Final

environmental statement

related to operation of

JAMES A. FITZPATRICK NUCLEAR POWER PLANT

POWER AUTHORITY OF THE STATE OF NEW YORK

DOCKET NO. 50-333

MARCH 1973

UNITED STATES ATOMIC ENERGY COMMISSION

DIRECTORATE OF LICENSING

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 actions are the continuation of Construction Permit CPPR-71 and the issuance of operating license to the Power Authority of the State of New York and the Niagara Mohawk Power Corporation for the operation of the James A. FitzPatrick Nuclear Power Plant in the Town of Scriba, County of Oswego, State of New York (Docket No. 50-333).

3. The James A. FitzPatrick Plant will utilize a boiling-water reactor with a designed thermal rating of 2436 megawatts to produce 821 megawatts net electrical power and a maximum (stretch) rating of 2557 megawatts thermal (MWt). The condenser cooling will be accomplished by using once-through cooling water drawn from and discharged to Lake Ontario at the rate of 370,000 gallons per minute.

4. Summary of environmental impact and adverse effects:

   - About 22 acres of the 702 acres of land formerly used as an artillery range have been converted to the Plant facilities.

   - The transmission lines rights-of-way construction will result in the alteration of approximately 1000 acres of natural area and the displacement of some wildlife presently in the area. Although the overall construction of the transmission line is environmentally acceptable, there are several instances where State and Federal guidelines have not been followed. These occurred at a few road and stream crossings and in rough hilly areas. The transmission corridor interferes only in a minor way with prior land use.

   - Fish will be impinged on the intake screen. Although it should have little or no noticeable effect on the fish population of the lake as a whole, the kill rate at Nine Mile Point, Unit 1, considered in conjunction with the kill rate at the FitzPatrick Plant, may be unacceptably high in relation to the fish population in the region of Nine Mile Point. A program of monitoring the kill rate and of determining the local fish population will be required to determine the seriousness and extent of the problem.

- Fish and fish larvae are not expected to survive passage through the plant cooling system, which will add an incremental loss of the fish population. Zooplankton are expected to suffer a high mortality rate in the summer. However, even if the rate were 100% the impact of such mortality among organisms with a short generation time will not be measurable in the area.

- The thermal discharge is not expected to have any significant deleterious effects on the biota due to the rapid dissipation of heat. Some juvenile fish may travel into the heated effluent and die; their number, however, is expected to be relatively small. No shifts in algae populations from abundance of diatoms and green algae to blue-green algae are expected.

- Although outages are not planned for winter, should the Plant be shut down during winter due to unavoidable circumstances, fishes residing in the plume may die. Considering the small area of impact, such fish kills, if any, are not expected to appreciably affect the fish population in the area.

- The chemical discharges will be in very low concentrations and pose no threat to aquatic life.

- Small amounts of radioactive gaseous and liquid effluents will be released to the environment. The combined gaseous and liquid discharges from the FitzPatrick Plant and Nine Mile Point, Unit 1, are expected to meet the requirements given in 10 CFR Parts 20 and 50. The total man-rem from all effluent pathways, received by the approximately 1,000,000 persons (1980 projections) who will live within a 50-mile radius of the FitzPatrick Plant and Nine Mile Point, Unit 1, would be about 56 man-rem per year. By comparison, an annual total of about 125,000 man-rem is delivered to the same population as a result of natural radiation background.

- The risk of accidental radiation exposure to nearby residents will be low.

5. Principal alternatives considered:

   - Abandonment of the facility and construction of another nuclear plant on another site.

- Fossil fuel as an alternative power source at the present site.

- Purchase of power from outside sources.

- Heat dissipation with natural-draft and forced-draft cooling towers, cooling ponds, or spray ponds.

6. Comments on the Draft Environmental Statement were received from the agencies and organizations listed below and have been considered in the preparation of this Final Environmental Statement. Copies of these comments are included as Appendices and are discussed in Section 12.

   Environmental Protection Agency
   Department of Health, Education and Welfare
   Department of Transportation
   Department of Agriculture
   Department of Commerce
   Department of the Interior
   Advisory Council on Historic Preservation
   Federal Power Commission
   Power Authority of the State of New York
   State of New York Department of Environmental Conservation
   Ecology Action

7. This Final Environmental Statement was made available to the public, to the Council on Environmental Quality, and to other Governmental agencies in March 1973.

8. On the basis of the analysis set forth in this statement, after weighing the environmental, economic, technical and other benefits of the James A. FitzPatrick Nuclear Power Plant against environmental and other costs and considering available alternatives, it is concluded that the action called for under NEPA and Appendix D to 10 CFR Part 50 is continuation of Construction Permit CPPR-71 and the issuance of an operating license for the facility subject to the following conditions for protection of the environment:

   (1) The Applicant will establish a revised and comprehensive biological monitoring program to provide a base line of ecological data from which to measure the impact of Plant operation on the biota of Lake Ontario. (Sections 5.4, 6.1)

(2) The Applicant will conduct a monitoring and sampling program at the intake structures of Nine Mile Point, Unit 1 and FitzPatrick Plant as outlined in Sections 5.4 and 6.1 to determine the number, species, and size of fish killed at Unit 1 and the FitzPatrick Plant. When this information is available, the Staff will evaluate the magnitude of the fish-kill problem. If excessive numbers of juvenile or adult fish mortalities result from operation of the FitzPatrick Plant, modification of existing intake structures, and/or development and implementation of other preventive methods will be required within a specified time period.

(3) The Applicant will conduct transmission line construction cleanup, restoration, and maintenance in accordance with criteria set forth in the U. S. Department of Interior Publication "Environmental Criteria for Electric Transmission Systems" - 1970. (Section 4)

(4) The Applicant will conduct a radiological monitoring program considered by the Staff to be adequate to determine any radiological effects on the environment from operation of the Plant. (Section 6.3)

(5) The Applicant will institute a thermal discharge monitoring program, considered by the Staff to be satisfactory, to demonstrate that the Plant is operating within limits of the New York State thermal criteria. The Applicant will also prepare and submit a proposed positive course of corrective action to be taken, considered satisfactory to the Staff, to ensure operation of the Plant in compliance with the New York State thermal criteria during periods of anticipated potential violations of the State's limits. (Section 3.3)

(6) The Applicant will define a comprehensive environmental monitoring program for inclusion in the Technical Specifications (for the Plant operation) which is acceptable to the Staff for determining environmental effects which may occur as a result of the operation of the Plant. (Sections 6.1, 6.2)

(7) If harmful effects and/or evidence of irreversible damage are detected by the monitoring programs, the Applicant will provide to the Staff an analysis of the problem and a plan of action to be taken to alleviate the problem.

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

APPENDICES

FIGURES

FIGURES

TABLES

TABLES

FOREWORD

This Final Environmental Statement on environmental considerations associated with the proposed continuation of the construction permit and issuance of an operating license for the James A. FitzPatrick Nuclear Power Plant was prepared by the U. S. Atomic Energy Commission (Commission or AEC), Directorate of Licensing (Staff) in accordance with the Commission's regulation, 10 CFR Part 50, Appendix D, implementing the requirements of the National Environmental Policy Act of 1969 (NEPA).

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

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

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

(i) The environmental impact of the proposed action,

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

(iii) alternatives to the proposed action,

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

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

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

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

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

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

Single copies of this statement may be obtained by writing the Deputy Director for Reactor Projects, Directorate of Licensing, U. S. Atomic Energy Commission, Washington, D.C. 20545.

Mr. Jan A. Norris is the AEC Environmental Project Manager for this Final Environmental Statement (301-973-7263).

1. INTRODUCTION

This Final Environmental Statement on the James A. FitzPatrick Nuclear Power Plant (the Plant) (Docket No. 50-333) is associated with the continuation of Construction Permit CPPR-71 and the proposed issuance of an operating license to the Power Authority of the State of New York, an agency of the State of New York[1], and the Niagara Mohawk Power Corporation (the Applicant). The Plant is situated on a 702 acre site on the south shore of Lake Ontario, at Nine Mile Point in the Town of Scriba, County of Oswego, State of New York.[2] The Plant will be operated and maintained by the Niagara Mohawk Power Corporation[3] under contract to the Applicant, who retains responsibility for the sale of power.

The Applicant filed an application with the United States Atomic Energy Commission (AEC) for a construction permit on December 30, 1968. A public hearing with respect to the application was held in Pulaski, New York on March 31, 1970. The AEC issued the construction permit on May 20, 1970.

Documents entitled "Applicant's Environmental Report - Operating License Stage"[2] and "Supplements Nos. 1, 2, 3, and 4 to Applicant's Environmental Report" were submitted by the Applicant on May 22, 1971, November 19, 1971, May 15, 1972, August 11, 1972, and January 8, 1973, respectively. The Commission forwarded copies of these reports to appropriate Federal agencies.

Copies of these reports were also placed in the Commission's Public Document Room at 1717 H Street, N.W., Washington, D.C., and in the Oswego Public Library, Oswego N.Y. A notice of availability of "Applicant's Environmental Report" and "Supplement No. 1" together with a request for comments, was published in the Federal Register on January 18, 1972 (37 F. R. 747).

The Directorate of Licensing, on November 14, 1972, issued a Draft Environmental Statement. Notice of availability of that Draft Environmental Statement, with a request for comments, was published in the Federal Register (37 F. R. 24378) on November 16, 1972. Copies of the Draft Statement, with requests for comments, were sent to appropriate Federal, State and local agencies.

This Final Environmental Statement takes into account the Applicant's and agencies' comments on the Draft Environmental Statement, and the Applicant's reply to agency comments.

A "Notice of Consideration of Issuance of Facility Operating License and Opportunity For Hearing" was published in the Federal Register (37 F.R. 20740) on October 3 ,1972. Two petitions to intervene were filed in response to this notice.

The Applicant is required to comply with Section 401 of the Federal Water Pollution Control Act, as amended (33 U.S.C. § 1151 et seq., 86 Stat. 816, 1972).

1.1 STATUS OF PROJECT

On October 1, 1972, construction of the physical plant was about 80 percent completed. The major buildings (pump and screenwell, turbine, the reactor, the radwaste, administrative) were all in place. The cooling water intake, discharge tunnels, and the 385 foot high stack also had been constructed. Most of the work remaining is associated with the installation of equipment within the structures themselves and the interconnection of the various components. The switchyard has been installed, and the transmission line was about 45% completed in all its phases. The Plant is scheduled to be placed in operation in October 1973.

1.2 SITE SELECTION

The Plant site, acquired from the Niagara Mohawk Power Corporation, was part of the original site surveyed by Niagara Mohawk for the Nine Mile Point Nuclear Power Station which is about 3000 feet to the west of the Plant. The Applicant[3] states that the primary reason for selection of the site was that the area meets their seismic, population, ecological, and meteorological requirements determined in studies carried out on the site since 1963 by the Niagara Mohawk Power Corporation for the Nine Mile Point Station. The proximity of the site to the Applicant's 345 kV upstate transmission system was also an important factor in the choice.

Neither alternate inland sites nor definite alternate sites on the lakeshore were considered by the Applicant. If the plant were located farther to the east, it would be closer to the dunes area near the Selkirk Shores State Park. This area has the potential for future recreational development. Also, if the Plant were located on the lakeshore to the west or northeast of its present location it would be farther away from the load center and the main transmission system.

There are four fossil-fuel generating plants in the Oswego area about seven miles to the west, producing a total of 407 MWe. An 840 MWe oil-fired generating plant is now under construction by Niagara Mohawk Power Corporation.

1.3 STATUS OF APPLICATIONS AND APPROVALS

The Power Authority of the State of New York is exempt from many provisions of State and local law.[5] Although the Applicant is not required to obtain permits under Article V of the State Conservation law, which relates to stream protection, the Applicant nevertheless intends to apply to the New York State Departments of Health and Environmental Conservation for said permits.

Table 1.1 contains Applicant's list of permits, licenses and approvals for which it has or intends to apply as of August 11, 1972. The list does not include permits and licenses which may be required by Title IV of the Federal Water Pollution Control Act Amendments of 1972.

TABLE 1.1 Licenses, Permits and Approvals for Construction and Operation of the James A. FitzPatrick Nuclear Plant

Granting Agency	Description	Status
U. S. Atomic Energy Commission	Permit to construct nuclear facility	Issued May 20, 1970
U. S. Atomic Energy Commission	License to operate a nuclear facility	Not yet issued.
Department of the Army (Corps of Engineers)	Permit to construct a channel and boat slip on Lake Ontario	Issued May 5, 1970
Department of the Army (Corps of Engineers)	Permit to construct submerged intake and water discharge structures on Lake Ontario	Issued July 15, 1970
Department of the Army	Permit to operate a water discharge on Lake Ontario	Application Not Filed
New York State Department of Environmental Conservation	Permit to operate the intake and discharge structures on Lake Ontario	Issued Nov. 27, 1972
New York State Department of Environmental Conservation	Permit for the installation and operation of auxiliary steam boilers for plant heating	Issued Feb. 22, 1972
New York State Department of Health	Permit to construct intake and discharge structures on Lake Ontario	Issued April 14, 1970
New York State Department of Health	Letter of approval of sewage disposal facilities for the plant	Approved Nov. 13, 1970
Federal Aviation Administration	Approval of proposed construction of 385 foot high stack	Approved Oct. 14, 1970

References

1. New York State "Power Authorities Act" L1939 C 870 Effective June 15, 1939.

2. "Environmental Report on the James A. FitzPatrick Nuclear Power Plant," Power Authority of the State of New York, May 1971, Docket No. 50-333.

3. Ibid. p. 8.

4. Ibid. p. 67.

5. New York "Power Authorities Act," Section 1002.

2. THE SITE

2.1 SITE LOCATION

The Plant is located on a 702-acre site on the south shore of Lake Ontario, known as Nine Mile Point, in the Town of Scriba, Oswego County, New York. It is 7 miles east of Oswego, 36 miles northeast of Syracuse, and 135 miles east of Buffalo. Other towns and points of interest are shown in Fig. 2.1.

The site was purchased by the Applicant from Niagara Mohawk Power Corporation, which had set this area aside for power plant use. To the west, immediately adjacent to the site is the Nine Mile Point Nuclear Station Unit 1 owned by Niagara Mohawk Power Corporation. This nuclear station (610 MWe) has been in operation since December 1969.

2.2 REGIONAL DEMOGRAPHY AND LAND USE

During most of the year, the total population within a 5-mile radius of the site is approximately 3000. The Town of Scriba had a population of 3600 in 1970. In addition to the year-round population, a few cottages along the lakeshore are occupied in the summer months. The Ontario Bible Conference operates a summer camp, known as Lakeview, 1.5 miles west of the site. The Applicant indicates that groups of up to 500 persons use this camp in July and August, and that during the summer a maximum of 1500 persons may be at the camp for short periods on weekends.

The nearest permanent residence is about 0.7 mile from the site. The 1971 population distribution in a 0-5 mile radius is given in Fig. 2.2. The 1970 population distribution, 0-50 mile radius, is given in Fig. 2.3. Table 2.1 gives the present and projected population of the ten counties which wholly or partially fall within the 50-mile radius of the Plant. This projection was prepared by the New York State Office of Planning Services.[1]

The land within five miles of the site lies in the towns of Scriba and New Haven and is primarily rural. Much of the land in the immediate vicinity of the Plant and in Oswego County was formerly farmed but is now covered with second-growth trees and brush. Such areas constitute about half the land in the county. The remainder is made up of wooded areas and farms. According to a recent publication by the Bureau of the Census,[2] approximately 26% of the land

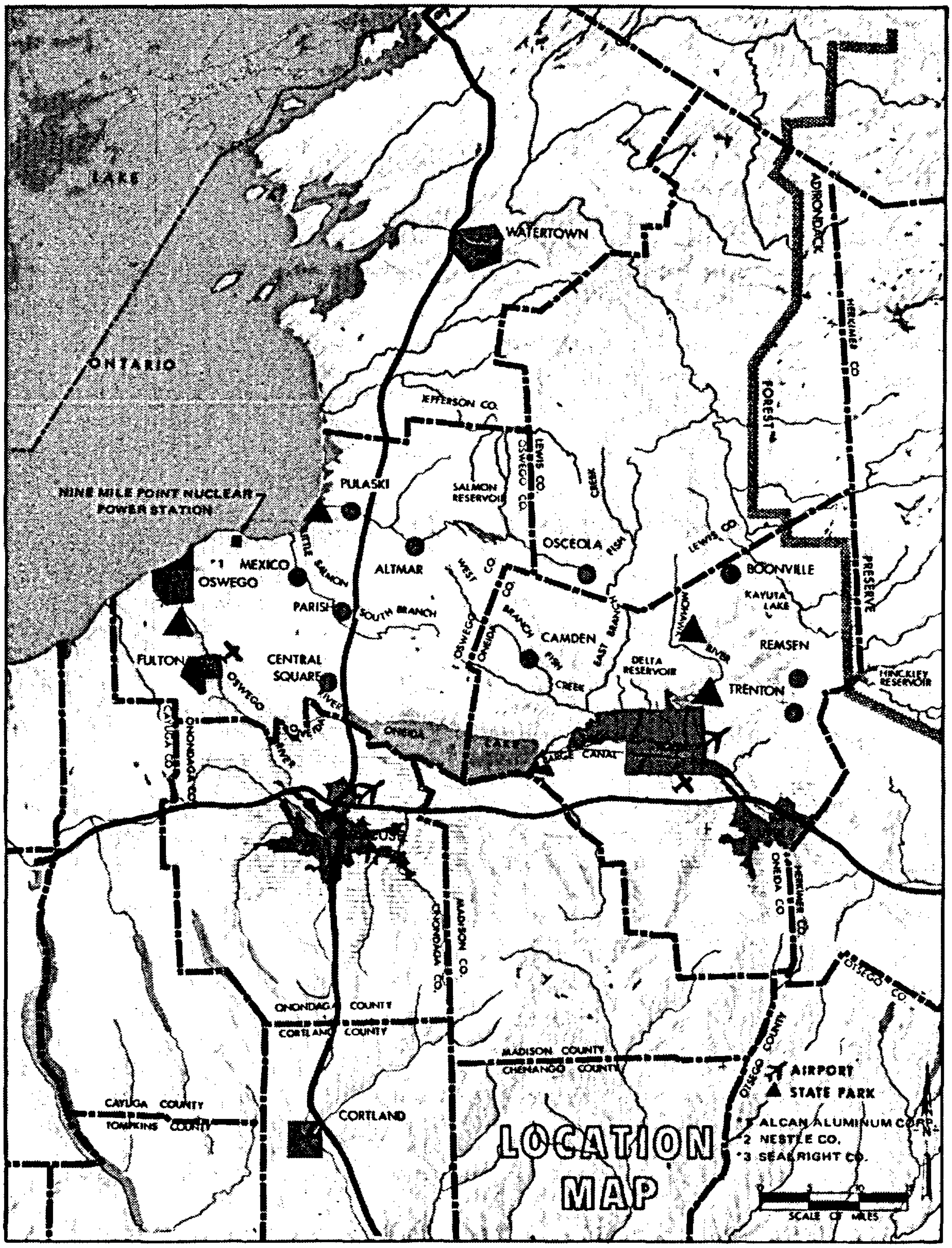


Fig. 2.1. Towns and Points of Interest near the FitzPatrick Nuclear Plant. From Applicant's Environmental Report.

