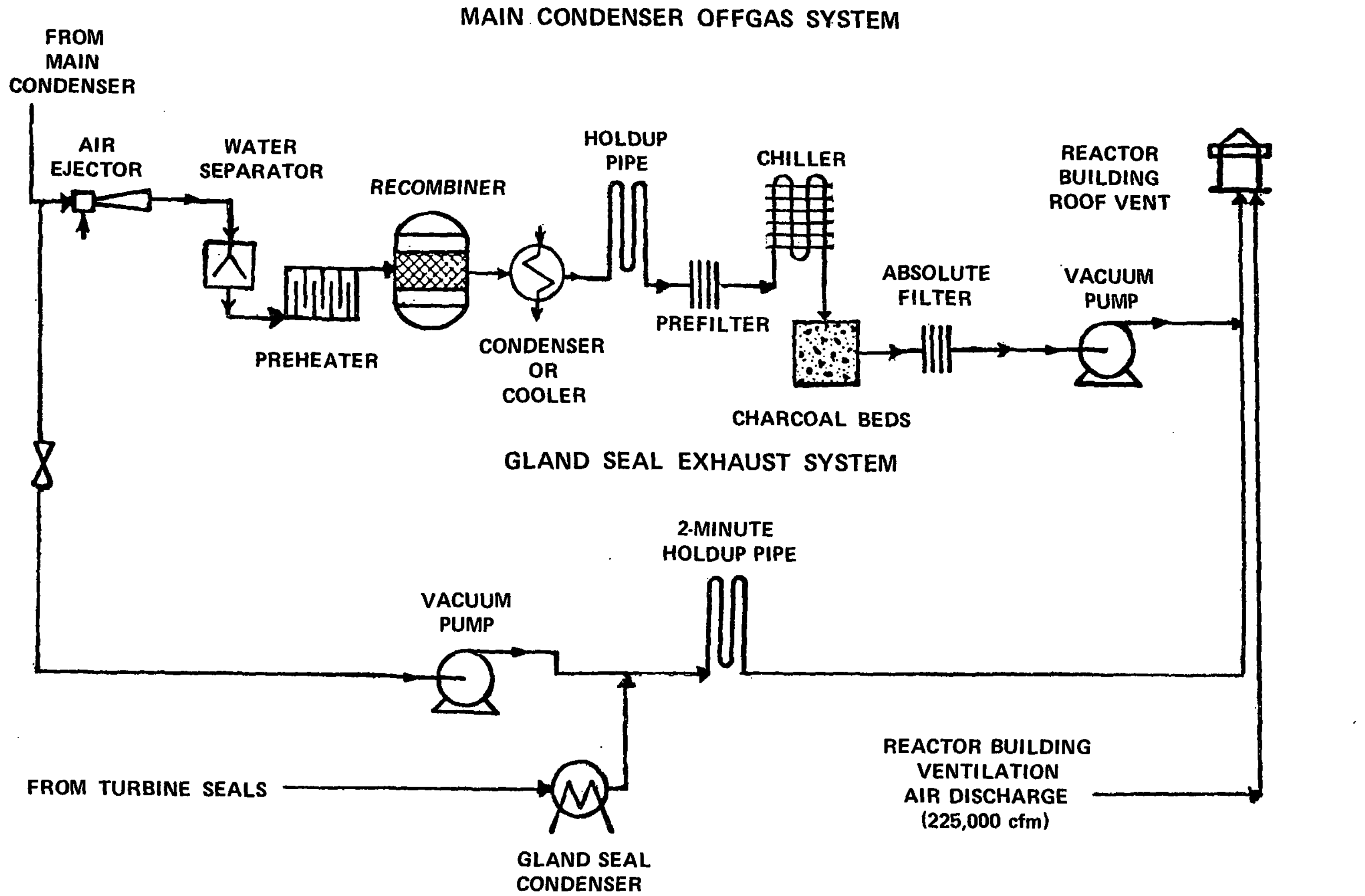


FIGURE III-2. SCHEMATIC DIAGRAM OF THE MAIN-CONDENSER OFFGAS AND GLAND-SEAL EXHAUST SYSTEM

TABLE III-1

Holdup Characteristics of the Main Condenser Off-Gas System

Carrier gas	100 Minutes
Krypton	1 Day
Xenon	14 Days

the Fermi-2 gaseous radwaste system is based on an input of 10^5 μCi/sec of a 30-minute-old diffusion mixture of fission gases.

(2) Gland-Seal Exhaust System:

Gases taken from the main turbine gland seal will have a small radioactive component originating in the main steam supplied to the seals. These gases will be drawn through a 2-minute delay pipe before being mixed with the general reactor-building exhaust. Flow rates up to 3,100 cfm at 1 atmosphere and 145°F will be accommodated. About 30% of the gaseous radioactivity to be released from the plant after treatment will be by this route.

The system is depicted in Figure III-2.

(3) Standby Gas-Treatment System (SGTS):

The standby gas treatment system is designed to process primary-containment-system (dry well and pressure suppression chamber) air and/or secondary-containment-system (reactor building) air following detection of radiation above preset levels in these atmospheres. It is an engineered safeguard designed for use during abnormal occurrences. Normally the exhaust from these systems will be released without treatment through the reactor-building roof vent, and the standby gas-treatment system will be inoperative.

During reactor operations, the drywell atmosphere will be exposed to neutron radiation and some radioactive gas will be produced. In addition, small quantities of fission or radiolytic decomposition gases may leak with primary coolant to the drywell. If entry to the drywell is required, the drywell will be purged with reactor-building air. During startup the pressure in the primary containment will increase with increasing temperature and there will be some venting at 0.5 pound per square inch above ambient pressure. If radiation exceeds preset levels, these discharges will be made through the standby gas treatment system.

TABLE III-2

ANTICIPATED ANNUAL RELEASE OF RADIOACTIVE MATERIALS IN GASEOUS EFFLUENT FROM THE FERMI-2 PLANT*

(100% Power)

Radionuclides		Ci/yr
Kr-85m		7,520
Kr-85		292
Kr-87		72
Kr-88		4,000
Xe-133		38,000
	Total	∿ 50,000
Iodines and Particulates		∿0.5 Ci/yr

* Ground level release, unless specifically indicated otherwise.
Based on a Charcoal Delay System

TABLE III-3

ANTICIPATED ANNUAL RELEASE OF RADIOACTIVE MATERIAL IN LIQUID EFFLUENT FROM THE FERMI-2 PLANT

(100% Power)

Nuclides	Ci/yr
Sr-89	0.45
Sr-90	0.029
Sr-91	.00044
Y-90	0.10
Y-91m	0.028
Y-91	0.22
Y-93	0.0044
Zr-95	0.0047
Zr-97	0.000079
Nb-95	0.0048
Nb-97m	0.000076
Nb-97	0.0000079
Mo-99	0.095
Tc-99m	0.091
Ru-103	0.0034
Ru-106	0.0011
Rh-103m	0.0034
Rh-105	0.00033
Rh-106	.0011
Te-127m	0.00097
Te-127	0.0010
Te-129m	0.0091
Te-129	0.0058
Te-131m	0.0010
Te-131	0.00019

TABLE III-3 (cont.)

Nuclides			Ci/yr
Te-132			0.040
I-130			0.000096
I-131			1.2
I-132			0.042
I-133			0.14
I-135			0.00013
Cs-134			0.25
Cs-136			0.073
Cs-137			0.19
Ba-137m			0.036
Ba-140			0.65
La-140			0.5
Ce-141			0.0050
Ce-143			0.00055
Ce-144			0.0032
Pr-143			0.0040
Pr-144			0.0032
Nd-147			0.0016
Cr-51			0.040
Mn-54			0.0035
Fe-55			0.18
Fe-59			0.0066
Co-58			0.42
Co-60			0.044
Zn-65			0.000088
Zn-69m			0.000021
W-187			0.016
Na-24			0.0021
P-32			0.0015
	Total	∿	5 Ci
H_3		∿	20 Ci

The standby gas treatment system will also be invoked to process reactor-building air if high radiation levels are detected at the rooftop vent monitor.

The system will consist of two parallel lines of air-cleaning equipment, each capable of processing 3000 cfm, to remove particulates and halogens before release through the rooftop vent. Each line will include demisters and heaters to remove excess water and to reduce the relative humidity of the gases to below 70%. Each line will also include an activated charcoal adsorber. This adsorber is preceded and followed by a high efficiency particulate air (HEPA) filter. The standby gas-treatment system is shown in Figure III-3.

b. Liquid-Radwaste System:

The liquid-radwaste system will receive all radioactive liquids generated within the plant and will treat them in order to remove radioactivity before the liquids are returned to the plant or discharged to Lake Erie. The wastes involved will include: (1) equipment drain wastes, (2) floor drain wastes, (3) laundry and shower drain wastes, (4) chemical drain wastes, and (5) slurries carrying demineralizer resins, spent filter media, and evaporator residues.

Liquids will be treated variously by filtration, demineralization, and evaporation, depending on their quality. Flexibility will be provided by cross connections that permit processing through demineralizers, filters, and evaporators as needed. Volumes will be processed in batches, with water quality determinations and radioactivity sampling at various steps. Provisions will be made for recycling batches within the liquid-radwaste system if additional cleanup is required. A simplified flow diagram is shown in Figure III-4.

Most of the liquid volumes carrying radioactive waste generated within the plant will be returned to the plant after treatment. Thus, the high purity wastes collected in the equipment drain tanks will be returned to the condensate storage system after treatment; liquids collected in the floor drain tanks will be returned to the plant when their quality, usually determined by conductivity measurements, and the plant water balance permit.

Approximately 1,000 gallons per day of treated liquids, mainly from the chemical and detergent waste tanks, will be discharged from the system into the lake. The treated liquids will be pumped out at 5 gpm into the 6,000 to 12,000 gpm flow from the residual heat-removal pond to the lake.

Tritium release by the liquid radwaste system is expected by the applicant to be in the range of 4 to 8 Ci/yr, based on estimated turnover time for the primary coolant ranging from 1 to 12 months. It is attributable

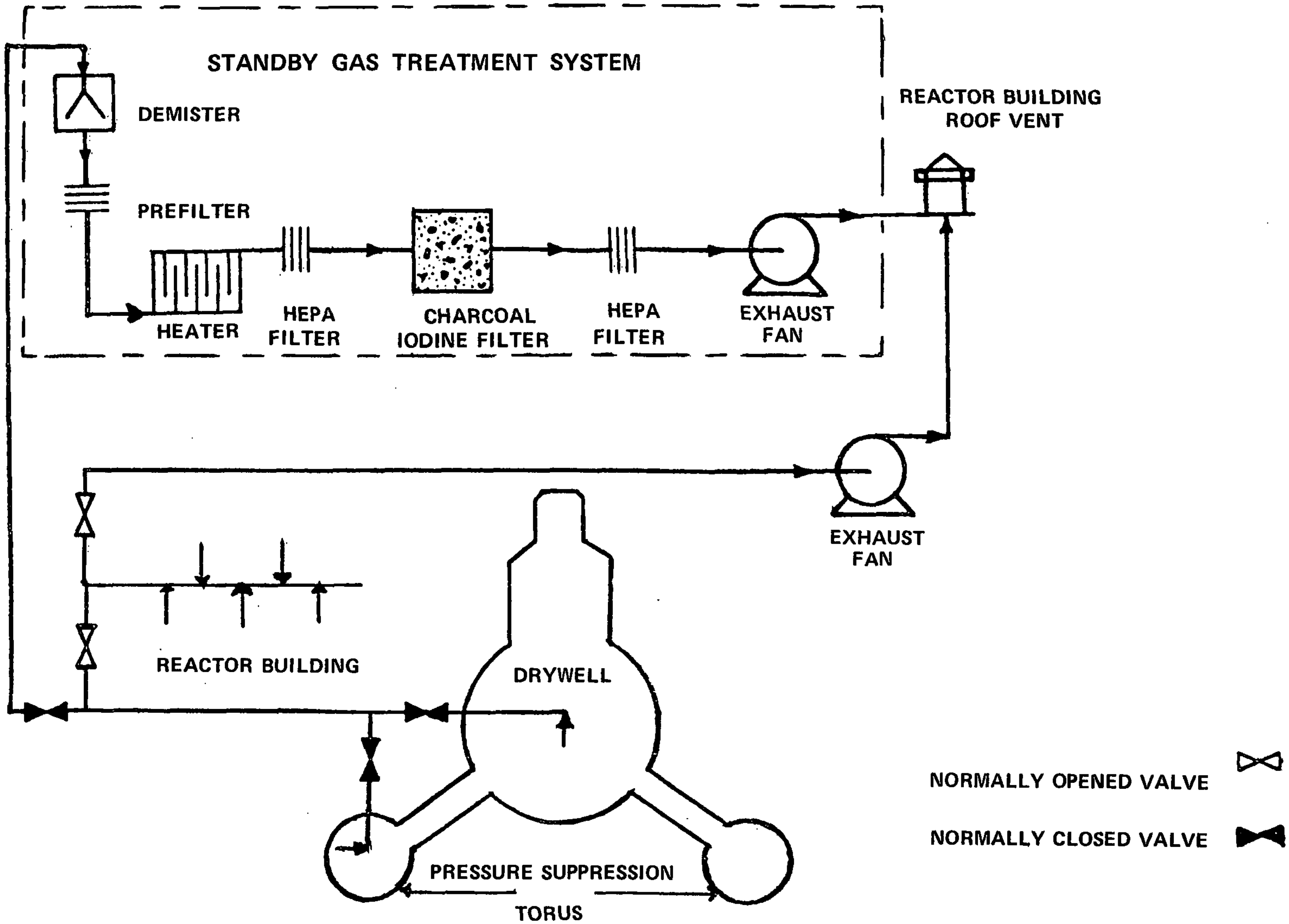


FIGURE III-3. SCHEMATIC DIAGRAM OF THE REACTOR-BUILDING VENTILATION INCLUDING THE STANDBY GAS-TREATMENT SYSTEM

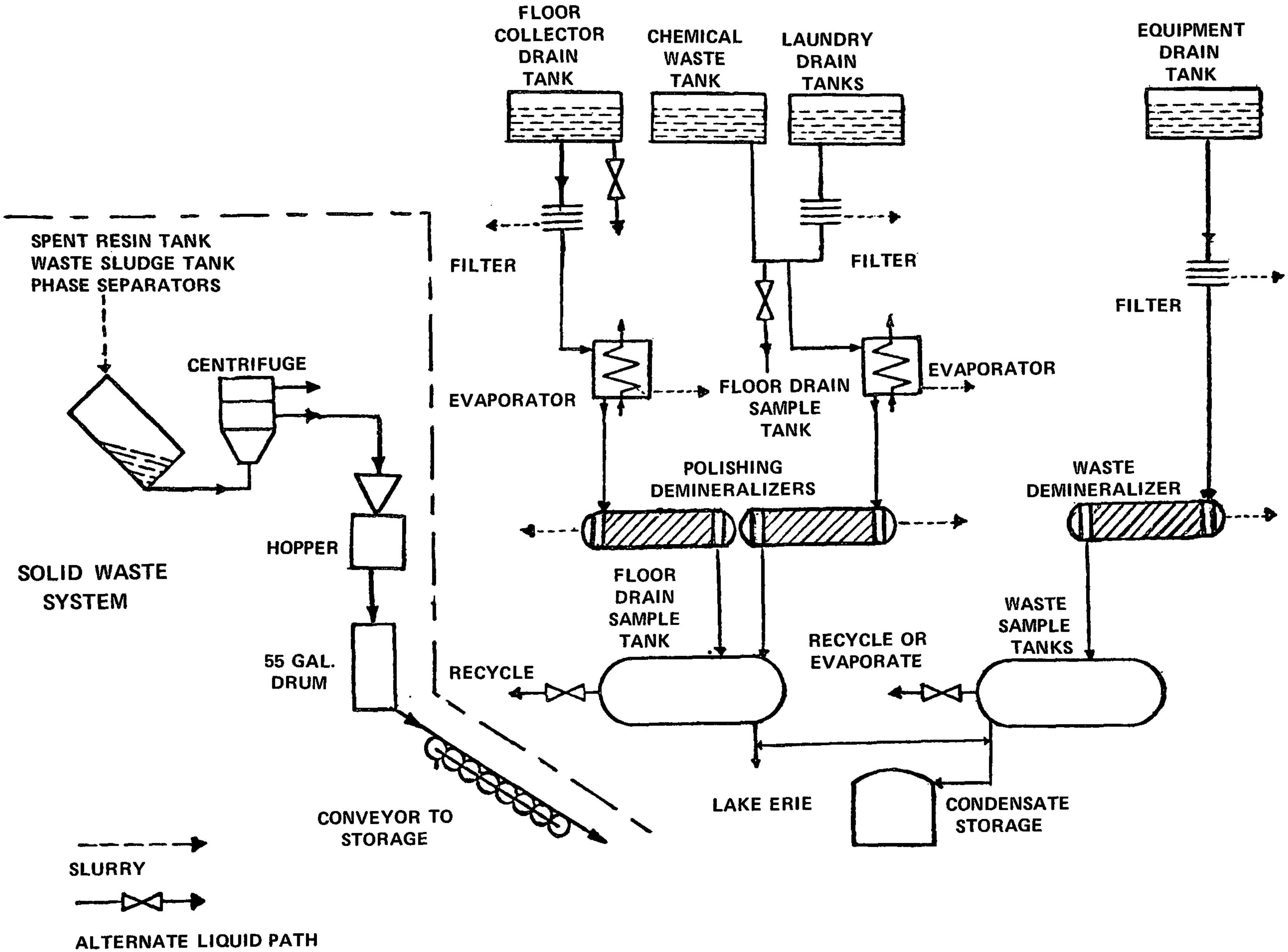


FIGURE III-4. SCHEMATIC DIAGRAM OF THE LIQUID- AND SOLID-RADWASTE SYSTEMS solely to the production of approximately 9 Ci/yr in the deuterium fraction in the coolant and implies an equilibrium activity there between 1 and 5 Ci. This figure agrees well with measurements made at operating boiling-water reactors.[25,30]

However, tritium will also be produced at the rate of about 0.4 Ci/yr in each of the 15,000 stainless steel-clad boron carbide tubes in the control rods and in the 37,000 Zircaloy-clad fuel rods. Thus, cladding defects in 0.1% of these tubes could introduce up to 20 Ci/yr into the primary coolant and cause an increased release of tritium to the environment.

Sampling and monitoring for radioactivity may be done at several stages in the liquid-radwaste cycle and will be done before release to the lake. During release, the effluent stream will be monitored and recorded. Preset alarms will warn if discharge is occurring in excess of operational limits; and the release will be terminated if such limits would otherwise be exceeded. A composite water sample taken from the floor-drain sample tanks and the waste sample tanks will be analyzed for tritium on a quarterly basis by an outside organization.

The slurries will be dehydrated and transferred to a packaging station for disposal as solid waste. No resins will be regenerated.

c. Solid-Radwaste System:

The solid-radwaste system will collect, process, and prepare radioactive solid wastes for shipment offsite and disposal in accordance with applicable regulations.

The solid-radwaste system will be contiguous with the liquid-radwaste system. It will receive wet solid wastes comprised of spent demineralizer resins and filter sludges. These will be pumped as a slurry from phase separators and waste-sludge tanks through a centrifuge, where they will be dehydrated and dumped into hoppers from which 55-gallon drums will be filled. The drums will be handled semi-remotely behind shield walls. They will be filled at two stations by remote manual control of a filling valve using remote visual observation. Refilling and temporary storage areas will be equipped with drains that connect to the radwaste-system sump.

Dry wastes will consist of a variety of contaminated or potentially contaminated items, including paper, rags, clothing, tools, equipment parts, solid laboratory wastes, and used reactor equipment such as activated poison curtains, fuel channels, in-core monitoring chambers, and other pieces of equipment which cannot be effectively decontaminated.

These dry wastes will be packaged according to size and radiation level in steel drums, fiber drums, cartons, or boxes. Wastes will be segregated, generally according to origin, in order to minimize shielding requirements during storage and shipping. Highly activated reactor equipment may be kept in the fuel storage pool for decay before final disposal. Some solid wastes of low activity such as clothing, rags, and paper will permit manual handling. Where possible, these wastes will be compacted.

The applicant estimates that each year 540 drums per year of solid wastes, containing some 600 curies of radioactivity will be shipped offsite for burial at a Commission-approved site. The location of this site is unspecified at this time. Radioactivity in each drum will run between 0.5 and 7 Ci with the higher levels associated with spent demineralizer resins from the reactor-water cleanup system. Packaging and transport of these wastes will be done in accordance with applicable regulations. The solid radwaste system is designed to handle approximately 3000 drums per year. Technical specifications on conductivity and chloride ion concentration will limit the quantity of spent demineralizer resins produced as a result of in-leakage of cooling water through failed condenser tubes.

3. Chemical and Sanitary Wastes

Chemical and biological wastes will be of four different types: (a) the combustion gases from auxiliary fossil-fueled units; (b) dissolved sodium and sulfate from regeneration of supply-water demineralizers; (c) sewage from sanitary sewage facilities; and (d) blowdown effluent from the chemically treated circulation-water system. Details of lake water quality, chemical discharges and relevant standards are presented in the applicant's Environmental Report, especially Sections 3-4, and 4-2. Chemical composition of lake water is given in Table 2.3, p. 2.8.

a. Combustion Gases:

The sources of combustion gases will be oil-fired units, as follows: an auxiliary heating boiler for Fermi-1; a peaking power unit, 162 MW; a gas-turbine peaking power unit; and an auxiliary heating boiler for Fermi-2. Each of these units has a separate exhaust stack.

The extent to which these units are used is variable. In 1970, the oil consumption was about 40 million gallons (0.3% sulfur), more than 80% of the consumption being due to the peaking units. However, when the Monroe coal-fired station is fully operative in 1974 at its rated 3,200 MWe, use of the peaking units will be substantially reduced.

b. Waste from Regeneration of Demineralizer Beds:

Ion-exchange resin beds will be used to demineralize the water supply for makeup of reactor-coolant water. These demineralizer beds will be periodically regenerated with sulfuric acid and sodium hydroxide solutions and the beds flushed with about 1,000 gpd of water from the potable-water system. This effluent, when discharged and diluted in the 6,000 to 12,000 gpm blowdown of the circulating-water system, will have contaminants of concentration only of 20-40 parts per billion (ppb) sulfate and 6-12 ppb sodium.

c. Sanitary Waste

Sanitary waste from the plant will be handled by the existing facilities of Fermi-1, which have a capacity sufficient for 250 persons. The facilities are operated in accordance with the State of Michigan standards. The State imposed limits for the Fermi-2 facility are that the discharge not contain more than 25 mg/l suspended solids, 25 mg/l BOD, 1,000 coliform bacteria per 100 ml, and that the phosphate be reduced by 80%. The effluents at the plant are individually regulated by the State. The Fermi-1 plant currently processes about 12000 gallons of sanitary waste per day through a trickling filter type system.

To keep the level of coliform bacteria low in the sewage effluent, chlorine will be added as sodium hypochlorite. The chlorine concentration in the 8-hour holdup tank will be controlled between 0.3 ppm and 0.7 ppm and average about 0.5 ppm at the point of release into the north lagoon. It will then be diluted by the Fermi-1 cooling water effluent as it flows to Swan Creek near the lake.

Recently, approval has been received from the Monroe County Health Department and State of Michigan, Department of Natural Resources (Order of Determination No. 1528), for the installation of a permanent sewage treatment facility for the Fermi Science Center for initial operation in 1972.

d. Circulating Cooling-Water System:

The circulating cooling-water system, as described in Section III.D.1, will remove the waste heat from the Fermi-2 plant and create two "chemical" effluents: (1) the blowdown or flushing water from the circulating-water system which will be returned to the lake, and (2) the evaporated water and drift (entrainment) sent into the atmosphere from the cooling towers.

(1) Effluent to Lake.

The effluent returned to the lake from the circulating cooling-water system will average 8,000 gpm blowdown. This effluent will differ from its lake-water origin in that (a) the dissolved-solids content of the water will have been increased about threefold due to evaporation of the cooling water; (b) the higher alkalinity due to increased dissolved-solid content will have been neutralized by the addition of sulfuric acid; and (c) residual free chlorine will be present from the chlorination given the circulating-water system as needed to prevent fouling of heat-transfer surfaces in the condenser by the formation of bacterial slime.

In the circulating cooling-water system, there will be two chlorination stations. In both stations water will be chlorinated by controlled dispersion of chlorine gas. Chlorine will arrive at the site in liquid form in 30-ton tank cars and will be vaporized at each chlorination station from 1-ton cylinders. One chlorination station will be at the pump house for the general-service water system and for the makeup water supplied to the circulating cooling-water system. Chlorine will be added continuously to provide a peak concentration of 5 ppm in the maximum of 31,500 gpm of water drawn from Lake Erie through the Fermi-1 intake canal. A monitoring station for measuring residual chlorine will be provided for this water supply at the point where it joins the 900,000 gpm circulating water system at the downstream end of the main cooling condenser. Chlorine addition will be controlled so that the residual free chlorine of the supply water at this point will be in the range of 0.5 to 0.7 ppm. Free chlorine added to the supply water will be consumed principally by reaction with organic impurities in the water in its passage through the pump house and piping up to the measuring station. The daily chlorine requirement for this operation is estimated to be about 1,500 lb/day.

The other chlorination station in the circulating cooling-water system will be at the inlet of the circulating-water pump house before entry of the 900,000 gpm cooling-water flow into the main condenser. This chlorination will not be carried out continuously, but only intermittently to provide a chlorination "shock," which is most effective in preventing slime formations from fouling the heat-transfer surfaces of the condenser. The chlorination will be controlled to provide a maximum of 5 ppm free chlorine in the circulating water. The chlorination will be controlled by a residual-chlorine measurement at the condenser exit to keep the residual chlorine concentration in the range of 0.5 to 0.7 ppm. The requirement of chlorine for this operation is estimated to be about 2,100 lb/day. Consumption of chlorine will occur in the recirculating-water-system by reaction with any organic or other pollutants in the water and by deactivation processes in the cooling towers and in the open 50-acre pond that is part of the system. Contact with air and sunlight will contribute to this deactivation. The return to the Lake of the average 8,000 gpm of blowdown will conform to a State of Michigan standard of a maximum of 0.1 ppm residual chlorine for such an effluent. This procedure is consistent with recognized practices in industrial operations. The effect of chlorination and alternatives is discussed in Section V.B.2. and Section IX.A.

(2) Effluent to Air.

The major effluent to air from the cooling towers will be the evaporated water.

e. Drift from the Cooling Towers.

In the contact of air with the circulating water in the cooling towers, some water droplets are entrained with the exit air. Such entrained liquid droplets are termed "drift." To eliminate most of the drift, the towers have internal baffles placed in the path of the vertically rising air at a point just above the fill where the water-air contacting takes place. The towers also use louvers at the point of air inlet near the bottom of the towers. The inlet louvers will minimize the loss of droplets in the horizontal direction during strong wind conditions. The Fermi-2 towers are designed and constructed by the Marley Corporation.

The quantity of entrained droplets will be small, usually less than 0.1% of the total circulating water entering the tower. Although accurate measurements of drift have not been reported (because of the considerable difficulty involved in making such measurements), some recent attempts at measurement indicate that actual drift may be as low as 0.01%. Assuming a circulating-water rate of 900,000 gpm, an upper-limit drift specification of 0.1%, a solids-concentration factor of three (due to evaporation in the circulating-water system), and an average dissolved-solids content of inlet water of 162 ppm (from western Lake Erie), the dissolved solids contained in the drift would amount to 5,300 lb/day. A more realistic estimate would be about 1,000 lb/day.

4. Other Wastes:

Solid wastes from miscellaneous nonradioactive sources will be removed to a suitable land disposal area offsite. These materials will include trash, garbage, and solid debris from general site activities. The nonradioactive waste will include material collected at the trash rack of the Fermi-2 inlet. Collections from the traveling screens, however, will be flushed back to the lake because fish and other organisms larger than 3/8" in diameter could be trapped in this way and would be killed if the traveling screen debris were buried. The disposal of these miscellaneous solid wastes will be in accord with local regulations.

IV. ENVIRONMENTAL IMPACTS OF SITE PREPARATION AND PLANT CONSTRUCTION

A. CONSTRUCTION PLANS AND SCHEDULES

Prior to initiation of construction activities, a comprehensive site-development plan was prepared by a land-use planning firm. Principal objectives in planning for the site were to ensure the preservation and enhancement of the natural site environment, to permit maximum public use of the site, and to minimize any adverse impact of the plant facilities on the surrounding environment.

The Applicant's Revised Environmental Report provides a description of the site plan including the planting program, other site improvements, and traffic flow. In addition to the plant facilities the plan provides for a wildlife preserve, a Science Center, space for a future Ecological Interpretive and Research Center, a natural region for waterfowl, a quarry lake, and picnic, day camp and hiking areas.