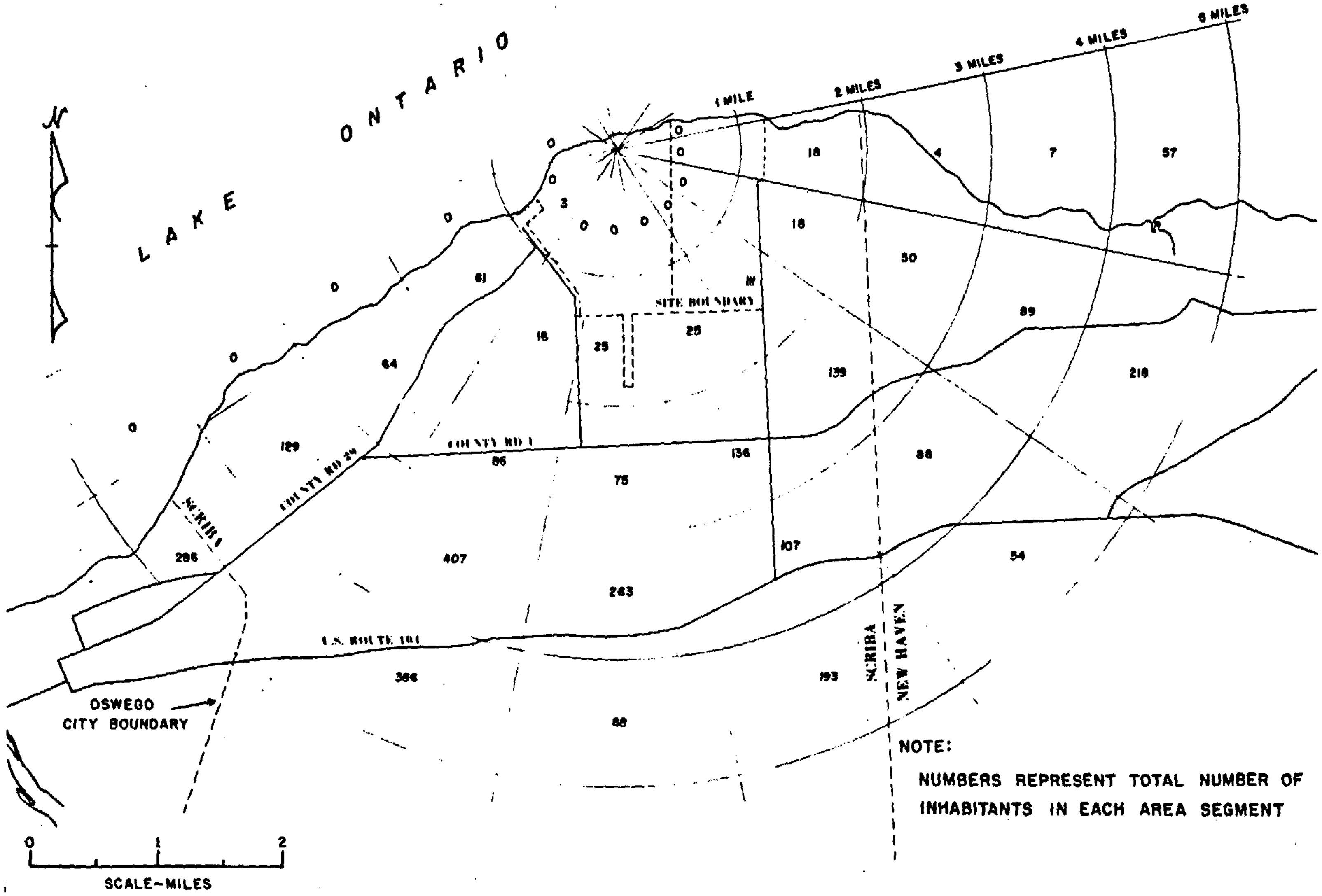


Fig. 2.2. Population Distribution (1971) within Five Miles of the FitzPatrick Nuclear Plant. From Niagara Mohawk Power Corp. Environmental Report for Nine Mile Point, Unit 2.

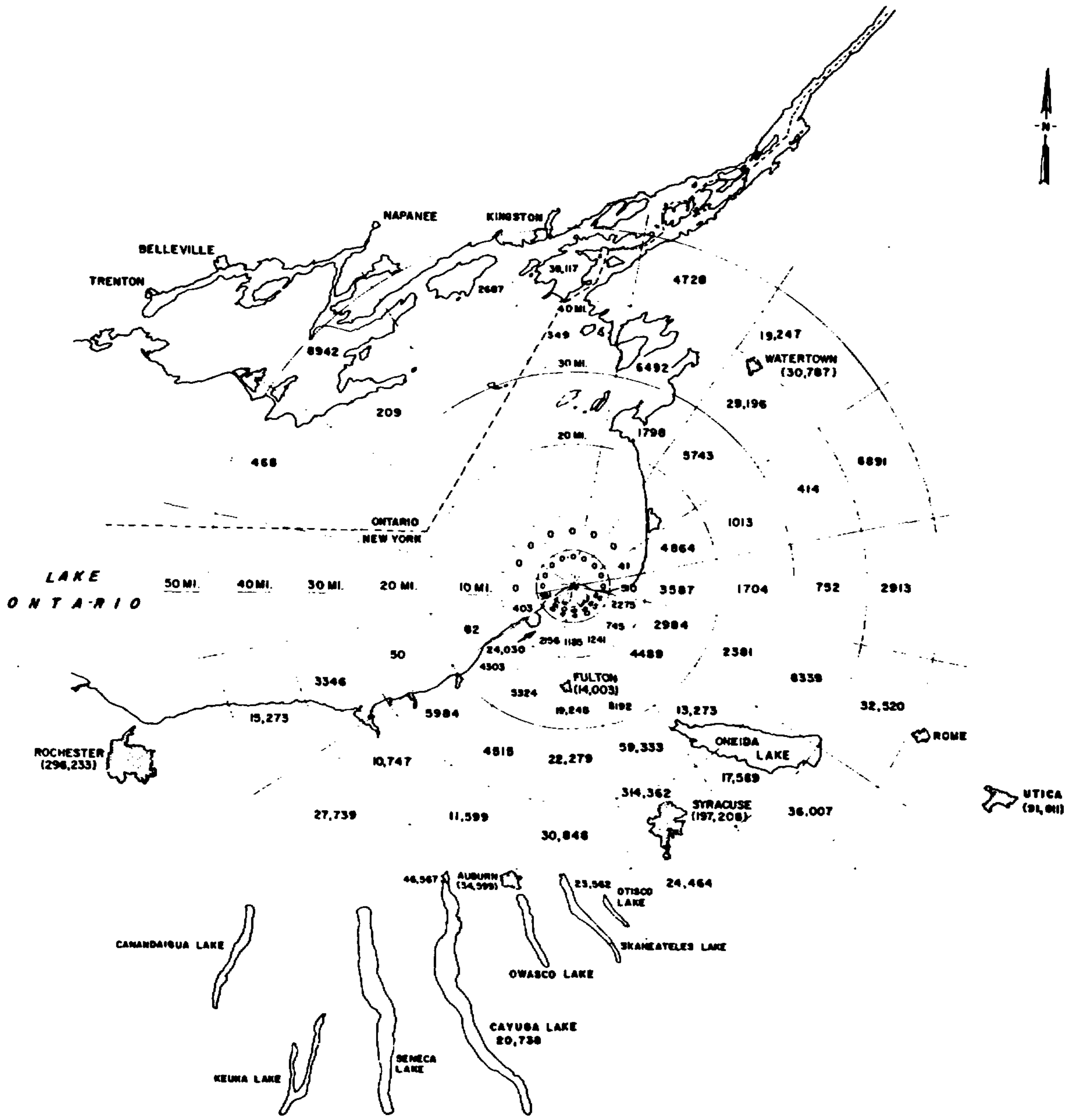


Fig. 2.3. Population Distribution (1970) within 50 Miles of the FitzPatrick Nuclear Plant. From Niagara Mohawk Power Corp. Environmental Report for Nine Mile Point, Unit 2.

TABLE 2.1 Population Projections for Oswego and Neighboring Counties* (Thousands)

County	1970	1980	1990	2000
Cayuga	77	82	87	91
Jefferson	89	89	91	92
Lewis	24	24	25	26
Madison	63	73	83	94
Oneida	273	285	300	308
Onondoga	473	518	581	639
Ontario	79	91	108	125
Oswego	101	122	147	178
Seneca	35	38	41	44
Wayne	79	93	112	131

*Prepared by the New York State Coordinating Services.

in Oswego County was devoted to farming and dairying in 1969. However, only about 10% of the land has farms that appear capable of supporting viable farm businesses throughout the foreseeable future. The number of farms in the Ontario Lake Plain, which includes Oswego County, decreased 40% in the period 1949-59 and about 21% in the 1959-64 period. It is projected by the New York State Office of Planning Coordination[2] that land under farming in this area will continue to decline more rapidly than in the state as a whole. According to the New York State Development Plan,[3] land use projections for 1990 indicate that the northeast half of Oswego County (which includes the plant site) will remain sparsely settled and predominantly natural open space.

The site and adjacent areas along the shore of Lake Ontario have little potential for water-based recreation. The lake in this area is not suitable for swimming as the lake bottom is largely bedrock and there are few natural harbors or landings. There are two state parks nearby--Selkirk State Park ten miles northeast of the Plant site along the lakeshore, and Battle Island near Fulton 15 miles southwest of the site. About 250,000 vacationers visit these parks in a year.

The Applicant has stated that a wildlife management program will be established on about 600 acres of the southern portion of the site as soon as the New York State Department of Environmental Conservation and the Applicant formulate plans for such a program. The Applicant further stated that the plans will be drafted after construction and restoration in the northern portion of the site are completed. Most of this land is covered by forest. As yet no definitive plans for a wildlife management program have been formulated.

There are two hospitals in Oswego County--the Oswego Hospital with 176 beds is about 7 miles from the site in Oswego, and the Lee Memorial Hospital with about 60 beds is located 15 miles away in Fulton. The closest school is the New Haven Elementary School, which is 5 miles southeast of the site.

The only industrial establishment along the lakeshore in Scriba is the Alcan Aluminum Corporation located 3-1/4 miles southwest of the site. This plant employs 750 people. The nearest grazing pasture is about 6500 feet from the site.

Other nuclear facilities on the southshore of Lake Ontario are Nine Mile Point Nuclear Station, Unit 1 (610 MWe) owned by the Niagara Mohawk Power Corporation, 3000 feet west of the site, and the Robert E. Ginna Nuclear Station (420 MWe), owned by Rochester Gas and Electric

Corporation, about 50 miles southwest of the site. An application has been filed for a construction permit by Niagara Mohawk Power Corporation to build the Nine Mile Point Nuclear Station Unit 2 (1100 MWe), to be located between Nine Mile Point Unit 1 and the site.

2.3 HISTORICAL AND NATURAL LANDMARKS

There are no known historic places within the site or in the right-of-way of the transmission line. The nearest historic site is seven miles east of the Plant at Spy Island. None of the historic sites listed in the National Register of Historic Places will be affected by the construction of the transmission line connecting the Plant to the Edic Sub-station near Utica, New York. There are no known archeological deposits on the Nine Mile Point area.

The Applicant has contacted the New York State Liaison Officer for Historic Preservation in New York State and received a certification that the transmission line and plant as proposed will not have a harmful effect on any sites of historic or architectural importance.

2.4 TOPOGRAPHY AND GEOLOGY

The Plant and its associated transmission line lies mainly within the Erie Ontario Lowlands physiographic province. This province consists of a relatively flat plain which rises gently from Lake Ontario to the Appalachian Uplands which form its southern border. The Erie-Ontario Lowlands is bounded on the east by the Tug Hill Upland, through which small portions of the transmission line also pass.

The Plant site is a generally flat and featureless plain. A photograph of the area before construction of the Plant is shown in Fig. 2.4. Figure 2.5 shows the topographical features of the site. It has an elevation of 270 feet rising to 310 feet one mile away at its southern extremity. The surface soils consist of bouldery-ablation tills which immediately overlay a compact basal till lying on bedrock. The underlying rock is flat-lying sandstone imbedded with shale of Ordovician Age. This bedrock is known as Oswego Sandstone. The shale content increases with depth; at approximately 130 feet below the surface the Oswego Sandstone grades into the underlying Lorraine group, which is predominantly shale with some sandstone members.

The transmission line moves along the southwestern fringe of the Tug Hill Upland. This area has low rolling hills with moderate slopes

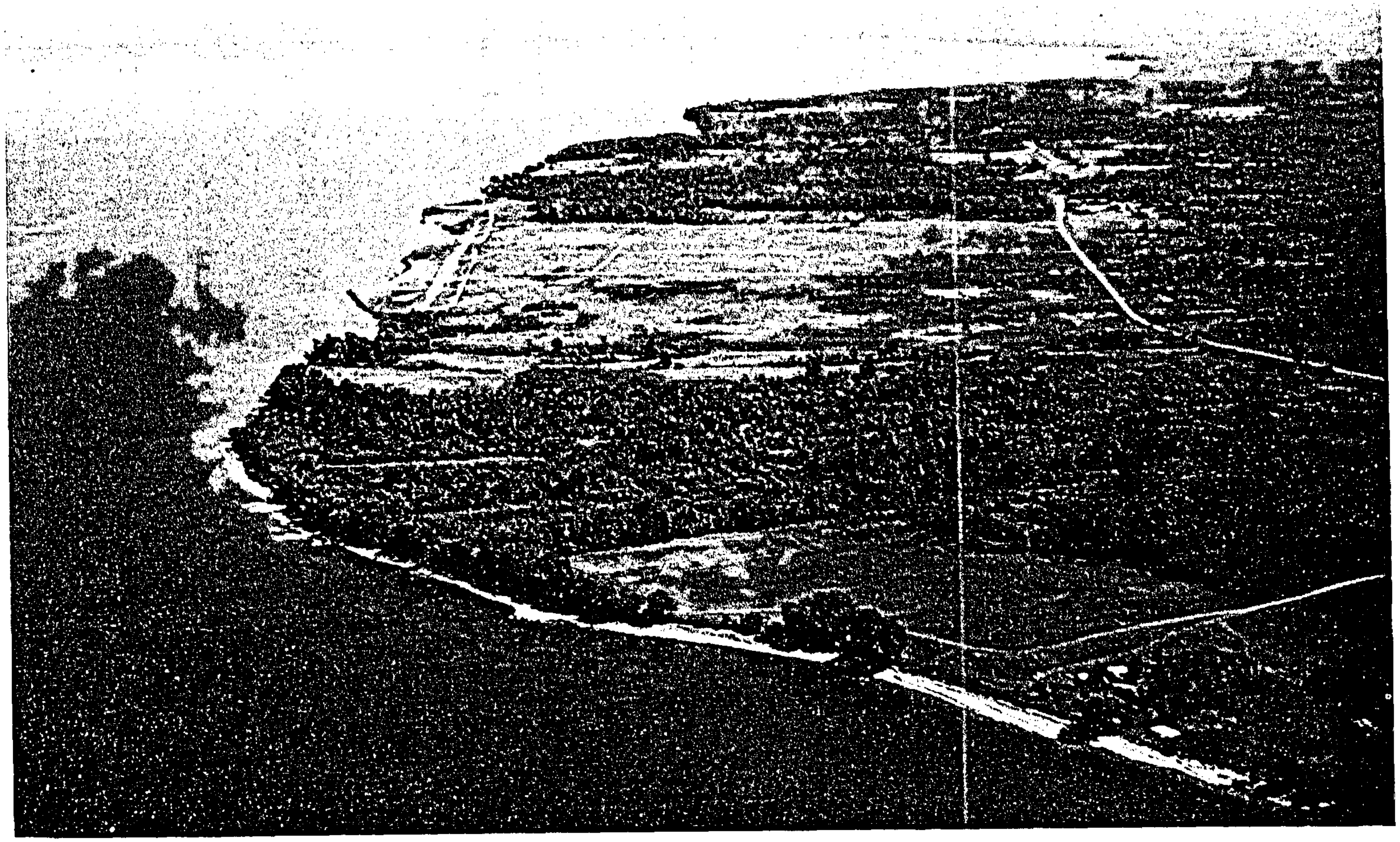


Fig. 2.4. Nine Mile Point before Construction of the FitzPatrick Nuclear Plant and the Nine Mile Point Nuclear Station, Unit 1. From Applicant's Environmental Report.

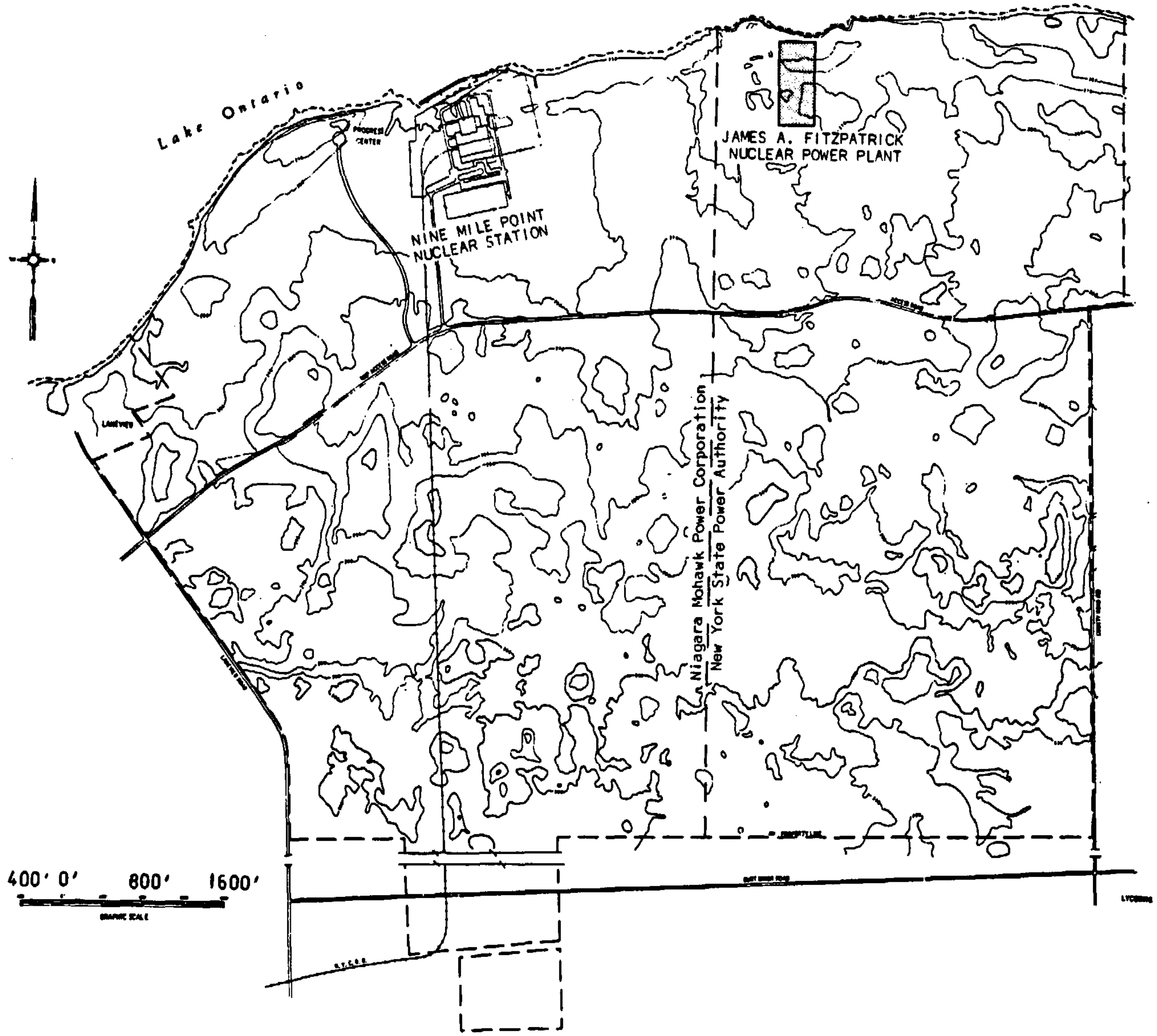


Figure 2.5 Site plot of FitzPatrick Nuclear Plant

and an elevation of 1800 to 2000 feet with little relief. The Tug Hill Upland is composed of Oswego Sandstone. This resistant rock rests on a thick layer of sandy shales which, in turn, overlay Trenton and Black River limestone. The soils over the entire province are generally acid, unfertile and have poor drainage.