Site-preparation and other activities, permitted under AEC rules or exemptions prior to issuance of a construction permit, began in the spring of 1969, and all major excavation and fill work are expected to be completed in 1973. Public access to the recreational facilities is scheduled to begin in 1974.

Approximately 150 acres will be used for the power generating facilities on the site, principally in the northeast sector of the site adjacent to the lake shore.

Below-grade construction of the reactor building began late in 1970, and the turbine, radwaste, and service buildings, and the cooling towers are now being constructed. Approximately 10% of the plant construction has been completed, and the facility is scheduled for completion early in 1975.

B. IMPACTS ON LAND, WATER, AND HUMAN RESOURCES

1. Land

Approximately 150 acres will be disturbed and modified by the plant construction activities, and about 100 acres will be permanently occupied by buildings, switchyards, roads, parking lots, cooling towers, and the pond. Of the remaining acreage, approximately 30% will be developed and 70% left in its natural state. Excavated muck and soils will be redistributed onsite, in accordance with the site development plans. Several million tons of rock from the quarrying operation onsite are being used as a foundation material for buildings, roads, and cooling towers and for a lake-shore protection dike. Water seeping into the quarry is being stored in exploited northern portions of the quarry, and eventual flooding of the entire quarry will create a picturesque lake. There has been some adverse impact of the quarrying, however, as discussed in Section IV.B.2.

Salvageable construction materials are being accumulated and sold. Some of low value will be buried onsite. A burning pit is being used for moderate quantities of combustible waste, and eventually the pit will be filled in.

Most of the land development and construction activities do not create any significant noise problems offsite because the site is large and the activities are concentrated in a limited area far from the site boundaries other than the lake. However, blasting has elicited local community complaints. A controlled blasting program is being conducted under engineering supervision to minimize the possibility of detrimental foundation rock movement or slippage, and to prevent damage to existing structures at the site. Noise levels measured during typical construction activities ranged from 55 to 64 dBA at the quarry and 54 to 80 dBA near the plant. For comparison, the sound level associated with an average city street is in this range (about 70 dBA). The noise range at the quarry is that for sounds associated with the rock crusher and trucks. Since most of the quarrying operation is below ground level, the walls of the quarry provide some shielding from these noises. During blasting, which is done around noon and 4 p.m., the noise level is momentarily higher. At the nearest site boundary, the peak sound level is approximately 120 dB for an 800-lb. charge. While this sound is of high intensity, the duration is extremely short. Most of the blasting has been accomplished without reports of incidents; however, some nearby residents have complained about blasting noise, vibration and property damage. Measures taken to mitigate these effects are discussed in Section IV.C. In the plant construction area, trucks, earth-moving equipment and cranes are major sources of noise. Use of diesel-powered machinery results in some noise and the release of moderate amounts of combustion products to the atmosphere.

The increase in the accessibility of this marshy site and the provision of sound structural foundations required considerable movement of ground and rock. In providing for plant and public uses, about 220 of the original 1,088 acres were put to uses that removed them from wildlife habitats. The site transformation is indicated in Table IV-1. The lands used for structures associated with power generation were principally wetland and scrub-growth areas. The woodland area will be increased from 16% to 18% and 5% of the site will be converted to food plots for wildlife. Appendix B of the applicant's Revised Environmental Report provides a detailed account of the landscaping for the site. When completed, the site will contain about 650 recreational, educational and wildlife acres, about 60% of the total area. The site preparation and construction will result in some relocation of wildlife. Experience with Fermi-1 shows this relocation will be temporary. The wildlife reserve areas, buffer zones, onsite bird and mammal food crops, tree planting, and quarry lake will enhance the long-term value of the site for wildlife.

The conservation zone will include a wildlife and bird-nesting reserve and a woodland and stream habitat with supplemented forestation and aquatic planting. An area available for ecological interpretive research activities

TABLE IV-1

GENERAL FEATURES OF THE FERMI SITE

(1,088 acres or 1.7 square miles)

	Before Fermi 2 %	After Fermi 2 %
Plant Area	2.4	12.7
Inland Water Bodies	24.1	20.4
Woodland	16.1	18.1
Scrub Growth	22.5	15.1
Reeds and Marsh	25.1	10.1
Lake Erie and Swan Creek	8.5	7.4
Beach	0.8	0.6
Railroad, Paving, and Buildings	0.5	4.0
Food Plots	--	4.9
Landscaped Areas	--	6.7
	100.0	100.0

will also be included and available for use by area schools and universities. Hiking trails will traverse this zone and also the public recreation zone.

The recreation zone contains a deep-water quarry lake, a shallow water marsh, the south lagoon, a day camp, picnic sites and play fields. Surrounding the quarry lake will be prairie, lake forest, and oakwood biomes characteristic of Michigan. Dryland hillsides provide a southern boundary for this zone. An adjacent visitors' center will provide instructional and experimental facilities related to power generation and transmission, and to environmental sciences.

The installation of the new 345-kV transmission lines does not appear to make significant changes in the environment. In certain vacant areas, the erection of the new towers and line installation may result in a temporary relocation of nearby wildlife, but the towers themselves and the lack of major excavation work will not constitute any obstacles to restoration of the habitat. The extent of clearing of trees is limited to a narrow corridor, 50 to 200 feet wide, to provide access to the towers and to assure that falling of tall trees would not damage the wires or towers.

In the existing corridor, less than 10 acres of the 576 acres which now form this 37-mile long corridor will require additional clearing. There has been some selective cutting of the 15 to 20% of the new 10-mile long, 180 acre corridor, which is wooded. As is the applicant's usual practice, trees are selectively cut, under the supervision of the applicant's forester, to avoid a "swath" appearance. Some additional clearing of vegetation will be required for tower installation in the existing rights-of-way, all of which are located in flat, relatively open country.

Visibility of the new 345-kV transmission lines will depend on particular circumstances in the locale. With the exception of the new 10-mile section east of the Milan Station, the lines will parallel existing lines, which are already a familiar part of the landscape. The use of these existing corridors is sound land-use policy, and the installation of the new lines is in accordance with established standards.[37,38] The various permits and approvals required for the construction of the new lines are described in Section I.C above.

2. Water

Site alterations will reduce the onsite water areas by about one-third, mainly those originally occupied by reeds and marshes. Modifications to Lake Erie are confined to infrequent dredging of the intake channel, which now serves Fermi-1 and will also be used for this plant, and to dredging of a barge channel for delivery of the pressure vessel. The onsite barge slip will be filled in after receipt of the pressure vessel. Although local damage to benthic animals will occur due to dredging, no prolonged effects are anticipated since the lake bottom will be restored by natural processes soon after the vessel is delivered.

Lake Erie currents move fine sand into the intake channel, gradually resulting in insufficient water depth for plant operation. In the past, approximately 18,000 cubic yards of sand have been removed annually from the channel, usually in the late fall of the year when the lake water level experiences a seasonal low. Dredged material is placed on land, in an onsite diked disposal area. The frequency of dredging, quantity of material removed and the disposal method are not expected to change significantly in the future.

The one-time dredging of a channel for delivery of the reactor vessel is planned for late spring or early summer, to take advantage of the seasonally high lake levels. Approximately 65,000 cubic yards of material will have to be removed, in order to provide adequate vessel flotation.

Onsite surface-water flow is predominantly into the lagoon areas. Since the immediate vicinity of the south lagoon will not be disturbed and extensive modifications to the north lagoon are in progress, silting is not considered to be a problem during construction. Muck dredged from the lagoon area is temporarily contained by clay dikes to reduce erosion and silting during the construction and site-development phases. At the start of site modifications, the proposed construction area was surrounded by a clay dike. Movement of additional dike fill material by truck served to compact the dike. The resulting basin was dewatered, dried, excavated and refilled to finished grade level with better structural fill. The dike prevented siltation, and erosion was limited by the flat and gently sloping terrain in the construction area. Planting plans for the subsequent site development will help to minimize erosion.

The quarrying operation and, to a lesser extent, reactor excavation dewatering have disrupted the natural flow of groundwater in the vicinity of the site and have caused some problems with nearby well-water supplies.

The onsite quarry had been used as a source of material for Fermi-1 construction from 1958 to 1962 and was reactivated in early 1969 in connection with site preparation for Fermi-2. Prior to reactivation, the quarry had been allowed to fill with water. From October 1969 to August 1970 an average of 770 gpm was pumped from the quarry to the lagoon because of upwelling of groundwater through the joints and solution openings in the dolomite on the floor of the quarry.

Since August 1970, over 40 complaints have been received by the applicant from nearby residents regarding problems with their well-water supplies.

Subsequent measures taken by the applicant to control adverse effects of lowered groundwater levels are discussed in section IV.C.

3. Roads

Site preparation work began with the construction of a new access road to accommodate the construction work force and divert heavy traffic from the road used by local residents. This new road extends from the site to the Dixie Highway (State Route 56) and the applicant has contributed funds for upgrading that highway. No public funds are used for construction or maintenance of the temporary and permanent onsite roads.

4. Human Resources

Presently about 900 men are involved in the construction activities, and the labor force is expected to peak near 1,400 late in 1972. The construction is phased behind that for the fourth coal-burning power plant at the applicant's Monroe site. Between 90 and 95% of the construction force for the plant will be drawn from the Detroit metropolitan area, and the coordination with the construction at the Monroe site (and possibly with future plants at the Fermi site) will reduce fluctuations in the employment level in the vicinity.

Since at least 90% of the construction force will be recruited locally, the local schools, housing and business establishments will not be perturbed seriously. The applicant did consider establishing a temporary mobile-home community, but abandoned this idea as unnecessary since existing residential facilities were found to be adequate. No assistance has been sought from the applicant by any of the school districts in the area, indicating that the influx of children of school age (if any) accompanying transient workers has been distributed over a large geographical area. Although no public transportation facilities serve the site, the increased traffic caused by the construction work force has not been perceptible on the Detroit-Toledo Freeway (Interstate Highway 75). Roads in the immediate vicinity, such as the Dixie Highway, are now under-utilized because of the proximity of the Freeway, so that rush-hour traffic to and from the site is accommodated with only minor inconvenience to the local residents.

C. CONTROLS TO REDUCE OR LIMIT IMPACTS

A long-range plan for site development is intended to minimize adverse impacts on the environment during construction. Construction limits have been established, and a continuing effort is exerted to avoid adverse effects.

A temporary sewage-treatment plant, approved by the Monroe County Health Department and the State of Michigan Department of Natural Resources, was installed in mid-1970 to treat sanitary waste from four toilet trailers used by the construction forces. The plant uses an extended aeration treatment process. The plant is sized for 12,000 gallons per day. Currently about 3,000 gallons per day, primarily human waste, are received for processing. The State-imposed limits for the effluent are the same as for the permanent sanitary facility (see Section III.D.3.c). Routine operation and maintenance are supplemented by periodic inspection, effluent sampling, and equipment adjustment by a certified sewage-treatment-plant operator.

The dust level is reduced by frequent watering of the temporary roads used by the construction and materials movement vehicles. Measures are employed to reduce undesirable redistribution of muck and soils displaced during construction. Because of numerous drainage paths, flooding is not a problem on this site. Appropriate post-construction planting and landscaping is planned to restore and protect the natural characteristics of the area.

Blasting operations have been modified in response to complaints of noise and other effects by nearby residents. The size of blasting charges, used principally in the quarrying operations, has been reduced and the time and sequence of the blasts have been regulated in an effort to minimize offsite effects. Instrumentation and continuous monitoring are provided to assure that blasting for foundation excavations does not exceed established safe limits.

The applicant has taken a number of measures to limit and reduce impact on water-wells in the area adversely affected by lowering of the groundwater levels owing to quarrying and dewatering operations.

The north end of the quarry was diked off into two compartments and quarrying and associated dewatering in that end of the quarry have been stopped to allow the water to rise and partially restore the groundwater level in the adjacent portions of the aquifer to a level closer to that of the previous natural state which existed prior to the quarry's reactivation. After the abandoned northern end of the quarry was allowed to refill, quarrying operations were relocated immediately to the south. About 30 gpm of water seeping into the presently used quarry are also pumped back to the northern end. Most of this flow originates from the northern end itself.

The modified operation has apparently been successful in restoring groundwater conditions to a satisfactory state. New complaints have averaged only one per month since the initial 24 of August 1970. Data[48] from monitoring the water level in ten nearby wells since March 1970 verify the adverse effect of the reactivation of the original quarry and the partial alleviation of the groundwater problem by the modified operation.

The applicant has, in addition, taken other actions to alleviate the well-water problems. Deep-well pumps have been provided for some of the affected wells; some new wells have been dug; and water has been supplied by tank truck when necessary. The applicant is investigating all complaints and, whenever justified in the applicant's opinion, action is taken in an attempt to reach an amicable resolution of difficulties experienced by residents as a result of the alteration of the groundwater supply.

Whatever future measures are taken at the quarry might have potentially adverse or beneficial effects. For example, if the applicant follows a plan to allow the presently used south end of the quarry to fill, a scenic lake for a recreation area will result and a groundwater recharge supply will exist. However, this same action might result in raising of the water table to the south with possible adverse effect on septic fields in the area.

The staff has these matters under continuing review; and licensing of the plant will be conditioned upon the applicant's satisfactory resolution of problems arising from quarrying operations by providing a program to minimize further adverse impacts, enhance beneficial impacts, and taking measures to control, mitigate and alleviate adverse effects.

V. ENVIRONMENTAL IMPACTS OF PLANT OPERATION

Operation of the plant will have both favorable and potentially detrimental environmental effects. Included in the former are the development of recreational, cultural, and educational uses of the site. Included in the latter are the release of low levels of radioactivity to the environment, the discharge of small quantities of chemicals, and the atmospheric effects of the cooling towers.

A. LAND USE

Intended site changes have been discussed in Section IV. In this section attention is directed to effects anticipated after completion of construction and modifications.

1. Onsite Impacts

Understandably, a significant fraction of the site area is committed to requirements associated with the operation of a large power plant, including the residual heat removal pond associated with heat dissipation.

The public will experience some minor inconveniences in using the recreational and educational facilities. Access to the plant area and its adjacent shoreline must understandably be denied to the general public. 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 for a nuclear plant. Finally, in simulated emergency conditions and in the unlikely event of a real incident associated with the operation of the nearby power-producing facilities, it might be necessary to temporarily restrict public access to all onsite areas.

2. Offsite Impacts

In general, adverse impact on areas adjacent to the site will be minimal. The drainage pattern in the vicinity has been altered deliberately, mainly in the vicinity of the quarry lake in order to avoid its contamination by fertilizers and herbicides used in neighboring agricultural activities.

Of the approximately 100 permanent employees to be required for operation of the plant, approximately 5% will be recruited locally, 25% will be domiciled within 10 miles and the remainder will commute from greater distances. Thus no significant impact on local residential and commercial functions will occur.

The Advisory Council on Historical Preservation, in a letter on May 28, 1969 to the AEC, advised that construction and operation of the plant would not adversely affect anything of historical value. Moreover, the proposed activities at the Fermi site are consistent with the regional development plan prepared by the Southeastern Michigan Council of Governments under a Federal land-use planning grant.

More distant from the site, new power-transmission facilities needed because of the plant, will require the purchase or lease of 180 acres of land over a 10-mile stretch east of the applicant's Milan Station. Presently this acreage is predominantly abandoned or marginally useful farm land, and from 15-20% is woodland. No parks, recreational areas or federal lands exist in this proposed new transmission-line corridor. After erection of the required towers and lines, this land should be available for a variety of recreational uses such as hiking, riding (bicycle and horseback), and ball games.

It is the applicant's policy, wherever possible, to lease acquired right-of-way for transmission lines back to the original owner at a nominal fee. Thus, for farmland, only the land around the tower bases is lost from productive use. Inspection of the transmission lines is performed by airplane, so that the only clearance required in the corridor is that needed for access of maintenance vehicles and for freedom of intrusion of trees on the safe operation of the lines.

The applicant uses herbicides and defoliants where necessary to prevent tall trees from interfering with transmission lines. Biodegradable, nontoxic materials are used for this purpose rather than more persistent or more toxic chemicals. Their applications are rigidly controlled by the applicant's forester, in accordance with specifications established by the applicant. Care is taken not to destroy desirable species of ground cover and bushes used as a habitat by small game. Permits are obtained and companies applying these materials are licensed by the Michigan State Department of Agriculture.[39]

Based on past experience, the applicant anticipates no problem resulting from inductive coupling or direct faulting with railroad communication and signal lines. Neither the 345 kV line from the plant to the Brownstown Station nor that to the Milan Station are immediately adjacent to or closely parallel rail lines, signals, or related communications equipment.

3. Cooling Towers

Two 400-foot-high, natural-draft cooling towers will be used to dissipate most of the waste heat associated with the operation of the plant. The suitability of cooling towers for the Fermi site may be considered in regard to the following factors:

a. visual impact of the towers and their plumes;
b. obstruction to flight;
c. weather effects of the plume; and
d. water-supply.

a. Visual Impact. The 400-foot-high towers are much higher than any other natural or man-made features of the region except for the 800-foot-high chimneys at the applicant's Monroe plant. Because the terrain in the region is very flat, the towers will be visible for many miles. However, the prominence of their appearance from the ground will depend on local structures and trees. The plumes from the towers, because of their greater elevation and horizontal extension, will be visible from greater distances than the towers. Their visibility depends on their persistence (nonevaporation) and elevation (plume rise). On the other hand, the plumes will be a "sky effect" rather than a "ground effect" and will have a different aesthetic impact. The prominence of the plumes and the visual impact of the towers will be reduced by certain natural weather conditions, especially fog, cloudiness and precipitation.

Because the prevailing winds are from the west, and somewhat from the south, the plumes will tend to be carried away from populated areas to the open lake. This westerly wind direction holds for every month except May, when the prevailing winds are mainly from the north and south. The applicant estimates that the plumes will move toward the lake 65% of the time. From time to time, however, there are lake breezes which tend to carry plumes inland and to limit plume rise. The importance of this effect, as well as other local phenomena, will be investigated in meteorological studies planned by the applicant utilizing a 492 ft tower to be installed near the plant.

b. Obstruction to Flight. Another important consideration is whether the cooling and meteorological towers will be a significant obstruction for aircraft and birds. Custer Airport is approximately 9 miles west, Marshall Airport about 2 miles west and Carl Airport about 5 miles northwest of the site. The nearest major airports are the Willow Run Airport and the Detroit Metropolitan Airport, about 24 and 19 miles north-northwest of the plant, respectively.

Marshall Airport, the closest, is not subject to the Federal Aviation Administration (FAA) so no traffic data are recorded. Staff phone conversations with airport and FAA personnel indicate, however, that the traffic at Marshall is "very light," approximately 50 flights per week of light aircraft. Landing strips at Marshall extend in SW-NE and NW-SE directions, so the cooling towers due east are not in the flight paths of aircraft using that airport. Furthermore, most of the use of Marshall is local, so it is reasonable to assume that pilots using it will be aware of the existence of the towers.

The distance to Willow Run and Detroit Metropolitan Airports, and minimum altitude regulations, preclude any interference with aircraft using those airports except in the case of a major pilot or instrument error.

Based on the above considerations, the Federal Avaiation Agency and the Michigan Aeronautics Commission have approved the construction of the towers, subject to provision of four equally spaced 1000-watt lights at the 132- and 270-foot levels and four 360°, 1000-watt stationary beacons at the top for each cooling tower. In addition, an aviation orange band will be painted on the towers, extending from 8 to 48 feet from the top. Each tower will be lighted at the 55-foot level for ground-level illumination.

There is an abundance of local and migratory birds on and near the site. Their possible interaction with the towers is more difficult to evaluate. It is reasonable to assume that they will be successful in avoiding the towers under conditions of good visibility. If birds should collide with the towers under conditions of poor visibility corrective measures such as the use of additional floodlighting could be considered.

c. Weather Effects. The effects of the cooling tower plumes on the weather have been predicted by the applicant, on the admitted basis of limited and often contradictory information, to be small and infrequent. The prevailing westerly winds and the plant's location at the western shore of Lake Erie tend to minimize weather effects on the nearby population, since any alteration of the weather would usually occur over the lake. The applicant estimates that 5% of the evaporated water in the plumes will be returned to the lake by precipitation. More study is needed, especially measurements of actual performance of operating cooling towers in regard to both local and overall effects. It is possible, for example, that the towers may produce some local fog and icing. But these effects are expected to be relatively small, and to occur very infrequently, i.e., less than 10 days per year.

To overcome the possible unacceptability of poorly defined risks, the applicant has undertaken specific studies of tower performance and of relevant meteorological conditions. Based on such studies, modification of plant operation would be undertaken if necessary.

d. Water Supply. The amount of water lost locally by evaporation and windage through the use of cooling towers will depend upon the reactor power level, the temperature of the intake water from the lake, and atmospheric conditions. A maximum release of 17,000 gpm is anticipated. This is trivial compared with 1) the 76,000,000 average gpm input to Lake Erie from the Detroit River, and 2) the normal evaporation losses from the 10,000 square miles of surface area of Lake Erie. Regarding the magnitude of the latter, the applicant has estimated that, at 94°F, 2,500 gpm will be lost by evaporation from its 50-acre residual heat removal pond. The dissolved solids in the water withdrawn from the lake are virtually all returned thereto, so the evaporation losses in the cooling towers do result in an increased level of solids in the waters immediately adjacent to the plant. Drift solids will be distributed over a large area. Since the solids content is that naturally occurring in the lake, and since the region is washed by precipitation of about 31 inches/yr, no adverse effect from deposition is likely.

Other possible means of heat dissipation at the site are being studied. Two types of spray units are being investigated in onsite waters, in order to assess the merit of spray ponds as a means of heat dissipation in conjunction with or in partial substitution for use of cooling towers for future system expansion.

4. Regional Development

The location of the Fermi site close to the city of Detroit and on the shore of Lake Erie places it in juxtaposition to land potentially favorable for resort residences and for public parks, particularly if water-pollution abatement measures are successful for the lake. The marshy land of much of the Fermi site proper is, by itself, not fully suitable for such use, although dredging and fill operations required to locate the plant near the lake make it economically practical to improve the area for public use. Apart from the specific use of the Fermi site, there has been little regional planning for the provision of park and wildlife facilities adequate for the growing urban population. The entire west shore of Lake Erie merits consideration for wildlife facilities and park development for the growing urban population. The Fermi site, with its plans for public access for education and recreational purposes, would fit in well with such a regional development.

The intended use of the site is consistent with the existing regional land use plan prepared by the Southeastern Michigan Council of Governments. The development of much of the Fermi site for recreational use by the general public is a positive step toward further beneficial land and water use in the region.

B. WATER USE

Plant operation will require a maximum of 31,500 gpm for heat dissipation purposes and 80 gpm for potable and other in-plant uses. Lake Erie will be the source for all of this water unless a domestic water supply is made available for the in-plant uses.

Of this maximum of about 31,600 gpm, 17,000 gpm will be lost locally by evaporation and drift in the cooling towers and 2,500 gpm evaporated from the pond. The remaining 12,100 gpm will be returned to the lake, 12,000 gpm after being used to control the concentration of the dissolved solids in the closed-circuit cooling system, and less than 100 gpm after use within the plant.

The effects of this water usage will be limited to surface waters, particularly Lake Erie, and the chemicals and aquatic life therein. No additional discharge of water from the plant is intended, other than the flow in the closed-circuit cooling system to the pond. Local bedrock aquifers containing potable water in the site area are of a relatively low permeability. The water table is relatively flat, and the direction of the ground water movement is toward Lake Erie at a slow rate. The relatively impervious surficial soils in the area have produced an artesian ground water condition in the bedrock. Bedrock in the vicinity ranges in depth from approximately 15 to 30 feet below the elevation of Lake Erie, and therefore the vertical component of the ground water movement is upward, which precludes the possible contamination of the bedrock aquifers from accidental discharge of fluids on or below the ground surface.

1. Alterations in Lake Temperature

Because of the use of cooling towers most of the waste heat from the plant will be released to the atmosphere by transfer to the air circulating through the towers and by evaporation of some of the cooling circuit water. The portion of the water withdrawn from the lake which will eventually be returned in order to control the chemical concentrations in the closed-circuit water will experience a 4-1/2-hour holdup in the pond, since the pond will contain 230 million gallons of water. Although evaporation from the pond itself does dissipate some of the waste heat, between 56 and 78 million Btu, depending on the time of year, will be returned to the lake per hour, at temperatures 12 to 23°F above the lake temperature. No recommended thermal input limit exists for Lake Erie. The heat content of the pond effluent is less than 20% of the upper limit proposed for Lake Michigan early in 1971 by the Lake Michigan Enforcement Conference. The plant outfall is very near the shore, at a position corresponding to the expected low-water level. Discharge of water from the pond during periods of extended plant shutdown, e.g., during refueling operations, will be intermittent, depending on the requirements for blowdown and radwaste dilution.

2. Alterations in Chemical Content of the Lake

Evaporation in the cooling towers and from the pond will result in a threefold increase in the concentration of dissolved solids contained in the water returned to Lake Erie, compared with their concentration in the lake. There will be a further addition of sulfuric acid (to adjust the pH of the water as a way to minimize corrosion) and of chlorine (to inhibit algal growth in the closed-circuit cooling system). The solids consist almost entirely of the naturally prevailing dissolved solids in the lake water. Material added in plant operation is a small amount of chlorine and sulfate, as described below. Although some of this material may fall to earth in the immediate vicinity of the tower (in large droplets), the solids contained in small droplets may be carried over large areas with atmospheric currents as droplets or as solid particles remaining after evaporation of liquid water in the droplet.

Even if ground deposition of these solids occurred at that calculated for 0.1% drift, natural washing of the ground due to rain would tend to prevent accumulation. For the location of the plant, the average yearly rainfall is equivalent to 12 million pounds per day per square mile. Thus, if all the solids in the drift were deposited over only 10 sq. miles, rainfall would dissolve the solids and carry them off at a concentration of 45 ppm. This concentration of dissolved solids is only about one-fourth as high as that presently found in Lake Erie. Except possibly for some very local effects on the site, it would appear that the drift would not produce any significant change in the environment due to fallout of solids.

Lake Erie water near the plant intake contains about 165 ppm of dissolved solids and its pH is about 8.3. The factor-of-three higher concentration in the discharged water will increase the pH to 8.8 which is at the upper limit of the 6.5 to 8.8 range allowed by State of Michigan standards.[4,5] Therefore about 60 ppm of sulfuric acid (H_2SO_4) will be added to the closed-circuit cooling water at the point of discharge from the cooling tower into the pond to neutralize the water. The resulting sulfate compounds will not be environmentally significant.

Chlorine used for control of the growth of attached microorganisms in the closed cycle cooling system is potentially of environmental significance. Liquid chlorine, from storage cylinders, will be vaporized and introduced into the water used in the operations at two points by means of diffusers and injectors. At the general water pumphouse, a maximum of 5 ppm of chlorine will be injected into the water used as general service water and pond makeup. For 25,000 gpm, this will be as much as 1,480 pounds of chlorine per day. Once or twice a day, chlorine at a maximum concentration of 5 ppm will be introduced at the circulating-water pumphouse. For two such shocks to the 840,000 gpm, as much as 2,100 pounds of chlorine will be required. Thus, the maximum addition of chlorine will be about 3,600 pounds per day. A very small part of this chlorine will be released as gas in the cooling tower.[22] Because of the 4-1/2-hour average retention time in the pond, the major portion of the chlorine will eventually be released to the lake as organic and inorganic chlorine compounds.[7,8,14]

The blowdown will be monitored for total residual free chlorine, but the level may be so low that it will not be detected. The State of Michigan's order of determination for the applicant's Monroe plant presently sets a value of 0.1 ppm residual chlorine at the effluent point. If required for the Fermi-2 plant, sodium thiosulfate can be used to reduce the residual chlorine to less than 0.1 ppm. Monitoring of the circulating water as it enters the cooling tower will also be performed, with an allowed range of 0.5 to 0.7 ppm of free chlorine.

A variety of structural materials will be in contact with the circulating water in the plant. These include carbon steel, type 304 stainless steel, bronze, rubber, concrete, copper, zinc, nickel, polyvinylchloride, and asbestos-cement (fill). Because the water will be neutralized (by the addition of sulfuric acid), pick-up of corrosion products from those materials should be minimal.

The existing Fermi-1 sewage plant will be used to process the shower, laundry and lavatory waste water from the Fermi-2 plant. License limits established by the State of Michigan Water Resources Commission are 25 milligrams per milliliter (mg/ml) for Biochemical Oxygen Demand and for suspended solids, and 1000 coliform bacteria per 100 ml. Normal practice introduces 0.3 ppm free residual chlorine, usually from bottles of hypochlorite, to control coliform bacteria. The sewage-plant effluent is released to the north lagoon whence, in diluted form, it reaches Lake Erie by way of Swan Creek.