For a short distance the transmission line passes through a part of the Hudson-Mohawk Lowlands. This province has low elevation and relief. The top rock layers overlay Ordovician shales which are exposed in certain areas by the southward and westward stripping off of the Silurian and Devonian limestones. Soils in this region are generally well drained.

Numerous earthquakes have been recorded at distances greater than 50 miles from the Plant site.[26] Most of these have occurred in the St. Lawrence and Hudson River Valleys and the Buffalo-Rochester Area. The St. Lawrence River Valley trend appears to be the most active.

From 1853 to 1963, at least thirteen earthquakes have been recorded within fifty miles of the FitzPatrick Plant. The highest intensity earthquake during this period occurred at Lowville in 1853; it was VI intensity on the Modified Mercalli Scale. Most of the remaining earthquakes in this area had an intensity of III or less.[27]

There is a minor fault line at Nine Mile Point area which crosses the intake and discharge tunnels at right angles trending N 78°W and dipping approximately 60° to 64° South, and a system of joints at the barge slip with an altitude similar to the fault which crosses the tunnels. The United States Department of Interior considers these geological features to be of minor significance as far as the safety of the intake and discharge tunnels is concerned. The last movement along the fault is thought to be geologically old, probably much older than the last glacial episode in the area.[28]

The site seismology as related to the safety of the Plant, its design and seismic design criteria have been considered in detail by the Staff in the safety review.[29]

2.5 HYDROLOGY

2.5.1 Surface Water Hydrology

The Plant is located in the northeast portion of the Lake Ontario Plain drainage basin. This basin encompasses about 34,800 square miles, exclusive of lake surface, in New York and the Province of

Ontario and has an average annual precipitation of 34 inches. Approximately 50% becomes stream flow and, of the remaining 17 inches, approximately 15 inches is lost by evapotranspiration and about 2 inches to groundwater.

Although the basin has numerous large streams, none is in the immediate vicinity of the plant. Catfish Creek (approximately three miles east of the Plant) and the Oswego River (eight miles to the west) are the closest large streams. Surface water runoff from the Plant site flows into the smaller creeks and marshes nearby which, in turn, flow northward into Lake Ontario.

2.5.2 Lake Water Hydrology

Lake Ontario, the easternmost of the Great Lakes, is 193 miles long and 53 miles wide at its widest point. It has a shoreline length of 726 miles and a surface area of 7340 square miles. The surface of the lake is 245 feet above mean sea level. Its greatest depth is 840 feet; the average depth 300 feet. The total volume of the lake is 390 cubic miles. Lake Ontario has a large volume of water per unit of surface area, with approximately 85% of the water mass below the epilimnion.

The major inflow (about 80 percent) is from Lake Erie via the Niagara River, which discharges, on the average, approximately 200,000 ft^3/sec into Lake Ontario. Other rivers draining into the lake are the Genesee, which flows from the Appalachian Front; the Oswego, which drains the Finger Lakes Region; the Black River, which flows from the Adirondacks; and the Trent River, which drains a portion of the Province of Ontario. The St. Lawrence River carries the outflow of Lake Ontario to the Atlantic Ocean.

Lake Ontario is a dimictic lake (with spring and fall turnover) having a maximum surface temperature of 77°F in summer, (Fig. 2.6) and a large thermal gradient. The computed retention time for water in the lake is on the order of 15 years if stratification, circulation, and mixing are taken into consideration.

In the summer, the lake becomes vertically stratified (thermally and chemically). A warm readily-circulating upper layer (epilimnion) and a cold undisturbed lower layer (hypolimnion) develop with a zone of rapid temperature change (thermocline or metalimnion) between the two. Since the epilimnion and hypolimnion do not mix, nutrients released by decay processes in and near the bottom sediments remain trapped in the bottom waters. Upwellings of the cold, nutrient-rich, bottom water (caused by storm action) can lead to sudden, rapid temperature changes in the inshore waters.

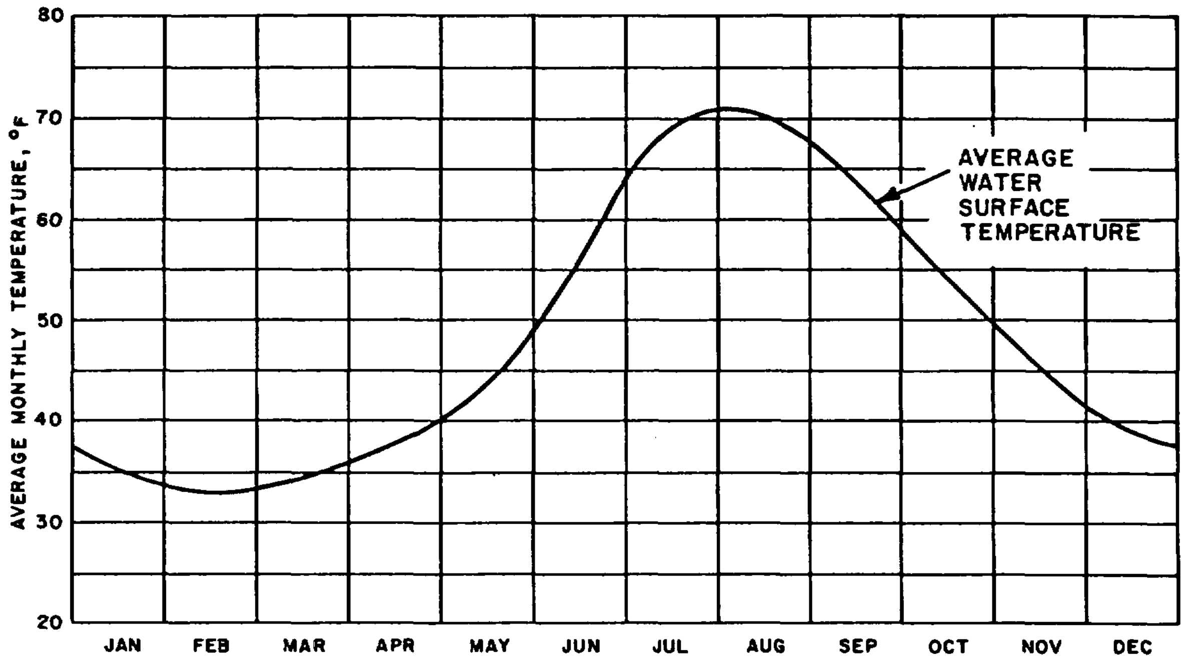


Fig. 2.6. Average Monthly Temperature of Lake Ontario. From Applicant's Environmental Report.

In the fall, the upper waters cool and the lake becomes vertically isothermal. In the winter, for all practical purposes, the lake can be considered as essentially isothermal. It does not freeze over except near land, particularly in slack bay areas in the eastern end of the lake.

In the spring, after the ice melts, the entire lake begins mixing (spring turnover). In the course of mixing, due to preferential heating of the shallow inshore waters, a "thermal bar" gradually develops and moves toward the center of the lake until it disappears early in June. During its existence nutrients carried into the lake by streams may become trapped for short periods of time in the inshore waters.

The circulation of the lake is generally in a counterclockwise direction. This applies to the surface currents (upper 33 feet) intermediate currents, (33-66 ft) and to the bottom currents (below 66 ft). The surface currents are strongly dependent on wind conditions, especially during summer stratification, while the bottom currents are modified by friction and topography. The surface currents have a mean speed of about 0.1 ft/sec and a range from 0-0.5 ft/sec. Surface currents react quite rapidly to changes in wind speed and direction. The flow pattern can change in periods of less than four hours. On the other hand, the response time of wind-induced circulation at intermediate depth may be about 40 hours. Under isothermal conditions the wind can affect the currents at the intermediate depth to a far greater extent than it can during the summer when the lake is stratified.

The Applicant has measured lake currents in the vicinity of the site near the proposed intake and discharge structures about 1000 feet offshore.[4] Currents appeared to be primarily wind induced, generally of low speed and with relatively frequent changes in east-west direction.

Tides in Lake Ontario are small, less than 1 inch. Seiches (lakewide internal, standing waves) generally have amplitudes of less than two feet. Wind-driven surface waves up to 15 feet in height can occur.

The lake bottom in the vicinity of the site is rocky and the bedrock out to the 15-ft depth is relatively free of overburden because of heavy wave activity. The bedrock in deeper waters is covered with loose overburden. The shoreline in the area is abrupt and there are no beaches.

Lake Ontario is morphometrically an oligotrophic lake.* The nutrient input from Lake Erie tends to give this lake a mesotrophic trend; however, since most of the lake is over 120 ft deep, full utilization of the nutrients does not take place. The dissolved oxygen concentrations in the deep waters are normally 90% to 100% of saturation; such a high concentration indicates low rates of oxygen consuming processes in the deep waters. Changes in the chemical characteristics of Lake Ontario closely approximate the trends exhibited by Lake Erie. Available data[5] indicate that sodium, chloride, sulfate, and calcium concentrations have been increasing over the last 50 to 60 years. The high total dissolved solids and low transparency are indicative of a eutrophic trend. Water quality data of the inshore waters off Oswego are given in Table 2.2.

The inshore waters are less oligotrophic than offshore waters. This is a reflection of the shallow depths involved and the fact that most nutrient inputs, both natural and man-derived, enter along the shores.

2.5.3 Ground Water Hydrology

Of the seven lithologically similar hydrologic-bedrock units in central New York, only two rest under the Plant site. A sandstone layer, found beneath the surface, is bedrock composed of two geologic rock units: Albian Group is the upper layer of fine-to-coarse grained red sandstone and Oswego Sandstone; the lower layer is a gray fine-grained sandstone. The combined thickness of these layers is 500 feet. Some water is obtained from wells that are drilled into the upper 5- to 10-foot fractured zone of the Oswego Sandstone. Yields in this material average about 10 gallons per minute. Below the sandstone bedrock there is another hydrologic bedrock unit. This layer, lower shale, is composed of black and gray shale; it is 800 feet thick and wells yield an average of 3 gallons of water per minute.

Ground water is utilized for private needs in the area. The nearest known producing well is situated about 3,500 feet from the Plant. The location of this and other private water supplies is given in the Applicant's Environmental Report. In the vicinity of the Plant site the ground water flows north to the lake.

---

*"Eutrophic" lakes are characterized by a high production of organic matter and "oligotrophic" lakes have low production of organic matter. A "mesotrophic" condition can be described as an intermediate or a transient condition.

TABLE 2.2 Lake Ontario Water Quality Data*

Parameter	Units	No. of Samples	Record of Data	Concentrations Min.	Concentrations Mean	Concentrations Max	Maximum Concentrations, USPHS or HYS
Hardness ($CaCO_3$)	mg/ℓ	54	6/64-1/71	112	146	240	—
Alkalinity ($CaCO_3$)	mg/ℓ	16	3/65-11/66	85	94	101	—
Ammonia, Nitrogen	mg/ℓ	54	6/64-1/71	0.0	0.47	1.31	—
Calcium	mg/ℓ	54	6/64-1/71	32.0	44.0	54.0	—
Chlorides	mg/ℓ	54	6/64-1/71	3.8	30.3	55.5	250
Iron	mg/ℓ	54	6/64-1/71	0.0	0.9	0.6	0.3
Manganese	mg/ℓ	54	6/64-1/71	0.00	0.01	0.13	0.3
Magnesium	mg/ℓ	51	9/65-1/71	4.9	8.9	29.0	—
Nitrates (N)	mg/ℓ	54	6/64-1/71	0.0	0.14	0.51	10
Nitrites (N)	mg/ℓ	54	6/64-1/71	0.0	0.005	0.029	—
Phosphates	mg/ℓ	54	6/64-1/71	0.0	0.19	1.65	—
Potassium	mg/ℓ	54	6/64-1/71	0.5	1.6	11.4	—
Sodium	mg/ℓ	54	6/64-1/71	1.0	16.6	45.0	—
Sulfates	mg/ℓ	54	6/64-1/71	13.0	30.1	50.0	250
pH	—	71	5/64-1/71	7.2	7.9	9.0	—
Turbidity	ft	71	5/64-1/71	1.0	8.4	25.0	5
Temperature	°F	70	5/64-1/71	34	49.3	73.4	—
Dissolved oxygen	ppm	70	5/64-1/71	6.8	10.9	14.4	—
5-day BOD	ppm	66	5/64-1/71	0.2	1.25	3.0	—
Color	—	68	6/64-1/71	2	8.5	20	15
Conductivity	mmhos	53	6/64-1/71	131.0	306	437.0	—
Coliform bacteria	No/100	70	5/64-1/71	2.2	56	240	1.1
COD dichromate	ppm	51	6/64-1/71	0.2	7.9	28.1	—
Res. on evap. (Total)	ppm	54	6/64-1/71	128	243	533	—
Res. on evap. (Fixed)	ppm	51	9/65-1/71	73	135	367	—
Suspended solids (Total)	ppm	51	9/65-1/71	1	10.5	44	—
Suspended solids (Fixed)	ppm	26	8/66-1/71	0	5.5	17	—

*Data recorded by New York State Department of Environmental Conservation of Oswego, N. Y., city water intake, 6500 ft into the lake at 40 ft below lake level.

2.6 METEOROLOGY

The climate at the Nine Mile Point area is essentially continental, with cold winters and warm summers. The winters are usually long with an average temperature near 25°F, while the summers are short with an average temperature close to 70°F. For a ninety-year period ending in 1960, the extremes recorded were 100°F and -23°F.

The climate in the area is controlled by the St. Lawrence Valley storm track and moderated by Lake Ontario. During the summer, the lake stores heat which is dissipated in the fall and early winter. The resultant warm air moves inland in the fall and prolongs the warmer weather onshore. During later winter, spring, and summer, the lake is a heat sink; it absorbs heat from the sun and warmer air. The cool winds from the lake cause the near shore temperature to be lower in the spring and summer. The lake also affects the humidity, cloudiness and precipitation onshore; in the fall and winter, wind currents absorb moisture over the lake and deposit it inland in some form of precipitation (usually snow showers). Low pressure areas moving along the St. Lawrence storm track also bring moist air into the southern shore of Lake Ontario area from the Gulf of Mexico.

Precipitation is moderate and rather uniformly distributed throughout the year. It consists mainly of thundershowers during the summer and snow during the winter. The average annual precipitation is 33.6 inches and the average annual snowfall is 88.1 inches. Winter snowfall averages 1 to 2 feet per month during December through March. The maximum short-term (3-day) snowfall on record is 75 to 90 inches during the winter of 1965-66.

Prevailing winds range from west to southwest to southeast, the most prominent direction being west-southwest. High winds in the Lake Ontario area result mostly from intense winter storms, and severe thunderstorms. An absolute peak wind speed of 73 miles per hour was observed by the Applicant during two years of observation at the site.

The meteorological joint frequency distributions of wind speed, direction, and atmospheric stability used by the Staff were those presented in Supplement 9 of the FitzPatrick FSAR. The Applicant submitted data for a two-year period of 1963 and 1964. Joint frequency distributions of wind speed and direction measured at the 31-foot level and vertical temperature differences (Δ T) between the 30- and 202-foot levels were used to evaluate building and vent releases. For releases from the 117 meter (385 ft.) stack, the joint frequencies of wind speed and direction measured at the 203-foot level and Δ T between the 30- and 202-foot levels were used.

The area is virtually devoid of tornadoes. During a period of over 80 years, the nearest occurrences of significant tornadoes to the site were all at a distance of approximately 150 miles to the southwest of the site area. These three occurrences were in Allegheny County, N.Y., (1920), Jamestown, N.Y., (1945), and Sinclairville, N.Y., (May 17, 1969).

Using the Thom formulation, the calculated probability of a tornado striking a 2.8209 square mile area at 43°30' latitude and 76°22' west longitude is 1.5×10^{-4}.. The recurrence interval for such a tornado is 6667 years.[25]

2.7 ECOLOGY

2.7.1 Terrestrial Ecology

The Plant site and transmission line occupy parts of three game-range divisions in Central New York: Erie-Ontario Lake Plain and fringe areas of the Tug Hill Plateau and Mohawk Valley.

a. Site Environs

The Plant is located wholly within the Erie-Ontario Lake Plain.

There is an extensive northern hardwood forest in this region which has sugar maple, beech, white ash, basswood, black birch, hemlock, yellow poplar, chestnut, and red, black, white, and bur oaks. White pine is only found near swamps. Elm, alder, maple, and ash swamps are numerous. Arborvitae and cattail swamps are scattered throughout the area. Much of the land in the vicinity of the Plant and in the surrounding areas was formerly farmed but is now covered with second growth trees and brush. These areas constitute about half the land in the county. The remainder is made up of wooded areas and farms. The woody vegetation consists of red cedar hawthorne, grey birch, raspberry, meadowsweet, and red osier dogwood. Crops such as wheat, cabbage, corn, beans, and tomatoes are still grown in this region. There are also apple, pear and cherry orchards.

The wildlife species found near the site are typical of the northeastern United States. The most common mammals include the cottontail rabbit, fox, raccoon, chipmunk, and gray squirrel. Very few white-tailed deer are present in this area. Predatory birds which inhabit the more-open spaces include sparrow hawk, red-tailed hawks, marsh hawk, broad winged

hawks, and turkey vultures. Two species of game birds, ruffed grouse and woodcock, are found throughout the site. Very few pheasants are found in this area. Lake Ontario, in the vicinity of Nine Mile Point, has important concentrations of diving ducks in the winter, with lesser scaup being the most abundant species. Dabbling ducks, such as wood duck, black duck, mallard, blue winged teal, can be found on the few ponds of the region; this is a breeding area for these ducks. The southern shore of Lake Ontario is a major migration route used by many waterfowl and other migratory birds. The American sprey and bald eagle use this route also.

b. Transmission Line Environs

After passing through the Erie-Ontario Plain, the transmission line traverses through the fringes of the Tug Hill Plateau and the Mohawk Valley.