3. Alterations in Volume of the Lake

Loss of water has meaning only in terms of a localized effect. As mentioned in the discussion of cooling tower effects in Section V.A. above, a maximum evaporation of 17,000 gpm in the cooling tower and 2,500 gpm from the pond is anticipated. These quantities are trivial compared with the Lake Erie volume of 100 cubic miles and with the 76-million gpm inflow to the lake from the Detroit River. Thus the effect of this loss on the lake level will be negligible. The 19,500-gpm evaporation, if all were deposited as precipitation in a 25-square-mile area, would add about 14 inches per year. This compares with the local annual precipitation of 31 inches in this area. Only about 5% of this evaporated water is actually expected to be returned to Lake Erie by precipitation.

4. Recreational Use of the Lake

Since the plant will use the existing Fermi-1 water-intake channel, no additional impediments to use of adjacent beach and near-shore waters will result from the construction of this plant, except for the limited area occupied by the outfall structure. Because of a need for space in excess of that available in the Fermi-1 screenhouse, a separate screenhouse will be provided for this plant, but it will be located at a portion of the beach now restricted from public use by the existing intake structures. The waters in the immediate vicinity of the site have not heretofore been outstanding for fishing, and the plant's impact is not likely to alter this situation significantly, although the thermal plume may attract some fish. The reduction in onsite water area could conceivably reduce its attractiveness to waterfowl. Conversely, the enhancement of feed due to planned site improvements might result in an increased attraction of water fowl. Since these same improvements are associated with increased public usage of the area, however, in the interest of public safety the use of the onsite waters for duck hunting has been prohibited since 1971.

5. Use of the Lake for Municipal Water Supply

Plant effluents will not have any significant effect on the quality of lake water used elsewhere as a source of potable or industrial water. The only municipal water intake in the vicinity of the site is that of Monroe located 2 miles southeast of the plant. A multiple industrial intake that serves six companies is located about 4 miles south of the site. The Toledo intake is located about 25 miles south of the site. The nearest municipal water supply that relies on surface water other than from Lake Erie is on the Huron River, about 10 miles north of the site. The Huron River discharges into Lake Erie; the intake is about 7 miles inland.

Lake Erie currents in the vicinity of the site vary with the direction of the wind. Winds from northwest through northeast produce a general southwesterly shoreline flow. Winds from the south-southeast through west cause northeasterly shoreline currents. Onshore winds from east through southeast and offshore winds from northwest through west-northwest produce variable current patterns.

Water in the north lagoon flows northward into Swan Creek, which forms the northernmost boundary of the site. Swan Creek, in turn, discharges into Lake Erie about 1 mile north of the plant. The Unit-1 facility, already in operation, uses Lake Erie water for once-through condenser cooling. The lagoon and Swan Creek are used as the cooling-water discharge for the Unit-1 facility. No cooling water will be either taken from or discharged into the lagoon or Swan Creek from the plant during its operation. The configuration of the surface drainage pattern permits no flow toward inland areas.

The dilution of flow into Lake Erie from Swan Creek has been measured for each primary current pattern. Probable dilution estimates were made for the existing Fermi-1 intake, the Monroe intake, and the Toledo intake, located about 25 miles south of the site. Worst condition estimates for a southerly current flow indicate dilutions of 20 times at the Fermi-1 intake, 45 times at the Monroe intake, and 370 times at the Toledo intake. These estimates represent a minimum mixing effect and should be considered very conservative. The probable dilutions of Swan Creek effluent for a north-current condition would be 79,000 times at the Monroe intake and 374,000 times for the Toledo intake. These dilutions are so great as to prevent any significant effect on municipal supplies.

6. Monitoring

The applicant will monitor residual chlorine, pH, and dissolved and suspended solids at the point of water return to Lake Erie. Temperature, flow, and radioactivity level will be recorded continuously. All observations will be checked for compliance with authorized limits by the applicant and reported to the appropriate regulatory agencies of the State of Michigan on a regular schedule. Also, the State will perform toxicity tests.

C. BIOLOGICAL IMPACT

1. Terrestrial Ecosystem

The plant will not release any significant amount of combustion products. The limited amount of combustion products released from construction machinery, a small heating boiler, and emergency power diesels will have no significant adverse effect on the environment.

No noise problem will be created by operation of the plant because none of the systems or equipment used for production of electricity generates a high noise level. Furthermore, all these systems and equipment, except for the cooling towers, are located within enclosed structures. The natural-draft cooling towers generate no noise since they do not require the use of motor-driven fans.

The height of the two natural-draft cooling towers and the buoyancy of the plumes will minimize the possibility of tower-plume grounding onsite and offsite. The elevated release of the moist air from the towers will result in dissipation of waste heat to the atmosphere without significant problems or annoyance to the public under nearly all weather conditions. The prevailing winds are away from the land, toward Lake Erie. The cooling-tower and meteorological studies underway will further upgrade the understanding of the potential effects of cooling towers. These tower plumes are not expected to cause fog more than a few days per year. When the fog does occur, it is not expected to last more than a 1- to 4-hour portion of the mornings. The increased humidity due to the cooling-tower plumes is not expected to be significant. Icing in winter as a result of freezing mist from the towers may occasionally occur on the site, but it is not expected that the public roads immediately adjacent (North Dixie Highway and Pointe aux Peaux Road) will be iced at any time by the freezing of the Fermi tower-plume condensates.

The possibility of ecological or human-health damage due to toxic chemical or microorganism fallout is very remote. There will be radiological and toxic chemical monitoring of the cooling-tower intake water from the condenser, and the effluent from the retention pond. This will make corrective measures possible, if they are necessary. The pH of the water from the cooling-tower effluent will be kept at about 7 by the addition of sulfuric acid. Neither the threefold higher concentrations of sodium chloride and other salts in the effluent waters nor the fallout from the tower plumes is expected to cause significant damage to either terrestrial or aquatic fauna and flora. This aspect of the biological impact analysis will be monitored by the applicant after startup.

2. Aquatic Ecosystem

The principal factors to be evaluated in regard to the impact of the plant on aquatic life in Lake Erie apply to the organisms entrained in the intake cooling water and those in the lake that are not taken into the power plant but bathed in the plant's effluent.

a. Intake Effects. Water for the plant will be taken from the existing Fermi-1 intake canal after a relatively small amount of additional dredging. A separate screen house for Fermi-2 will be built at the end of the canal. The condenser cooling makeup water for Unit 2 will be pumped through the Unit 2 General Service Water Pump House, which will be located on the existing Unit 1 intake canal. Fermi-1 and 2 will thus share a common intake canal, but have separate screen houses and intakes from the canal. When Fermi-1 and -2 are in full operation, the flow velocity of the water in the main part of the canal will be approximately 0.13 foot per second (fps). At the entrance of the screen house, the velocity will be about 1.0 fps. The Unit 2 intake flow represents only a 24% increase over present use, based on the maximum Unit 2 intake flow of 31,500 gpm, and the present Unit 1 intake flow of 131,000 gpm.

Based on Fermi-1 operating experience, it is anticipated that the total amount of fish caught will be small. Fish have been seen swimming in the canal and in the Fermi-1 screenhouse near the screens. They then swam back into the canal with no difficulty. Fish easily swim from the canal into the lake. Thus, water velocities are low enough to preclude entrapment. Any juvenile fish caught by the traveling screens (3/8-inch mesh) will bypass the remainder of the power plant and be flushed from the screens, then returned to Lake Erie via the Fermi-1 overflow lagoon and Swan Creek. It was learned from experience at Monroe that washing the screens and returning the debris and occasional small fish to Lake Erie ensures the survival of some of the fish. However, other fish will die eventually, if not immediately, due to mechanical or water jet trauma, exposure to low oxygen concentration, chemical effluents in the lagoon, and/or increased predation due in part to habitat displacement. No known incidents of fish kills have been associated with the operation of the Fermi-1 intake structures. The use of additional water required by Fermi-2 is not expected to increase fish entrapment.

Plankton and other small organisms less than 3/8 inch in size (Tables II-4 and II-5) that happen to be in the cooling-water intake will likely pass through the traveling screens and condenser where they will be exposed to a temperature increase up to 12°F in summer and 23°F in winter. In addition, these organisms will be subjected to chlorination of up to 5 ppm, cooling-tower effects, and treatment with sulfuric acid as the cooling-tower condensate is neutralized to a pH of about 7. Consequently, these small organisms are not likely to survive.

However, the numbers of organisms that will be affected are not expected to have significant biological impact on the ecology of Lake Erie because: (1) Only a minute fraction of the total lake water volume will pass through the Fermi-2 station per year, about 4% of that required by a similar plant with once-through cooling; (2) the generation times of the bulk of these small organisms are by nature relatively rapid, ranging from one generation or more per day to one generation every few weeks, and thus the replacement will be rapid; (3) the lake is shallow and turbulent near the Fermi site, and is not a productive benthic or fish spawning area due to disturbances of the waters and basin by wave action; and (4) present data indicate that rooted aquatic plants are excluded from the turbulent shallow region within 1500 feet of the Fermi-2 intake, which is <6 ft deep. Regardless of whether or not a given species of fish utilizes aquatic plants or clear bottom for spawning, there is essentially no evidence of fish spawning activity near the Fermi-2 site. However, the applicant has initiated plankton and fish studies in the area, similar to those done at the nearby Monroe plant. See references 4, 13, 17, 32, and Section II.E.2.b.

A gross estimate of the biological cost can be made if it is assumed that all organisms entrained in the cooling water are killed by a combination of effects, and that damage can be related to the total fish catch of Lake

Erie. The total volume of water from the lake utilized annually by the plant is about 1.7 x 10^{10} gallons of a total of 1.1 x 10^{14} gallons. Thus about 0.015% of the lake volume is used. The total fish catch (mostly carp) is about 1.3 lbs/acre.* This leads to a total cost of about 1200 lbs. of fish per year. However, this is an over simplification. The total impact of the plant on fish eggs, larvae, and other organisms in the lower trophic levels may be considerably greater than could be estimated on the basis of assuming a one-to-one relationship between organisms killed and the total commercial fish catch. A 5-year study is being made for the applicant on the aquatic ecosystem near Fermi-2.[4]

b. Discharge Effects

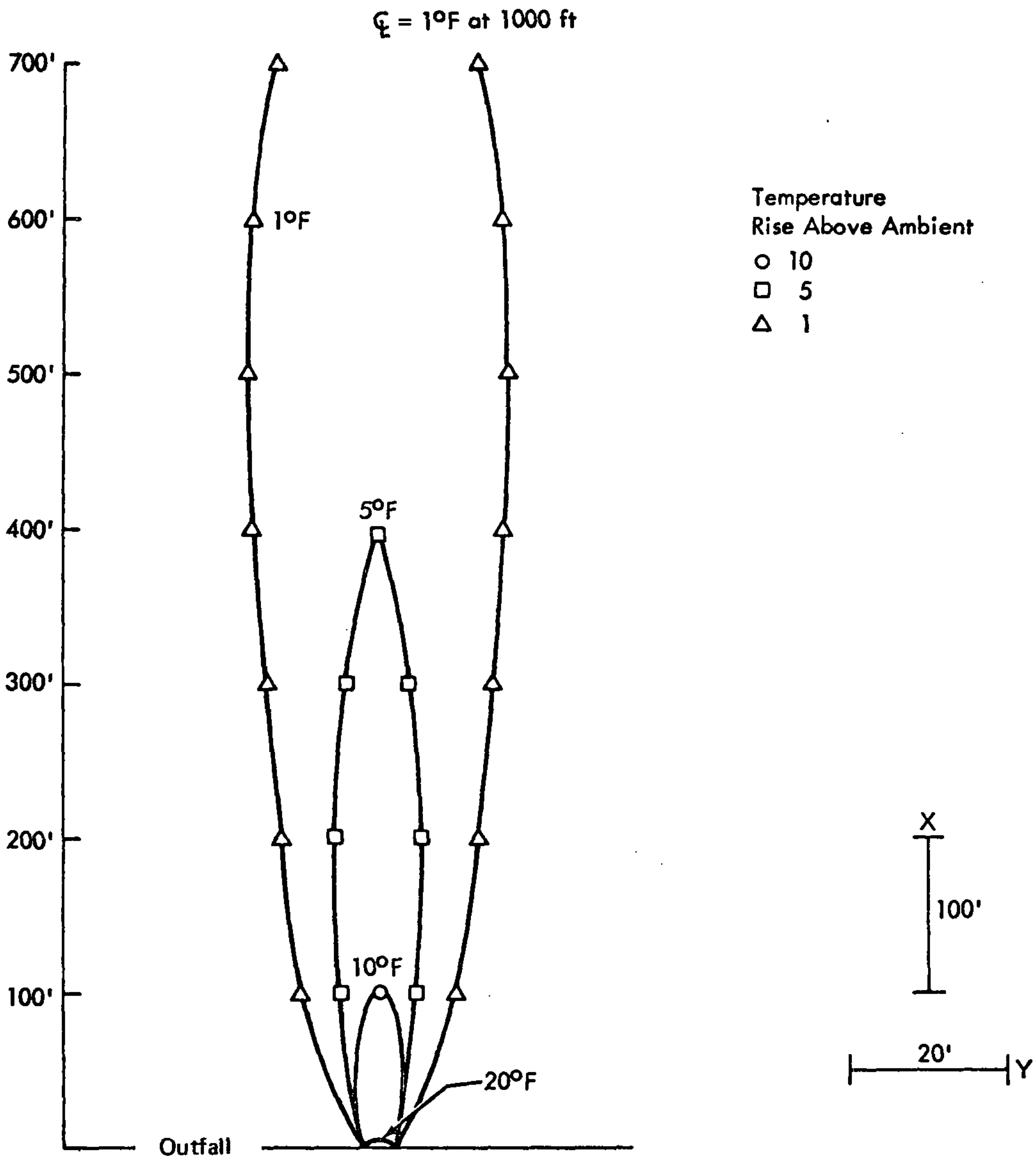
(1) Temperature changes: The volume of heated water returned to Lake Erie will be minimal because of the closed-cycle cooling system, but some discharge will be essential to control the concentration of the dissolved solids. The discharge flow rate will usually range from 6,000 gpm at 23°F above ambient in winter to 12,000 gpm at 12°F above ambient in summer (78,300,000 Btu per hour, maximum). This will be less than 20% of the recommended limit proposed by the Lake Michigan Enforcement Conference in the spring of 1971 for Lake Michigan.

However, the increase in temperature and dissolved solids may have some slight effect on the algae in the thermal plume, which will be confined to about 1,500 feet from the discharge point near the shoreline (Figure V-1).

The characteristics of a thermal plume in Lake Erie resulting from the discharge of water from the pond have been predicted for the following extreme conditions: 12,000 gpm flow; 76°F lake temperature; effluent 24°F above ambient; and near calm atmospheric conditions. The isotherm model for these hypothetical conditions is shown in Fig. V-1. These conditions are extremely conservative since they represent twice the maximum predicted summer heat release.[4] The mathematical model used for this prediction was developed by the applicant and has been tested by plume measurements at other of the applicant's power plants.

In view of the insignificant plume characteristic for this extreme condition, the results for average conditions were not computed. As previously noted the region within about 1500 feet of the shoreline is a highly unstable and harsh environment for most forms of Lake Erie life.[4] These thermal effects will probably increase the rate of photosynthesis of algae, increase to some limited degree the reproduction and growth rates of plankton, and affect the viability of some organisms within the thermal plume.[20,21] However, the combined thermal and chemical effects of the Fermi-2 blowdown

* National Marine Fisheries Service, 1971. Current Fisheries Statistics No. 5563, Michigan, Ohio, and Wisconsin Landings, Annual Summary 1970. Washington. (NOAA XCFSA-5563 GL-2). 7 pp.



℄ Temp, °F	Vel, ft/sec	@	Distance, ft
24	6.7		0
10.1	3.1		100
7.2	2.2		200
5.7	1.8		300
4.9	1.55		400
4.3	1.4		500
1	- -		1000

Given Conditions:

Flow = 12,000 gpm
ΔT Above Ambient = 24°F
Lake Temp. = 76°F
Near Calm Atmospheric Conditions

FIGURE V-1. ENRICO FERMI ATOMIC POWER PLANT, UNIT 2
THERMAL PLUME FROM POND DISCHARGE TO LAKE ERIE

discharge on the Lake Erie biota are not likely to have a significant impact. Although algae blooms may occur in the area, it does not appear that any bloom of significant size will be induced by the heat and/or other wastes (sanitary, dissolved solids) discharged at the Fermi-2 site. The volume of water released, its quantity of heat, and chlorine concentration (0.1 ppm), all already low, will be rapidly dispersed.

The Monroe power plant is located about 8 miles south of Fermi-2; no interaction of the plumes is expected. The thermal discharge from Fermi-1 reaches Lake Erie by way of Swan Creek. The temperature increment of the water from the Fermi-1 overflow is not measurable at the point Swan Creek enters Lake Erie.

Thermal discharges also attract some species of fish, especially during the winter when the temperature in the surrounding natural water is low. A local increase in the concentration of fish native to these waters (Table II-3) may then occur, making them more available to fishermen. Whether this will bring a greater number of fish into the intake canal is speculative. The effluent pipe and intake canal will be separated by at least 1,600 feet over which distance the temperature increase from the thermal plume will be largely dissipated.

As long as the heated discharge flow is continuous, fish are not likely to be killed. However, discontinuous flows that produce sharp changes in temperature can be harmful to fish. Any such sharp temperature change will be ameliorated at the plant, since the return is from the large-volume pond and not directly from the main condenser. A continuous, heated return flow, the size of the one described, and the intake of makeup water by the plant are unlikely to have recognizable effects on the limnological resources in the vicinity. Waterfowl should benefit in the winter because the lake will be free of ice in the area of the discharge plume. During refueling or repair shutdown periods the applicant could gradually release the heated water from the pond to avoid sharp temperature changes and prevent thermal shock to lake biota.

During a plant shutdown the cooling tower valves would, as part of the winter operating procedure, be placed into the bypass position and therefore reduce the cooling effects on the water. Secondly, warm makeup through the general service water system would continue; thus, the blowdown requirements, although reduced, would not be stopped because reservoir water inventory must be maintained.

Therefore, the effect at the discharge point over several days would be a reduction in blowdown flow, followed by a slow decrease in temperature as the reservoir cools. Even with the plant in a shutdown mode, some heat from the auxiliary systems cooled by general service water is continuously introduced into the reservoir at varying rates and heat content.

An estimate of the temperature decrease experienced at the blowdown outlet during a winter shutdown is 9°F after 2 days.

(2) Eutrophication: It can be postulated that the addition of heat from the Fermi-2 effluent will to some degree aggravate the general problem of eutrophication of western Lake Erie.[19] Algal blooms occasionally occur naturally in western Lake Erie. Because of cooling towers and the consequent small volume of effluent and quantity of heat, the acceleration of eutrophication is not expected to be significant. The Biochemical Oxygen Demand (BOD) at the Fermi-1 intake is 1 to 3 mg/liter or higher, depending on wind and currents. The cooling-water effluent from Fermi-2 will not cause problems either of high BOD or low dissolved oxygen.

(3) Dissolved Solids: The dissolved minerals in the pond water returned to Lake Erie will be identical to those already in the lake. Because of evaporation in the cooling-tower cycle, the concentration of these dissolved solids in the discharge will be about three times higher than the concentration in the makeup water drawn from the lake. No significant adverse effects to aquatic biota are anticipated as a result of this increased concentration.

(4) Chlorine: Chlorine used for condenser cleaning will be released into the cooling water no more than twice a day for a maximum duration of 30 minutes. The concentration in the effluent to the lake will be 0.1 ppm or less, which meets the water-quality standards for the State of Michigan. This concentration of chlorine should be lowered if practicable.[14,15] Chlorine was chosen over other biocides for the prevention of biological fouling of the cooling systems because it is effective and less persistent in the environment when compared to the mercurials, arsenicals, and cupreous compounds in use. Also, it is apparently not concentrated by organisms. Sufficient sulfuric acid will be added to the water entering the pond from the cooling towers to control the pH (7.0 to 7.5). Based on a water discharge rate of 12,000 gpm, the sulfuric acid addition is equivalent to about 60 ppm sulfate. Most of this sulfate will precipitate in the residual heat removal (RHR) reservoir; therefore, actual sulfate addition through the discharge will be considerably lower, in the range of 4 ppm. These discharges are not expected to result in significant adverse environmental effects.

(5) Sewage Effluent: The sewage treatment facility for the Fermi-1 and -2 plants will accommodate 250 persons. The sewage will be treated with hypochlorite (sodium hydroxide + 50% free chlorine) from bottles. The final residual chlorine concentration in the sewage effluent released into the north lagoon will range between 0.3 and 0.7 ppm, and average about 0.5 ppm. The coliforms will be controlled at or below the 1000/100 ml standard. This relatively small discharge of sewage effluent is not expected to have an adverse effect on aquatic life in western Lake Erie, because the effluent will be diluted in flowing from the north lagoon into Swan Creek and then into the lake. The Fermi-1 sanitary system is not sufficient for all proposed public use. An additional sanitary waste treatment plant to serve the public will be built in conjunction with the Fermi Science Center. It will have the capacity to handle and properly treat 2,000 gallons per day of waste (Sec. III.D.3.c.) without any expected adverse environmental effect.

(6) Radiation Doses to Species Other Than Man: Organisms living near the Fermi plant will be exposed to radiation from the radionuclides released in the plant effluent. Samples of water, sediments, fish, plankton, and benthos will be taken from a number of sampling stations near the site and analyzed for several parameters, including concentration of specific reactor-related radionuclides. A number of these stations are within 500 feet of the effluent discharge point for the plant. Terrestrial organisms can be expected to receive approximately the same dose as those received by man (see Section V.D.). Aquatic organisms which live in the discharge water receive an immersion dose of about 2 mrad/yr. In addition, they receive an internal radiation dose from ingestion of radionuclides in their food or absorption from the water.

The internal doses were estimated for the radionuclide release rates presented in Section III and the bioaccumulation factors presented in Table V-1. The doses were estimated from the equation

$$D_i = 1.87 \times 10^7 W_i C_i E_i,$$

where

D_i = dose rate due to i^{th} radionuclide (mrad/yr),

1.87×10^7 = a constant to convert microcuries per gram of organism to mrad/yr,

W_i = the amount of radionuclide in water (μCi/ml),

C_i = biological accumulation factor, and

E_i = the effective absorbed energy (MeV).

Estimated total doses for plants, invertebrates, and fish were about 7.0, 0.88, and 0.29 rad/yr, respectively. These estimates assume that the organisms live in the undiluted effluent.

No limits have been established for radiation exposure of species other than man. Very few studies have been conducted on the effects of low-level radiation on natural populations of the lower organisms. The most recent and pertinent studies have been reviewed by Auerbach et al.[40] and by Templeton et al.[41] However, it is generally agreed that the limits established for man are very conservative when applied to plants and lower animals.

3. Cooling-Tower Effects

The two natural draft cooling towers will release moist, heated air with suspended water droplets that appear as a visible white plume. The amount of water released from the towers will vary, depending on reactor power, the lake temperature, and atmospheric conditions. The largest releases will occur in July (17,000 gpm) when the ambient air temperature, lake temperature, and relative humidity are high. Conversely, the smallest releases will occur in January. The drift will consist of droplets of water from the circulating water system, containing 500-ppm dissolved solids, or about three times the dissolved solids concentration of Lake Erie water. The drift will be blown toward Lake Erie more than 50%

TABLE V-1

BIOACCUMULATION FACTORS[39] USED TO ESTIMATE THE RADIONUCLIDE CONCENTRATION IN AQUATIC PLANTS, INVERTEBRATES, AND FISH

Element	Plants	Invertebrates	Fish
Sr	500	700	40
Y	10,000	1,000	100
Zr	10,000	1,000	100
Nb	1,000	100	30,000
Mo	100	100	100
Ru	2,000	2,000	100
Rh	2,000	2,000	100
Te	1,000	150	400
I	100	25	1
Cs	200	1,000	1,000
Ba	500	200	10
La	10,000	1,000	100
Ce	10,000	1,000	100
Pr	10,000	1,000	100
Nd	10,000	1,000	100
Cr	4,000	2,000	200
Mn	10,000	40,000	25
Fe	5,000	3,200	300
Co	1,000	1,500	500
Zn	4,000	40,000	1,000
W	30	30	1
Na	160	27	32
P	100,000	100,000	100,000

of the time. The nearest offsite structures are dwellings one-half mile north of the cooling towers along Swan Creek. The wind blows toward the north less than 5% of the time.

Cooling-tower-plume releases may affect the local environment in two ways: (1) through presence of water from the towers themselves in the form of plumes, fog, icing or precipitation; and (2) through influence on natural condensation and precipitation processes. The local increases of sensible heat and water vapor (i.e., gaseous water in the atmosphere) are insignificant additio to the environment, except as they may influence natural convection and precipitation. The quantitative assessment of the two kinds of effects at this time can be made only from observations of releases from similar cooling towers in similar climates and from incomplete theoretical calculations.

The effects of the two plumes on the biota of the environment, its ecology, and on man himself are not expected to be damaging. The drift will cause no damage to vegetation and no significant corrosion to wood structures or painted steel surfaces. Information at hand--meteorological physics, plume rise and diffusion theory, and cooling-tower-plume observations--suggests that the only significant environmental effect will be a minor increase in the incidence of fog and, at times, a local increase in cloudiness downwind from the cooling towers.[4]

D. RADIOLOGICAL IMPACT ON MAN

1. Introduction

During routine operation of the Fermi-2 plant at full power, small quantities of radioactive materials will be released to the environment. The AEC licensing and inspection procedures will ensure that the radiation dose received by persons living near the plant will be "as low as practicable" in accordance with 10 CFR Part 50.36a,[42] and will be well within 10 CFR Part 20[43] limits.

The staff has made calculations of the radiation dose using the estimated release rates of radionuclides presented in Section III and using stated assumptions relative to dilution, biological accumulation in food chains,[44] and "use factors" by people. Means by which man can be exposed to radioactivity released to the environment (i.e., exposure pathways) are shown schematically in Figure V-2. The exposure pathways shown are those found from experience to be most important and include the following:

a. direct exposure to the off-gas plume,
b. consumption of milk from areas around the plant,
c. drinking Lake Erie water,
d. eating fish caught in Lake Erie, and
e. bathing, swimming, boating and recreation in or along the shore of Lake Erie.

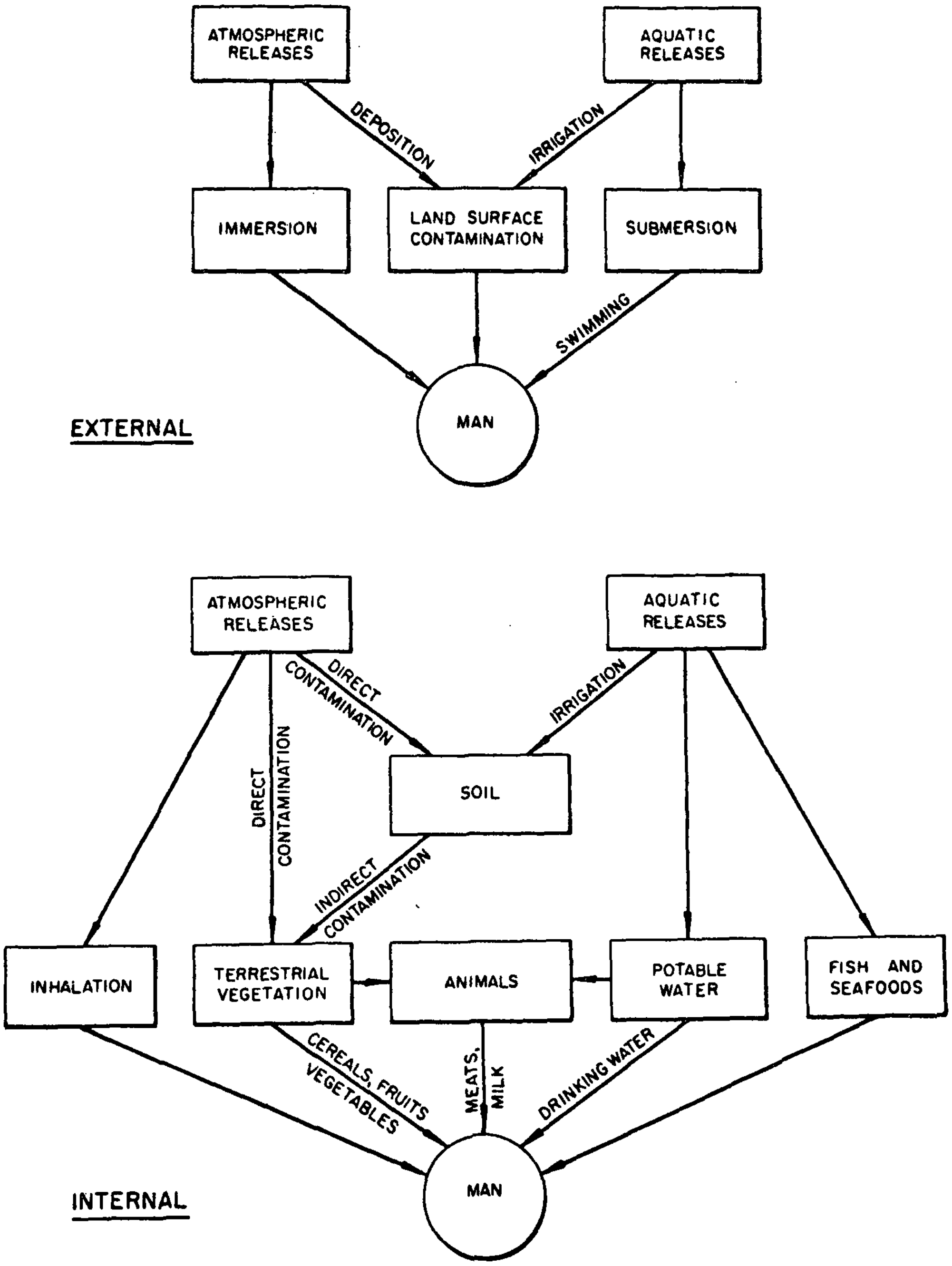


FIGURE V-2. PATHWAYS FOR EXTERNAL AND INTERNAL EXPOSURE OF MAN FROM ATMOSPHERIC AND AQUATIC RELEASES OF RADIOACTIVE EFFLUENTS.

These pathways will be considered in terms of estimated yearly average releases from the plant. Two cases will be considered: (1) Dose to individuals living, working, and utilizing recreational facilities in the vicinity of the plant, and (2) Dose to a suitably large population.

The second case considers the total dose to a large population expressed in man-rem. This gives a reasonable basis for comparison of the possible effects of radiation on a population. It carries the assumption that such effects are dependent on total dose to the population without regard to details of its allocation. The man-rem evaluation will be based on an extrapolated population for the year 1980 of about 6,500,000 people (Table II-2).

The models for determining internal and external doses were obtained from the work published by the International Commission on Radiological Protection.[45] All of the doses were calculated for adult individuals under equilibrium conditions, except those for the thyroid from milk consumption where the dose to a child's thyroid was determined. A summary of the estimated doses from various pathways is presented in Table V-2.

2. <u>Radioactive Materials Released to the Atmosphere</u>

Expected release rates of radioactive materials to the atmosphere were discussed in Section III.D. From these release rates and the dispersion calculated by an atmospheric transport model[46] utilizing the applicant's site meteorological data, annual average radionuclide concentrations in the air were estimated for distances up to 50 miles from the site. Based on the above, the highest dispersion rate (χ/Q) at locations which would be continuously occupied was 1.2×10^{-6} sec/m^3.

The primary exposure pathways for radioactive materials released to the atmosphere are: (1) air immersion at the site boundary, (2) inhalation of radioiodines at the site boundary, and (3) consumption of milk produced near the plant.

The estimated dose from the air immersion pathway is that dose which an individual who resides continuously at the site boundary would receive, with no allowance for occupancy or shielding considerations from living part-time indoors. The total body dose was estimated to be 2.6 mrem/yr from this pathway.

Doses from the air inhalation pathway were based upon continuous occupancy at the site boundary and a breathing rate of 20 m^3/day.[45] The total body and thyroid doses from this pathway were 0.002 and 0.2 mrem/yr, respectively.

The estimate of the dose from the milk pathway was based on the assumption that an infant (with a 2-gram thyroid) consumes 1 liter of milk per day from cows grazing at the location of the highest iodine concentration outside the exclusion area for 5 months per year. The thyroid dose received by an individual from this pathway was 28 mrem/yr. The thyroid dose due to milk from any other location in the vicinity of the plant will be lower.

TABLE V-2

SUMMARY OF THE ESTIMATED ANNUAL RADIATION DOSE TO INDIVIDUALS AT POINTS OF MAXIMUM EXPOSURE TO EFFLUENTS FROM THE FERMI ATOMIC POWER PLANT

PATHWAY	LOCATION	DOSE (millirem/yr) TOTAL BODY	THYROID
Gaseous Effluents			
1. Air Immersion	Site Boundary	2.6 (4.4)*	2.6
2. Inhalation of Radioiodine	Site Boundary	0.002	0.19
3. Milk Consumption	Site Boundary	--	28
Liquid Effluents			
1. Fish Consumption	Lake Erie (adjacent to the site)	9.2	0.8
2. Swimming and Other Water Contact Activities	Lake Erie (adjacent to the site)	0.024	0.024
3. Shoreline Use	Lake Erie (adjacent to the site)	0.024	0.024
4. Water Consumption	Monroe Intake (2.0 miles from site)	0.0045	0.15

* The number in parenthesis is the dose received by the skin only.

3. Radioactive Materials Released to the Receiving Water

Expected release rates of radioactive materials to the receiving water were discussed in Section III.D. These releases are made by way of the service water discharge system, which has a flow rate of 6,000 to 12,000 gpm. The dispersion of Fermi's liquid effluent in Lake Erie was calculated using the diffusion model of Okubo.[28] From these considerations, radionuclide concentrations were calculated for municipal drinking water intakes and for recreational use of Lake Erie adjacent to the site.

The primary exposure pathways for radioactive materials released to the receiving waters of Lake Erie are: (1) consumption of fish caught near the site, (2) swimming and other water contact activities near the site, (3) recreational use of the shoreline near the site, and (4) consumption of drinking water derived from Lake Erie.

Doses received from the fish consumption pathway were based on the consumption of 20 g/day[47] of fish reared in the immediate vicinity of the discharge point. The bioaccumulation factors presented in Table V-1 were used in the dose estimate and, a delay of 24 hours was allowed between fish harvest and consumption. The total body and thyroid doses received from this pathway were estimated to be 9.2 and 0.8 mrem/yr, respectively. Doses for the GI tract and bone were also estimated, but were not significant.

Doses received from the swimming pathway were based on an individual swimming in the vicinity of the discharge point for 100 hours per year. The "vicinity" as used in this estimate was the region near the discharge where no significant dilution occurs. The total body and thyroid doses estimated for this pathway were each 0.024 mrem/yr. The dose to the individual from shoreline activities in the discharge vicinity is estimated to be 0.024 mrem for each 100 hrs spent at these activities.

The whole body dose to an individual from drinking water is estimated to be 1.4 mrem/yr on the assumption that he drinks 1.2 liters per day directly from the plant outfall before dilution in Lake Erie. Under the same conditions, the dose to an individual's thyroid would be about 46 mrem per year and the dose to his GI tract would be about 2.3 mrem per year.

Whole body dose to the population via the drinking water pathway was calculated using the information about public water supplies on Lake Erie contained in Table V-3. The diffusion model of Okubo[28] normalized for an annual average dilution factor of 310 at the Monroe intake was used.

4. Population Dose from All Sources

The combined dose to all individuals who eat fish harvested in the vicinity of the Fermi Station was evaluated from commercial catch information (59,000,000 pounds of fish from Lake Erie in 1969). One-third of this catch

TABLE V-3

DOSE TO POPULATION FROM PUBLIC WATER SUPPLIES

INTAKE	DISTANCE (miles)	POPULATION	WHOLE BODY INDIVIDUAL DOSE (mrem/yr)	MAN-REM
E. Fermi-2 Plant	0.5	200	0.018	0.0036
Monroe, Michigan	2	25,000	0.0045	0.11
Toledo, Ohio	15	500,000	0.0006	0.030
Port Clinton, Ohio	35	15,000	0.00026	0.0039
Sandusky, Ohio	45	36,000	0.00020	0.0072
Totals		776,200		0.42

was assumed to be edible, and an average dilution of 1000:1 between the plant discharge and Lake Erie was used to estimate the dose. The total body population dose from this source was estimated to be 11 man-rem per year of reactor operation.

The combined dose to individuals obtaining their drinking water supply from municipal sources located on Lake Michigan within 50 miles of the site was 0.42 man-rem per year of reactor operation.

The population doses which result from use of the lake shoreline for recreational purposes and swimming near the Fermi site were estimated by assuming that 1% of the population within 50 miles of the site was engaged in each of these activities for 1% of the year (about 1 hour per day for 3 months). Assuming a dilution factor of 80, the population doses from these sources were 1.6 man-rem/yr for each pathway.

The combined dose to all individuals living within a 50-mile radius of the site from exposure to gaseous effluents is estimated to be 56 man-rem/yr for the projected 1980 population. Population doses for the various radial distances from the site are presented in Table V-4.

The annual dose to the population (approximately 270,000 people, including transportation workers) from the transportation of radioactive materials was estimated to be 0.84 man-rem. This estimate was based on the direct gamma radiation exposure the population would receive from normal shipment of reactor fuel and solid radioactive wastes.

The above doses are summarized in Table V-5.

5. Evaluation of Radiological Impact

Based on conservative estimates, the total population dose from all exposure pathways to the estimated 6.6 million people who will live near the Fermi plant when it begins operation, would be about 72 man-rem per year of reactor operation at full power. By comparison, an annual total of about 890,000 man-rem to the same population results from the natural background dose rate of 135 mrem/yr.

Operation of the Fermi plant will contribute only an extremely small increment to the radiation dose that area residents receive from natural background. Since fluctuations of the natural background dose may be expected to exceed the small dose increment contributed by the plant, the incremental increase will be unmeasurable in itself and will constitute no meaningful risk.

TABLE V-4

CUMULATIVE POPULATION, ANNUAL MAN-REM DOSE, AND AVERAGE DOSE FROM GASEOUS EFFLUENTS IN SELECTED CIRCULAR AREAS AROUND ENRICO FERMI ATOMIC POWER PLANT, UNIT 2

RADIUS (miles)	CUMULATIVE POPULATION (Projected) 1980 Population)	CUMULATIVE DOSE (man-rem)	AVERAGE DOSE (mrem)
1	590	0.84	1.4
2	4,830	2.6	0.54
3	10,200	3.6	0.35
4	18,100	4.5	0.25
5	30,000	5.3	0.18
10	162,000	10.5	0.065
20	729,000	19	0.027
30	2,863,000	37	0.013
40	5,413,000	52	0.0096
50	6,575,000	56	0.0086

TABLE V-5

SUMMARY OF THE ESTIMATED ANNUAL RADIATION DOSES TO THE POPULATION DUE TO OPERATION OF THE FERMI ATOMIC POWER PLANT

Pathway	People Exposed	Population Dose (man-rem/yr)
Fish Consumption	1,200,000	11
Drinking Water	776,000	0.42
Swimming	66,000	1.6
Shoreline Recreation	66,000	1.6
Air Immersion	6,600,000	56
Transportation of Radioactive Materials	270,000	0.84
	Total	72

6. Environmental Monitoring Program

In conformity with AEC Safety Guide 21, the undiluted plant effluents will 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 program will be audited yearly by the National Sanitation Foundation at the University of Michigan.

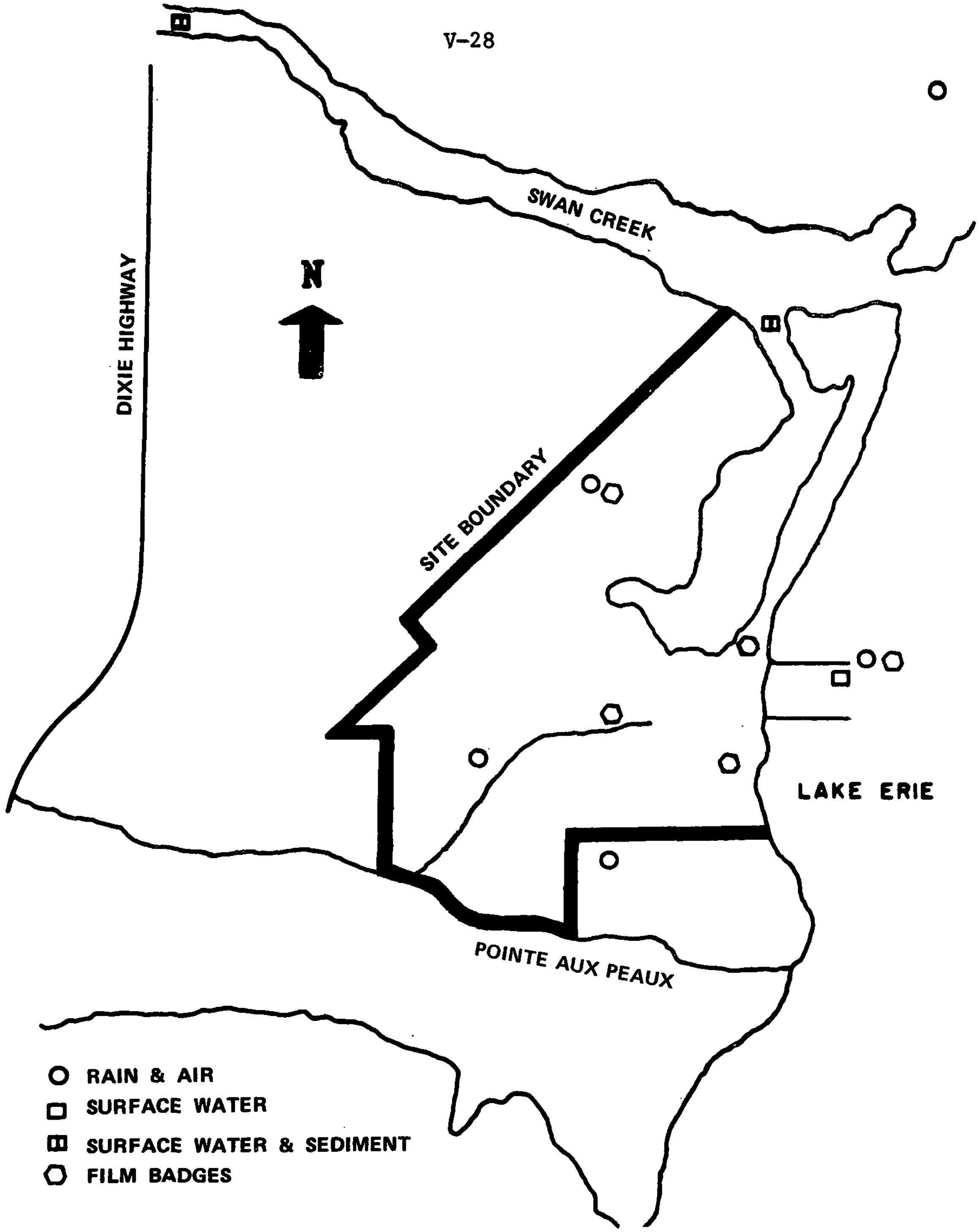
The program will be a slightly modified version of the program that has been carried out for Fermi 1 since 1958 by the National Sanitation Foundation. Measurements are made of airborne particulates, airborne iodine, ambient gamma radiation, surface water, raw water (before treatment for drinking water), sediments, fish, and milk. The samples are taken from two groups of stations. One group is on or near the site and the other is at distances up to 40 miles from the site. The locations of the stations and the types of sample obtained at each station are indicated in Figures V-3 and V-4.

Fish samples are obtained from the Lagoona Beach embayment and from a provincial fish station near Point Pelee, Ontario. Milk samples are obtained from two dairy farms within four miles of the site in the WNW and SSW directions. These were selected because of their proximity to the site and because they are small herds fed on local fodder. Milk samples are also obtained from a dairy at Yspilanti and at Ann Arbor.

The samples are analyzed variously for gross α, gross β, and for specific gamma emitting nuclides as indicated in Table V-6. To date, no radioactivity attributable to Fermi 1 has been detected except possibly in sediment samples taken from the Fermi discharge canal. The overall trend indicated by the environmental sampling has been a reduction in radiation levels detected following the cessation of large scale nuclear testing in the atmosphere.

The applicant is also sponsoring a 5 year radiological study by Michigan State University to evaluate the aquatic environment in the vicinity of the Fermi site. This study, which began in 1971, will include an investigation of aquatic biota in the human food chains as well as a study of the bottom sediments and of the ratio of radioactive to stable nuclides in Lake Erie water. As part of the study, water, sediments, fish, plankton and benthos are to be taken from a number of locations and analyzed for several parameters including concentration of reactor-related radionuclides. Several of these sampling locations will be within 500 feet of the Fermi 2 discharge.

The monitoring and surveillance system alarm and trip settings for radioactivity will be established on the basis of the pre-operational monitoring program, including the meteorological observations. These will be specified in the applicant's Final Safety Analysis Report and in the Technical



ENRICO FERMI
ATOMIC POWER PLANT - UNIT 2

FIGURE V-3 ENVIRONMENTAL SAMPLING AND MONITORING STATIONS ON AND NEAR THE FERMI SITE

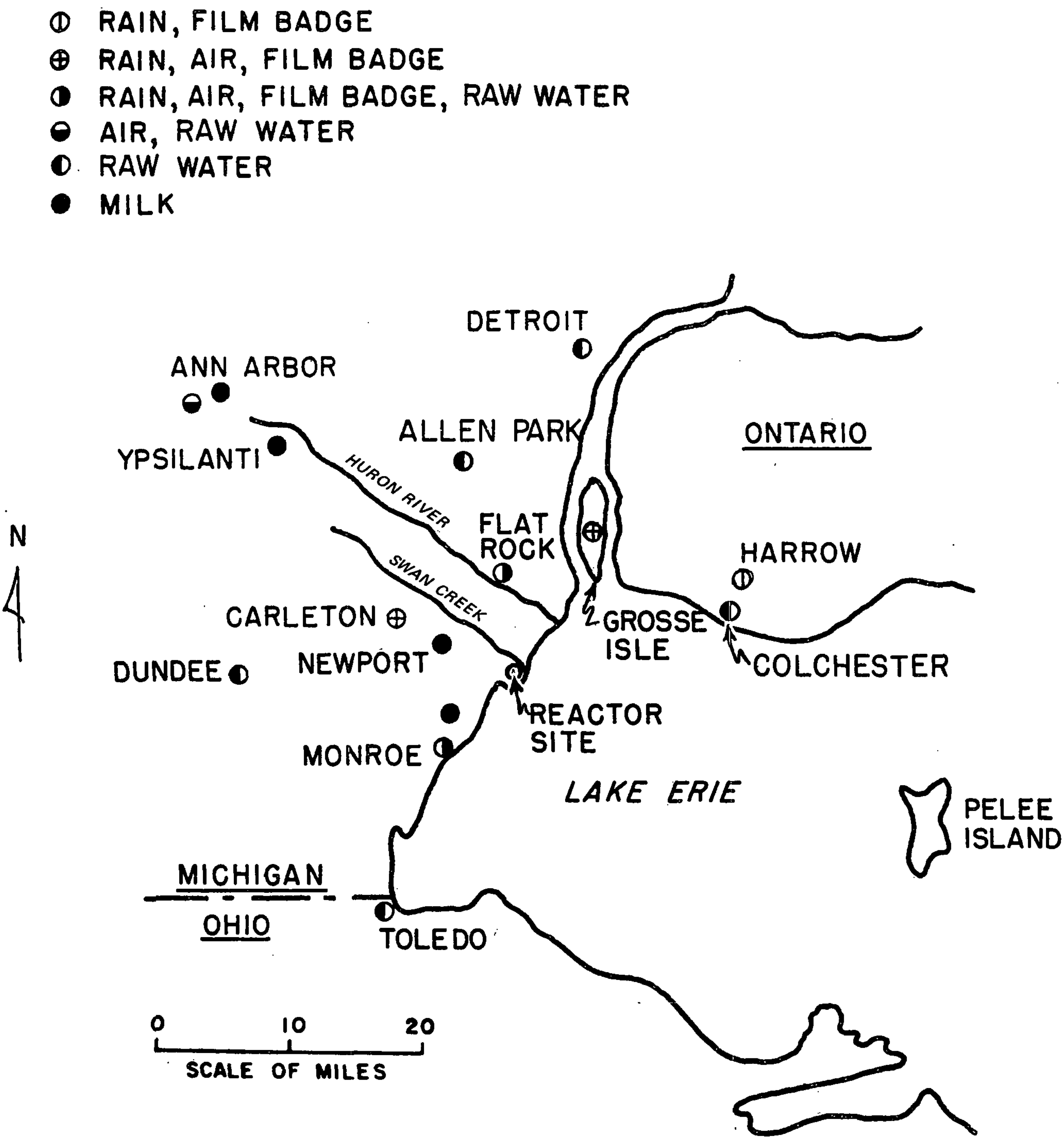


FIGURE V-4 OFFSITE ENVIRONMENTAL SAMPLING AND MONITORING STATIONS

TABLE V-6

TYPES AND FREQUENCY OF SAMPLING AND ANALYSIS

Sample	Method	Number of Stations	Frequency	Type of Analysis
Airborne particulates	Continuous filter	10	Weekly	α, β, γ[a,b]
Airborne iodine	Activated carbon cartridge	10	Weekly	I^{131} gamma
Rain	Continuous	10	4 Weeks	α, β, γ[b]
Ambient gamma	Film badge	10	4 Weeks	γ
Surface water	Grab	3	Weekly	β, γ[a]
Raw water	Daily composite	8	Weekly	β
Sediment	Grab	2	Quarterly	γ
Fish	Net	2	Quarterly	β, γ[b]
Milk	Grab	4	4 Weeks	I^{131} gamma

[a] If samples show high β activity.

[b] Gamma analysis for: ^{144}Ce, ^{144}Pr
^{103}Ru, ^{106}Ru
^{137}Cs
^{95}Zr, ^{95}Nb
^{54}Mn
^{40}K
^{131}I
^{226}Ra

Specifications for the plant and will be selected to ensure that the requirements of 10 CFR 20 and Appendix I to 10 CFR 50 in regard to radioactivity releases will be met.

E. ENVIRONMENTAL IMPACT OF ACCIDENTS

Protection against the occurrence of postulated design basis accidents in the plant is provided through the defense in depth concept of design, manufacture, operation and testing, and the continued quality assurance program used to establish the necessary high degree of assurance for the integrity of the reactor primary system. These aspects were considered in the Commission's Safety Evaluations for the Fermi-2 facility, dated May 17, 1971 and August 19, 1971. Off-design conditions that may occur are limited by protection systems which place and hold the power plant in a safe condition. Notwithstanding this, the conservative postulate is made that serious accidents might occur, even though 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 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 evaluating the adequacy of engineered safety features and for comparing calculated 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 presented in the Safety 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 the Fermi-2 revised Environmental Report, Construction Permit Stage, dated December 14, 1971.

The applicant's report has been evaluated, using the standard accident assumptions and guidance issued by the Commission as a proposed amendment to Appendix D of 10 CFR Part 50 on December 1, 1971 (Federal Register, Vol. 36, No. 231). Nine classes of postulated accidents and occurrences ranging in severity from trivial to very serious have been identified by the Commission. In general, accidents in the high potential consequence end of the spectrum have a very low occurrence rate, and those on the low potential consequence end are characterized by a higher occurrence rate. The examples selected by the applicant for these classes of accidents are shown in Table V-7. The examples given are reasonably homogeneous in terms of probability within each class.

Certain assumptions made by the applicant, such as the assumption of an iodine partition factor in the suppression pool during a loss of coolant accident and the efficiency assigned to the charcoal filters in the standby gas treatment system, in our view, are optimistic but the use of alternative assumptions does not significantly affect the overall environmental risk.

TABLE V-7

CLASSIFICATION OF POSTULATED ACCIDENTS AND OCCURRENCES

Class	AEC Description	Applicant's Examples
1	Trivial incidents	None
2	Miscellaneous small leaks released outside containment	Reactor coolant leaks (below or just above allowable tech spec limits) outside primary containment or the reactor building
3	Radwaste system failures	Any single equipment failure or any single operator error
4	Events that release radioactivity into the primary system	Fuel failures during transients outside the normal range of plant variables, but within expected range of protective equipment and other parameter operation
5	Events that release radioactivity into primary and secondary systems	Primary coolant loop to auxiliary cooling system - secondary side heat exchanger leak
6	Refueling accidents inside containment	Dropping of fuel assembly on reactor core, spent fuel rack, or against pool boundary Dropping of spent fuel shipping cask in pool or outside pool
7	Accidents to spent fuel outside containment	Transportation incident involving spent and new fuel Shipment onsite but outside primary containment or reactor building
8	Accident initiation events considered in design - basis evaluation in the SAR	Reactivity transient Loss of reactor coolant inside or outside primary containment
9	Hypothetical sequences of failures more severe than Class 8	None

Commission estimates of the dose which might be received by an assumed individual standing at the site boundary in the leeward direction, using the assumptions in the proposed Annex to Appendix D, are presented in Table V-8. Our estimates of the integrated exposure in man-rem that might be delivered to the population within 50 miles of the site are also presented in Table V-8. These man-rem estimates were based on the projected population around the site for the year 2000.

To rigorously establish a realistic annual risk, the calculated doses in Table V-8 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 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 V-8 are weighted by probabilities, the environmental risk is very low. The probabilities of occurrence in Class 9 involve failures more severe than those required to be considered for the design basis of protection systems and engineered safety features (i.e., Class 8 accidents). 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.

The information given in Table V-8 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 10 CFR Part 20. The tabulated information 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 than that from the naturally occurring radioactivity, which corresponds to approximately 1,270,000 man-rem/yr based on a natural background level of 135 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 analysis that the environmental risks due to postulated radiological accidents at the Fermi-2 facility are exceedingly small and need not be considered further.

TABLE V-8

SUMMARY OF RADIOLOGICAL CONSEQUENCES OF POSTULATED ACCIDENTS DETERMINED BY THE A.E.C.

Class	Event	Estimated Fraction of 10 CFR Part 20 Limit at Site Boundary 1/	Estimated Dose to Population in 50 mile Radius, man-rem
1.0	Trivial incidents	2/	2/
2.0	Small releases outside containment	2/	2/
3.0	Radwaste system failures		
3.1	Equipment leakage or malfunction	0.06	40.
3.2	Release of waste gas storage tank contents	0.24	158.
3.3	Release of liquid waste storage tank contents	<.001	0.14
4.0	Fission products to primary system (BWR)		
4.1	Fuel cladding defects	2/	2/
4.2	Off-design transients that induce fuel failures above those expected	0.003	4.1
5.0	Fission products to primary and secondary systems (PWR)	N.A.*	N.A.
6.0	Refueling accidents		
6.1	Fuel bundle drop	0.001	0.84
6.2	Heavy object drop onto fuel in core	0.01	6.9

* N.A. = Not Applicable

TABLE V-8 (Cont.)

Class	Event	Estimated Fraction of 10 CFR Part 20 Limit at Site Boundary 1/	Estimated Dose to Population in 50 mile Radius, man-rem
7.0	Spent fuel handling accident		
7.1	Fuel assembly drop in fuel storage pool	0.002	1.5
7.2	Heavy object drop onto fuel rack	0.004	2.8
7.3	Fuel cask drop	0.09	59.
8.0	Accident initiation events considered in design basis evaluation in the safety analysis report		
8.1	Loss-of-coolant accidents		
	Small break	<.001	<0.1
	Large break	0.025	130.
8.1(a)	Break in instrument line from primary system that penetrates the containment	<.001	<0.1
8.2(a)	Rod ejection accident (PWR)	N.A.	N.A.
8.2(b)	Rod drop accident (BWR)	0.003	4.8
8.3(a)	Steamline breaks (PWR's outside containment)	N.A.	N.A.
8.3(b)	Steamline breaks (BWR)		
	Small Break	0.002	1.4
	Large Break	0.011	7.0

1/ Represents the calculated whole body dose as a fraction of 500 mrem (or the equivalent dose to an organ).

2/ These releases will be comparable to the design objective indicated in the proposed Appendix I to 10 CFR Part 50 for routine effluents (i.e., 5 mrem/yr to an individual from liquid or gaseous effluents).

F. TRANSPORTATION

1. Transportation of Nuclear Fuel and Solid Radioactive Waste

The nuclear fuel for the Enrico Fermi Atomic Power Plant Unit 2 is slightly enriched uranium in the form of sintered uranium oxide pellets encapsulated in zircaloy fuel rods. Each fuel element is made up of a number of fuel rods and is about 16 feet long. Each year in normal operation about 190 fuel elements are replaced.

The applicant has indicated that cold fuel and solid waste will be transported by truck and the irradiated fuel by rail. The applicant has not indicated where the fuel or solid wastes will be shipped. We have assumed a distance of 900 miles for shipping the cold fuel and the irradiated fuel and 500 miles for shipping the solid radioactive wastes.

a. Transport of Cold Fuel

The applicant has indicated that cold fuel will be shipped in AEC-Department of Transportation (DOT) approved containers which hold two fuel elements per container. About 6 truckloads of 16 containers each will be required each year after the first loading which will require about 24 truckloads.

b. Transport of Irradiated Fuel

Fuel elements removed from the reactor will be unchanged in appearance and will contain some of the original U-235 (which is recoverable). As a result of the irradiation and fissioning of the uranium, the fuel element will contain large amounts of fission products and some plutonium. The radioactive decay produces radiation and "decay heat." The amount of radioactivity remaining in the fuel varies according to the length of time after discharge from the reactor. After discharge from a reactor, the fuel elements are placed under water in a storage pool for cooling prior to being loaded into a cask for transport.