The Tug Hill Plateau includes land which generally ranges in height from 1000 to 2000 feet. At the top of the plateau, the forests are composed mostly of red spruce, fir, yellow birch, and hemlock; at lower elevation near the bottom of the plateau, northern hardwood species such as beech, sugar maple, yellow birch and hemlock are dominant. There is little agriculture in this region because of the soil which is acid, stony, and poorly drained. The fauna at the fringes of the Tug Hill Plateau resembles that of the Erie-Ontario Lake Plains in many respects.

The chief game species in this region are white-tailed deer, varying hare, cottontail, ruffed grouse, and black duck, which is the most abundant breeding waterfowl in this area.

The Mohawk Valley division is situated in a narrow river valley which is extended in an east-west direction and is enclosed by hills which rise to 600 feet. There are two types of northern hardwood forests in this region: a beech, maple, and hemlock forest and an oak, hickory hardwood forest. A large fraction of this region is being farmed; dairying is the main type of agriculture. The fauna in this region is similar to that of the Erie-Ontario Lake Plain. Principal game species are pheasants, varying hare, cottontail, and white-tailed deer. Some black ducks and wood ducks breed in this region.

The bog turtle, Clemmys muhlenbergi, classified as endangered by the New York State, is probably found in some of the marshes through which the transmission line passes.

2.7.2 Aquatic Ecology

Generally the benthos and plankton of Lake Ontario indicate an oligotrophic situation. The deep water benthos is comprised mostly of the fairy shrimp Mysis relicta, the amphipod Pontoporeia affinis and oligochaetes. Phytoplankton, though abundant at times, consists mostly of diatoms. The abundance of diatoms Melosira islandica and Asterionella formosa in the pelagic waters of the lake suggests oligotrophy. However, the preponderance of Stephanodiscus tenuis in inshore waters may indicate higher nutrient concentrations along shore.[6]

Considerable change in the relative abundance of fishes has occurred in Lake Ontario. The Atlantic salmon (Salmo salar salar), which was once abundant, almost disappeared by 1880. Lake Sturgeon (Acipenser fulvescens) was over exploited and was greatly reduced in all the Great Lakes by early 1900's. The Cisco (Coregonus artedii) declined between the 1929's and the present. The abundance of lake trout (Salvelinus namaycush) and blue pike (Stizostedion vitreum glaucum) has also declined during recent years. The sea lamprey may have affected the abundance of large species. The presence of alewife (Alosa pseudoharengus) dates back to 1870; however, in the absence of large predators it has flourished and is now the most abundant fish in the lake. An increase in the abundance of white perch (Morone americana) has been noticed recently. Despite the high nutrient content of Lake Ontario, the fish production is relatively low.[7]

The total commercial catch has declined from 7.5 million pounds in 1890 to 3.2 million pounds in 1970. Landings for lake herring and chubs, white fish, walleye, lake trout and blue pike have consistently decreased in recent years.[5] The recent commercial landings have been dominated by white perch, carp, bullheads, yellow perch, white fish, smelt, eel, sunfish, and walleye.

The commercial fishing in the U. S. portion of the lake is a small fraction of the total catch (330 thousand pounds compared to 2,905 thousand pounds in Canadian waters in 1970) and is mostly confined to the extreme northeast section of the lake in Chaumont Bay (approximately 40 miles from Nine Mile Point) and its nearby shoal areas. Additional fishing is conducted from Sacketts Harbor westward and Oswego Harbor eastward.

The aquatic biota of this area is described below on the basis of the Applicant's preoperational studies described in the Applicant's Environmental Report and information available in literature on Lake Ontario.

a. Fishes

The fishes in the Nine Mile Point area in decreasing order of yearly abundance are as follows:

Common Names	Scientific Names
alewife	*Alosa pseudoharengus*
yellow perch	*Perca flavescens*
white perch	*Morone americana*
northern redhorse sucker	*Maxostoma* sp.
rock bass	*Ambloplites rupestris*
small mouth bass	*Micropterus dolomieui*
blue gill sunfish	*Lepomis macrochirus*
brown bullhead	*Ictalurus nebulosus*

Other species in the area include:

carp	*Cyprinus carpio*
coho salmon	*Oncorhynchus kisutch*
walleye	*Stizostedion vitreum vitreum*
smelt	*Osmerus mordax*
gizzard shad	*Dorosoma cepedianum*
white bass	*Morone chrysops*
bowfin	*Amia calva*
calico bass	*Pomoxis nigromaculatus*
minnows	*Notropis* spp.
northern pike	*Esox lucius*
white sucker	*Catostomus commersonnii*
lake white fish	*Coregonus clupeaformis*

Observations incidental to the survey conducted by the Applicant indicate that the alewife spawns in the vicinity of the site. In spring, the alewife eggs are deposited in the Cladophora mat close to the shore. However, because of limited sampling, the possibility of spawning by other species cannot be discounted.

Heavy wave activity will tend to discourage use of shallow waters in this area for spawning by species which build nests and take care of the eggs and/or young for some period. Mexico Bay, located just east of the site offers shallow waters suitable for spawning and nursery use.

Information about spawning, food habits and importance of fishes abundant in the Nine Mile Point area has been derived from References 8, 9, 10, and 11 and is given in Table 2.3.

A fathometric survey conducted by the Applicant and given in the Environmental Report has shown higher concentrations of fish in the area along the 25-ft depth contour and in slightly deeper water than in shallow, near shore waters. Fish are most abundant in the area during May. Such abundance could be related to the spawning activity during this period. The abundance declines in August and few fish are left in the area as winter approaches. Large concentrations of fish were noted between 30 to 40-ft depths between 10 PM and 3 AM. These studies also indicated a two-fold increase in numbers of fish from shallow water (10 ft) to deeper water (20 ft).

Experimental gill netting showed a preponderance of alewives near the surface. Relatively few were caught near the bottom. Yellow and white perch are the other two abundant species in the area. Perch and minnows were captured in the nets close to the shore. Except for alewives, very few fish were found near the surface. Mass mortality of alewives was observed in the lake during the spring of 1970; the cause of such mortality is not fully understood.

Food preference studies of fishes in the area as given in the Applicant's Environmental Report have indicated that small alewives, a few minnows, darters, and alewife eggs are the major food supply during spring. Later in the season, Gammarus (an amphipod), cray-fish, minnows, and darters serve as principal forage.

b. Benthos

Several studies have described various aspects of benthic macroinvertebrates of Lake Ontario.[12-16] Oligochaetes comprise the largest

TABLE 2.3 Spawning, Food Habits, and Importance of Fishes Abundant in the Nine Mile Point Area of Lake Ontario

Species	Spawning: Parental Care	Spawning: Time/Temp, °F	Spawning: Place	Food Habits	Importance
Alewife	No	55 to 72 Late May to early August	6" to 12" deep in vegetation	Zooplankton, insects, crustacea, small fish	Forage
Yellow perch	No	44 to 54 April and May	Inshore at night	Small crustaceans, insect larvae, small fish	Sport, commercial food
White perch	No	April, May and June	Fine gravel near shallow areas	Plankton, insect larvae, crustaceans, large invertebrates	Commercial, food sport
Rock bass	Yes	70 to 78 June, July	Nest in a gravel bed	Insects and other small invertebrates, crayfishes, small fishes, large insects.	Food, sport
Small mouth bass	Yes	65 or above	Nest in a depression circular	Small animals in shallow water.	Commercial, food
Bluegill sunfish	Yes	80 to 90 June, July	Nests on sand beaches or gravel bars	Crustaceans, insects, crayfishes, fishes	Food, sport
Brown bullhead	Yes	65 or above May, June	Nest	Crustaceans, insect larvae, fish fisheggs, molluscs, plants	Sport, food
Smelt	No	April, May at cold temperature	Shallow, sandy beaches	Plankton, fingernail clams, smelt young, shiners	Commercial, food

group of macrobenthos in the lake. These are represented by four families: Enchytraeidae, Lumbriculidae, Naididae, and Tubificidae. The Enchytraeids are wide-spread but not abundant and do not exhibit depth preference. Stylodrilus heringianus (Lumbriculidae) has been found to occur throughout the lake. The species of Naididae have been found to occur in shallow water. None of them, however, is abundant. The greatest number of species and individuals belong to the family Tubificidae.

Amphipods are represented by Pontoporeia affinis and Gammarus. P. affinis seems to be more abundant in the shallow zone than in deep zones. Gammarus is limited to waters less than 100 feet deep.

Chironomids (midge fly larvae), with a few exceptions, are not found in the lake at depths over 160 feet. The majority of these midge fly larvae and all gastropods (snails) are restricted to the shallow zone.

Observations by the Applicant indicate that benthos in the vicinity of the Nine Mile Point site is characterized by abundance of Cladophora (filamentous green alga) along the 10 ft depth contour; the growth is sparse at 5 and 20 ft. The maximum growth occurs in June and declines in August. Temperatures higher than 65°F tend to limit the growth. Gammarus has been found to be abundant in Mexico Bay and at the 10-ft depth in Nine Mile Point area. It is more abundant in August than in June. Snails of three species have been recorded at the 15-ft depth. The midge fly larvae, Tendipes, has also been observed in this area.

In situ photosynthetic and respiration rates of Cladophora fracta were determined in Lake Ontario near Oswego during the months of June-July and September-October 1965.[17] The average photosynthetic rate for the early summer months was 2.63 μℓ O_2/hr/mg ash-free dry weight. This rate decreased to an average of 1.27 μℓ O_2/hr/mg ash-free dry weight during fall months.

c. Periphyton

A study of the periphytic organisms in Mexico Bay, Lake Ontario (adjacent to Nine Mile Point area) was conducted during May-November 1966.[18] The ash-free dry weight was 78.3 mg per square decimeter for the total period. The maximum average abundance of organisms for each month was obtained at a depth of 4 inches. With the exception in June, the harvest average value at all stations and during all months occurred at the 12 foot depth. The monthly value for all stations was highest in June and

lowest in October. Zoospores of an alga of the family Chlorophyceae (green algae) were bserved in large numbers in May and June samples. A total of 35 genera were recorded. Ten of the genera belonged to Chlorophyceae of which Cladophora was most abundant. The Chrysophyceae (yellow green or yellow brown algae) was represented by three genera. Bacillariophyceae (diatoms) was most cosmopolitan, represented by 17 genera, Melosira and Stephanodiscus being abundant at all stations. Myxophyceae (blue green algae) was represented by 5 genera, although none were abundant.

d. Plankton

(1) Zooplankton

Results of a lake wide study on composition and horizontal distribution of crustacean plankton in Lake Ontario[19] indicate that most of the species appear in June and July in the eastern end of the lake with zones of abundance later expanding westward. By October there is tendency toward uniform distribution throughout the lake. Ninety percent of the zooplankters occupy the 0 to 167-foot stratum. Eleven species each of copepods and cladocerans have been reported from the lake, the most abundant forms being: Cyclops bicuspidatus, Tropocyclops prasinus maxicanus, Daphnia retrocurva, Bosmina longirostris, Bosmina coregoni coregoni, and Ceriodaphnia lacustris. During maximum abundance a directly proportional relationship was observed between zooplankton abundance and the heat content of the water column from 0 to 84 ft. The eastern zone of the lake was found to have 1.7 times more individuals than the western zone of the lake. Whether this effect is produced by an acceleration of zooplankton growth rates or by increased production of food organisms has not been ascertained. The eastern zone of the lake has a small second peak of abundance in October. The abundance of zooplankton in a given area can be affected by the general pattern of the wind over the lake.

(2) Phytoplankton

The phytoplankton of Lake Ontario have been described in various studies.[6,20-22] Phytoplankton along the shore have a higher number of species per milliliter and high percentage abundance of Stephanodiscus tenuis. Asterionella formosa, Melosira islandica, Melosira binderana, and Nitzschia sigma are the other important species. The midlake and locations 6 miles offshore have a lower abundance of Stephanodiscus tenuis, and Melosira islandica and Asterionella formosa become more abundant.

Information on the abundance of major diatom species in the vicinity of the Nine Mile Point area (derived from Ref. 21) is given in Table 2.4.

Observations by the Applicant in 1964 on distribution of plankton near the site indicated higher plankton concentrations in the surface waters and dependence of plankton abundance on winds and currents, the plankton being more abundant in the area with no shore winds and currents. Very few fish larvae were observed in the plankton samples collected in 1964.

e. Water Quality

Changes occurring in the water quality of Lake Ontario in general have been described briefly in the beginning of this section. The analysis of lake water sampled at the Oswego water intake is given in Section 2.5.2.

Sporadic sampling in the Nine Mile Point area conducted by the Applicant during August 1969 and May 1970 for concentrations of nitrates and phosphates have yielded variable results. Even during the warmest period of the year, dissolved oxygen concentration of 11-12 ppm (near saturation) is not uncommon with no decrease at night. No other water quality characteristics were measured.

2.8 BACKGROUND RADIOLOGICAL CHARACTERISTICS

The radiological aspects of the area about the Plant are average for the region. There are no conspicuous natural sources, and radiation from all sources is below average for the U. S., as is typical[23] of the northeastern rain-belt. Measured dose rate from natural background for the area is about 125 mrem/yr.

Some 25 State and Federal monitoring stations have been active within 124 miles of the Plant for the last two decades. In addition, a monitoring program has been in operation at Nine Mile Point Unit 1, since 1967.[24] Values reported by the nearest stations, in recent years, are summarized in Table 2.5. Postoperational values for Nine Mile Point Unit 1 (i.e., preoperational for the FitzPatrick Plant) are also included. This large accumulation of available data provides an adequate baseline to which the Plant's impact may be compared.

TABLE 2.4 Abundance of Major Diatom Species at a Sampling Station near Nine Mile Point September 8-18, 1964

Major Diatom Species	Abundance (cells/mℓ)	
	Surface	10 meter
Asterionella formosa	4.6	0.6
Fragilaria crotonensis	21.4	30.0
Melosira islandica	1.3	-
Stephanodiscus astraea	2.0	2.0
Stephanodiscus var. minutula	10.0	12.0
Stephanodiscus tenuis	4.0	0.6
Tabellaria fenestrata	7.4	8.6
Total	57.5	58.1

*Data taken from Ref. 21, Station 74.

TABLE 2.5 Environmental Sampling Stations in the Area of the FitzPatrick Plant, 1969-1972

Station	Samples Taken[a]		Range[a]	Mean[a]
Albany, N. Y.	PM	Sr-90	0-11	6
	SA	Gross beta	0-5	1
	P	Gross beta	2-29	7.7
	SW	Gross beta	0-3	2
	SW	Tritium	0-1600	<200
	TW	Tritium	0	<200
Buffalo, N. Y.	PM	Sr-90	0-10	7
	SA	Gross beta	0-4	1
	TW	Tritium	0-500	<200
(Niagara Falls)	SW	Gross beta	3-5	4
(Lake Erie)	SW	Gross beta, diss.	3-10	7
		Gross beta, susp.	<3-11	3
		Gross alpha, diss.	<3	<3
		Gross alpha, susp.	<0.2-2	1.2
Massena, N. Y.	PM	Sr-90	3-14	7
	SW	Gross beta, diss.	2-8	4.7
		Gross beta, susp.	2-5	3
		Gross alpha, diss.	<0.2-1	<0.2
		Gross alpha, susp.	<0.2-06	<0.2
New Haven, N. Y.	SW	Gross beta	3-8	4
	TW	Tritium	0	<200
Oswego, N. Y.	SW	Gross beta	3-5	4
	TW	Tritium	0	<200
Rochester, N. Y.	SW	Tritium	0	<200
		Gross beta, diss.	3-4	3
		Gross beta, susp.	0	0
		Gross alpha, diss.	0	0
		Gross alpha, susp.	0	0
Rome, N. Y.	TW	Gross alpha	0	0
		Gross beta	3	3
Syracuse, N. Y.	PM	Sr-90	5-13	7
Toronto, Ont.	PM	Sr-90	3-9	5
	SA	Gross beta	0-1	0.1
	P	Gross beta	1-25	4.4
Utica, N. Y.	TW	Gross beta	6	6
		Gross beta	0	0
Watertown, N. Y.	SW	Gross beta	3-6	3.5
Nine Mile Point [b]	P	Gross beta	3-27	8[b]
	SA	Gross beta	03-5	2
	SW at inlet	Tritium	2400	2400
	Vertebrates, Aquatic, Gross beta		0-5[b]	2[b]
	Invertebrates, Aquatic, Gross beta		0.5	0.5
	Plants, Aquatic Gross beta		14	14
	Vertebrates, Aquatic Gross gamma		0-1	0.2
	Invertebrates, Aquatic Gross gamma		0.5	0.5
	Plants, Aquatic Gross gamma		37	37

From Environmental Protection Agency, Radiation Data and Reports Vol. 1-13, (1972) and Semiannual Reports of Operation, Nine Mile Point Nuclear Station for 1971.

[a]PM = Pasteurized milk, pCi/ℓ
SA = Surface air, pCi/m^3
P = Precipitation, nCi/m^2/month
SW = Surface water, pCi/ℓ
TW = Tap water, Tritium, pCi/ℓ

[b]pCi/gm dry weight, for biota.

References

1. "Population Projections for New York State Counties: 1970-2000." New York State Office of Planning Services. Albany, N. Y., 12207.

2. "1969 Census of Agriculture," Part 7, Section 2, Volume 1, p. 273, Bureau of the Census, May 1972.

3. "New York State Development Plan-1." New York State Office of Planning Coordination, January 1971.

4. "Environmental Report for the James A. FitzPatrick Nuclear Power Plant, Appendix I," Power Authority of the State of New York.

5. A. M. Beeton, "Changes in the Environment and Biota of the Great Lakes," in Eutrophication: Causes, Consequences, Correctives, National Academy of Sciences, pp. 150-187, 1969.

6. C. Nalewajko, "Composition of Phytoplankton in Surface Waters of Lake Ontario," J. Fish. Res. Bd., Canada, 23: 1715-1725, 1966.

7. S. H. Smith, "Trends in Fishery Management of the Great Lakes," in A Century of Fisheries in North America, N. G. Benson, Ed., Am. Fish. Soc. Sp. Pub. No. 7, 1970.

8. K. D. Carlander, "Handbook of Fresh Water Fishery Biology," Vol. I, The Iowa State Univ. Press, Ames, Iowa, 1969.

9. E. C. Raney, "Some Young Freshwater Fishes of New York," The Conservationist, N. Y. State Conservation Department, Aug.-Sept., 1959.

10. E. C. Raney, "Some Pan Fishes of New York," The Conservationist, N. Y. State Conservation Department, Apr.-May, 1965.

11. E. C. Raney, "Some Pan Fishes of New York," The Conservationist, N. Y. State Conservation Department, June-July, 1965.

12. R. O. Brinkhurst, et al., "Components of the Bottom Fauna of the St. Lawrence Great Lakes," Univ. Toronto, Great Lakes Inst. Publ. No. PR 33, 1968.

13. J. K. Hiltunen,, "The Benthic Macrofauna of Lake Ontario," Contribution No. 389 of the Ann Arbor Biological Laboratory, National Marine Fisheries Service, Ann Arbor, Mich., 1969.

14. M. G. Johnson and R. O. Brinkhurst, "Production of Benthic Macroinvertebrates of Bay of Quinte and Lake Ontario," J. Fish. Res. Bd., Canada 28: 1699-1714, 1971.