Although the specific cask design has not been identified, the applicant states that the irradiated fuel elements will be shipped after at least 100 days cooling period in approved casks designed for transport by rail. The cask will weigh perhaps 100 tons. To transport the irradiated fuel, the applicant estimates 8 rail carload shipments per year with 25 fuel elements per cask and 1 cask per carload. An equal number of shipments will be required to return the empty casks.

c. Transport of Solid Radioactive Wastes

The applicant estimates that the solid radioactive wastes generated by the reactor will amount to about 4000 ft^3/yr. The applicant indicates most of the waste will be compacted in 55-gallon drums, about 540 per year. The applicant estimates 12 truckloads of drums of wastes each year.

d. Principles of Safety in Transport

Protection of the public and transport workers from radiation during the shipment of nuclear fuel and waste is achieved by a combination of limitations on the contents (according to the quantities and types of radioactivity), the package design, and on the external radiation levels. Shipments move in routine commerce and on conventional transportation equipment. Shipments are therefore subject to normal accident environments, just like other nonradioactive cargo. The shipper has essentially no control over the likelihood of an accident involving his shipment. Safety in transportation does not depend on special routing.

Packaging and transport of radioactive materials are regulated at the Federal level by both the Atomic Energy Commission (AEC) and the Department of Transportation (DOT). In addition, certain aspects, such as limitations on gross weight of trucks, are regulated by the States.

The probability of accidental releases of low-level contaminated material is sufficiently small that, considering the form of the waste, the likelihood of significant exposure is extremely small. Packaging for these materials is designed to remain leakproof under normal transport conditions of temperature, pressure, vibration, rough handling, exposure to rain, etc. The packaging may release its contents in an accident.

For larger quantities of radioactive materials, the packaging design (Type B packaging) must be capable of withstanding, without loss of contents or shielding, the damage which might result from a severe accident. Test conditions for packaging are specified in the regulations and include tests for high-speed impact, puncture, fire, and immersion in water.[33]

In addition, the packaging must provide adequate radiation shielding to limit the exposure of transport workers and the general public. For irradiated fuel, the package must have heat-dissipation characteristics to protect against overheating from radioactive decay heat. For fresh and irradiated fuel, the design must also provide nuclear criticality safety under both normal and accident damage conditions.

Each package in transport is identified with a distinctive radiation label on two sides, and by warning signs on the transport vehicle.

Based on the truck accident statistics for 1969,[34] a shipment of fuel or waste from a reactor may be expected to be involved in an accident about once every six years. In case of an accident, procedures which carriers are required[35] to follow will reduce the consequences of an accident in many cases. 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.

2. Radiological Impact - Transportation

Exposures During Normal (No Accident) Conditions

a. Cold 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 6 shipments, with two drivers for each vehicle, the total dose would be about 0.01 man-rem* per year. The 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

Irradiated fuel will be transported by rail. Based on actual radiation levels associated with shipments of irradiated fuel elements, we estimate the radiation level at 3 feet from the rail car will be about 25 mrem/hr.

Train brakemen might spend a few minutes in the vicinity of the car at an average distance of 3 feet, for an average exposure of about 0.5 millirem per shipment. With 10 different brakemen involved along the route, the cumulative dose for 8 shipments during the year is estimated to be about 0.04 man-rem.

A member of the general public who spends 3 minutes at an average distance of 3 feet from the rail car might receive a dose of as much as 1.3 mrem. If 10 persons were so exposed per shipment, the total annual dose for the 8 shipments by rail would be about 0.1 man-rem. Approximately 270,000 persons who reside along the 900-mile route over which the irradiated fuel is transported might receive a cumulative annual dose of about 0.06 man-rem. The regulatory radiation

*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., 100,000 persons along the shipping route).

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 amount of heat released to the air from each cask will be about 250,000 Btu/hr. For comparison, 35,000 Btu/hr is about equal to the heat released from an air conditioner in an average size home. Although the temperature of the air which contacts the loaded cask may be increased a few degrees, no appreciable thermal effects on the environment will result because the amount of heat is small and is being released over the entire transportation route.

c. Solid Radioactive Wastes

About 12 truckloads of solid radioactive wastes will be shipped to a disposal site. Under normal conditions, the individual truck driver might receive as much as 15 mrem per shipment. If the same driver were to drive the 12 truckloads in a year, he could receive an estimated dose of about 180 mrem during the year. The cumulative dose to all drivers for the year, assuming 2 drivers per vehicle, would be about 0.4 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 for the 12 shipments by truck would be about 0.2 man-rem. Approximately 150,000 persons who reside along the 500 mile route over which the solid radioactive waste is transported might receive a cumulative annual dose of about 0.05 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.

3. Transportation Accidents

Exposures Resulting from Postulated Accidents

a. Cold 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 a radius of 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.

b. Irradiated Fuel

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

(1) 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 which include tests and examination of the closed container prior to each shipment. Such an accident is highly unlikely during the 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.

(2) 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 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 which would be involved, including a major fire. 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[36] of the Environmental Protection Agency.

c. Solid Radioactive Wastes

It is highly unlikely that a shipment of solid radioactive waste will be involved in a severe accident during the 40-year life of the plant. If a shipment of low-level waste (in drums) becomes involved in a severe accident, some release of waste might occur 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 clean-up 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. More severe accidents 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 these 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 station, have been examined by the staff for the general case. 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.

VI. ADVERSE EFFECTS WHICH CANNOT BE AVOIDED

The applicant has demonstrated considerable concern about environmental effects associated with the construction and operation of the plant and has sought to reduce adverse effects to a minimum. Professional consultants on land use have been retained to develop a plan to minimize the disruption to the site caused by construction activities and to provide public recreational facilities on that part of the site not required directly for the plant and related activities. The applicant's engineering staff has made design changes intended to reduce environmental effects, such as changes in the heat dissipation and radwaste systems. Thus the remaining adverse environmental effects are generally ones for which a significant further reduction was considered impractical or ones that are conjectural and depend on opinions and attitudes.

A. LAND USE

Acquisition of the site and dedication of a portion of it to industrial activity obviously are disruptive influences on the prior land use. However, it is not apparent that there will be a shortage of land in the region for uses displaced by the construction of this plant, except possibly for marshland available to waterfowl. Abundant farmland exists in Monroe County, and recreational use of the acquired land will, under the planned site development, be well suited to the requirements of a majority of the public. Only hunters are likely to be affected adversely on a long-term basis, and this only locally.

The industrial plant buildings and grounds will occupy about 100 acres of the 1088 acre site. These 100 acres will thus no longer be in their natural marshland state. Also, a quarry lake will be made from abandoned stone quarries on site, and some of the surrounding lowlands have been built up and contoured with rocks, soils of various kinds, and muck removed from dredged areas. Disturbance of the natural state of a portion of the site will be major during the construction and site development activities, but eventually a useful although less natural condition will exist. The displacement of wildlife should likewise be only temporary, since the redevelopment will result in an improved habitat.

B. WATER

Construction, dredging and water-fill operations will result in localized changes in the contour of onsite and adjacent lake basins, and in some silting and erosion. Eventually equilibrium will be restored, but under somewhat modified conditions.

Localized water loss will occur on a continuing basis, through evaporation and drift in the cooling towers and through increased rates of evaporation brought about by higher than ambient temperatures in the residual heat removal pond and in the thermal plume from the outfall. This redistribution of water is not considered significant in view of the large volume of Lake Erie.

There will be a variety of chemical additions and increases in concentrations of dissolved solids in the waters immediately adjacent to the plant. The closed-circuit cooling blowdown will cause a threefold increase in the concentration of dissolved solids. Further, chlorine and sulfuric acid will be added to the water used in the cooling circuit; and hypochlorite will be added in the sanitary waste treatment facility. Some of the dissolved solids released by evaporation of the drift from the cooling towers will fall on the adjacent waters (and land). Some of the radioactive materials extracted by the radwaste system will be diluted with plant water and released into the lake. Thus there will be a continuing addition of chemicals to the nearby waters. While these chemicals will be diluted by wind-induced currents in the lake, they nonetheless constitute a sustained net increase in the dissolved solids in the nearby water.

C. AIR

The principal materials released to the air by plant operation will be water vapor and droplets from the cooling towers, and small amounts of gaseous radionuclides from the radwaste system. Some chlorine will also be released from the water circulating through the cooling towers, but in relatively small amounts.[22]

The higher release point for moist air from the natural-draft cooling towers, and the lower surface-to-volume ratio of the plume, compared with mechanical-draft cooling towers, will cause the moist air to rise to appreciable heights. This will greatly reduce the likelihood of localized fogging and icing; such conditions are likely only under unusual meteorological conditions. The formation, extent, height, and direction of a visible plume depend upon meteorological conditions existing at the time. Resulting cloudiness and shadowing of the earth's surface are expected to occur most infrequently and over a very small area. Eventually, the moisture released from the tower will return to the earth's surface as precipitation, but this will be widely distributed.

D. BIOLOGICAL EFFECTS

Revegetation of filled areas, and efforts towards preservation of other parts of the site in the natural state, so that they are not industrialized or urbanized, may eventually more than compensate for 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 health and numbers of herbivores (deer, etc.). Some specific areas have been set aside and planted with vegetation selected as food for endemic wildlife.

The temporary dredging operations at the Fermi-1 inlet required for Fermi-2, and those required for delivery of the Fermi-2 reactor vessel will not cause significant damage to any of the benthic populations.

The risk of widespread adverse thermal effects on the biota of Lake Erie from the operation of the plant is a remote one and very unlikely, particularly since cooling towers and a pond will be used to dissipate most of the waste heat.

The heated water effluent from the pond into the lake will be essentially dissipated within 1,500 feet of the outlet (Figure V-1). Free-swimming organisms are not expected to remain in the plume unless they gradually adapt to it. Especially during the winter months, some fish will be attracted by the thermal plume in the lake, but no significant adverse effect is anticipated because of this. The ice-free water in the area of the effluent will provide a safe open space for waterfowl in winter.

While many minute organisms having a minimum diameter of less than 3/8 inch will be killed in the condenser cooling water, this will not cause a significant impact on the population level in Lake Erie. Fish and other organisms greater than 3/8 inch in diameter will be caught in the intake water screens and sluiced back into the lake via the Fermi overflow canal and Swan Creek (Section V.C.2.a.). Some of these are expected to survive. Some of the aquatic organisms, including relatively low numbers of fish, will be traumatized at the screenhouse as they are flushed from the moving screens, but such losses will be small.

The releases of radioactive materials from Fermi-2 will conform to the AEC requirements that they be "as low as practicable," that the resulting concentrations in air and water meet or, if possible, be lower than specified limits, and that the resulting dose to people in the environs be well within an acceptable range.

Dissipation of biota, including coliforms, streptococcus, pathogenic protozoa, and viruses from the cooling towers into the atmosphere are not expected to be a public health problem. The staff has no evidence to indicate that this has been a problem elsewhere.

E. AESTHETIC ASPECTS

The plant's design generally reflects good judgment in architectural use of construction materials, although the function of some of the components cannot be camouflaged conveniently. The presence of the structures in the industrial zone should not detract from the public's enjoyment of the recreational and educational facilities elsewhere on the site. But from other locations, such a compensation will not exist. The aesthetics of the natural shoreline, already modified by Fermi-1, will be changed further by the two cooling towers and other plant buildings when viewed both from the lake and from the land. The presence of very high, massive cooling towers in a moderately populated region of flat terrain may be an unpleasant reminder of industrialization. In a similar way, the additional transmission lines, especially those in the new 10-mile corridor east of the Milan Station, may evoke a negative reaction in spite of the use of streamlined supports instead of conventional lattice-type towers. The transmission lines are likely to be less objectionable than the cooling towers, however, since they are not only lower and less prominent but are also located in a rural region.

VII. SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

The site has been used during the past decade for the Fermi-1 plant. For accounting purposes, the Fermi-2 plant will have a 35-year life, starting on the date that it first achieves commercial operation in 1975. However, the plant has a design life of at least 40 years. In addition, the current site plan allocates space for both a future water reactor and a future breeder reactor. The former is designated as Fermi-3, an 1,150-MWe unit presently planned for startup in 1979. Less definite plans exist for the future breeder reactor, although startup sometime in the 1980's is not unrealistic. Thus, present plans for the site anticipate continuing use for the production of power well into the 21st century. In fact, it is anticipated that the applicant's system must achieve an eight-fold expansion in capacity by the year 2000 in order to supply expected demands for electricity. Because of this anticipated growth and the expectation that over half the installed capacity will be nuclear by the year 2000, it seems unlikely that this site will be restored to its original state in the foreseeable future. Therefore, it is appropriate to describe the use of the site as short-term only in the context of the greater long-term history and productivity of the Detroit metropolitan area.

The Comprehensive 1990 Plan for the Detroit Region, mentioned previously, allocates this land to use by utilities. Consequently, the subsequent remarks regarding short-term use of Fermi-2 should not be interpreted as indicating that the entire industrial zone of the site will be restored to its preproduction status.

It is useful to consider productive uses of the land and adjacent waters before the advent of electric-power-production facilities. The site was in large part covered by water and marsh land. The beach was marginal in terms of recreational use, both because of its physical characteristics and the growing pollution of the water. In their natural state, those portions above water level were mainly a cluttered assortment of trees, underbrush, and weeds able to survive the climate and soil conditions existing on the site. Although unappealing to people, the beach and marshland did provide an attractive habitat for native wildlife. A small portion of the site was cultivated farm land.

A marked improvement in attractiveness and appeal to people for recreational activities will result from the site development underway, and beneficial occupancy by native wildlife should not be impaired once the development is completed. The site will augment the recreational facilities available to the region's population. The near-term use of the 60% of the site now being developed for public access will, it is expected, be sustained in the long-term future.

At some future date, the Fermi-2 plant will become obsolete and be retired. Recent experience with experimental and developmental nuclear plants has demonstrated the feasibility of decommissioning and dismantling a nuclear power plant sufficiently to restore its site to its former use. The Fermi-2 fuel could be removed and reclaimed, residual radioactivity removed or shielded, components salvaged, structures dismantled, and the reactor vessel sealed. The degree to which this will be done will depend on the balance among health and safety considerations, salvage values, and environmental impact.

Operation of the plant will cause some loss of water by evaporation, small releases of chemicals to the water, small releases of radioactive materials to both water and air, destruction of a small fraction of the marine biota, and a very localized perturbation of the aquatic ecology due to heating of the lake water. Most of these disturbances of the environment will cease when the plant is shut down, and a rebalancing of the biota will then occur. Thus, the tradeoff between production of electricity and small changes in the local environment is reversible in terms of water and air. The extent to which the land in the industrial zone is restored to its former state will be influenced strongly by desired uses for the land beyond the life of the Fermi-2 plant and the relationship between benefits achieved thereby and the cost of restoration.

VIII. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Only that portion of the nuclear fuel that undergoes fission or is not recovered in reprocessing is irretrievably lost for other uses. Slightly enriched uranium will be used as the fuel material, so it is mainly the uranium-235 isotope that is consumed. Some uranium-238 undergoes fission, and some captures neutrons. The latter effect results in production of plutonium-239 which is also a useful form of fuel for nuclear reactors. The net loss of readily fissionable material in a single plant of the Fermi-2 type will not be a serious drain on the supply of uranium available in this country.

Much of the material used in construction of the plant represents an irreversible commitment of natural materials used in producing finished products such as steel, concrete, plastics, and wiring. Some of the construction material can be reclaimed and reprocessed as scrap. Local natural resources such as rock and earth are being used in site-preparation and foundation work in advance of plant construction, but this is merely a localized redistribution of materials and an alteration of site characteristics. None of these uses of natural resources is expected to result in a shortage for other purposes.

The land to be occupied by the plant and its ancillary equipment could be restored to its original use after the plant is retired, except possibly for that portion containing the reactor vessel and shield. The net water removed from Lake Erie during plant operation is a trivial portion of the lake's volume. Its loss is a localized effect, since it ultimately returns to the earth's surface through precipitation.

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

The applicant has provided a discussion of alternatives and a cost-benefit analysis in its Environmental Report Supplement. The staff's independent review is summarized below. In many cases the staff found the applicant's estimates adequate, and these were used in the analysis. In other cases estimates were made independently.

A. SUMMARY OF ALTERNATIVES

During the planning and decision-making in the late 1960's, which led to the plant currently being constructed as the best answer to the problem of expanded system capacity, the applicant's management staff based its decision on a weighing of factors considered pertinent. Among these factors were technical feasibility, costs, environmental aspects and possible social implications.

The selection of an alternative site was considered and rejected since development of such a site would be not only needlessly expensive, but also would require premature development of a new site for power generation purposes. The decision to use the present Fermi-1 site for the construction of Fermi-2 is in accord with sound land use policy, in that land presently assigned to the production of electricity would be utilized before new land is acquired (see Section I. B.).

The need for power is considered in detail in Section I. The alternative of not producing the power was considered to be unacceptable since prolonged operation with the resulting reserve deficiency would significantly increase the probability that the applicant's system would be unable to meet its customers' demands during much of the year. The applicant is obligated to provide the electrical power demanded by the customers in its territory. By custom, an electric utility functions as both producer and distributor of power, although it is encouraged to cooperate with electric utilities serving other regions. The reasons for this cooperation are to avoid a need that the installed capacity within each system be always adequate for peak demand, and to provide assistance under emergency conditions.

For a base-load generating facility, a location close to the load center is desirable, and provision must be made for the dissipation of large quantities of waste heat. Location in a sparsely populated region is a plus factor. The territory served by the applicant is bounded on the east by large bodies of water (Lake Huron, the St. Clair River, Lake St. Clair, the Detroit River and Lake Erie) and the major load center (metropolitan Detroit) is also on the eastern boundary. Thus, it is not surprising that the applicant's existing large plants are clustered along this boundary. Proximity to the population center is desirable for a large variety of industrial activities so, in a heavily industrialized area such as that in and near Detroit, such sites are in short supply. The site chosen for this plant seems to be well-suited for the intended use in terms of desirable criteria, including minimal environmental impact. It is reasonable to assume that the applicant has underway a continuing evaluation of other sites which will be needed to satisfy its requirements for the coming decades.

1. Alternative Fuel

In 1968, the applicant decided that a nuclear plant was the best choice to satisfy increased future demand in terms of cost and acceptable environmental impact. By the end of 1971, about $75 million of the estimated total cost of $339 million for construction and site development was spent and an additional $80 million was committed. If the construction had been permanently discontinued at that time, charges of about $50 million would have been incurred in canceling these commitments.

The applicant has compared levelized annual costs for what were considered to be the only other realistic ways to provide the capacity and energy expected from the plant with that cost for the plant. These alternatives are:

1) Install 1,150 MWe of base-load fossil-fueled capability, to be on line by 1977, two years later than planned for Fermi-2 with purchase of power in the interim;

2) Install 1,150 MWe of diesel-generator peaking capacity (400 diesel generator sets) by the anticipated 1975 startup date for the plant; and

3) Renovate the 950 MWe of obsolete generating capacity now scheduled for retirement and add 200 MWe of peaking capacity.

The levelized annual costs of owning and operating the generating facilities for each of these alternatives and for Fermi-2 were given by the applicant as follows:

Alternative 1	$94,100,000
Alternative 2	$96,600,000
Alternative 3	$89,400,000
Fermi-2 Plant	$63,800,000

The usual staff approach is to consider total generating costs, defined as the sum of the capital investment in generating facilities and the present worth of the annual operating costs for 30 years of operation. Here the present worth is calculated for 1975, the year when Fermi-2 is scheduled to begin operation, and is based on a discount rate of 8.75% per year. The results of this calculation are as follows:

Alternative 1	$941,000,000
Alternative 2	$950,000,000
Alternative 3	$924,000,000
Fermi-2 Plant	$572,000,000

By either method, the costs are much less for the Fermi-2 Plant than for any of the alternatives. This is due primarily to the lower fuel costs for the nuclear plant than for the fossil-fuel plants.

a. Alternative 1 - Base Load Fossil Plant

The probability that an adequate supply of natural gas would not be available, and the long-term supply problem for oil makes the use of coal as fuel for the alternative unit of identical capacity the most practical choice. Eighteen percent of the investment cost for the hypothesized fossil-fueled plant was assumed to be required for wet-scrubbing chemical treatment of the combustion products to remove ash and sulfur dioxide. Purchase of power at the Michigan Pool rate was assumed for the 2 years before 1977 startup of the fossil-fueled plant, although availability of this power is by no means assured.

The most feasible alternative to the nuclear plant would be a base-load fossil plant, as discussed in detail in the applicant's September 1971 Environmental Report, pages 6.15 to 6.22. Thermal discharges to the cooling water would be less for the fossil plant, due to the basically more efficient thermal cycle and the fact that some of the waste heat is lost directly to the atmosphere via the stack gases. Efficient fossil plants reject approximately 3800 BTU/KW to the cooling water, which is 60% of the approximately 6400 BTU/KW rejected to the cooling water by nuclear plants. However, the fossil-fueled plant would cause adverse environmental impacts in the transportation, storage and handling of 3 million tons of coal per year, disposal of 1 million tons of ash and sludge per year, and emission of ash and sulfur dioxide.

Transportation of the coal would be either by unit train operating between mines in southern Ohio or West Virginia and the site, or by train to a Lake Erie port and by barge from there. Noise, interference with highway traffic, and dispersal of coal dust are obvious disadvantages. Onsite storage of the coal would reduce the land available for public recreational purposes. Disposal of the ash and sludge would add to the transportation and materials-handling problems and require additional land use. There is no operating experience with wet scrubbers of the size required, so the developmental nature of the unit installed could result in stack emissions higher than allowed.

b. Alternative 2 - Diesel Peaking Capacity

Use of low-sulfur distillate oil for the 400 diesel generator sets was assumed in this alternative. Using this equipment in an economic manner at times of peak demand would result in its contributing about 800,000 MWh (9%) of the annual 8,600,000 MWh expected from the plant. The difference would be provided by increased production by the existing fossil-fueled plants.

Under this scheme, the environmental impact due to fuel transportation, storage, waste disposal and additional land use for the wastes can be expected to be almost as great as that for alternative 1. The existing plants, which would produce 91% of the energy, are principally coal-fired with once-through cooling. Thus both stack emissions and waste-heat discharge to adjacent waters would be higher than for operation of the Fermi-2 plant with cooling towers. In addition, shipment of the fuel required for the diesel units would have a potential for oil spills. Also, noise from the 400 diesel-generators would require reduction to acceptable levels.

c. Alternative 3 - Renovate Obsolete Plants and Add Peaking Capacity

This scheme has essentially the same environmental problems as alternative 2. About 950 MWe of obsolete generating equipment, having an average age of 45 years in 1975 when the last is scheduled for retirement, would be retained in the applicant's system. A present, their operating, maintenance, and fuel costs are high and the plants do not meet 1975 emission standards. Thus, extensive modification and repair would be required in order to prolong their life for an additional 35 years. The additional 200 MWe of peaking units would probably be diesel-generator sets identical with those considered for alternative 2.

We conclude, based on the foregoing analysis, that each of the three alternatives involves not only significantly higher cost than the nuclear plants but significantly greater adverse environmental effects as well.

2. Alternative Plant Design

Two major design changes made in the plant since the applicant's original application demonstrate the applicant's intention to reduce the environmental impact of the plant beyond what might have been considered to be acceptable. These changes, discussed below, are in the radioactive-waste-treatment system and in cooling methods.

a. Radwaste Systems

Several alternatives to the original radioactive liquid and gas treatment systems have been considered by the applicant, and the original design concepts have been drastically modified to incorporate additional equipment in both systems. This resulted in an increase in capital costs of about $15 million and will add about $1.8 million to the annual operating costs. These systems will be required to meet the Commission's "as low as practicable" requirements for release of radioactive materials during plant operation.

b. Cooling Methods

Originally the plant was designed to use once-through cooling. About 900,000 gpm of water would have been withdrawn from Lake Erie and returned at about 18°F above ambient. Possible adverse environmental effects for this system were (1) short-term effects associated with the construction of a 4,000 foot-long intake structure in the lake and a large discharge structure; (2) local changes in the lake's ecology due to the addition of 7×10^9 Btu per hour and passage of aquatic organisms through the condensers;

and (3) damage to or destruction of fish by the high intake velocity and screens in the intake structure. Consequently, alternative methods for heat discharge were evaluated by the applicant.

The costs of six heat disposal methods were estimated by the applicant, as summarized in Table IX-1.

TABLE IX-1 ESTIMATED COST OF ALTERNATIVE COOLING SYSTEMS

Type	Investment Cost ($)	Capitalized Operating Cost ($)	Total Evaluated Cost ($)
Once-Through	22,585,000	572,000	23,157,000
Mechanical-Draft Towers	23,713,000	7,310,000	31,023,000
Natural-Draft Towers	28,663,000	5,980,000	34,643,000
Spray Pond	19,626,000	7,880,000	27,506,000
Cooling Pond	30,021,000	3,640,000	33,661,000
Dry Towers	-	-	60,000,000 to 70,000,000

On the basis of these estimates, use of dry cooling towers was rejected because their cost was about a factor or two greater than any of the other methods. Spray-pond technology is currently being developed, and performance tests are now being conducted by the applicant; however, existing uncertainties and possible inadequacy eliminated its serious consideration for this plant.

Both natural- and mechanical-draft cooling towers were judged more favorable, on balance, than once-through cooling in terms of environmental impact. They require withdrawal of about 3% as much water from the lake as once-through cooling, markedly reducing the effects on fish and aquatic organisms. Further, they return to the lake only about 1-1/2% of the amounts of heat and water involved in once-through cooling, which significantly reduces detrimental effects on the lake's ecology. Use of cooling towers also reduces the short-term effects of construction, since the existing Fermi-1 intake channel and smaller intake and discharge structures can be used. Release of water-vapor plumes to the atmosphere slightly offsets these advantages, because towers may sometimes stimulate meteorological conditions such as fog and icing which could be annoying in the immediate vicinity. Mechanical draft towers were considered to be less advantageous than natural draft towers. The release point for plumes is lower from mechanical-draft towers, so their local meteorological effects would be greater. In addition, they are slightly less reliable because they require motor-driven fans and the low elevation of the vapor plume release can cause equipment icing. They are also noisy.

Water withdrawal from, and water and heat return to the lake for a cooling pond are comparable to those for cooling towers. A cooling pond would require flooding of about 1,500 acres; however, since the site is only 1,100 acres, this would virtually eliminate the availability of the planned public recreational facilities and would require acquisition of some adjacent, productive farm land. Also, such a pond might be a greater source of local fogging and icing.

These considerations of the environmental effects and reliability of the various methods of heat dissipation contributed to a design change from once-through cooling to natural-draft cooling towers at an increased cost of $11.5 million.

3. Alternative Cleaning of Cooling-Water Tubing

A mechanical-abrasion method (Amertap) was considered as an alternate method for cleaning the condenser cooling-water tubing but rejected, at least temporarily. This decision was based on difficulties experienced in tests of this method on the applicant's River Rouge plant several years ago. This and other mechanical-cleaning methods are more expensive, and reliable usages are not as well established as for the chlorination method. However, the applicant is actively testing mechanical-cleaning designs, and plans to monitor the effluent for residual chlorine. Because the impact of chlorinated effluent seems small for the closed-cycle cooling design (as evaluated in previous sections of this statement), the applicant has chosen chlorination for Fermi-2.

B. SUMMARY OF COST-BENEFIT ANALYSIS

1. Land Use

Preparation for construction of the plant has caused reassignment of 1,088 acres, mostly scrub growth and marshland, although only about 150 acres will be used for power plant facilities. The applicant has planned recreational, educational, and research facilities, including a wildlife reserve for the remainder of the land. In addition to the benefit to users of the facilities, the reserve should be beneficial to the biota on the site.

With the exception of a 10-mile section east of the Milan Station, all the new 345-kv transmission lines will parallel existing 345-kv lines. The new 345-kv lines from the site to I-75 will be installed on modern, slender steel poles for the best aesthetic results. Similar poles will be used in the new 10-mile section east of the Milan Station. The balance of the new lines will be installed on lattice-type towers similar to those now in use for the existing 345-kv lines. The new 345-kv lines will have no significant adverse effect on the environment. In certain areas, the erection of the new towers and line installation may result in a relocation of nearby wildlife, but in view of the short time required for installation and the absence of major excavation work, any wildlife displacement will be temporary and of short duration.

2. Water Use

Construction of the plant will reduce the onsite water areas, occupied mostly by reeds and marshes, by about one-third. Dredging in Lake Erie is not expected to have a significant environmental impact.

Operation of the plant will require a maximum of 31,600 gpm of water from Lake Erie, with 12,100 gpm returned to the lake. (These maximum flows will occur in the summer, and the minimum flows occuring in the winter will be substantially less.) Evaporation of up to 19,500 gpm in the cooling towers and pond will result in a threefold increase in the dissolved solids concentration over that of lake water. Also, chemicals will be added to the discharge water. These and the discharge of treated sanitary wastes are not expected to affect water quality except for possible effects on biota.