15. M. G. Johnson, "Benthic Community Metabolism in Bay of Quinte and Lake Ontario," J. Fish. Res. Bd., Canada, 28: 1715-1725, 1971.

16. M. G. Johnson, "Associations and Species Diversity in Benthic Macroinvertebrates of Bay of Quinte and Lake Ontario," J. Fish. Res. Bd., Canada, 28: 1682-1697, 1971.

17. D. F. Jackson, "Photosynthetic Rates of Cladophora fracta from Two Sites in Lake Ontario Under Natural and Laboratory Conditions," Pub. No. 15, Great Lakes Research Division, Univ. of Mich., Ann Arbor, pp. 44-50, 1066.

18. D. F. Jackson, "A Study of the Periphytic Organisms of the Eastern End of Lake Ontario," Proceedings, Tenth Conf. on Great Lakes Res., pp. 31-36, 1967.

19. K. Patalas, "Composition and Horizontal Distribution of Crustacean Plankton in Lake Ontario," J. Fish. Res. Bd., Canada 26: 2135-2164, 1969.

20. R. E. Ogawa, "Lake Ontario Phytoplankton, Sept. 1964," Contribution No. 388, Ann Arbor Biological Laboratory, National Marine Fisheries Service, Ann Arbor, Mich., 1969.

21. J. F. Reinwand, "Planktonic Diatoms of Lake Ontario," Contribution No. 387, Ann Arbor Biological Laboratory, National Marine Fisheries Service, Ann Arbor, Mich., 1969.

22. C. Nalewajko, "Phytoplankton Distribution in Lake Ontario," Proceedings, Tenth Conf. Great Lakes Research, pp. 63-69, 1967.

23. "Radiation Data and Reports," Vol. 1-13, 1959-1972, U. S. Environmental Protection Agency.

24. "Environmental Report for Nine Mile Point Unit 2, Niagara Mohawk Power Corporation," Syracuse, N. Y., 1972.

25. "Tornado Probabilities," Monthly Weather Review, October-December p. 734, 1963.

26. Earthquakes in New York State, D. H. Newland New York State Museum, Albany, N. Y. September 1933, Circular 14 18 p.

27. Letter from Ronald Pendersen Deputy Commissioner of the State of New York Department of Environmental Conservation.

28. Letter from W. A. Radleigh, Acting Director of the United States Department of Interior Geological Survey A. E. C. Docket No. 50-333 Geology Field Survey.

29. Safety Evaluation of the James A. FitzPatrick Nuclear Power Plant, Docket No. 50-333, USAEC, November 20, 1972.

3. THE PLANT

3.1 EXTERNAL APPEARANCE

The Plant consists of five principal buildings which are interconnected to form one large structure approximately 640 feet long and 250 feet wide. These buildings will house: (1) the turbine, (2) the reactor, (3) the radwaste, (4) the pump house and screenwell, and (5) administrative offices. In addition to the above, there will be a 385-foot stack located approximately 400 feet south. The 345-kV switchyards are located approximately 200 feet west. The Plant buildings and switchyards will occupy one percent of the site area and about 600 acres will be left in their natural conditions. A layout of the plant is shown in Fig. 3.1.

The Plant's exterior is being constructed of concrete and fluted metal siding colored brown. The expanse of the concrete will be broken by a pattern of formwork. The most prominent and extensive view of the Plant's structure will be from the lakeside (north) from which the Plant will appear as a single large building, very much as shown in a recent photograph (Fig. 3.2). An artist's rendering of the complete Plant is shown in Fig. 3.3.

3.2 REACTOR AND STEAM-ELECTRIC SYSTEM

A single unit boiling water nuclear reactor will generate steam at 1000 psig to drive the turbine-generators. The reactor has a nominal power rating of 2436 MWt and a "stretch" power rating of 2557 MWt. The net electrical output corresponding to 2436 MWt will be 821 MWe. The reactor and the turbine-generator are manufactured by General Electric Company. Stone and Webster Engineering Corporation is the architect-engineer and the builder of the Plant.

3.3 HEAT DISSIPATION SYSTEM

The Applicant proposes to use a once-through cooling system to dissipate waste heat from the turbine condensers and service water cooling system to the environment. The circulating water for the Plant will be drawn from Lake Ontario via a submerged inlet, circulated through the condensers, and returned to the lake through a submerged jet diffuser. The intake and discharge tunnels pass through rock 60 ft below the lake bottom to a screenwell and pumphouse located onshore. Figure 3.4 shows the locations of the intake and discharge structures in Lake Ontario.

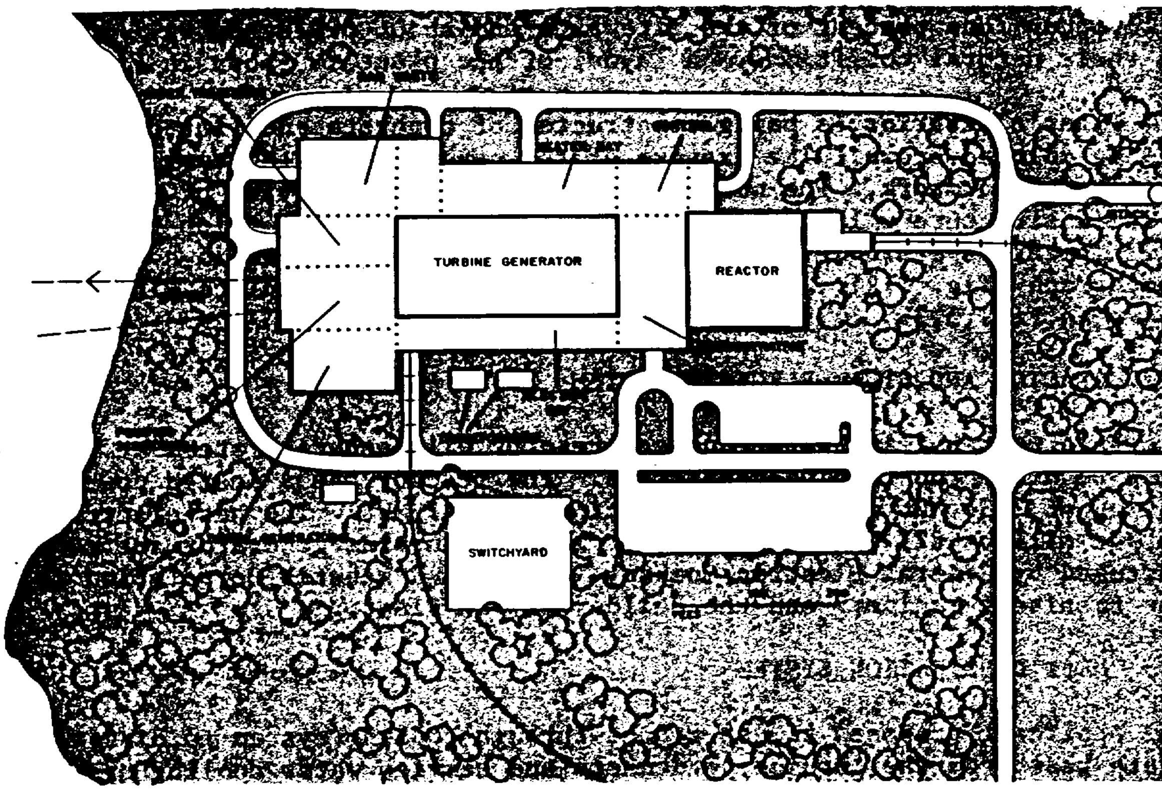


Fig. 3.1. Layout of the FitzPatrick Plant. From Applicant's Environmental Report.

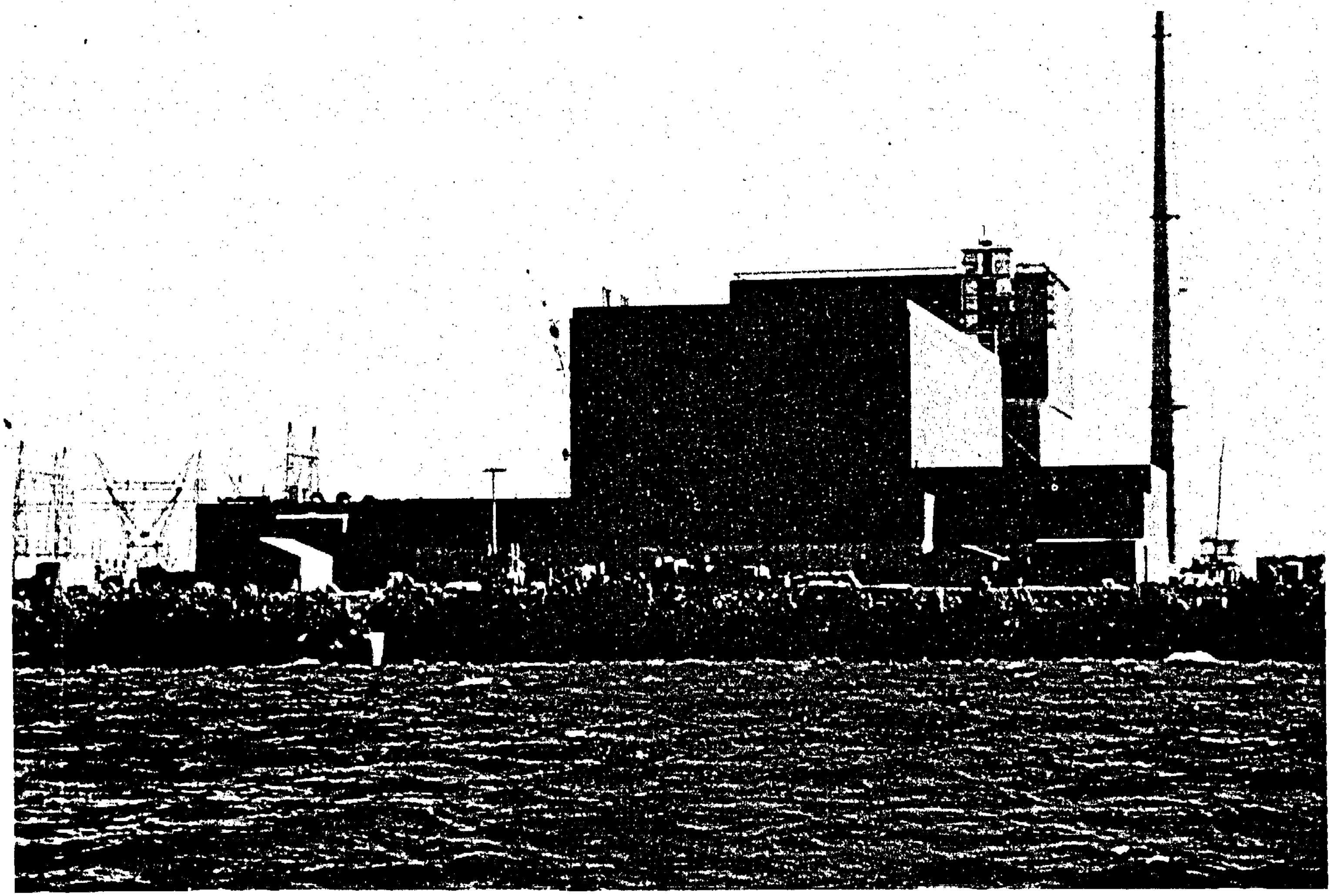


Fig. 3.2. The FitzPatrick Plant as Seen from the Lake.

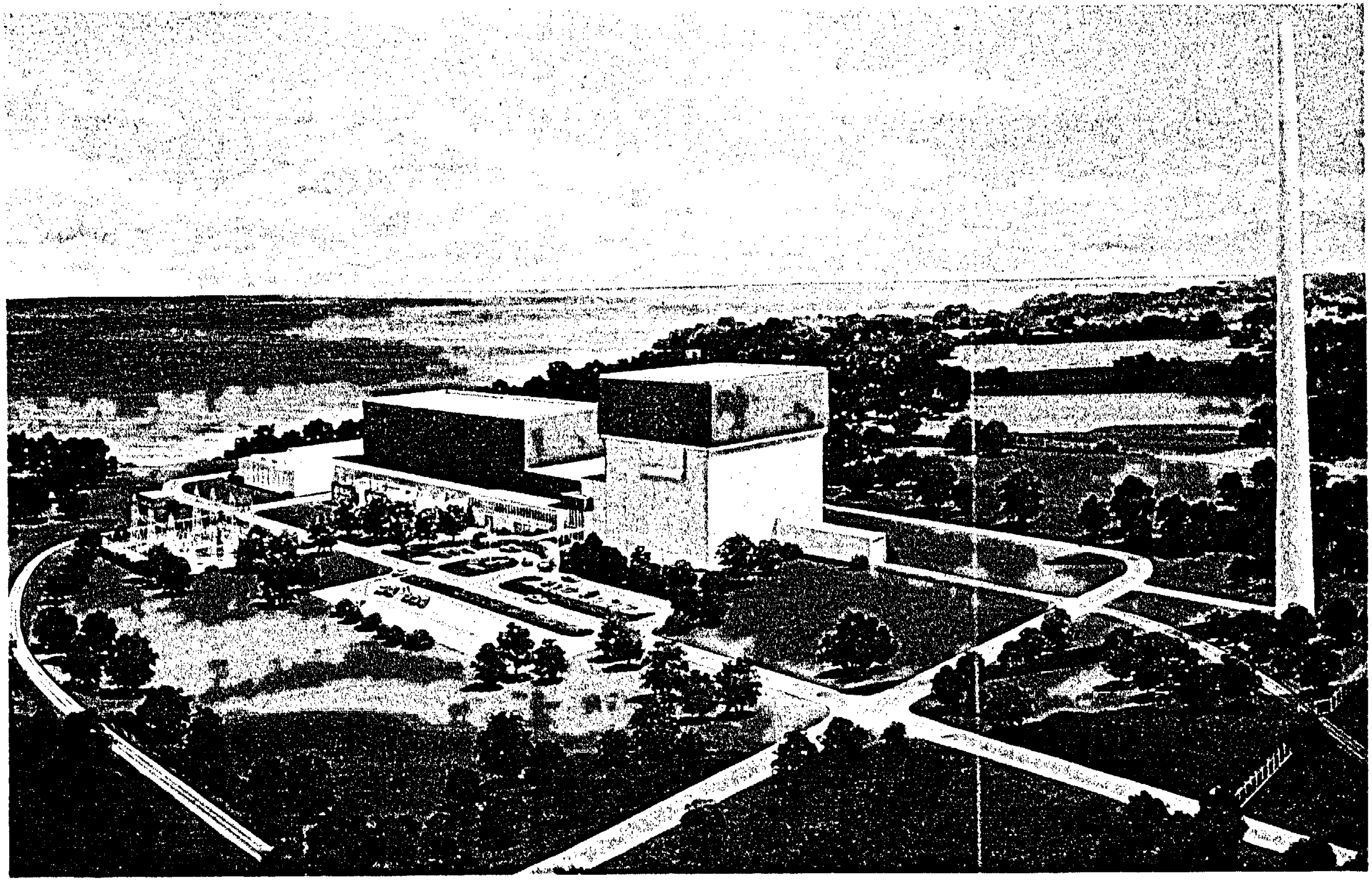


Fig. 3.3. Artist's Drawing of the FitzPatrick Plant. From Applicant's Environmental Report.

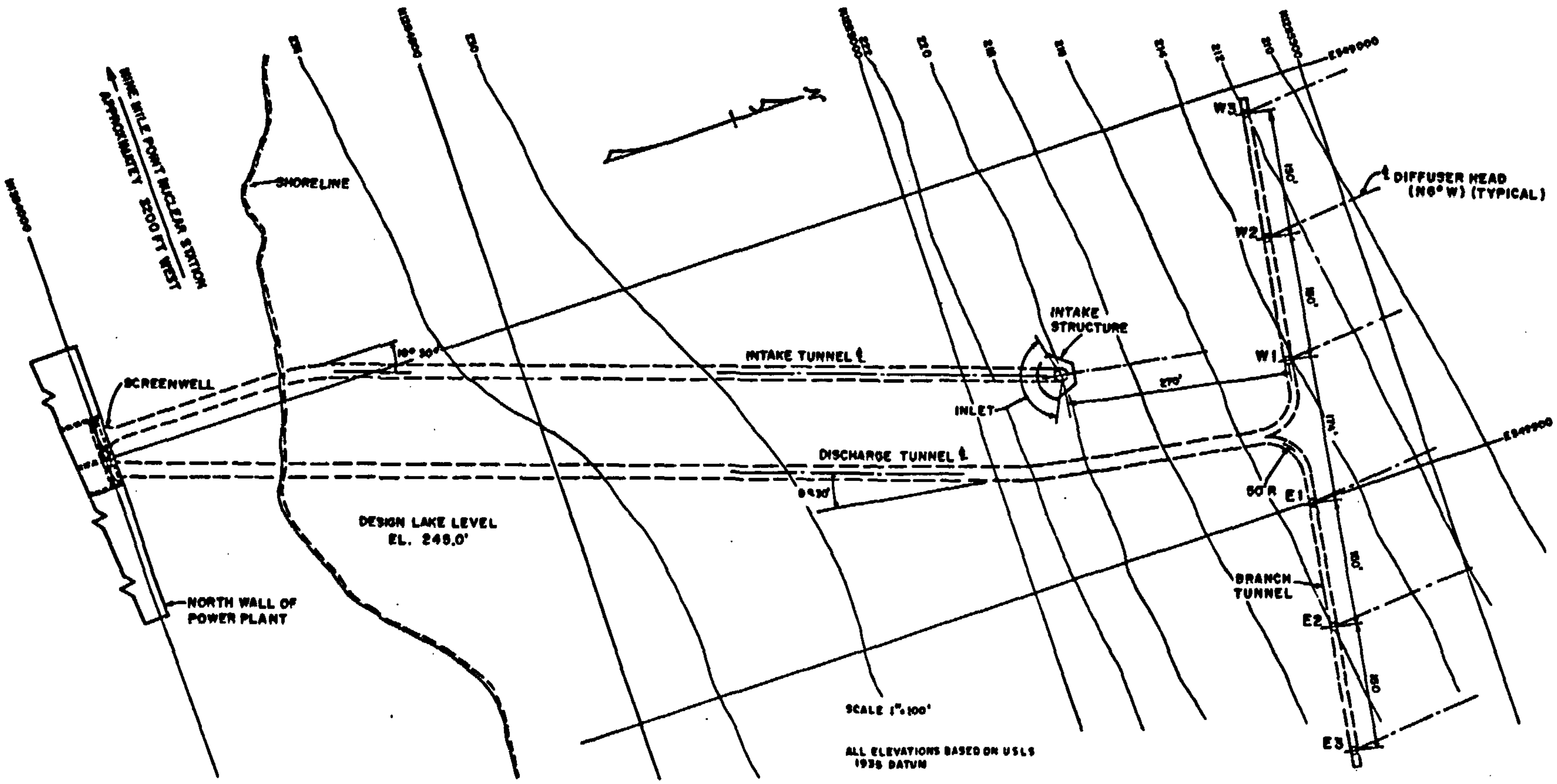


Fig. 3.4. Water Intake and Discharge Arrangement. From Applicant's Environmental Report.