Drift from the cooling towers may cause fog a few days per year and produce icing on the site at times. These are not expected to affect highways. Effects on the lake would be negligible. (See Sections III.D.1. and 3. and V.A.3.)

3. Biological Impact

The potential effect of thermal and chemical discharges on the biota in the vicinity of the plant is expected to be quite small. However, studies are planned to assess any effect. One aspect is the combination of thermal, chemical, and mechanical effects on organisms entrained in the cooling water. The annual cost of these effects is estimated to be about 1200 lbs of fish per year. This may be compared with an average annual catch for commercial fishing in Michigan waters of Lake Erie during the period 1961-70 of 1,186,000 pounds having a value of $106,000 (figures from Great Lakes Fishery Commission). Currently, such commercial fishing is banned by the State of Michigan because of high mercury levels in many fish species.

Other biological impacts of Fermi Unit 2 are difficult to evaluate either in terms of dollars or of social values but are expected to be small in view of the limitations on effluents in the plant design.

4. Radiological Impact

The year 1980 annual whole-body dose to the population living near the plant is estimated to be about 72 man-rem.

5. Applicant's Cost-Benefit Analysis

The benefits cited by the applicant for the plant are the following:[4]

1. The plant will contribute a reliable base-load of 1,150 MWe to the applicant's service area whose population is expected to expand from 4.8 million people to 10 million people in 30 years.

2. More than half the load is for expanding industrial and commercial use.

3. The plant represents the least expensive base-load generating capacity that could be installed in the area.

4. The site development plan will result in (a) greatly increased use of the site for public recreation, (b) provision of a science center for public information and (c) improvement in natural areas onsite by plantings and maintenance of wildlife reserves.

5. Local governmental units will receive taxes.

The direct-cost penalty of abandoning the plant as of January 1, 1972, would have amounted to approximately $125 million, which would have had to be recovered in increased revenues. The present penalty would be greater.

The environmental costs are listed by the applicant as follows:

1. Construction activities will disrupt the site environment for a short time.

2. The plant will withdraw some land for industrial use.

3. The outfall of the closed-cycle cooling system will contain heat and chemicals described, but will not have an appreciably adverse effect on Lake Erie.

4. The cooling towers may have rare, local atmospheric effects, such as icing or fogging.

5. Some radioactive gases and liquids will be released, but exposure levels are insignificant compared to naturally occurring sources of radiation.

6. An extremely low probability of a serious accident exists. Although limited quantities of radioactivity could be released to the environment in such an event, no injury to operators or the public would be expected.

The social costs of not meeting the long-term power demand would be an adverse effect (a) on residential comfort, health, and safety, (b) on commercial and industrial activity, and (c) on provision of special medical care.

The environmental costs of not meeting the need for power would include adverse effects (a) of not retiring older fossil-fuel power units which are relatively high-cost, higher-polluting units and (b) of delay in provision of pollution-abatement processes for residential and industrial heating and other activities.

6. Cost-Benefit Balance

The plant as designed is expected to have only small impact on the environment. The alternatives do not have advantages with regard to environmental impacts over the proposed design. A cost-benefit summary of the proposed design is given in Table IX-2.

TABLE IX-2 COST-BENEFIT SUMMARY

Primary benefits	
Electric energy to be supplied	8.6 billion kilowatt hours per year
Electric capacity contributing to reliability of power supply of Michigan Pool	1,150,000 kilowatts
Secondary local benefits	
Peak employment during construction	Between 1400 and 1500 persons
Employment of operating staff	About 100 persons
Local taxes	About $5,000,000 per year
Recreational and educational	Wildlife reserve, picnic and day camp sites, and Fermi Science Center for public use; an Ecological Interpretive and Research Center at some future date.
Environmental Costs	
Thermal - Chemical - Mechanical Impact - Plankton	∿ 1200 lbs of fish per yr
Radioactivity - People (year 1980)	72 man-rem/yr

TABLE IX-2 COST-BENEFIT SUMMARY (cont'd)

Land use	Of the 1100 acre site, Fermi-2 will use about 150 acres for plant area, railroad, paving and buildings.
Water use	Maximum evaporation of 19,500 gpm, which is negligible loss to Lake Erie.
Meteorology	Possible local fogging or icing from cooling-tower plumes, with a frequency of less than 10 days per year.

Small impacts from transmission lines, transportation, cooling towers, and potential plant accidents as discussed in text.

Aesthetics	Intrusion on the landscape of two 400-foot-high cooling towers visible for several miles and of 10-mile-long new corridor for transmission lines.

X. DISCUSSION OF COMMENTS RECEIVED ON THE DRAFT ENVIRONMENTAL STATEMENT

Pursuant to paragraphs A.6 and D.1 of Appendix D to 10 CFR Part 50, the draft detailed statement was transmitted, with a request for comment, to: the Environmental Protection Agency; the Federal Power Commission; the Corps of Engineers; the Department of the Interior; the Department of Commerce; the Department of Health, Education, and Welfare; the Department of Agriculture; the Department of Housing and Urban Development; the Department of Transportation; the Advisory Council on Historic Preservation; the Governor of Michigan; the Department of Natural Resources; Water Resources Commission, State of Michigan; and the Supervisor, Frenchtown Township. In addition, the AEC requested comments on the draft environmental statement from interested persons by a notice published in the Federal Register on March 11, 1972 (37 F.R. 5265).

Comments in response to the requests referred to in the preceding paragraph were received from the Environmental Protection Agency; the Federal Power Commission; the Department of Commerce; the Department of Agriculture; the Department of the Army (Corps of Engineers); the Department of Transportation; the Department of the Interior; and the Advisory Council on Historic Preservation.

Our consideration of comments received is reflected in part by revised text in other sections of this statement and in part by the following discussion.

A. ACCIDENTAL RELEASES

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. The small quantities of dispersed radioactive material which might enter the food chain would not be significant in terms of endangering aquatic life.

B. AIR QUALITY

The discharge of gaseous radioactive materials to the air during plant operation was considered in Section III.D.2.a. However, other factors which serve to reduce air quality were not mentioned. In addition to dust caused by construction activities and its reduction by frequent watering of the roads, mentioned in Section IV.C., blasting, rock-crushing, concrete mixing, land-clearing and burning of combustible waste all are contributors to airborne particulate matter during construction. The quantities and their disposal depend strongly on the amounts of each activity and the weather conditions, and also on offsite contributors to air pollution. Since no quantitative data are available, only a subjective judgment, based on conditions at the time of the site visit, is feasible. On this basis, the air at the site was not polluted by any of these sources to a noticeable extent beyond what is to be expected in connection with a construction project of this type.

Air contamination should be reduced markedly upon completion of plant construction. Release of combustion gases from oil-fired units on site was mentioned in Section III.D.3.a. The only such source associated with Fermi-2 is an auxiliary heating boiler whose expected annual consumption of fuel oil is only a very small fraction of that used by the peaking units. The only other noteworthy pollutant released routinely during plant operation is chlorine gas from the water in the cooling tower. A quantitative value for this release can only be obtained after operation begins. However, as mentioned in Section V.B.2, past experience argues that "contrary to a popular misconception, the loss of chlorine through a tower is practically negligible."[22]

C. CHLORINE

1. Residual Chlorine Levels

Environmental Protection Agency-recommended concentration standards for residual chlorine of 0.002 mg/liter for receiving water do not specify either the size of the mixing zone or the total mass rate of discharge. The Fermi-2 discharge of residual chlorine is controlled at no more than 6 lb/hr and the mixing zone for concentration above 0.005 mg/liter is estimated at less than 1 acre of a lake with a surface of over 6 million acres.

2. Chlorine Usage

Some of the commenting agencies expressed concern for any usage of chlorine as an anti-fouling agent in view of the availability of alternative mechanical cleaning methods. In addition to the higher costs and limited proven reliability of the mechanical-cleaning methods, it is expected that, for the closed-cycle cooling system as operated, the zone of residual chlorine toxicity (above 0.005 mg/liter) will be so small (about 1 acre) in the outfall that the impact upon the receiving water and the lake ecology will be negligible. The acceptability of the present design is subject to the results of a continuing investigation by the applicant, however, both in respect to the performance of mechanical alternatives and in respect to the observed impact of such small chlorine releases.

D. COST-BENEFIT

Because the performance of the radwaste systems as modified is expected to result in radioactive effluent releases within the numerical guides set forth in AEC proposed amendments (dated June 9, 1970) to 10 CFR Part 50 embodied in a new Appendix I, no formal cost-effectiveness analysis was deemed necessary for alternative system designs. This limitation to the consideration of alternatives, besides being a matter of practicality for such low releases, is expressly set forth in Section IV.A., p. 4, of the current AEC "Guide for Submission of Information on Costs and Benefits of Environmentally Related Alternative Designs for Defined Classes of Completed and Partially Completed Nuclear Facilities" (issued May 1972).

E. GAS TREATMENT SYSTEMS

1. Choice of System

The gaseous radwaste treatment system purchased was based on technological assessments made in 1970. At that time, boiling water reactors were discharging gaseous effluent without treatment other than delay. The decision was made to treat the main condenser off-gas which carried greater than 99% of the released gaseous radioactivity by passing it through a recombiner-charcoal bed system. The applicant expects this treatment to reduce the activity released by this path by a factor of 100. More efficient systems may be possible--for example, the addition of a cryogenic collection system, but the staff is not aware that the feasibility of their use on this scale has been established. In any case, the chosen system is expected to achieve the "as low as practicable" guidelines of 10 CFR 50.

2. Gland Seal System

The cost of providing clean steam for the gland seals was investigated. The applicant states that the projected cost in 1970 would have been $5,000,000, and that the cost today would be about $10,000,000. The radioactivity released via this path should be less than 1% of that released via the main condenser air ejector without extended treatment or about 1/2 of that released with extended treatment. Perfectly clean gland steam, therefore, would only effect a reduction by about 30% of a dose that is already small.

3. Standby Gas Treatment System

The employment of the standby gas treatment system (SGTS) for routine processing of reactor building ventilation air is not compatible with its function as an engineered safeguard for use during abnormal occurrences. However it is available for processing this air under such conditions, and proper monitoring of the principal sources of gaseous effluents will ensure that it is invoked if needed.

F. LIQUID RADWASTE

Current plans call for the letdown of from 6,000 to 12,000 gpm from the residual heat removal (RHR) pond to be discharged to the Lake. The treated liquid radwaste will flow at 5 gpm into this letdown for dilution. An alternate possibility exists whereby the blowdown line is routed either to the Fermi 1 outflow or to the north lagoon. The additional dilution to be obtained by such rerouting is not certain in view of the uncertain future use of Fermi 1, and the natural runoff from Swan Creek. The population dose reductions derived from this additional dilution are likewise uncertain but would probably not exceed 15% of this already low figure.

G. MONITORING PROGRAM

Detailed descriptions of the Fermi-2 Process Radiation Monitoring, Area Radiation Monitoring, and Site Environs Radiation Monitors are provided in Sections 7.12, 7.13, and 7.14, respectively, of the Preliminary Safety Evaluation Report. The applicant is also sponsoring a long-term study of the aquatic community in the vicinity of the plant site. This study is being directed by Dr. Niles R. Kevern, Chairman, Department of Fisheries and Wildlife, and Dr. Robert C. Ball, Director, Institute of Water Research, both at Michigan State University. It is oriented toward predicting the concentrations in the aquatic system of released radionuclides and confirming their ultimate fate.

In Section 4-4.1 of the Environmental Report (September 1971), the applicant states that he will consider modifying or expanding the monitoring program if the present one proves inadequate in areas of adverse impact.

H. RESIDUAL HEAT REMOVAL HEAT EXCHANGER LEAKAGE

The residual heat removal (RHR) system heat exchangers are used to remove decay heat from the primary coolant during normal shutdown. A leak in one of the two RHR heat exchangers would therefore permit primary coolant water to leak into the secondary side service water which discharges to the RHR pond. Such a leak will be detected by monitors on the two lines leading to the pond. Since only one heat exchanger is sufficient to accomplish this task, the leaking unit can be isolated for repair.

I. TRANSMISSION LINES

Since much of the corridor for the new transmission lines is already existing right-of-way, and the new 10-mile section in essentially a minimum distance path across an area of low population density and land value, no benefit-cost evaluation of alternate routes was considered necessary. For these same reasons, consideration of a routing along existing pipe-line corridor was not examined.

J. TRASH DISPOSAL

Disposal of construction debris and solid non-radioactive wastes during operation was described in Section IV.B.1 and III.D.4 respectively. The processing details for those ordinary materials handled by commonly used and well-known methods were not considered as significantly contributive to an understanding or analysis of environmental impact. As indicated at the end of Section III.D.4, disposal will comply with existing local regulations.

K. LOCATION OF PRINCIPAL CHANGES IN THIS STATEMENT IN RESPONSE TO COMMENTS

Topics Commented Upon	Section Where Topics Are Addressed
Construction and Operating Effects	
Details of permanent sewage treatment system	III.D.3.c
Noise levels and abatement procedures	IV.B.1
Details of dredging operations	IV.B.2
Methods used to minimize erosion and siltation	IV.B.2
Effect of quarrying on ground water	IV.B.2
Details of temporary sewage treatment system	IV.C
Use of defoliants in transmission corridor	V.A.2
Air quality changes	X
Disposal of construction debris	X
Cost-Benefit	
Summary and analysis	IX.B
Ecology of Site and Environs	
Native sea gulls	II.D.7.b
Local grasses	II.E.1.b
Marsh animals	II.E.2.a
Lake Erie fish	II.E.2.b
Birds near Fermi-2	II.E.2.b
Zooplankton and phytoplankton	II.E.2.b
Sanitary waste	III.D.3.c
Terrestrial ecosystem	V.C.1
Intake effects	V.C.2.a
Plankton and fish	V.C.2.a
Fish	V.C.2.a
Discharge effects	V.C.2.a
Discharge effects	V.C.2.b
Chlorine and sanitary system effluents	V.C.2.b
Cooling tower effects	V.C.3
Fish on traveling screens	VI.D
Historical Significance	
Local historical resources	II.C
Indian remnants	II.C

Topics Commented Upon, Cont'd.	Section Where Topics Are Addressed, Cont'd.
Monitoring and Surveillance	
Details of radiological monitoring	V.D.6
Sampling near outfall	V.C.2.b
Adherence to AEC Safety Article 21	V.D.6
Discharge monitoring levels	V.D.6
Need for Power	I.A.
Non-Radiological Aspects of Intake and Discharge	
Design of RHR pond discharge	III.D.1
Average quantity of make-up water	III.D.1
Lake-water quality and standards	III.D.3
Fallout of drift solids	V.A.3.d
Effluents from major alternatives	IX.A.1.a
Mechanical alternatives to chlorination	IX.A.3
Radwaste and Treatment Systems	
Performance of radwaste system	III.D.2.a
Alternate release point of gaseous effluents	III.D.2.a
Standby gas treatment system as an engineered safeguard	III.D.2.a
Solid radwaste system	III.D.2.c
Site Selection and Development	
Population growth rate in vicinity	II.B
Joint regional planning	V.A.4
Location of intakes and discharges	III.D
Change in forested land	IV.B.1
Transmission Lines	
Federal guidelines	III.B
Impact of construction and maintenance	IV.B.1, V.A.2
Inspection method	V.A.2
Minimum clearance	V.A.2
Interference with railroad communications	V.A.2
Land requirements	V.A.2
Forest land (%)	V.A.2

FEDERAL POWER COMMISSION
WASHINGTON, D.C. 20426

FEB 16 1971

Mr. Harold L. Price
Director of Regulation
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Price:

This is in reply to your letter of October 7, 1970, requesting comments of the Federal Power Commission on the environmental impact of the Enrico Fermi Nuclear Unit No. 2, AEC Docket No. 50-341.

In keeping with the Interim Guidelines on Implementation of the National Environmental Policy Act of 1969, the FPC is pleased to forward its comments on the above project in terms of its area of expertise as designated in the Memorandum of July 29, 1970, of the Council on Environmental Quality and the Commission's responsibility under the Federal Power Act.

Sincerely,

John N. Nassikas

John N. Nassikas
Chairman

Enclosure
Comments on AEC
Environmental Statement

Federal Power Commission
Comments Relative to the Environmental Statement
on the Enrico Fermi Nuclear Power Station
of the Detroit Edison Company

Pursuant to the National Environmental Policy Act of 1969, and the role of expertise assigned to the Federal Power Commission as designated in the Memorandum of July 29, 1970, of the Council on Environmental Quality, the comments herewith are directed to the relationship of the electrical capacity of this unit to the prospective power supply and demand situation related to the type of plant and its environmental effects, and to comment on alternative means of meeting the power supply need for which the unit is proposed. It is understood that other agencies will review and comment on specific aspects relating to effects of the unit on air and water quality and other environmental factors.

The Need for Power

The Detroit Edison Company's Enrico Fermi Unit No. 2 with a net capacity of 1,123 MW is scheduled for operation in August 1974, and is a unit in the comprehensive plan of the East Central Reliability Agreement to meet the future electric power needs of the region.

The Detroit Edison Company, a summer peaking system, predicted a peak load of 5,525 megawatts for the summer of 1970, and projected a peak load of 7,175 megawatts for the summer of 1973, approximately a 9.2 percent average annual rate of growth. At this present rate of increase, the 1974 summer peak would be 7,835 megawatts. As of September 30, 1970, Detroit Edison had a dependable capacity of 6,139 megawatts. Scheduled through 1974 is an additional 4,673 megawatts, which would give Detroit Edison a total dependable capacity of 10,812 megawatts, with a reserve margin of 2,977 megawatts or 38.0 percent. If the proposed Enrico Fermi Nuclear Unit is not available for the 1974 summer peak, reserves will be reduced to 1,854 or 23.7 percent.

Though Consumers Power Company is a winter peaking system, the annual peak of the Michigan Power Pool in which the Detroit Edison Company and the Consumers Power Company are the principal members is expected to occur during the summer months.

The Michigan Power Pool estimated a peak load of 8,822 megawatts for the summer of 1970 and 11,491 megawatts for the summer of 1973, approximately a 9.2 percent average annual rate of growth. Assuming this same rate of increase, the Michigan Power Pool's peak load for the summer of 1974 would be 12,548 megawatts.

As of September 1970, the pool's dependable capacity was 9,871 megawatts. An additional 5,516 megawatts of new capacity is scheduled for service prior to the end of the 1974 summer peaking period. Thus, the pool expects to have 16,187 megawatts of capacity to meet its summer 1974 peak of 12,548 megawatts after allowing for sales of 200 megawatts to other systems. The Michigan Pool's reserves for the summer of 1974 are anticipated to be 3,639 megawatts which is equal to 29.0 percent of its estimated summer 1974 peak demand. If the Enrico Fermi 1,123-megawatt nuclear unit is not available for the summer peak, the pool's reserves will be 2,516 megawatts or 20.1 percent.

The reserve margins appear to be within an appropriate range in view of the sizes of the load of the Michigan Pool, and the fact that most of the new generating capacity will be in relatively large fossil and nuclear units whose construction schedules and availability can be highly uncertain. The Michigan Pool has been interconnected with the Hydro-Electric Power Commission of Ontario for a number of years. Last year the Michigan Pool was interconnected with the United States grid by the construction of 345 kV transmission lines into Ohio and Indiana.

The Federal Power Commission favors the construction of interconnections between systems as a sound practice for gaining the advantages of economy of scale and creating the inter-system means of emergency support. But even if time were available for new construction, the neighboring systems would be hard put under present conditions of environmental concern to find the sites for new plants whose principal purpose would be to export power to distant systems.

The Fuel Situation

In 1969, Detroit Edison used coal to generate 98.3 percent of its requirements with oil accounting for 1.3 percent and gas about 0.4 percent. The general unavailability of natural gas and residual fuel oil in Michigan has resulted in Detroit's generation being based on low to high sulfur coal from Ohio, Kentucky, West Virginia and Pennsylvania. Oil and gas are used by Detroit Edison mainly for its peaking gas turbine and diesel units.

A coal-fired plant as an alternative to the Enrico Fermi Nuclear Plant would necessarily add to the particulate and gaseous pollutants entering the atmosphere of the company's service area. Although neither Michigan nor Detroit have established air quality criteria, the Detroit Edison Company will soon be subject to national primary and secondary air quality standards as a result of the enactment of the Clean Air

Amendments of 1970. Consequently, without effective sulfur removal equipment or available low sulfur coal a coal-fired plant would be a much less desirable alternative to the Enrico Fermi Nuclear Plant.

A natural gas-fired alternative station with capacity equal to the proposed nuclear unit would require about 11,500 mcf of natural gas per hour or about 85,000,000 mcf annually. The gas suppliers in Michigan are currently experiencing difficulty meeting the normal load growth and are seeking or have already obtained standby authority to deny service when gas supply is inadequate. Accordingly, the lack of availability of an assured, adequate gas supply at this time precludes the construction of a gas-fired alternative generating station.

The general unavailability of natural gas and the difficulty of obtaining low-sulfur coal has caused the company to look to foreign sources for low-sulfur fuel oil which is not a desirable supply situation for a base-load plant.

Power Imports

The import of firm power from utilities bordering on the Michigan Pool as an alternative to adding the Enrico Fermi Nuclear Station does not appear to be feasible. This conclusion is based on a review of the present load-capacity situations in the surrounding area.

At the present time, the reserve margins of the areas adjoining or near the Michigan Pool are:

PSA	Nominal Area Covered	Reserve Margins in Percent Summer 1970
9,10,&12	American Electric Power Corp.	16.8
14	Northern Illinois	13.5
40	Southern Illinois	16.0
12	State of Indiana	9.7
9	State of Ohio	20.7
3,4	PJM Interconnection	18.1

These reserve margins are not high enough to enable them to export large blocks of power on a firm basis.

Even if time were available for new construction, these neighboring systems would be hard put under present conditions of environmental concern, to find the sites for plants whose principal purpose would be to export power to distant utility systems. These systems in common with utility systems everywhere are having difficulties in timely construction of new capacity to improve or to maintain their own reserve margins. From the standpoint of reliability and coordination in the planning and operation of system facilities, it is highly desirable to have a strong transmission network interconnecting utility systems in the Michigan area. These purposes would not be enhanced, however, by additional interconnections and out-of-the-area generation to provide for the export of large blocks of firm power. Furthermore, the construction of such facilities would not lessen the overall impact of power facilities on the environment.

It is evident, therefore, that if the Detroit Edison Company is to meet expected loads reliance cannot be placed on import of required firm power in lieu of construction of the Enrico Fermi Nuclear Power Station.

Hydro Power Alternative

A hydroelectric installation as a substitute for the Enrico Fermi Nuclear Power Station must be ruled out as a practical consideration. Conventional hydro sites that might be developed in the area would probably be of small size and utilized principally for peaking purposes. In 1973, the company will have 917 megawatts of peaking capacity from the Ludington pumped-storage hydroelectric installation, a facility which is jointly owned with the Consumers Power Company, being built under Federal Power Commission license. While there may be other pumped-storage hydroelectric sites which are within economical transmission distance of the company's service area, these sites are suitable for peaking capacity only. Therefore, hydroelectric developments would be incapable of providing capacity which could serve as a substitute for a base-load generating facility, such as Enrico Fermi.

AREA CODE 313
TELEPHONE 962-2100

THE DETROIT EDISON COMPANY

2000 SECOND AVENUE
DETROIT, MICHIGAN 48226

ROLD C. REASONER
CUTIVE VICE PRESIDENT
FOR PRODUCTION

September 18, 1970

Docket No. 50-341

Regulatory File Cy.

Dr. Peter A. Morris
Division of Reactor Licensing
United States Atomic Energy Commission
Washington, D. C. 20545

Dear Dr. Morris:

This should be considered to be information supplementing that contained in the letter to you dated June 11, 1970 from Mr. W. G. Meese.

Detroit Edison is a member of ECAR, the East Central Area Reliability Agreement, which is attempting to establish a minimum installed generation reserve criterion for the East Central Area. It is generally conceded within ECAR that such a criterion should be in the range from 15 percent to 22 percent of forecast peak load. A neighboring regional council has tentatively set its criterion at 20 percent of forecast peak load.

Detroit Edison is one of the ECAR companies which favors a more conservative value for a minimum installed generation reserve criterion in the order of 16 to 17 percent of forecast peak load. Such reserves are required to replace generating capacity forced out of service, to provide tie line regulation and frequency control, to perform maintenance that cannot be scheduled during off-peak load seasons, to provide some protection against slippage of new unit schedules, and to provide for unexpected load increases due to abnormal weather.

An examination of ECAR's operating records shows that for the summer of 1969, capacity which was planned to have been available but which was not, ranged from 12 percent to 21 percent of the summer peak load. Over half of that time, capacity equal to or exceeding 16 percent of the summer peak load was unavailable. ECAR load-frequency regulation requirements are 3 percent of forecast peak load, and its requirement for possible variations in load forecasting is 1 percent of forecast peak load. For future planning purposes a level of 20 percent is, therefore, not unreasonable.

THE DETROIT EDISON COMPANY

Dr. Peter A. Morris
Page 2
September 18, 1970

Although Detroit Edison would be satisfied with a somewhat lower value, it feels that a reserve level approaching 20 percent is desirable in 1974 until its four new 800 Mw Monroe Power Plant units have conclusively demonstrated reliable performance. Two of these units will have been one year old or less in 1974. Furthermore, it is recognized that many of Detroit Edison's older plants must be shut down during this period in order to install air-quality control facilities, which may be required by forthcoming local and state regulations.

Planned reserve levels of less than 15 percent are considered inadequate for a period four or more years in the future. This has been demonstrated in several areas in the east during the past two years.

In order to justify the need to have this project in commercial service before summer 1974, we are attaching Tables I and II which show in detail the capability and load situation in August and December 1974. Table I shows information concerning the Detroit Edison system while Table II shows similar information concerning the Consumers Power-Detroit Edison Electric Power Pool. Both tables indicate the forecast situation during the peak load weeks in August and December 1974.

The tables show capability that may exist in 1974 assuming all new capacity is brought in on schedule prior to 1974 and assuming the retirement of the low pressure sections at four of our older power plants.

We are obligated to local authorities to retire 131 Mw at our Marysville Power Plant in October 1972.

Seven units installed between 1918 and 1939 at our Conners Creek Power Plant, three units installed between 1929 and 1933 at our Delray Power Plant, and six units installed between 1927 and 1928 at our Trenton Channel Power Plant are presently under severe smoke restrictions. Although we have converted most of this equipment to oil and/or gas firing, we have not been able to arrange for an adequate fuel supply for these units beyond 1972. It would cost about $8,000,000 to provide an adequate dust collector system at Trenton Channel alone. We have advised the appropriate local authorities that we will retire this old equipment as soon as possible. We have also informed the Michigan Public Service Commission that we will retire the above sixteen units in 1973.

When we were negotiating with Babcock and Wilcox for the steam generator for Monroe No. 4 we found that the only open manufacturing space for the delivery times needed had been reserved by Ohio Edison.

THE DETROIT EDISON COMPANY

Dr. Peter A. Morris
Page 3
September 18, 1970

Ohio Edison relinquished their claim on this open space with the understanding that Michigan would supply 200 Mw to their power pool via Toledo Edison for fifteen consecutive months beginning October 1, 1973. Edison's share of this delivery is shown as 100 Mw in Table I.

The data shown in the tables were prepared by the Consumers-Edison Power Pool Planning Committee which is responsible for planning schedules for new capacity additions. The reserve margins will not be adequate in 1974 if Fermi No. 2 is not available for commercial service at that time. It is a fact that about 200 Mw of the pool capacity is always unavailable due to condition factors, outages of auxiliary equipment and the condition of fuel. Thus in 1974, without Fermi No. 2 in commercial operation, the Consumers-Edison pool available reserves would be reduced to zero every time one of five 800 Mw units should be out of service for any reason. Probability calculations indicate that one of these five large units can be expected to be forced out of service about twenty to twenty-five times per year.

Very truly yours,

Harold A. Sonner

AKF/WJM/erh
MEN70-513
encl.

copies: A.E.C. - Orig + 2

TABLE I

FERMI NUCLEAR POWER UNIT NO. 2

THE DETROIT EDISON COMPANY LOAD AND CAPACITY FORECAST

All Values in Megawatts (MW)

	AUGUST 1974		DECEMBER 1974	
	With Fermi 2	Without Fermi 2	With Fermi 2	Without Fermi 2
Net Demonstrated Capability	10220	9070	10220	9070
Net Seasonal Capability	10040	8890	10220	9070
Receipts (Deliveries) - Other Systems	(100)	(100)	(100)	(100)
Available Capability	9940	8790	10120	8970
Scheduled Maintenance	0	0	600	400
Available Capability for Load	9940	8790	9520	8570
Forecast Peak Load	7725	7725	7025	7025
Reserve Over Load	2215	1065	2495	1545
Less Equalization with CPCo	(865)	(385)	(1240)	(842)
Net Reserve Over Load*	1350	680	1255	703
ECAR Required Operating Reserve	618	618	560	560
Net Margin	732	62	695	143
* Percent Installed Reserve Margin	17.5%	8.8%	17.9%	10.0%

AKF/mk
9/17/70

TABLE II

FERMI NUCLEAR POWER UNIT NO. 2

CONSUMERS-EDISON POWER POOL LOAD AND CAPACITY FORECAST

All Values in Megawatts (MW)

	AUGUST 1974		DECEMBER 1974	
	With Fermi 2	Without Fermi 2	With Fermi 2	Without Fermi 2
Net Demonstrated Capability	15329	14179	15329	14179
Net Seasonal Capability	15042	13932	15329	14179
Receipts (Deliveries) - Other Systems	(200)	(200)	(200)	(200)
Available Capability	14842	13732	15129	13979
Scheduled Maintenance	0	0	900	600
Available Capability for Load	14842	13732	14229	13379
Forecast Peak Load	12625	12625	12155	12155
Reserve Over Load*	2217	1107	2174	1224
ECAR Required Operating Reserve	1010	1010	970	970
Net Margin or (Deficiency)	1207	97	1204	254
* Percent Installed Reserve Margin	17.5%	8.8%	17.9%	10.0%

AKF/mk
9/17/70

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ADVISORY COUNCIL
ON
HISTORIC PRESERVATION
WASHINGTON, D.C. 20240

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Appendix D
Comments of Advisory Council on Historic Preservation

April 6, 1972

Dear Mr. Rogers:

This is in response to your request for comments on the environmental impact statement identified by a copy of your cover letter attached to this document. The staff of the Advisory Council has reviewed the submitted impact statement and suggests the following, identified by checkmark on this form:

_____The final statement should contain (1) a sentence indicating that the National Register of Historic Places has been consulted and that no National Register properties will be affected by the project, or (2) 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 assure 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, March 15, 1972.

_____In the case of properties under the control or jurisdiction of the United States Government, the statement should show evidence of contact with the official appointed by your agency to act as liaison for purposes of Executive Order 11593 of May 13, 1971, and include a discussion of steps taken to comply with Section 2(b) of the Executive Order.

__✓__The final statement should contain evidence of contact with the Historic Preservation Officer for the State involved and a copy of his comments concerning the effect of the undertaking upon historical and archeological resources.

_____Specific comments attached.

Comments on environmental impact statements are not to be considered as comments of the Advisory Council in Section 106 matters.

Sincerely yours,

John D. McDermott
Acting Executive Secretary

cc: Mr. Samuel Milstein, State Liaison Officer for Historic Preservation, w/c of inc.

DEPARTMENT OF AGRICULTURE
OFFICE OF THE SECRETARY
WASHINGTON, D. C. 20250

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Regulatory Mail Section

Appendix E
Comments of Department of Agriculture

April 12, 1972

Mr. Lester Rogers, Director
Division of Radiological and
Environmental Protection
Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Rogers:

We have had the draft environmental impact statement for the Detroit Edison Company's Enrico Fermi Nuclear Power Plant reviewed in the relevant agencies of the Department of Agriculture. Comments from the Soil Conservation Service, the Forest Service, and the Economic Research Service, all agencies of this Department, are enclosed.

Sincerely,

T. C. Byerly

T. C. BYERLY
Assistant Director
Science and Education

Enclosures

Soil Conservation Service, USDA, Comments on Draft Environmental Statement prepared by The Detroit Edison Company, Enrico Fermi Atomic Power Plant Unit 2.

This proposed project will not adversely affect any present or planned projects of the Soil Conservation Service.

The project site is not what we class prime agricultural land, so it will not affect the potential crop production base in the state. It is on land that is very flat and not conducive to serious water erosion and sedimentation. The impact statement does include a vegetative program which is believed adequate for the site. Much of the soil is of a texture that will compact from the weight of heavy equipment. This may create some problems in the preparation of a good seedbed and in getting a good stand established. Our agency will be available to provide you any desired assistance in the selection of adapted species and seeding methods that have proven successful.

When this area is fully developed, it appears that rather than detracting from the environment it will improve it from the standpoint of esthetics and some wildlife species.

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

We have reviewed the Draft Environmental Statement prepared by the U. S. Atomic Energy Commission which relates to the proposed issuance of a construction permit to the Detroit Edison Electric Company for operation of the Enrico Fermi Atomic Power Plant.

The plant is located in Monroe County, Michigan midway between Detroit and Toledo. The statement indicates that approximately 150 acres of land will be disturbed and modified by plant construction. The statement does not report how much land will be traversed by transmission lines that are needed as a result of the plant. In each case we believe the statement should provide the acreage of forest land that will be cleared.

In connection with the design, routing, construction and maintenance of the required transmission lines, we recommend guidelines be employed as developed by the Department of The Interior and Agriculture in "Criteria for Electric Transmission Systems" and "Guidelines for the Protection of Natural, Historic, Scenic and Recreational Values in the Design and Location of Rights-of-Way and Transmission Facilities" published by the Federal Power Commission.

On page 70, reference is made to the radiological environmental monitoring program for Fermi-2. We believe the monitoring program should be explained in more detail or a reference should be provided as to where the program is described. We are in agreement with the emphasis placed on radiological monitoring; however, the statement is not clear as to whether chemical, thermal and physical adverse impacts are being measured. If not, we would suggest that an environmental monitoring system be established and described to provide a basis for the detection of all significant environmental impacts.

Economic Research Service
ERS Comments on the Draft Environmental Statement for Unit 2, Enrico Fermi Nuclear Power Plant, Michigan

The statement conforms generally to the NEP Act criteria for content. In our opinion, the section concerning benefit-cost analysis and alternatives should be expanded to include more information concerning certain nonpecuniary impacts of the proposed power plant unit and alternatives to it. For example, relative rates of waste heat emission from alternative generating means would logically be reported in this section but are not present.

A more specific description of the local incidence of the harmful or unpleasant effects of the various alternatives on humans and other organisms would be useful to readers of the statement.

THE ASSISTANT SECRETARY OF COMMERCE
Washington, D.C. 20230

April 13, 1972

Appendix F
Comments of Department of Commerce

Mr. Lester Rogers, Director
Division of Radiological &
Environmental Protection
U.S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Rogers:

The draft environmental statement related to the proposed construction of the Enrico Fermi Atomic Power Plant, Unit-2, by the Detroit Edison Company, Docket Number 50-341, which accompanied your letter of March 6, 1972, has been received by the Department of Commerce for review and comment.

In order to give you the benefit of the Department's analysis, the following comments are offered for your consideration.

We have reviewed the draft statement on the Enrico Fermi Atomic Power Plant, Unit-2. The statement appears to give objective consideration to the probable impact and potential adverse effects of the operation of this nuclear power plant on the environment and the aquatic organisms inhabiting western Lake Erie near the project site. However, we feel that the statement might be strengthened by including additional information or discussion on the following points.

Under the Ecology of Site and Environs, on page 22, in the 4th paragraph, yellow perch are said to have been found to be most abundant in offshore (open lake) waters. It should be noted, however, that yellow perch utilize the shallow inshore areas for spawning. Yellow perch are broadcast spawners, and they utilize aquatic plants and brush to anchor their eggs, as do various other species in the "open lake" group.

On page 22, in the 5th paragraph, it should be noted that up until the recent ban on commercial fishing by the State of Michigan due to high levels of mercury in many fish species, western Lake Erie produced an average annual catch of 1,186,000 pounds, having a value of $105,600 (1961-70 average figures from Great Lakes Fishery Commission). It should also be noted that these figures represent the catch from Michigan waters only. When and if this ban is lifted, these resources will again be utilized commercially.

On page 24, in the last paragraph, the section on zooplankton could be improved by including additional information on population density and species distribution relative to the plant site. This additional information will be helpful when attempting to evaluate the effect of operation of the plant on zooplankton in the area.

On page 26, in the 1st paragraph, the discussion on phytoplankton contains insufficient information regarding population density and distribution of species in the vicinity of the plant.

With regard to the Plant Effluent System, on page 32, in the 3rd paragraph, the conclusion that the water returned to the lake is not environmentally significant simply because of its small volume (12,000 gpm) and low heat and chemical content would seem premature, especially in view of the fact that the outfall system has yet to be designed. Secondly, this conclusion is related to environmental impact; as such, it should be included in the impact section.

On page 48, in the 3rd paragraph, the environmental impact associated with periodic dredging for the intake channel and dredging of a barge channel will depend on various factors, such as the quantity of spoil, the disposal site for the spoil, the duration of the dredging operation, and perhaps the time of year that the dredging occurs. Information on these factors should be included.

On page 56, in the last paragraph, the residual chlorine level of 0.1 ppm in the blowdown, although perhaps low and difficult to detect, nevertheless may be damaging to aquatic organisms. Chronic exposure to concentrations of residual chlorine as low as 0.0034 mg/liter were found by Arthur and Eaton (in press) to inhibit reporduction of Gammarus Pseudolimneus. 1/ Another aspect that should be considered here and elsewhere is the effect of the presence of chloramines and other toxic chlorine-containing compounds in the treated water. It is mentioned that sodium thiosulfate can be used to reduce the residual chlorine to less than 0.1 ppm if desired. It might also be mentioned here (as noted on page 96) that the applicant has considered using the Amertap method of cleaning the condenser tubes, but has temporarily rejected this method as impractical based on studies done at their River Rouge plant several years ago.

On page 60, in the 3rd paragraph, it is stated that " . . . juvenile fish and/or other weak swimming organisms caught by the traveling screens (3/8-inch mesh) will bypass the remainder of the power plant because they will be flushed by water jets back into the lake via the effluent from the pond." It is contended that most of these organisms are expected to survive, and that "no known incidents of fish kills have been associated with the operation of the Fermi-1 intake structures." Despite such assurances, it would seem that there should be some discussion here of the possibility that many fish impinged on the screens and flushed off by a high velocity stream of water could be traumatized to such an extent that they would die eventually. Mortalities might not be readily observed, especially those that may be due to increased susceptibility to predation as a result of physical damage, coupled perhaps with physiological shock owing to exposure to chlorine.

1/Arthur & Eaton. In press. Chlorine toxicity to the amphipod, Gammarus Pseudolimneus, and the fathead minnow, Pimephales Promelas Rafinesque. Journal of the Fisheries Research Board of Canada.

On page 60, in the 5th paragraph, it is argued that the biological impact of entrainment of organisms is expected to be insignificant because (a) the volume of water affected will be small relative to the volume of Lake Erie, (b) the generation time of the planktonic organisms tends to be short, and (c) the lake is shallow and unproductive near the plant site. We consider a conclusion based on these assumptions premature and suggest that further studies may be required before conclusions can be reached. In our opinion, although the volume of water passing through the Fermi plant is small when considered by itself, the effect of its use may not be insignificant when considered in relation to all other water uses in the complex ecosystem of the basin. Secondly, the shallow region near the plant is part of the productive littoral zone, which contains many organisms. With reference to the potential adverse effect of mortalities due to entrainment, we offer the following comments that may be useful in supplementing this section of the statement.

a. Figures developed from unpublished Bureau of Sport Fisheries & Wildlife data on dispersal of young-of-the-year fish indicate that for a 180-day period during the summer and fall 2,942,438 larval fish would pass through the condensers and be killed. These figures are conservative at best since they represent abundance over the entire western basin and these life history stages would be more heavily concentrated in near shore waters.

b. Given the short generation time for the majority of these phyto-and zoo-plankters, the energy used to reach these levels would be lost each time the population was reduced and forced to regenerate. Figures based on Parkhurst (1971) indicate that the plant will entrain and kill 47.3 billion planktonic organisms per day, assuming a density of 300 organisms per liter. 2/ This loss would cause a reduction in food supply for fish and other organisms in the plant vicinity, and perhaps also affect the area to the south where the current carries the plant effluent.

2/Parkhurst, B.R. 1971, the Distribution and Growth of the Fish Populations Along the Western Shore of Lake Erie at Monroe, Michigan during 1970. Tech. Rept. #17, Thermal Discharge Series, Dept. of Fisheries & Wildlife, Inst. of Water Research, Michigan State University.

c. The western basin of Lake Erie has traditionally been a valuable spawning site for lake herring, whitefish, walleye, yellow perch, and other fish. The wave action referred to in this section is in part responsible for this since the resulting turbulence maintains the clean bottom required for successful spawning by most of these species. In recent years spawning of many species has been reduced or eliminated due to pollution. However, even in its polluted state, this area remains a valuable habitat; with the advent of pollution control, this area will increase in importance as a spawning site.

d. The tone of the entire section on "Aquatic Ecosystem" suggests that all effects will be insignificant or of little consequence. We feel, for the reasons mentioned above, that this assumption is not necessarily valid, or at least the situation is not quite as simple as presented in this section. The western Lake Erie area was said on page 22 (4th paragraph) to be an important growth area for five species of fish. This fact in itself is sufficient reason to require additional researc and collection of data to ascertain the severity of the impact of operation of this power plant on the biota of Lake Erie. Any such research to be undertaken should be referred to in this section.

On page 61, in the 1st paragraph, the method of estimating the biological cost appears to be overly simplified and perhaps unrealistic. The actual total impact on fish eggs, fish larvae, and other organisms in the lower trophic levels may be much greater than could be estimated on the basis of assuming a one-to-one relationship between organisms killed and the total commercial fish catch. Because the estimate of total biological cost is based on commercial harvest and its value, and does not take into consideration the actual social and esthetic value of all the affected natural resources, we suggest that the estimate might be altered to reflect the inadequacy of monetary evaluation based on information that is presently available.

On page 61, in the 2nd paragraph, the data on which the estimate of the size of the thermal plume is based should be provided. A map depicting the isotherms for temperature elevation due to the heated discharge should also be included.

On page 61, in the 3rd paragraph, it is stated that sharp temperature changes can kill fish, but that sharp changes will be unlikely to cause problems at Fermi-2 because the return flow is from a large pond instead of directly from the main condenser. It is further stated that the applicant could gradually release heated water from the pond to avoid sharp temperature changes and prevent thermal shock to large biota. It would be helpful if some estimate were provided of the temperature decrease that fish attracted to warm discharge area in the winter would experience during a shutdown that lasted for several days.

On page 70, in the 4th paragraph, the radiological environmental monitoring program is not described in sufficient detail to permit an evaluation of its adequacy. We have previously commented on the PSAR and amendments, and have noted that samples of aquatic biota were not collected near enough to the effluent discharge point. We recommended that sediment and water within 500 feet of the discharge be analyzed for radioactivity, but we do not know whether or not these comments have been acted upon. We suggest that this section be expanded to include additional information on the monitoring program, including the recommended additions to the monitoring plan.

In our comments of April 19, 1971 to the AEC Division of Reactor Licensing concerning the Fermi Unit 2 plant, we computed an average annual relative concentration of 1.5×10^{-6} sec m^{-3} at the nearest site boundary. This is in close agreement with Draft Environmental Statement value of 1.2×10^{-6} as listed on page 64. It should be noted, however, that the average annual value is only applicable if the routine release of off-gas effluents occurs regularly and is distributed throughout the entire year. A one-hour release, 20 times a year, as was the case in the Turkey Point AEC Statement, cannot be considered a routinely emitted effluent. The Fermi Statement should describe specifically the routine release characteristics.

In the case of the environmental impact of accidental effluents, we are unable to find the specific meteorological assumptions used to determine the radiological consequences. The only details given (page 74) are that the assumptions used are those in the "proposed Annex to Appendix D". This Annex was not available to the reviewer. The applicant, in Supplement 1, Radiological Impact of the Enrico Fermi Atomic Power Plant, Unit 2, December 1971, states that their radiological environmental effects determination is conducted using "reasonable assumptions, justifiable calculational models and techniques and realistic assessments of environmental effects." The only specific information given is that "average meteorology for a typical flat site was used for this analysis" and that a release height of 55 meters was assumed. Since the release point to the outside atmosphere would be from the turbine or reactor building or from a roof-top vent on the reactor building, we would assume a ground level source rather than the 55 meter height assumed by the applicant. We do not know what the AEC assumed in this regard.

In summary, without specific information on the source height, the source emission characteristics and the probability of atmospheric diffusion rates we cannot make an assessment of the environmental impact of accidental or inadvertent radiological releases to the atmosphere.

In the section pertinent to Adverse Effects, on page 88, in the 2nd paragraph, it is contended that the majority of the organisms larger than 3/8 inch in diameter caught in the intake screens and sluiced back into the lake are expected to survive. The data upon which this conclusion is based should be provided. Some consideration of delayed effects would be warranted, in view of the distinct possibility that although organisms might not be killed outright, physical trauma or physiological shock following impingement on the intake screens and exposure to heat and chlorine might significantly impair normal behavior and development.

On page 96, in the last paragraph, we note that as an alternative to the use of chlorine, the applicant has considered--and temporarily rejected--at least one mechanical-abrasion method (Amertap). In view of the difficulties experienced with the Amertap system, we are curious to learn if consideration has been given to testing and evaluating other mechanical cleaning systems. If other systems have been considered, some discussion of these alternative systems should be presented.

Finally, in this statement the cost-benefit summary presents quantitative estimates of tax, employment, and recreation benefits, whose derivations are not discussed in the text.

We hope these comments will be of assistance to you in the preparation of the final statement.

Sincerely,

Sidney R. Galler

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

Appendix G
Comments of Environmental Protection Agency

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

14 APR 1972

RECEIVED
APR 17 1972
U.S. ATOMIC ENERGY COMMISSION
Regulatory
Mail Section

Mr. Manning L. 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 Enrico Fermi Atomic Power Plant Unit-2.

We appreciate the difficult circumstances and time restrictions under which the Atomic Energy Commission must prepare a series of complex impact statements. We also recognize the difficulty in determining the appropriate degree to which an agency should go in developing and providing data to support conclusions reached in the impact statement. It is our judgment, however, that this statement should contain additional information in order to evaluate fully the environmental impact of the operation of the Enrico Fermi Unit 2 plant. We therefore recommend that the final impact statement contain the additional information outlined in our detailed comments which are enclosed.

The most significant environmental impact during operation of the plant will be from chemicals (especially chlorine) in the residual heat removal pond blowdown. The applicant should consider discharging the chemicals to the outfall lagoon onsite with subsequent discharge to Lake Erie rather than the present design of direct discharge to Lake Erie. The feasibility and benefits of mechanically cleaning the condenser rather than using chlorine should also be considered.

The construction and maintenance of transmission lines from the plant represents a potential environmental impact comparable to the impact of constructing the reactor plant.

To minimize this potential impact, EPA recommends that the applicant consider the feasibility and benefits of using alternative rights-of-way with the intent to minimize the potential impact on valuable recreation land and land use patterns.

The most significant radiological impact due to routine operation of Enrico Fermi Unit 2 will be from noble gas and radioiodine discharges from the plant. EPA recommends that the applicant consider several alternatives to the proposed gaseous waste treatment system prior to completing the system design. In particular, the statement should discuss the feasibility of additional treatment for turbine gland seal leakage, main condenser off-gases, and secondary sources of radioiodine.

We will be pleased to discuss our comments with you or members of your staff.

Sincerely yours,

Sheldon Meyers

Sheldon Meyers
Director
Office of Federal Activities

Enclosure

ENVIRONMENTAL PROTECTION AGENCY

Washington, D.C. 20460

April 1972

EPA #D-AEC-0043-25

ENVIRONMENTAL IMPACT STATEMENT COMMENTS

Enrico Fermi Atomic Power Plant Unit-2

TABLE OF CONTENTS

INTRODUCTION AND CONCLUSIONS

The Environmental Protection Agency has reviewed the draft environmental impact statement for the Enrico Fermi Atomic Power Plant Unit-2 prepared by the U.S. Atomic Energy Commission and issued on March 6, 1972. Following are our major conclusions:

1. Several alternatives to the proposed gaseous waste treatment system should be considered by the applicant prior to finalization of the system design. In particular, the statement should discuss the feasibility of additional treatment for turbine gland seal leakage, main condenser off-gases, and secondary sources of radioiodine.

2. The environmental impact of the condenser cooling water discharge and the radioactive liquid waste discharge can possibly be reduced either by releasing one or both of the discharges into the north lagoon or by combining one or both of these discharges with those of Unit 1. The final statement should discuss the feasibility, benefits and costs of these various alternatives prior to finalizing the discharge method to be employed for either the radioactive liquid wastes or the condenser cooling water.

3. Two radiological issues require further analysis and evaluation -- transportation accidents and accidents involving reactor systems. These issues are common to all nuclear power plants, and it is appropriate that they be handled on a general basis. It is our understanding that the AEC is studying the probability and consequences of such accidents and will apply the study results to

all licensed reactor facilities. EPA will work closely with the AEC in the conduct of this work.

4. The proposed closed-cycle cooling system should minimize the thermal impact of the operation of the plant on Lake Erie. Although there are no thermal discharge standards proposed for Lake Erie, the applicant indicated the thermal discharge from the plant would be less than the upper limit proposed for Lake Michigan by the Lake Michigan Enforcement Conference. We commend the applicant for selecting a cooling system that will minimize the thermal impact on the receiving waters.

5. The environmental impact of the proposed construction of transmission lines leading from the site should be discussed. Alternative rights-of-way should be considered to minimize the potential impact on valuable recreation land and land use patterns.

6. We estimate that the most significant environmental impact during operation of the plant will be from chemicals (especially chlorine) in the residual heat removal pond blowdown. The statement should consider discharge of the chemicals to the outfall lagoon onsite, rather than the present design of direct discharge to Lake Erie, and should evaluate the feasibility and benefits of mechanically cleaning the condenser, rather than using undesirable chlorine.

7. A comprehensive monitoring and surveillance program should be developed for the environment affected by the operation of the plant to insure continued compliance with existing standards.

RADIOLOGICAL ASPECTS

Radioactive Waste Management

The design of and administrative controls placed on the radioactive waste treatment systems will determine if discharges will be reduced to "as low as practicable." Since the plant is in its early construction stages, the applicant should consider several alternative modifications to the radwaste treatment systems before the system design is finalized. The alternatives should be discussed relative to achieving "as low as practicable" discharges.

It is not clear that the proposed main condenser off-gas holdup system represents selection of equipment to obtain the lowest practicable levels of discharge. Other boiling water reactor plants of current design, some with elevated stacks higher than the Fermi Unit 2 vent, are proposing gaseous holdup longer than the proposed Fermi Unit 2 design. An analysis of the additional dose reduction which can be obtained by extending the capability of the main condenser off-gas holdup system should be presented.

The applicant has proposed extended holdup for the gaseous waste from the main condenser; however, only the conventional two minute holdup is provided to treat leakage from the turbine gland seals. It is noted that other BWR facilities of current design have included clean steam systems for the turbine gland seals. Thus, this technique is apparently practicable for minimizing releases from this source, and the final statement should address the feasibility of including this system for Fermi Unit 2.

The applicant has indicated (Amendment 13 to the Preliminary Safety Analysis Report) that the use of cooling towers for elevated release points for gaseous wastes is being considered as a method to further reduce off-site doses. The applicant is planning an investigative program to evaluate the effects of discharging noble gases from the top of the towers. This alternative should be evaluated very carefully because of the meteorological effects of the cooling towers themselves. Since engineered control is preferred to environmental dilution for reducing doses to individuals, additional holdup of the gaseous waste may be a more favorable alternative for reducing off-site doses. However, we encourage the applicant to evaluate the feasibility of providing additional atmospheric dilution in the described manner taking into consideration that while this additional dilution will reduce doses, it is not an acceptable substitute for providing adequate engineered controls.

Fermi Unit 1 employs a once-through cooling system which results in a high dilution flow from the plant; however, Fermi Unit 2 has a much lower dilution flow because liquid radwaste is discharged to the Unit 2 cooling tower blowdown line. The feasibility of discharging Unit 2 liquid radwaste to the Unit 1 discharge structure or to the north lagoon should be evaluated. This method of discharge would reduce radioactive concentrations of effluents to Lake Erie by dilution with the flow of Unit 1 and by dilution in the north lagoon. Furthermore, lagoon dilution would occur even if Unit 1 is not operating.

Radioiodine in the main condenser off-gas line will probably be removed by the charcoal beds; however, radioiodine from other sources will be discharged untreated. Iodine will be released from the gland seal exhaust system and building vents. The statement should discuss feasibility and expected benefits of providing iodine adsorbers in the plant ventilation systems and the additional costs involved.

The standby gas treatment system will provide for charcoal and particulate filtration of gaseous effluents from the purging of the drywell, suppression chamber, and reactor building. The statement indicates that this system may be employed to minimize gaseous releases from the reactor building; however, the levels of radioactivity which determine when this system will be utilized were not specified. The standby gas treatment system is designed as an engineered safeguard; therefore, it may not be desirable to use the system during routine operations because of reliability considerations. The statement should discuss the feasibility of using the system during routine operations and the measures that will be taken to insure the availability and reliability of the system as an engineered safeguard. If the standby gas treatment system is not to be utilized to treat routine releases from the reactor building and containment purging, alternative methods of treatment should be discussed.

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 potential for such accidents is 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 is necessary. A general study would result in a better understanding of the environmental risks than would a less-detailed examination of the questions on a case-by-case basis in individual impact statements. For this reason we have reached an understanding with the AEC that they will conduct such analyses, with EPA participation, concurrent with reviews of impact statements for individual facilities and will make the results public in the near future. We believe that any changes in equipment or operating procedures for individual plants required as a result of the investigations can be included without unnecessarily delaying plant completion. If major redesign of the plants to include engineering changes were expected, or if immediate public or environmental risk were being taken while these two issues are being resolved, we will, of course, make our concerns known, and a new impact statement may be necessary.

The statement concludes "...that the environmental risks due to postulated radiological accidents at the Fermi-2 facility are exceedingly small and need not be considered further." 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 stated 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 Atomic Energy Commission will apply the results to all licensed facilities.

NON-RADIOLOGICAL ASPECTS

Thermal Discharges

Although there are no thermal discharge standards proposed for Lake Erie, the statement indicates the thermal discharge from Unit 2 will be less than the upper limit proposed for Lake Michigan by the Lake Michigan Enforcement Conference. We commend the Detroit Edison Company for their interest in minimizing the potential environmental impact of the thermal discharge. It appears that the proposed closed-cycle cooling system will minimize the thermal impact of Fermi Unit 2 on Lake Erie. However, the statement did not adequately discuss the potential impact in relation to existing thermal discharges from facilities in close proximity. The final statement should present estimates of the thermal discharges from the nearby facilities (such as Fermi Unit 1 and the Monroe Generating Plant) and should discuss the total biological impact of these discharges on the lake. This discussion should also present the assumptions and their bases listed to calculate the environmental impact.

Calculations indicate that the values given in the draft statement for evaporation, blowdown, make-up, and drift are excessive. The following values were computed:

	Maximum	Average Annual
Evaporation	18,000 gpm	12,000 gpm
Blowdown	11,000 gpm	8,000 gpm
Make-up	29,000 gpm	20,000 gpm

The maximum calculated values are comparable to the data given in the statement (pages 32 and 52), but the average annual values are substantially lower. The amount of dissolved solids contained in cooling tower drift is estimated to be from 260 to 530 pounds/day, as opposed to the excessive amounts of 1000 pounds/day, estimated in the statement (page 45). Adjustments of these data should be made in the final statement.

Biological Effects

The western end of Lake Erie is the nursery area for the entire lake. As a result, the western end is also one of the most sensitive areas in the Great Lakes with respect to changes in the hydro-climate. The draft statement should independently consider the biological effects of the blowdown discharge. For example, the acceleration in the growth of exotic saltwater diatoms in the area and the possibility of this evolutionary phenomenon extending up the food chain should be discussed. In addition, the blowdown discharge should also be considered in combination with other effluents to determine their combined effect on the existing blue-green algae growth in the area. The increase in temperature, which is at critical levels during the summer months, and the increase in the concentration of dissolved solids may have a significant effect on algae blooms. This could result in a decrease in the DO levels because of the higher temperature and BOD that result from such increased algae blooms.

In addition, the statement does not consider biocides, other than chlorine and anticorrosive agents, as to their impact on the aquatic biota of Lake Erie. This subject should be addressed in the final statement.

The condenser cooling makeup water for Unit 2 will be pumped through the existing water intake structure of Unit 1. The statement should discuss the environmental consequences of the present Unit 1 water intake flow and the projected water intake flow when both units will be operating. For example, the statement should discuss the operating experience regarding entrainment of organisms in the present Unit 1 intake. Furthermore, estimates of entrainment effects with both units operating should be presented.

Non-Radioactive Discharges

The statement did not adequately discuss the discharges of non-radioactive wastes from the plant. It should specify the location of Unit 1 & 2 discharges and should present a discussion of the interaction between the discharges. In addition, consideration should be given to the feasibility of releasing Unit 2 discharges into the north lagoon or combining the discharges with those of Unit 1. This would provide several possible beneficial effects. For example, if chlorination is used, any accidental over-use or misuse of this compound would not be directly discharged into Lake Erie. The time of passage through the lagoon, Swan Creek, and into the lake would probably result in a significant reduction of these accidental discharge levels. Further, since the fish life in this lagoon area is minimal, any problems encountered in the small heat discharges would be reduced.