The Applicant states that at the maximum anticipated power output the Plant will require a total flow of 370,200 gpm. Of the total flow, 352,300 gpm is for the main condenser which will raise the circulating water temperature 32.4°F and 17,900 gpm is for service water requirements which will produce a 13.5°F rise in temperature. The Plant will therefore discharge a total of 370,200 gpm with a net temperature rise of 31.5°F, above ambient temperature. The heat rejection rate in the condenser is expected to be 5.714×10^9 Btu/hr.

The intake structure is anchored to the natural bedrock 900 ft offshore. It is approximately 68 ft diagonally across and 14 ft high with the top surface being 10 ft below the minimum lake level. The water will be drawn through four openings (total intake area 8 ft x 70 ft) in the intake structure. Bar racks will be installed at the openings to prevent large objects from entering. Intake velocity through the bar racks is expected to be 1.4 fps. The water will travel approximately 60 ft downward to a tunnel connecting to the shore facility. The tunnel is D shaped with a flat bottom, vertical sides, and a round top. The water velocity is estimated at 4.7 fps. After passing through the tunnel, the water will rise into a large forebay. The forebay is divided into three separate bays which lead through bar racks to the recessed vertical traveling screens having 3/8-in. square wire mesh. Bar racks are also installed in the bays in front of the traveling screens. After passing through the traveling screens, water will flow into a well from which pumps will move it to the condensers.

The discharge structure starts at the screenwell pumphouse and extends approximately 1,400 ft northward to a junction with diffuser branches which are generally parallel to the shoreline. The discharge tunnel has the same cross section as the intake tunnel and the diffuser branch tunnels are 9 ft wide by 10 ft high with a slight arch. The discharge diffuser consists of six diffuser heads, three on each branch tunnel, with a distance of 150 ft between each of the heads. Each diffuser head is connected to the branch tunnel by a riser shaft and consists of two horizontal discharge nozzles separated by a horizontal angle of 42 degrees. Each nozzle has a diameter of 2.5 ft to produce an exit velocity of 14 ft/sec. The direction of the discharge is lakeward and normal to the local bottom contour lines. The nozzles are approximately 5 to 6 feet above lake bottom to minimize bottom scour and to ensure sufficient ambient dilution water below the jet. It is expected that the relatively high velocities in the nozzles, compared to the branch tunnel velocity, and the symmetrical geometry of the diffuser head, will produce equal flows from all nozzles.

With the unit operating at full power the total travel time from the intake entrance to the discharge release will be about 12 to 15 minutes. The residence time in the condenser is calculated to be 7.7 seconds.

3.3.1 Applicant's Hydraulic and Analytical Modeling

Analytical and hydraulic model studies were used by the Applicant to develop the hydraulic design of the structures and to ensure that the temperature patterns produced by the Plant operation under widely varying environmental conditions would comply with New York State thermal standards.[1] These standards limit surface water temperature rise to not more than 3°F outside a mixing zone 300 feet in radius, or the equivalent area, from the point of discharge. The hydrothermal analyses and design concepts were developed in the Environmental Engineering Division of the Stone and Webster Engineering Corporation, Boston, Mass. The hydraulic model tests were conducted by the Alden Research Laboratories, Holden, Mass.

The basic concept of the multiport discharge is to produce a rapid dilution of the Plant cooling water by entraining large quantities of cooler lake water. Reduction in temperature occurs by entrainment of ambient water into the jet stream as it approaches the surface. This dilution proceeds until the relative velocity between the jet stream and the surrounding water is reduced to zero. (This phenomenon is called "jet dilution" and occurs by turbulent transport mechanisms).

The behavior of the jet discharge as regards mixing with the lake under various hydrological and meteorological regimes has been examined by the Applicant in considerable detail by the hydraulic modeling and analytical studies. Model tests were used only to study overall flow patterns for various arrangements of the Plant's diffuser. Analytic studies were conducted to determine thermal effects beyond the immediate vicinity of the discharge structures of both the FitzPatrick Plant and Nine Mile Point, Unit 1, Nuclear Station.

The Applicant's combined hydraulic modeling and analytical schemes used for the Plant's discharge will be presented for the situations with and without shoreline currents.

a. Model Derivation for the Case with No Lake Currents

Figure 3.5 represents a typical flow pattern resulting from the diffuser under hydraulic-model testing. The tests indicated that the diffuser jets induced sufficient flow of ambient lake water for dilution to cause the maximum surface temperature rise of approximately 2.5°F above ambient at its centerline position. This occurred 300 feet lakeward from the line of discharge. The excess temperature 500 feet to either side of the centerline was found to roughly 2°F. The surface flow pattern and temperature profiles determined from the hydraulic model tests are illustrated in Fig. 3.6.

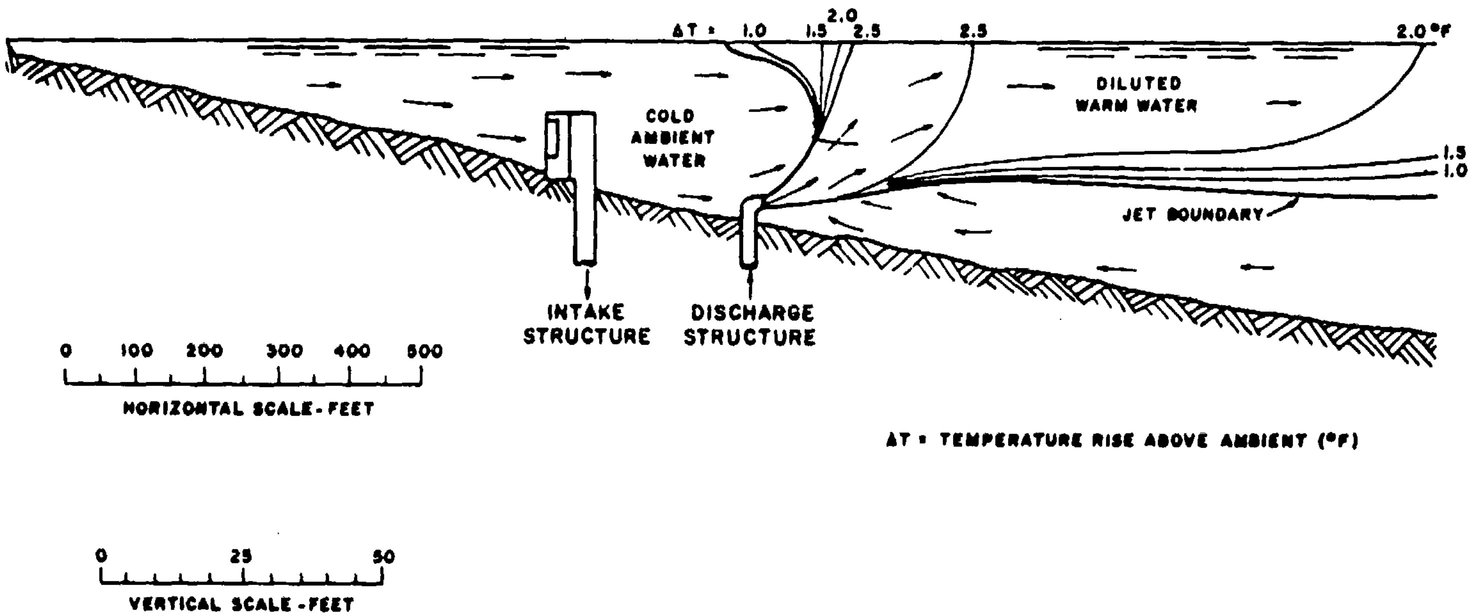


Fig. 3.5. Typical Flow Pattern and Temperature Distribution. From Applicant's Environmental Report.

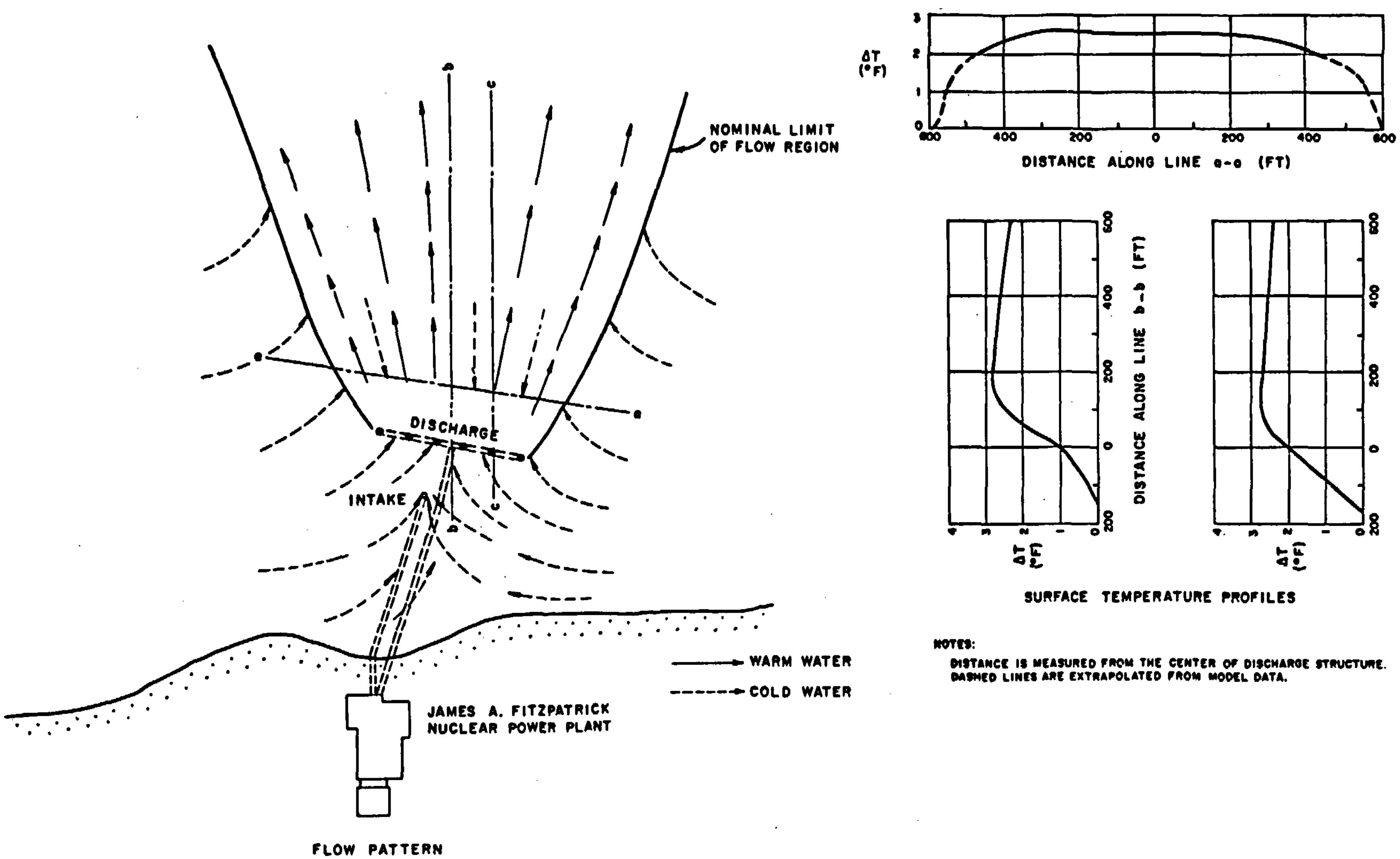


Fig. 3.6. Surface Flow Pattern and Temperature Profiles with No Natural Lake Current—Model Tests. From Applicant's Environmental Report.

The overall thermal patterns were determined analytically using results of the model tests for the hydrothermal conditions in the vicinity of the discharge structure. These patterns are shown in Fig. 3.7. It is evident that a symmetrical plume is formed lakeward of the diffuser, with a relatively rapid drop in temperature due to dispersion. The lake area with a ΔT greater than 0.5°F encompasses 296 acres.

b. Model Derivation for the Case with Lake Currents

The flow pattern and overall temperature distribution of the Plant's discharge are affected by lake currents, which deflect the discharge in the direction of the prevailing current.

Hydraulic modeling was again used to predict the temperature profiles (velocity profiles were not measured) within 300 feet of the diffuser in the lakeward direction. As in the zero-current situation, the diffuser jets again produced an approximate line source at 300-foot lakeward distance. Figure 3.8 shows the model flow pattern and surface-temperature increases produced with a current of 0.8 ft/sec to the east, and Fig. 3.9 shows the model flow pattern and surface-temperature increases for a current of 0.7 ft/sec to the west. The maximum surface temperatures measured in the hydraulic model for the above current conditions are seen to be 3.2 and 3.5°F, respectively. Hydraulic modeling for eastward currents of 0.2, 0.5, and 0.8 and westward currents of 0.2, 0.5, and 0.7 ft/sec had shown the temperature profile for each set of conditions at a point 300 feet lakeward of the diffuser to be near Gaussian in form. The profiles were similar to the no-lake-current case.

With the temperature profile determined by hydraulic modeling for a distance of up to 300 feet, an analytical procedure was used to yield the overall temperature distribution. As with the no-current case, the flow field at 300 feet is again considered to be a line source and to have resulted from a single hypothetical jet placed upstream.

Flow patterns and constant temperature contours were determined for eastward currents of 0.2, 0.5, and 0.8 ft/sec, Figs. 3.10, 3.11, and 3.12, respectively; and for westward currents of 0.2, 0.5 and 0.7 ft/sec, Figs. 3.13, 3.14, and 3.15, respectively. The Applicant concluded from these plots that as current velocity increases, there appears to be less dilution at a given distance and more area within a fixed isotherm. Generally, higher current speeds produced a more elongated plume with more total area within the 0.5°F isotherm than in the case of lower currents. As determined by the hydraulic tests the only apparent difference between westward and eastward currents occurs in the vicinity of the discharge structures.

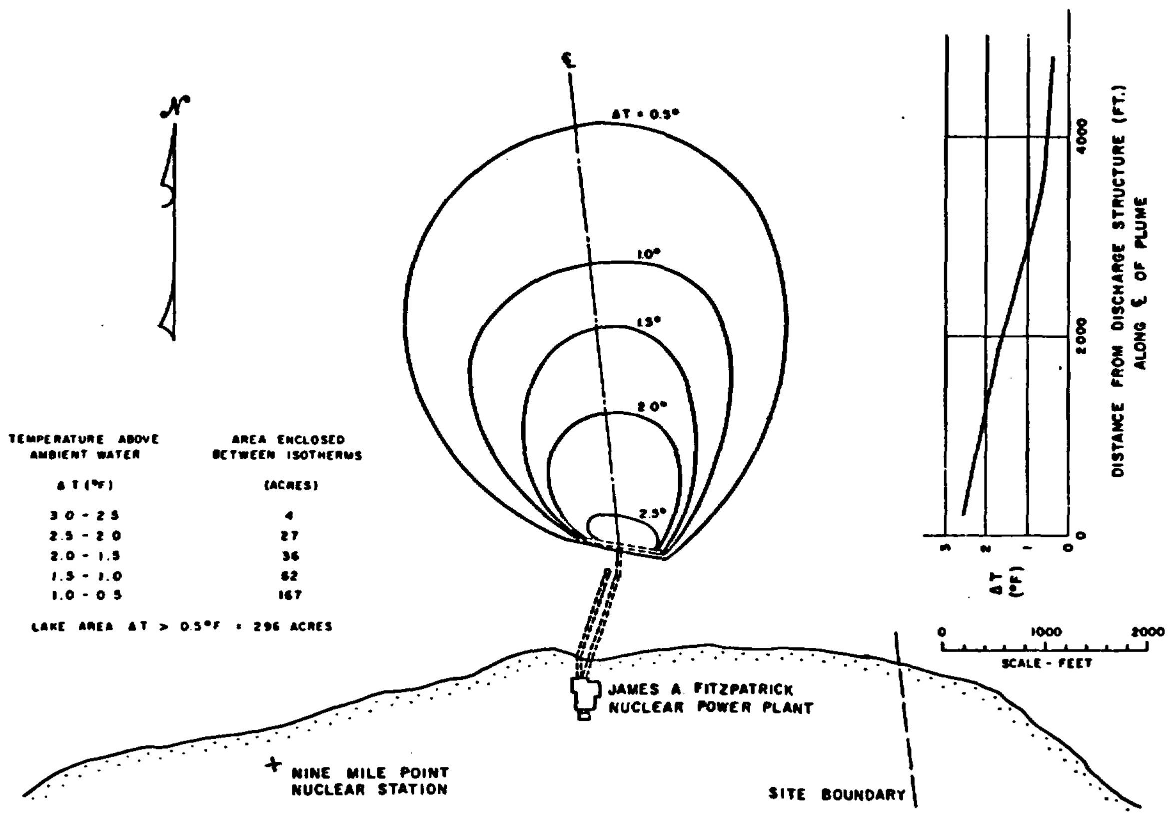


Fig. 3.7. Surface Temperature Pattern with No Lake Current. From Applicant's Environmental Report.

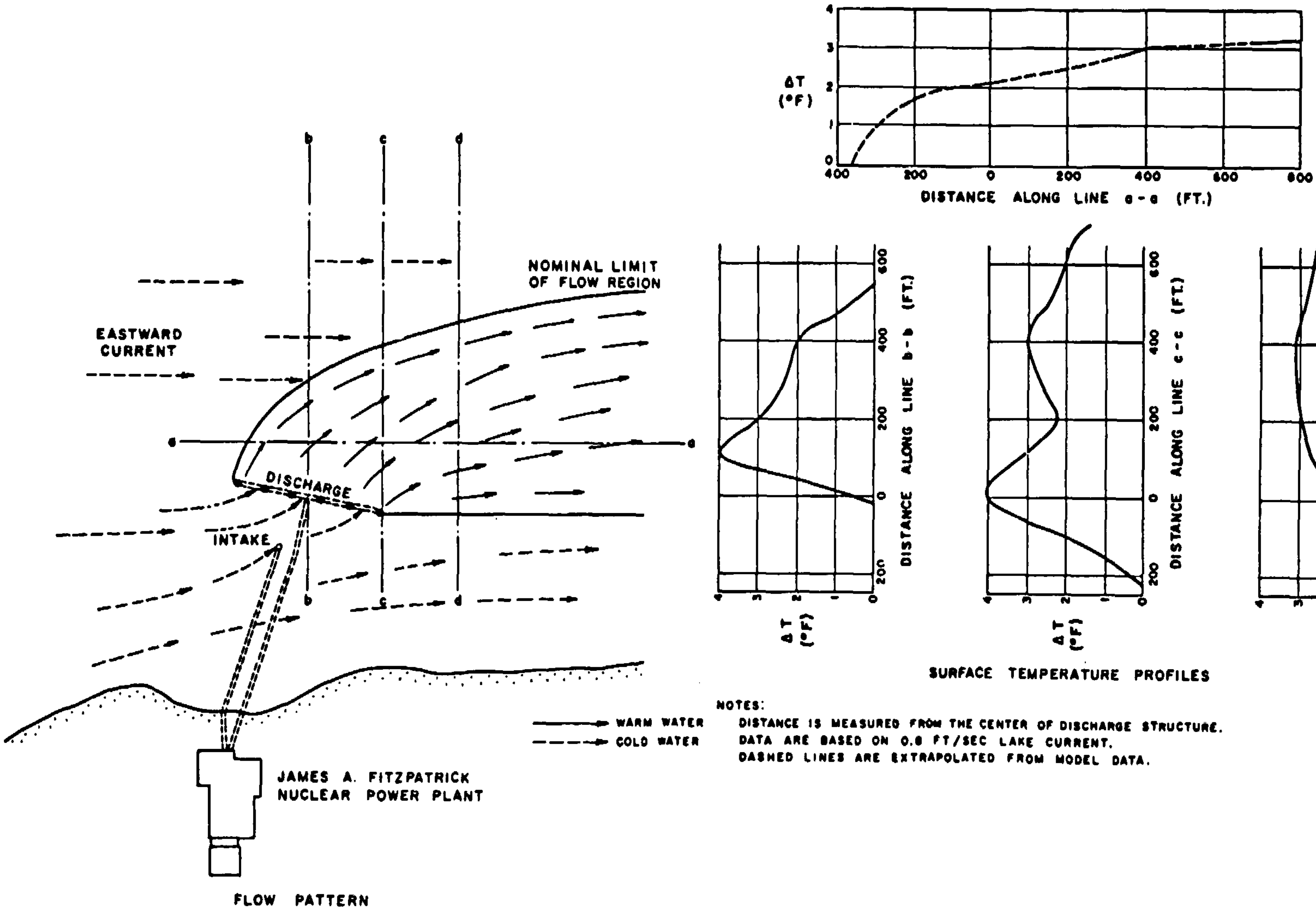


Fig. 3.8. Flow Pattern and Temperature Profiles with Eastward Lake Current - Model Tests. From Applicant's Environmental Report.

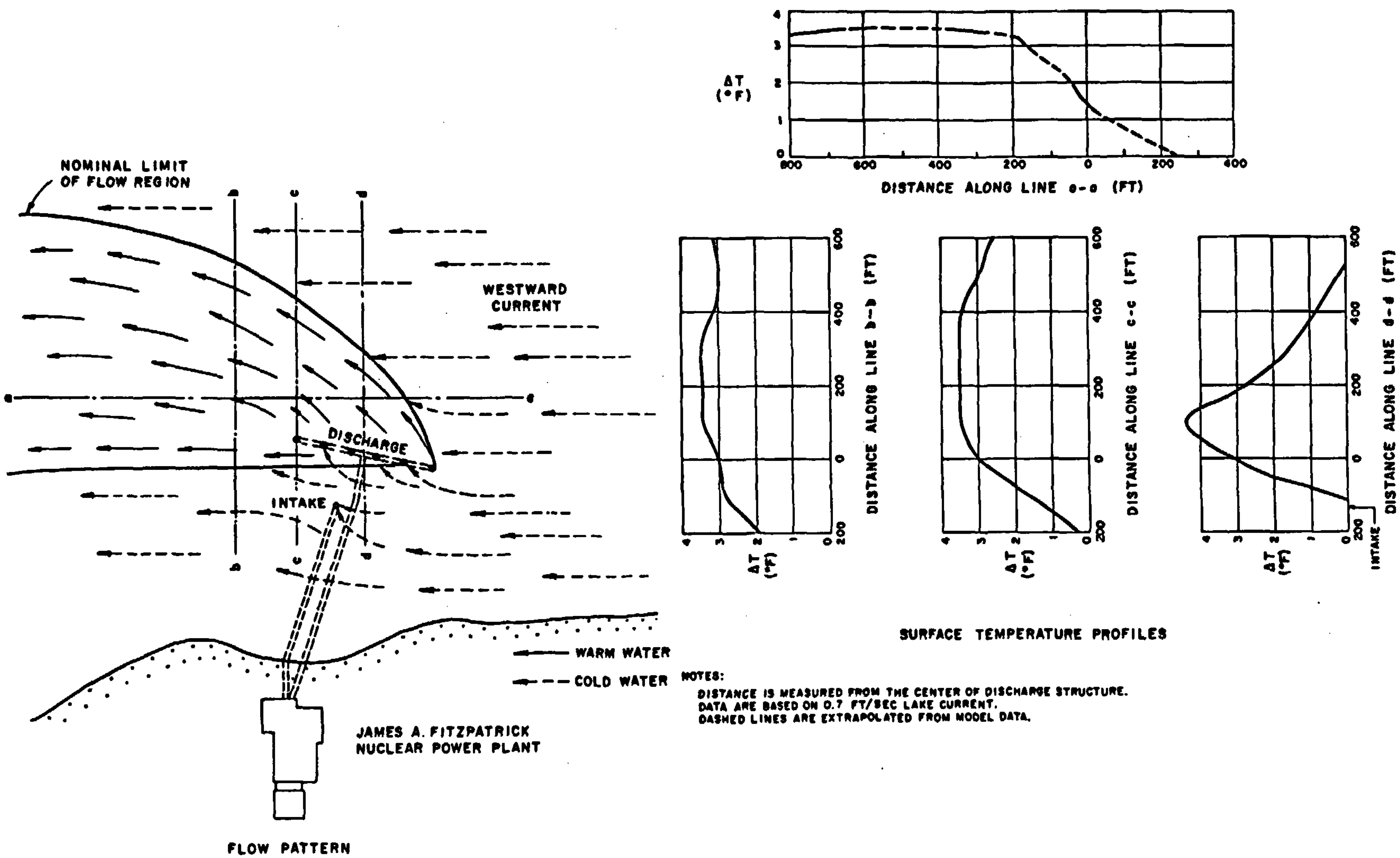


Fig. 3.9. Surface Flow Pattern and Temperature Profiles with Westward Lake Current--Model Tests. From Applicant's Environmental Report.

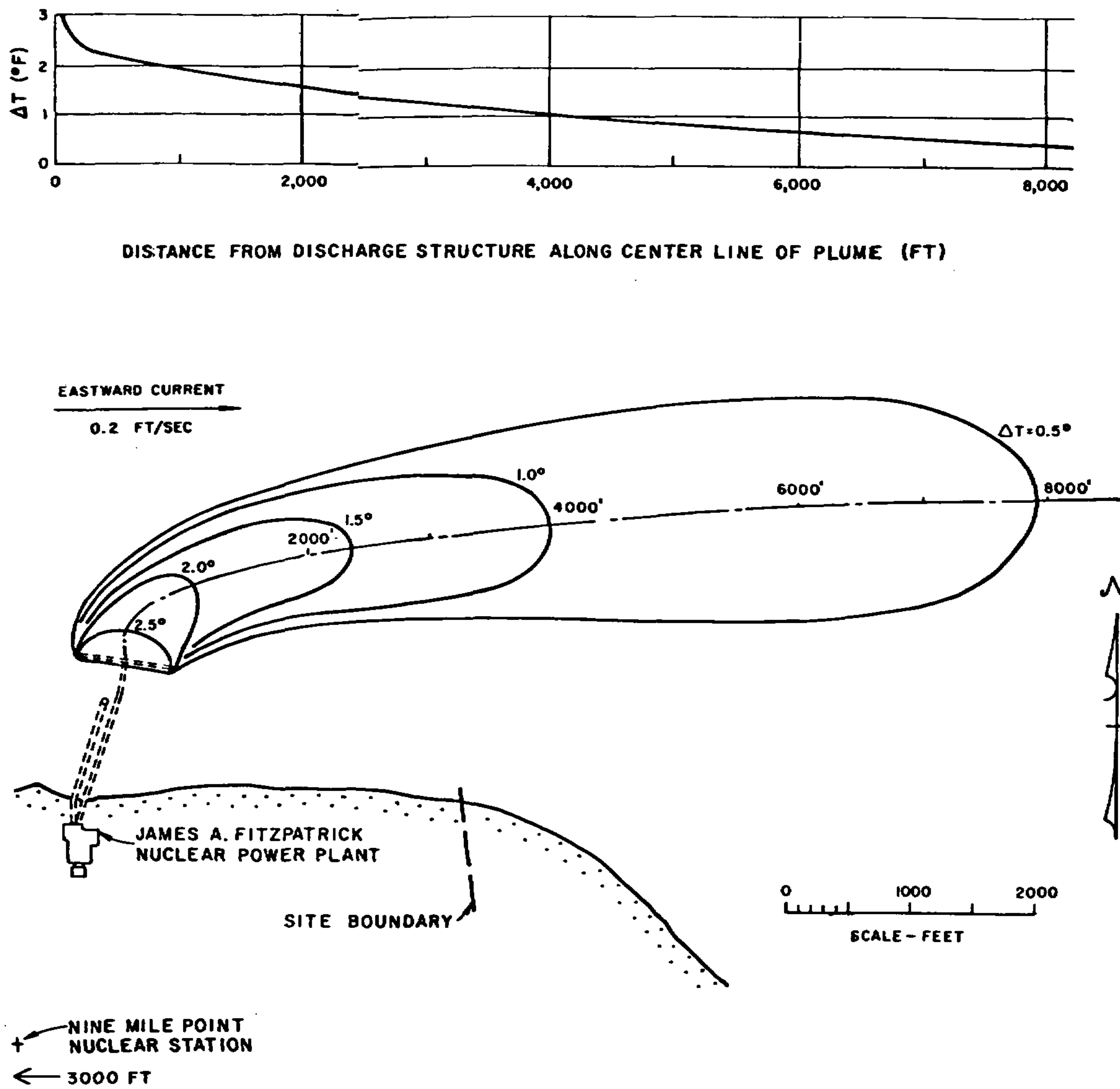


Fig. 3.10. Predicted Cumulative Temperature Pattern with 0.2 ft/sec Eastward Current. Modified from Applicant's Drawing.

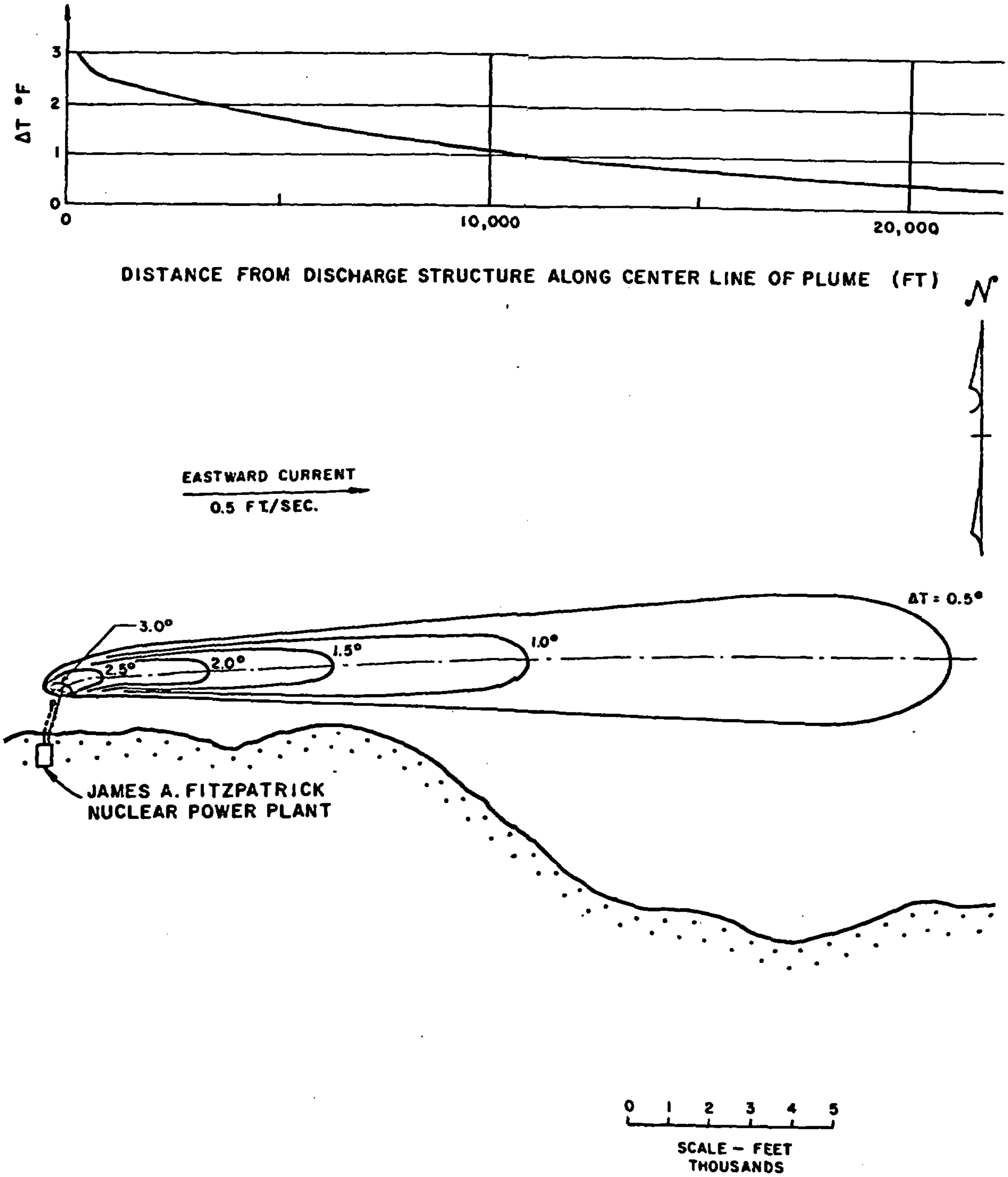


Fig. 3.11. Predicted Cumulative Temperature Pattern with 0.5 ft/sec Eastward Current. Modified from Applicant's Drawing.

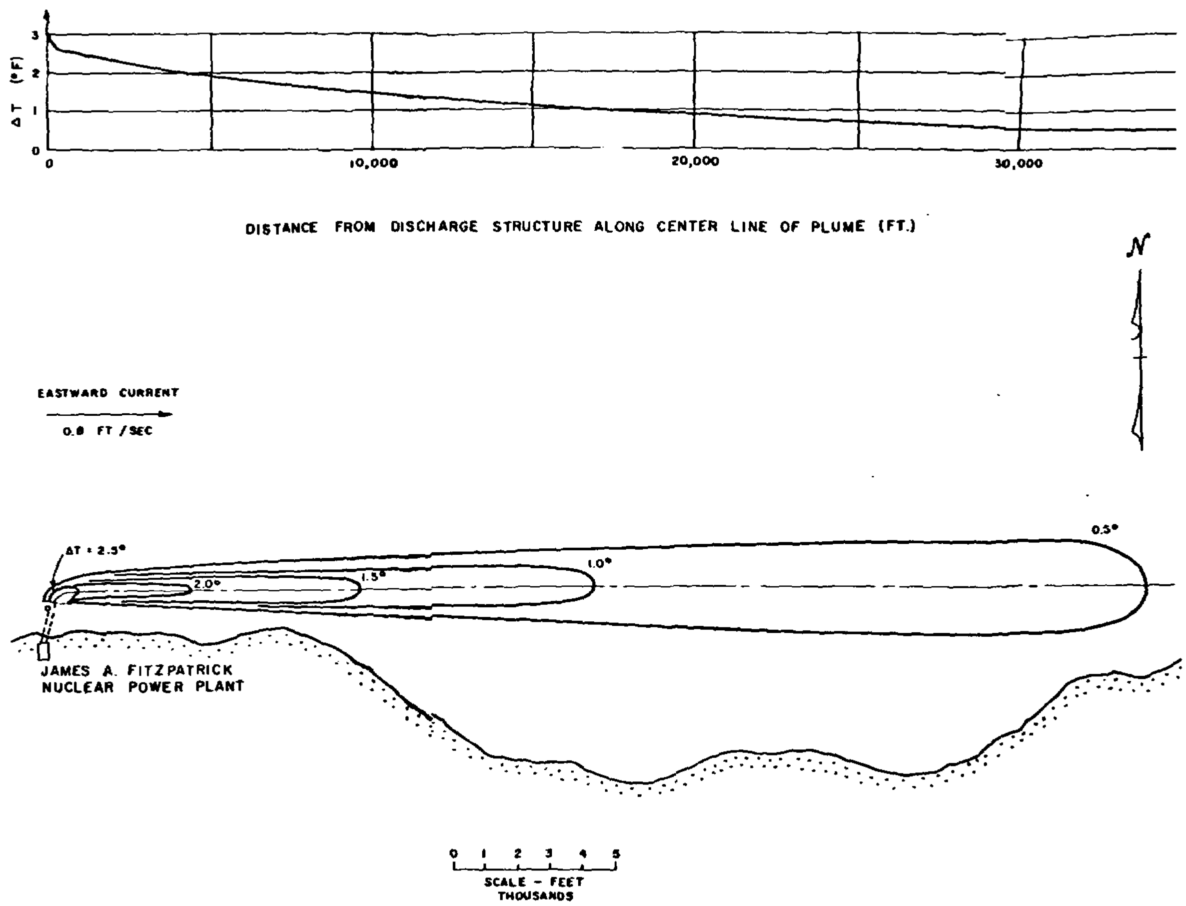


Fig. 3.12. Predicted Cumulative Temperature Pattern with 0.8 ft/sec Eastward Lake Current. Modified from Applicant's Drawing.

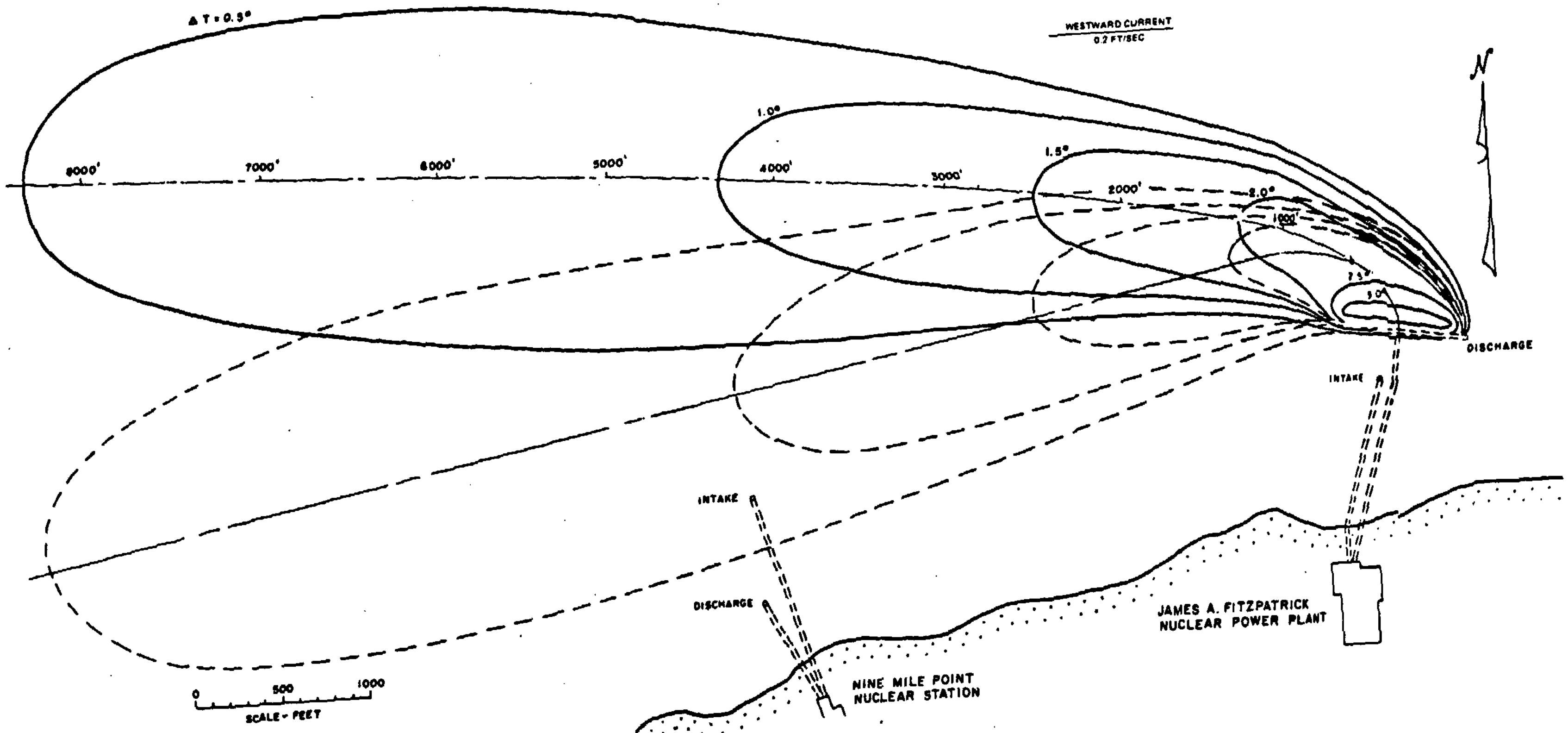


Fig. 3.13. Predicted Cumulative Temperature Pattern with 0.2 ft/sec Westward Lake Current. Solid lines show Applicant's predictions, the broken lines the Staff's.