To more fully evaluate the potential environmental impact of chemical discharges, it would be helpful if the following information were included in the final statement:

1. Concentrations of chemicals discharged from the plant should be specified along with the ambient chemical concentrations in the intake water. Current applicable water quality standards should be compared with the expected discharges.

2. It is recommended that residual chlorine in the recieving waters be limited to the following:

TYPES OF CRITERIA	RECOMMENDATIONS FOR RESIDUAL CHLORINE
Continuous	0.002 mg/liter
Intermittent	A. 0.1 mg/liter not to exceed 30 minutes/day
	B. 0.05 mg/liter not to exceed 2 hrs/day

3. Details of the outfall design related to effluent dispersion should be presented.

4. Chlorine usage, in our opinion, is not a reasonable solution to condenser fouling in light of current technology and the stage this plant's design and construction. Since there are practicabl mechanical cleaning systems for condensers, the feasibility of such systems should be addressed in detail.

The environmental impact of all chemical wastes released from the plant should be considered in relation to lake water quality. In particular, blowdown discharges to Lake Erie should be discussed in the final statement, especially the effects of phosphates.

COST/BENEFIT

EPA is in general accord with the AEC that construction of the Enrico Fermi Atomic Power Plant Unit-2 "is expected to have only a small impact on the environment."

The cost-benefit analysis in the statement, however, is not complete in several respects. Therefore, the following information should be presented in the final statement:

a. A quantitative assessment of the potential environmental costs of releasing the proposed concentrations of residual chlorine into Lake Erie.

b. Information on the cost-effectiveness considerations leading to the adoptions of the present designs of the radioactive waste treatment systems.

c. More quantitative details on the analysis that relates the impact of increased cloudiness, precipitation, fogging, and icing from the natural draft cooling towers to environmental costs.

d. Indication of the quantitative environmental costs of any deterioration of the air quality resulting from emission of various pollutants from the reactor.

e. Estimates of the costs and benefits of constructing transmission lines on new rights-of-way or presently owned rights-of-way. This analysis should discuss the environmental impact of the construction and maintenance of the lines, and the alternative rights-of-way available.

With regard to the assumptions used in the statement for the cost-benefit analysis, we note the following; a) local taxes are a transfer, not a benefit, b) the estimated 1974 reserve margins given by the Federal Power Commission in Appendix A of the statement differ substantially from those of the applicant. Apparently, a major portion of the discrepancy can be explained by a revised schedule of operation for the Fermi 2 plant.

MONITORING & SURVEILLANCE

A comprehensive monitoring and surveillance program should be developed for the environment affected by the operation of the Fermi Plant to insure continued compliance with existing standards and to prevent any significant damage to biota. EPA will be pleased to work with Federal and state agencies in developing general guidelines which can be used by the applicant in preparing a comprehensive and effective plan. We believe the plan should include the following areas:

1. Impact of plankton entrainment in cooling waters on the ecology of the area.
2. Continuous water temperature monitoring.
3. Dissolved oxygen monitoring to insure that receiving waters remain within applicable standards.
4. Biological monitoring. The development of this plan will depend on established base line biological data and demonstrated needs as determined by information generated by other elements of the monitoring system.
5. Monitoring of sulphates, phosphates, and toxic metals as well as oil and grease and any other material that may come in contact with water.

CONSTRUCTION EFFECTS

The land which is being or planning to be acquired for transmission line right of way represents a significant environmental impact. In terms of total land consumed, populations affected, and land uses involved, the transmission network probably has an environmental impact comparable to the environmental impact of the reactor plant site.

The proposed Detroit Edison transmission line which leads from the Fermi Unit 2 plant would cross and/or parallel valuable public recreation land as well as privately owned kettle moraine topography which is devoted to agricultural uses. Not only does the construction of the line have an environmental impact in terms of soil erosion or drainage patterns, but the maintenance of the line by the use of herbicides or other defoliants could have an adverse impact on wildlife. Therefore, the environmental impact of reducing or destroying the value of this recreation land and affecting land use patterns needs to be considered in the environmental impact statement.

The applicant and the Detroit Edison Company could minimize the potential environmental impact of constructing transmission lines by utilizing existing north-south network corridors in the south-eastern Michigan area. For example, the Michigan Consolidated Gas and Texas Eastern Panhandle pipeline right-of-way could be used for these lines since they parallel the Detroit Edison majestic transmission line. Further, the statement should discuss the feasibility, benefits, and costs of using alternative transmission line rights-of-way that are available to the utility.

In order to minimize damage to the aquatic biota, the scheduling of dredging in cold weather should be considered for materials having a high oxygen reduction potential or when dredging is done in eutrophic waters. In addition, dredged materials should be disposed of on land in an approved site above the mean high water level.

The statement should discuss measures being taken to minimize erosion and siltation during plant construction. For example, retention ponds for sediment control could be designed to safely contain both liquid and solid loads.

SITE SELECTION AND GENERAL DEVELOPMENT

The draft statement indicated that a major percentage of the construction site was previously wetland. We believe that wetland areas are a valuable natural resource and should be left undisturbed whenever possible. We recognize that the plant investment may obviate the option of relocating the plant; however, any future construction on the location should avoid disturbing the remaining wetland areas.

The plant is in the center of a relatively undeveloped area on Lake Erie approximately twenty miles from Detroit and Toledo. It is also between a state park (Sterling State Park), and a state game area (Pointe Mouillee State Game Area). Areas such as these are highly susceptible to industrial and residential growth. Therefore, simple extrapolation of past growth would be misleading. Thus, the low average growth rate of 2.5% purported for the next thirty years should be supported in the final statement. We realize the problem caused by additional population and development in the area is not a direct result of the Fermi Plant. To insure a quality environment proper land use, and protection of natural resources in the area, Detroit Edison should aid or join Federal, state, and municipal agencies in an interdisciplinary program for development of a land and water use plan. This plant should be designed to achieve a balance between population, land use, and resources of the region, which will permit high standards of living and a quality environment.

ADDITIONAL COMMENTS

During the review we noted in certain instances that the statement does not present sufficient information to substantiate the conclusions presented. We recognize that much of this information is not of major importance in evaluating the environmental impact of the Enrico Fermi Unit 2 plant. The cumulative effect, however, could be significant. It would, therefore, be helpful in determining the impact of the plant if the following information were included in the final statement:

Radiological

1. The statement should present a complete discussion of the activity and volume of radioactive solid wastes shipped offsite. The capability of the present system to handle variabilities in solid waste quantities should be presented, especially with regard to operational limits (e.g., in-leakage of lake water into the primary system through failed condenser tubes).

2. The statement should discuss the monitoring of liquid and gaseous discharges in greater detail. Discharges should be analyzed and reported with adherence to the AEC Safety Guide 21. In this manner, meaningful dose estimates can be calculated during operation of the plant. The final statement should also evaluate the amounts of liquid and gaseous radioactivity that could be released undetected and should present estimates of the amount of activity that will be discharged before monitoring alarms are activated and the discharge terminated.

3. The statement should discuss the realistic bases for liquid waste treatment equipment decontamination factors (DF's). This information is important especially since an overestimated DF will result in an underestimated liquid discharge level. The applicant did present references for the design bases DF's for demineralizers and evaporators in the PSAR. These references, however, referred to test data from equipment quite different from that proposed for Fermi Unit 2. Information on tests of the specific equipment for Fermi Unit 2 would provide greater credence to the analyses presented.

4. Additional information on aging characteristics and degradation of the charcoal beds should be provided and periodic testing of the retention characteristics of the filters should be performed. The applicant estimated the buildup of activity on the charcoal beds to be 4,000 curies of noble gases and 70 curies of particulate daughters. The consequences of the ultimate disposal of the charcoal containing residual quantities of radioactive material should be discussed.

5. The statement should present more information concerning the calculations of offsite doses, for example:

   a. Assumptions and their bases for the source terms for radioactive liquids (Table V-1 of the statement) and radioiodine (page 64 of the statement).

   b. Assumptions and their bases used to calculate a realistic child's thyroid dose from cow's milk. This should include such information as the distance to the nearest dairy farm and the atmospheric dispersion factor (X/Q) at the farm. Also, estimates of the cumulative thyroid dose expressed in thyroid man-rem, including all assumptions and their bases.

c. Details regarding assumed fish reconcentration factors, the dilution factors used for the fish consumption man-rem calculations, and the basis for the assumed 20 grams/day intake of fish (usually 50 grams/day is assumed).

d. Doses and their bases, from 1) secondary sources of noble gases and iodines (reactor building, turbine building, vent exhausts, etc.), 2) direct radiation from the turbine and other structures, and 3) accident classes 1, 2, and 4.1 should be presented in Table V-2 of the statement.

e. Table V-2 of the statement should include the existing environmental impact from the operation of Fermi Unit 1 and the combined effect of dual unit operation at the site.

f. The man-rem dose estimates cannot be obtained using the average doses and cumulative population estimates in Table V-3. The discrepancies in Table V-3 should be resolved in the final statement.

6. The dose consequences of transportation accidents involving spent fuel should be expanded to include the source terms utilized in the calculations, if this source term is different than that assumed for the general AEC transportation analysis.

7. The statement should discuss the potential leakage of primary coolant water through the residual heat removal (RHR) heat exchangers with subsequent discharge to the environment. The applicant indicates in the environmental report supplement that leakage is possible during the shutdown-depressurization mode of the RHR system. The statement should discuss the adequacy of the present system to prevent and control such leakage.

Non-Radiological

1. the statement should present predicted noise levels at the site boundary during construction and operation of the plant. Noise abatement procedures to be utilized during construction and land clearing operations, including the use of construction equipment, should be outlined.

2. A more detailed discussion of the air quality comments should be presented in the final statement. Anticipated air quality changes as a result of the construction and operation of the plant, including potential air pollution emissions resulting from 1) non-nuclear accidents (e.g., chlorine), 2) gas turbines, 3) rock crushing and concrete mixing plants, and 4) land clearing.

3. The production and disposal of non-radioactive wastes generated during construction at the site should be discussed in more detail. This discussion should include the location of the local landfill site, minimum earth cover used for wastes, and the production and disposal of excavation and plant construction solid wastes.

4. The statement should give values for expected volumes, characteristic concentrations, and types of treatment of sanitary wastes during construction and plant operation. The agreement of sanitary waste discharges with state standards should be discussed.

5. The statement should include a discussion of a spill prevention, containment, and counter measure plan for non-radiological toxic substances that may be stored at the site.

6. A detailed site plan should be included showing locations of all reactor structures, water intakes, and liquid and gaseous discharge points for Fermi Unit 1 and 2.

Appendix H
Comments of Federal Power Commission

FEDERAL POWER COMMISSION
WASHINGTON, D.C. 20426

IN REPLY REFER TO:

PWR-ER

April 12, 1972

Mr. Lester Rogers
Director, Division of Radiological
and Environmental Protection
U. S. Atomic Energy Commission
Washington, D. C. 20545

50-341

Dear Mr. Rogers:

This is in response to your letter of March 6, 1972, requesting the comments of the Federal Power Commission on the AEC's Draft Environmental Statement Related to the Proposed Issuance of a Construction Permit to the Detroit Edison Company for the Enrico Fermi Atomic Power Plant, Unit 2.

These comments update those submitted by the Federal Power Commission on February 16, 1971, which are Appendix A of the Draft Environmental Statement, and reemphasize the need for the facilities as related to the adequacy and reliability of the Applicant's electric system and that of the Michigan Power Pool of the East Central Area Reliability Coordination Agreement (ECAR) area of which the Applicant is a member. This review is in accordance with the National Environmental Policy Act of 1969 and the Guidelines of the President's Council on Environmental Quality dated April 23, 1971.

In preparing these comments, the Bureau of Power staff has considered the AEC's Draft Environmental Statement; the Applicant's Environmental Report and Supplement thereto; the Monthly Power Statements submitted to this Commission by the Applicant; related reports made in response to the Commission's Statement of Policy on Adequacy and Reliability of Electric Service (Order No. 383-2); and the FPC staff's independent analysis of these documents together with related information from other sources.

Need for the Facilities

The following tabulations show the electric system loads to be served by the Applicant and the Michigan Power Pool of which the Applicant is a member, and the relationship of the electrical output of the Enrico Fermi 2 unit (1,150 MW) to the projected available reserve capacities on the summer-peaking Applicant's and summer-peaking Pool's systems at the times of the 1975 summer, and the 1976 summer peak periods. The Detroit Edison Company and Consumers Power Company comprise the Michigan Power Pool. The 1976 peak load period is the now anticipated initial

Mr. Lester Rogers

service period of the new unit, but the life of the unit is expected to be some 35 years or more, and it is expected to constitute a proportionate part of the Applicant's total generating capacity throughout that period. Therefore, it 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. Until recently, the unit was scheduled to be in service to aid in meeting the 1975 summer peak period, but is now not expected to be in commercial operation until October 1975. The tabulation of the estimated situation for 1975 summer is included to show the trend of load growth and reserve margin levels, as indicated by Table I-1 of the Draft Environmental Statement.

The plans of the Michigan Pool members as contained in the April 1971 submission by ECAR to the Federal Power Commission in accordance with FPC Order 383-2 included the following additions and retirements of generating resources scheduled to obtain in the 1971-1976 construction program in order to meet the forecasted 1976 summer load period.

Nuclear Fueled Generation Additions

Palisades 1 - initially 700 megawatts, finally 800 megawatts
Fermi 2 - 1,150 megawatts
Midland 1 - 486 megawatts

Fossil Fueled Generation Additions

Monroe 1 - 786 megawatts
Monroe 2 - 789 megawatts
Monroe 3 - 789 megawatts
Monroe 4 - 786 megawatts
Karn 3 - 660 megawatts
Karn 4 - 660 megawatts
Saginaw Area - 390 megawatts (G.T. and combined cycle)
Miscellaneous small peaking - 87 megawatts

Pumped Storage Generation Additions

Ludington - 1,872 megawatts

Fossil Fueled Generation Retirements

Miscellaneous small obsolete units - 1,105 megawatts
(Includes 80 megawatts Saginaw River Plant already retired.)

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The only major unit included in the above list now in commercial operation is the Monroe No. 1 unit. This is to say that 2,436 megawatts of nuclear capacity, 4,074 megawatts of fossil fueled capacity, and 1,872 megawatts of pumped storage capacity, for a total of 8,382 megawatts, are yet to be brought into operation over this period.

Various factors encountered since the originally planned operating dates for many of these units, particularly the nuclear units, have occasioned delays in these schedules. The delay in the Fermi No. 2 unit has been previously noted, and the most recent information indicates that the Midland No. 1 unit will not be available until May 1977, rather than early 1976 as included in the above tabulation.

The Detroit Edison Company announced in November 1971 a proposed 750-megawatt oil-fired Greenwood No. 1 unit for March 1976 operation. The staff of the Bureau of Power has also learned that in view of this the plans for the 390 megawatts of gas turbine and combined cycle units shown above for the Saginaw Area have been abandoned for at least the time being. Furthermore, the Detroit Edison Company's planned retirement of small, old fossil-fueled units may proceed at a slower pace than initially scheduled. The net effect of these modifications to the construction program is reflected in the following tables, except that, because of lack of detailed information, no attempt has been made to factor in any change in planned retirements of the old small units.

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1975 Summer Peak Load Period

	Detroit Edison Company	Consumers Power Company	Michigan Power Pool
With Enrico Fermi No. 2 (1,150 Megawatts)			
Net Dependable Capacity, Megawatts	9,982 1/	6,089 2/	16,071 3/
Peak Load, Megawatts	7,842	4,566	12,408
Reserve Margin, Megawatts	2,140	1,523	3,663
Reserve Margin, Percent of Peak Load	27.3	33.4	29.5
Without Enrico Fermi No. 2 (1,150 Megawatts)			
Net Dependable Capacity, Megawatts	8,832 1/	6,089 2/	14,921 3/
Peak Load, Megawatts	7,842	4,566	12,408
Reserve Margin, Megawatts	990	1,523	2,513
Reserve Margin, Percent of Peak Load	12.6	33.4	20.3

1/ Reduced by net purchases 238 megawatts
2/ Reduced by net purchases 174 megawatts
3/ Reduced by net purchases 412 megawatts

Mr. Lester Rogers

1976 Summer Peak Load Period

	Detroit Edison Company	Consumers Power Company	Michigan Power Pool
With Enrico Fermi No. 2 (1,150 Megawatts)			
Net Dependable Capacity, Megawatts	10,732	6,749	17,481
Peak Load, Megawatts	8,019 1/	5,210 2/	13,229 3/
Reserve Margin, Megawatts	2,713	1,539	4,252
Reserve Margin, Percent of Peak Load	33.8	29.5	32.1
Without Enrico Fermi No. 2 (1,150 Megawatts)			
Net Dependable Capacity, Megawatts	9,582	6,749	16,331
Peak Load, Megawatts	8,019 1/	5,210 2/	13,229 3/
Reserve Margin, Megawatts	1,563	1,539	'3,102
Reserve Margin, Percent of Peak Load	19.5	29.5	23.4

1/ Reduced by net purchases 666 megawatts
2/ Includes net sales of 130 megawatts
3/ Reduced by net purchases 536 megawatts

The Applicant, in speaking generally of the factors to be included in the planning of reserve margin requirements, states, "For future planning purposes a level of 20 percent is, therefore, not unreasonable." The staff of the Bureau of Power has noted that without the Enrico Fermi No. 2 unit, the Applicant's projected reserve margin for the summer of 1976 peak period will be wholly vested in two large new units which will have to be proven in operation as to a mature availability status.

Transmission Facilities

It is noted that the Applicant plans the addition of two 345-kilovolt double-circuit EHV transmission lines with the Enrico Fermi No. 2 unit in order to integrate the plant output into the existing system. It is also noted that maximum use is to be made of existing transmission line corridors and that aesthetically designed supporting structures will be employed to soften environmental intrusion.

Mr. Lester Rogers

Alternates to the Project Facilities and Costs

The Applicant states that its decision to install the Enrico Fermi No. 2 nuclear unit to provide for its projected need for baseload capacity was predicated upon the best balance of economic and environmental factors. It did not find such baseload capacity available from outside sources, but considered that, even if it were, the cost would not be less than 8.0 mills per kilowatt hour. In making these evaluations, it used plant costs per kilowatt of capacity of $307 for nuclear, $280 for coal fired, and $150 for No. 2 oil-fired peaking units with respective fuel costs in cents per million Btu of 17, 55, and 105, or in mills per kilowatt hour of 1.7, 5.0, and 10.5. The staff of the Bureau of Power has examined these costs in the light of similar costs reported by others and finds them to be reasonable.

Conclusions

In view of the delays already experienced in bringing many large new generating units of all types into commercial operation on schedule, with the consequence that less than optimum economic or adequate and reliable operations results, the staff of the Bureau of Power concludes that it would be prudent to avoid further delay in the schedule for bringing the Enrico Fermi unit into commercial operation.

Very truly yours,

T. A. Phillips
Chief, Bureau of Power

Appendix I
Comments of Department of Interior

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

ER-72/269

APR 25 1972

Dear Mr. Muntzing:

This is in response to Mr. Rogers' letter of March 10, 1972, requesting our comments on the Atomic Energy Commission's draft detailed statement, dated March 1972, on environmental considerations for Enrico Fermi Atomic Power Plant, Unit 2, Monroe County, Michigan.

Historical Significance
The statement indicates that the proposal will not adversely affect any proposed or existing National Park Service area, natural or environmental educational landmarks, or properties listed in the National Register of Historic Places. However, we think that the final statement should include evidence of consultation with the State Liaison Officer for Historic Preservation. This will provide a measure of protection for any archeological or historical values of State or local significance. The Historic Preservation Officer for Michigan is the Director, Department of Natural Resources, Stevens T. Mason Building, Lansing, Michigan 48926.

In addition, the statement should clearly indicate that the presence or absence of archeological values is based on factual, professional knowledge and provide an evaluation of their significance, if present. Archeological advice can be obtained from Dr. James B. Griffin, Department of Anthropology, 221 Angell Hall, University of Michigan, Ann Arbor, Michigan 48104.

External Appearance
The site development plan adopted by the applicant and presented on pages 28 and 30 will provide public use of those areas not needed for power generation. According to the statement, the plan considered the two additional units with a view toward minimizing any future disruption of the site environment when these units are constructed.

Transmission Lines
Construction and maintenance techniques are important in minimizing the impacts of transmission lines. We suggest that normal inspection of the right-of-way be conducted by

airplane, helicopter, or on foot, thus eliminating the need to keep the entire right-of-way cut back. Clearing should be limited to only permit access of maintenance vehicles and to keep the line free from intrusion of trees which would interfere with safe operation of the line.

Effluent Systems

The final statement should include the location of the disposal site and method of disposal for solid radioactive wastes. This lack of information was recognized on page 80 but no indication was given as to its availability for inclusion in the final statement.

Environmental Impacts of Plant Operation

According to information on pages 45, about 1,000 pounds per day of dissolved solids are expected to be contained in the drift discharged from the cooling towers. Although the amounts of these solids are comparatively small, we suggest that the potential nuisance effects and property damage of solids fallout be considered. For example, over a long term, solids deposition on structures with intermittent flushing away by rain might lead to significant corrosion damage.

The discussion on pages 56 and 57 of the effects of chlorine on aquatic life appears to be less specific and up-to-date than the basic information presented on page 96 of the recent environmental impact statement on the Palisades Nuclear Station. The latter data show that even the stringent chlorine criteria of 0.1 ppm of the State of Michigan is above the concentration at which environmental damage may occur. It is recommended that the cooling system of the Fermi 2 be operated to minimize the concentration of chlorine discharged to the lake in the blowdown.

Biological Impact

The last phrase on page 60 states that the lake is shallow near the Fermi site and is known not to be a productive benthic or fish spawning area due to disturbances of the waters and basin by wave action. We think this statement should be qualified.

The extreme west end of Lake Erie frequently has winds from the west (over the land) which result in a quiet shore, especially during summer. The chart on page 17 shows that the wind is usually from the west.

Stoney Point is a traditional spawning site for whitefish and walleyes. The latter spawn in this area. Also, recent studies a few miles south of the plant site have shown the existence of good populations of juvenile yellow perch, white bass, spot-tailed shiners, alewives, and other fish in that shore area. We believe that comparable fishery studies in the Stoney Point-Fermi area might well confirm that similar populations exist there.

The statement recognizes that there will be some damage to aquatic life in the lake resulting from the heated and chemical discharges, from impingement and losses of fishes and other organisms at the intake, and from habitat changes. We think the applicant should provide mitigation measures for these unavoidable adverse impacts.

Accumulative Effects

We believe that a discussion of the two future units in relation to land use and projected environmental impacts should be given in this statement in order to put the proposed Unit 2 in proper perspective and to comply with the NEPA. Tables V-2 and IV-2 give dose calculations resulting from this unit for the populations in 1980 and 2000. However, since the applicant plans to have one additional unit in operation by 1980 and two additional units in operation by 2000, we think dose calculations should be given in these tables for all units expected to be in operation in those years, including Unit 1 which is presently operating.

It must be noted that the proposed action is a change in land use, one that is primarily industrial and, as such, constitutes another commitment of the western Lake Erie shoreline to industrial purposes. The cumulative effects of industrial growth on land in this area should be addressed.

Accidents

Section V, Environmental Impacts of Plant Operation, gives an adequate evaluation of impacts resulting from postulated accidents through Class 8 for air-borne emissions. However, the environmental effects of releases to water is lacking. Some of the accidents described in Table V-5 could result in releases to Lake Erie and should be evaluated in detail.

We also think that Class 9 accidents resulting in both water and air releases should be described and the impact 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 should be weighed.

The probability is low of a severe accident involving a truck transporting low-level solid wastes in 55-gallon drums to a disposal point. However, we suggest that emergency procedures be devised to maximize containment of spilled wastes, and to minimize personal contamination. These procedures should be included in the final statement.

Summary of Cost-Benefit Analysis

This section does not adequately evaluate the monetary or environmental impacts of the project. The benefits given in Table IX-2 of $1,684,318,000 compared to the generating cost of $417,150,000 is far from accurate. For instance, a comparison of these two figures shows that the applicant has a profit of about 300 percent which is far above that allowed for the regulated electric utilities. If this table is intended to show cost and benefits from the plant's standpoint, it would not include local taxes and employment on the benefits side, but rather on the cost side. However, if it is intended to show cost and benefits from the society's standpoint, taxes would be included on both sides since the applicant's customers pay the taxes as part of the electric power costs. It is not clear if the $1,605,174,800, given as the benefits of electric power produced and sold, is the value at plant site or at market. If it is at market value, then the $417,150,000, given as generating costs should be increased significantly in order to include transmission and distribution costs. Further, since additional permanent employment is involved, additional services, such as schools and public works, will also be involved and should be included on the cost side. We continue to believe that values which can be expressed in monetary terms should be included in the economic analysis and not in the environmental statement.

The evaluation of environmental impacts needs to be expanded to include items other than the approximately 1200 pounds of fish lost per year and the radioactive exposure to people. The loss of marsh lands and associated fish and wildlife should be evaluated more precisely. Other environmental impacts should be evaluated in terms of miles of transmission lines, length of shoreline, or distance from which the cooling towers can be seen.

We hope that these comments will be helpful to you in the preparation of the final statement.

Sincerely yours,

Deputy Assistant Secretary of the Interior

Mr. L. Manning Muntzing
Director of Regulation
Atomic Energy Commission
Washington, D. C. 20545

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

MAILING ADDRESS:
U.S. COAST GUARD (WS)
400 SEVENTH STREET SW.
WASHINGTON, D.C. 20590
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Appendix J
Comments of Department of Transportation

19 APR 1972

Mr. Lester Rogers, Director
Division of Radiological
and Environmental Protection
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Rogers:

This is in response to your letter of 6 March 1972 addressed to Mr. Herbert F. DeSimone, Assistant Secretary for Environment and Urban Systems concerning the revised draft environmental impact statement, environmental report and other pertinent papers on the Enrico Fermi Atomic Power Plant, Unit 2, Monroe County, Michigan.

The concerned operating administrations and staffs of the Department of Transportation have reviewed the papers submitted and the following is noted from the review by the Federal Railroad Administration.

> "We see no mention in that part of the draft environmental statement pertaining to transmissions lines that addresses the problem of proximity of railroad tracks, if any. Experiences with high voltage lines, such as the proposed 345 KV lines, have demonstrated that inductive coupling or direct faulting with railroad communication and signal lines occur all too frequently. We would like to suggest that the problem be addressed."

Noted in the review of the Office of Hazardous Materials is the following:

> "We have no specific comments to offer on this report. We find no statement or information regarding the transport of radioactive material which are inconsistent with existing DOT or AEC regulatory requirement."

It is the determination of this Department that the impact of this proposed nuclear power plant construction upon transportation is fairly minimal. It is requested, however, that the concern of the Federal Railroad Administration regarding faulting or inductive coupling, if indeed it is a problem, be addressed in the final statement. This Department can find no objection to the issuance of a construction permit.

The opportunity for the Department of Transportation to review and comment on the supporting papers relative to the Enrico Fermi Nuclear Atomic Power Plant Unit 2 is appreciated.

Sincerely,

J. M. Austin

J. M. AUSTIN
Captain, U. S. Coast Guard
Acting Chief, Office of Marine
Environment and Systems

DEPARTMENT OF THE ARMY
DETROIT DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1027
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Appendix K
Comments of Department of the Army

19 APR 1972

Mr. Lester Rogers, Director,
Division of Radiological and Environmental Protection
U.S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Rogers:

This is in response to your draft environmental statement transmitted on 6 March 1972 concerning the Enrico Fermi Atomic Power Plant Unit 2 to be constructed by the Detroit Edison Company, Docket Number 50-341.

The Detroit District has received a permit request from the Detroit Edison Company to dredge a temporary barge access channel to the subject plant site for delivery of the plant Reactor Pressure Vessel.

Our concern with this channel centered on the effects such a channel would have on the littoral drift along this section of the Lake Erie shoreline. Studies of the area do not conclusively show a predominant direction of littoral transport. It is probable that the existing stone groins (dikes for the intake canal to Fermi Plant No. 1) located approximately 1400 feet south of the proposed dredging site interrupt a significant portion of the littoral drift. Any additional material in littoral movement could be trapped in the proposed barge canal as if it were a settling basin. Since the applicant owns the property for about one mile either side of the proposed channel, it is considered that any adverse effects from the dredging would be confined to the applicant's property.

The District Engineer issued a Public Notice on 3 April 1972 concerning the application for a dredging permit under Section 10 of the River and Harbor Act of 1899. This notice expired 13 April 1972 with no apparent objections from the public sector; however, the permit has not been granted as of this date.

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Mr. Lester Rogers

19 APR 1972

We have no further comments regarding the final environmental statement. Thank you for the opportunity to review this document.

Sincerely yours,

MYRON D. SNOKE
Colonel, Corps of Engineers
District Engineer