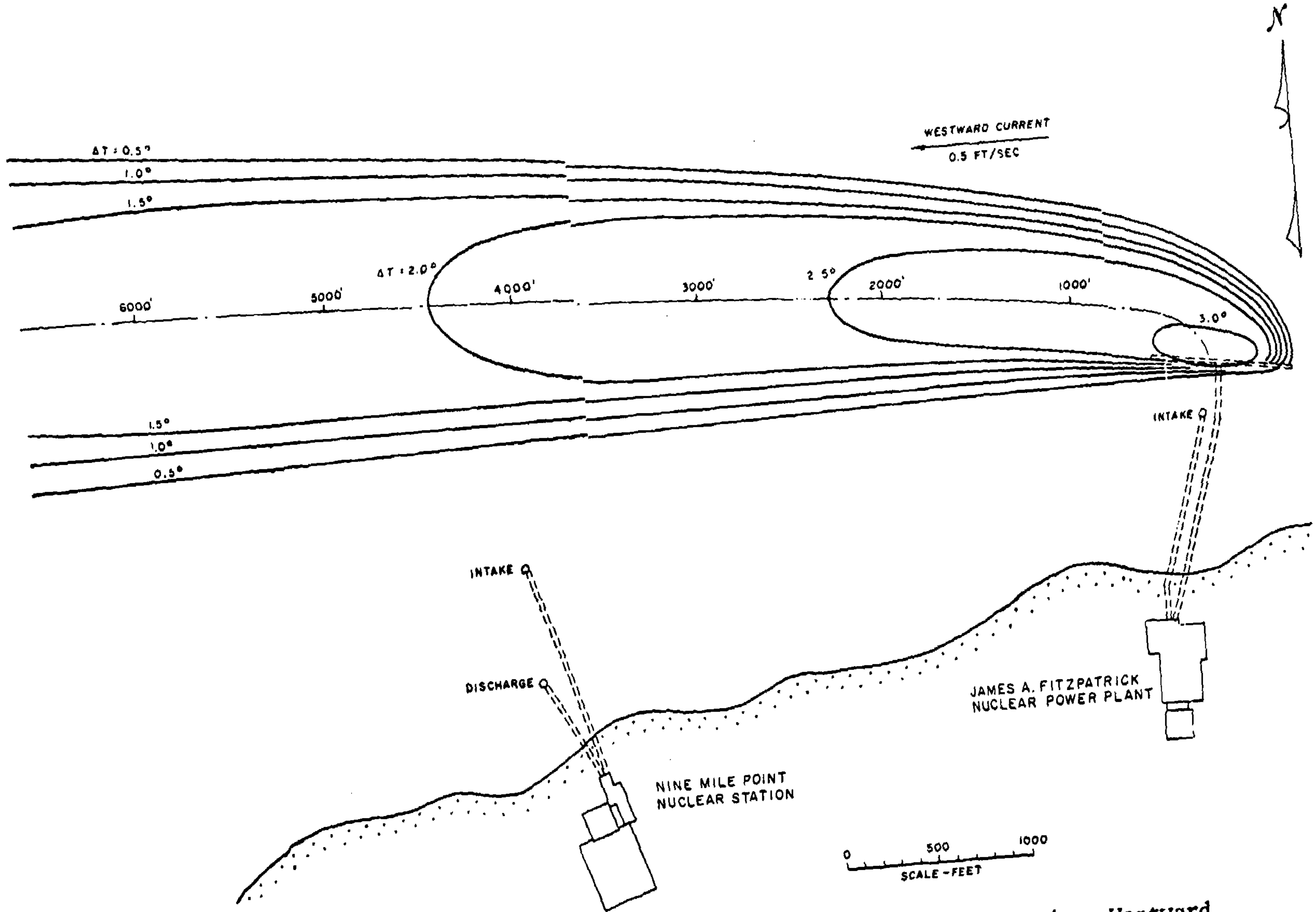


Fig. 3.14. Predicted Cumulative Temperature Pattern with 0.5 ft/sec Westward Lake Current. From Applicant's Environmental Report.

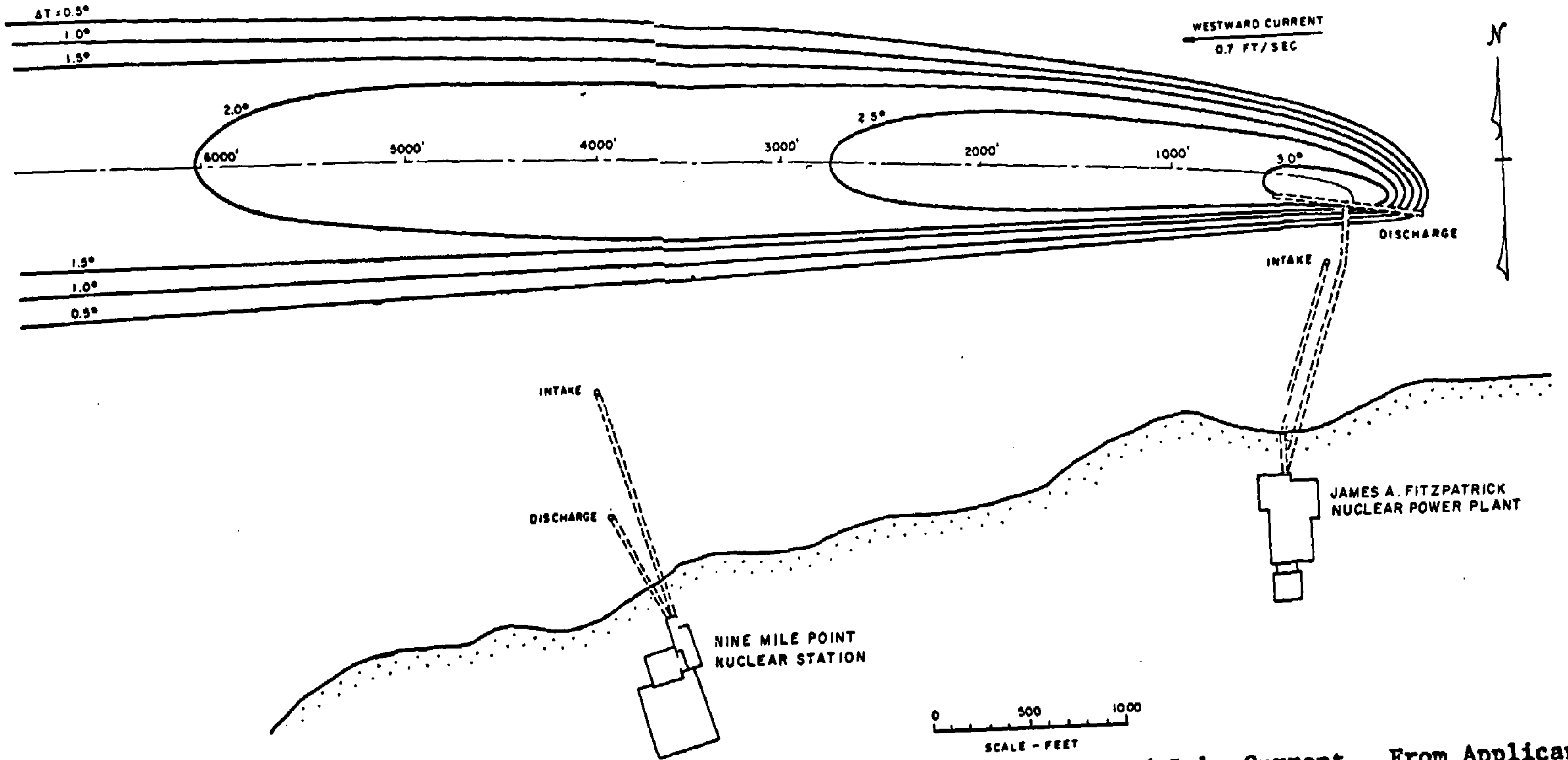


Fig. 3.15 Predicted Cumulative Temperature Pattern with 0.7 ft/sec Westward Lake Current. From Applicant's Environmental Report.

c. Interaction with Nine Mile Point, Unit 1, Nuclear Station

Because of the proximity of Nine Mile Point Nuclear Station, 3200 feet to the west, there is a possibility that the cooling water discharged from that Station will interact with the FitzPatrick intake and discharge. Nine Mile Point, Unit 1, Station discharges 600 cfs of cooling water with a temperature rise of 31.5°F through a symmetrical radial structure approximately 350 feet offshore.

Hydraulic models and analytical studies were also used to determine the cumulative thermal effect of both plants. According to the Applicant, these studies indicated that during "no current" and eastward current conditions there will be an interaction with the FitzPatrick's outfall, but in no case and under any current conditions will the maximum cumulative surface temperature be greater than 3°F outside the allowable mixing zone. In general, the Applicant contends that Nine Mile Point, Unit 1, Station contributes approximately 0.5°F to the cumulative temperatures at the FitzPatrick Plant during eastward currents. During westward current conditions, the FitzPatrick Plant's discharge according to the Applicant, does not interact with the Nine Mile Point, Unit 1 Station discharge because the diluted FitzPatrick flow is farther offshore than the Nine Mile Point, Unit 1, Station intake and discharge.

The above temperature contours were derived neglecting other factors which increase dilution. These include variations in current direction, shear produced by the velocity distribution, wind and wave effects, etc.

Consequently the isotherms plotted in the above figures are, according to the Applicant, conservative estimates of plume characteristics. Another factor which makes the temperatures in the plume conservative is that a lower cooling water flow and higher temperature rise was used in the model than in the prototype.

On the basis of the model testing and analyses the Applicant predicts that the temperature increase at the lake surface outside a 300-foot radius, or an equivalent area, from the point of discharge will be less than 3°F above ambient for all lake conditions and they will meet the thermal criteria of New York.

3.3.2 Staff's Assessment of the Applicant's Hydrothermal Analysis

a. Hydraulic Modeling for Near-Field Plumes

As mentioned above the Applicant used hydraulic modeling to design and locate the diffuser and intake structures and to provide the near-field

hydrothermal performance characteristics of the diffuser. The results suggested the system's ability to meet New York State's thermal criteria for stagnant lake and low ambient current condition. The cumulative effect of the Nine Mile Point, Unit 1, effluent on the FitzPatrick discharge was not directly considered in the hydraulic modeling effort. For a range of simulated lake current speeds exceeding 0.28 fps the hydraulic model results indicated excess temperatures greater than 3°F occurring outside the mixing zone. Subsequently, the Applicant modified the original data to account for a design change in the Plant's cooling water flow rate and for the model's diffuser alignment during easterly flowing currents. Two other minor corrections were also incorporated to make the model results more consistent with expected prototype behavior. The corrective factors as applied to the original hydraulic results are shown in Table 3.1. The validity of these corrections is uncertain.

The Staff is of the opinion that hydraulic modeling is particularly suitable for studying the region close to the diffuser. It is the best state-of-the-art tool available to simulate mixing and entrainment as a function of the complicated diffuser structure, local topography and lake currents. It is not, however, a perfect predictive tool. Hydraulic modeling is not refined to the point where very accurate quantitative thermal predictions are possible.[2] Considering the present state-of-the-art, comparisons of model and prototype are more likely to be qualitatively than quantitatively correct. Thus, the Applicant's hydraulic model data should be kept in perspective, and undue emphasis should not be placed on the tenths of a degree accuracies cited.

b. Analytical Modeling for Far-Field Plumes

It is generally recognized that hydraulic models possess significant limitations for modeling thermal plume reaches where plume behavior is primarily dictated by ambient lake dynamics and meteorological conditions.

Because of this the Applicant used mathematical modeling for determining the far-field temperature characteristics of the FitzPatrick plume. The results of this modeling are shown in Figs. 3.10 to 3.15 inclusive. A study shows[3] that there are too many unsupported assumptions and judgments built into the far-field mathematical modeling to place quantitative reliance in the far-field isotherm predictions given by these figures. The analytical model results represent reasonable state-of-the-art assessments which are more likely to be qualitatively than quantitatively correct in predicting the actual length and breadths of plumes.

TABLE 3.1. Applicant's Predicted Temperature Increases within 300 Feet of the FitzPatrick Diffuser[5]

Current direction	Easterly			Westerly		
Current velocity, ft/sec	0.2	0.5	0.8	0.2	0.5	0.7
Max. ΔT (hydraulic model) °F	3.0	3.5	3.4	3.0	3.5	3.6
Corrected ΔT,* °F	2.3	2.7	2.6	2.5	2.9	3.0

*Correction factors

1. Flow rate Modification, °F $\Delta T = \Delta T_{max} \times 0.89$
2. Turbulence level, °F $\Delta T_2 = \Delta T_1 - 0.1$
3. Velocity profile, °F $\Delta T_3 = \Delta T_2 - 0.1$
4. Alignment (easterly current only) °F $\Delta T_4 = \Delta T_3 \times 0.75$
5. Calculated Nine Mile Point, Unit 1, effect (easterly current only) ΔT_5

Velocity, fps	Correction, °F
0.2	0.4
0.5	0.5
0.8	0.5

Corrected $\Delta T = \Delta T_4 + \Delta T_5$

The plumes shown in Figs. 3.10 to 3.15 follow a centerline trajectory which carries the plumes offshore with increasing distance from the Plant. A more likely plume trajectory would be for the plume centerline to more closely follow parallel to the local shoreline or lake bottom contouring. The Applicant's field investigations[4] have indicated such a behavior. If a correction of 11° west is made to the Applicant's current meter data to account for the difference between magnetic north and true north, the observed currents were essentially shore parallel. This behavior is particularly important when one considers the position of the FitzPatrick plume under westerly flow conditions. In Figs. 3.13 to 3.15 the FitzPatrick plumes for three westerly current speeds are shown to lie north of the Nine Mile Point, Unit 1, intake and discharge structures. The Staff concludes that a more likely plume trajectory is one shown in Figure 3.13 by the dashed lines. The isotherms for the other two westerly flow conditions can be redrawn to show a similar behavior. Under these conditions the FitzPatrick plume would raise the surface water temperatures in the Nine Mile Point, Unit 1, vicinity one or possibly two degrees above normal lake ambient. The Nine Mile Point, Unit 1, intake is located in deep water far below any reasonable plume depth which the FitzPatrick plume is likely to attain. For this reason the anticipated impact of the FitzPatrick Plant on the Nine Mile Point, Unit 1, plant will be in the form of increasing the temperature of the surface water available to the Nine Mile Point, Unit 1, discharge. Such an increase in the dilution water temperature would result in moderately higher Nine Mile Point, Unit 1, plume temperature. The Staff estimates that the highest plume temperature would be increased respectively by one-third to two-thirds of a degree for a 1 or 2-degree surface dilution water temperature increase.

c. Influence of Nine Mile Point, Unit 1, Plume

Before the Nine Mile Point, Unit 1 plant went into operation, the Applicant made an analytical study to determine the influence of the Nine Mile Point, Unit 1, plume on the FitzPatrick Plant. On the basis of this study, the Applicant concluded that the Nine Mile Point, Unit 1, station would contribute at most 0.5°F to the cumulative temperature of the FitzPatrick discharge. Using these results together with the corrected hydraulic model data, the Applicant concluded that the maximum temperature rise outside of the mixing zone of the FitzPatrick Plant during any current conditions would be less than 3°F (see Table 3.1).

Since Nine Mile Point, Unit 1, has become operational, field investigations have been conducted specifically to determine the extent of the Nine Mile Point, Unit 1, plume under a range of lake conditions. Two aerial infrared studies[6] of the Nine Mile Point, Unit 1, plume performed

by the Applicant during 1971 (Figs. 3.16 and 3.17) show the surface water directly above the FitzPatrick discharge to be 3°F or more above ambient temperature. The Staff concludes that in the region of the FitzPatrick discharge on occasions it is possible for the lake temperature on the surface, and perhaps to a depth of 10 feet, to be more than 3°F above ambient due to the operation of Nine Mile Point, Unit 1, alone. If the FitzPatrick Plant were operational during those periods, it is likely, although not certain, that the Plant would exceed the allowable State thermal criteria. It is not completely certain that this would happen because the FitzPatrick discharge design primarily uses cooler subsurface water to mix with the discharge and it is possible that the FitzPatrick plume could break through the Nine Mile Point, Unit 1, plume water to surface at a temperature somewhat cooler than the Nine Mile Point, Unit 1, layer. If this occurs the State thermal criteria would be met. This behavior would depend upon the thickness and temperature of the Nine Mile Point, Unit 1, plume, the current speed, and the temperature stratification existing down to the diffuser discharge. If the FitzPatrick plume is sufficiently low in temperature that it possesses a significant negative buoyancy with respect to the warmer Nine Mile Point, Unit 1, layer, "the break through" phenomenon will not occur. Should such a situation arise, the FitzPatrick plume will merely distribute itself (stratify) under the Nine Mile Point, Unit 1, layer. Admittedly, this would be a rare occurrence.

To evaluate the plume surface water temperature for "break through" condition, the Staff has performed a calculation of surface temperature differentials for a number of assumed conditions. Figure 3.18 shows a diagram applicable to the model employed. Table 3.2 gives the assumptions employed and lists the results.

Table 3.1 suggests that 3°F and 4°F Nine Mile Point, Unit 1, plume water will more likely reach the FitzPatrick site with increasing speeds of easterly current. The table shows, however, that the diffuser is less efficient with increasing current speeds. Thus there is a greater potential for the FitzPatrick Plant to exceed the temperature criteria established by the State of New York with faster easterly currents. The Applicant indicates that easterly currents of speeds greater than 0.3 fps occur less than 5% of the time and last for a very short time, usually less than 10 hours.

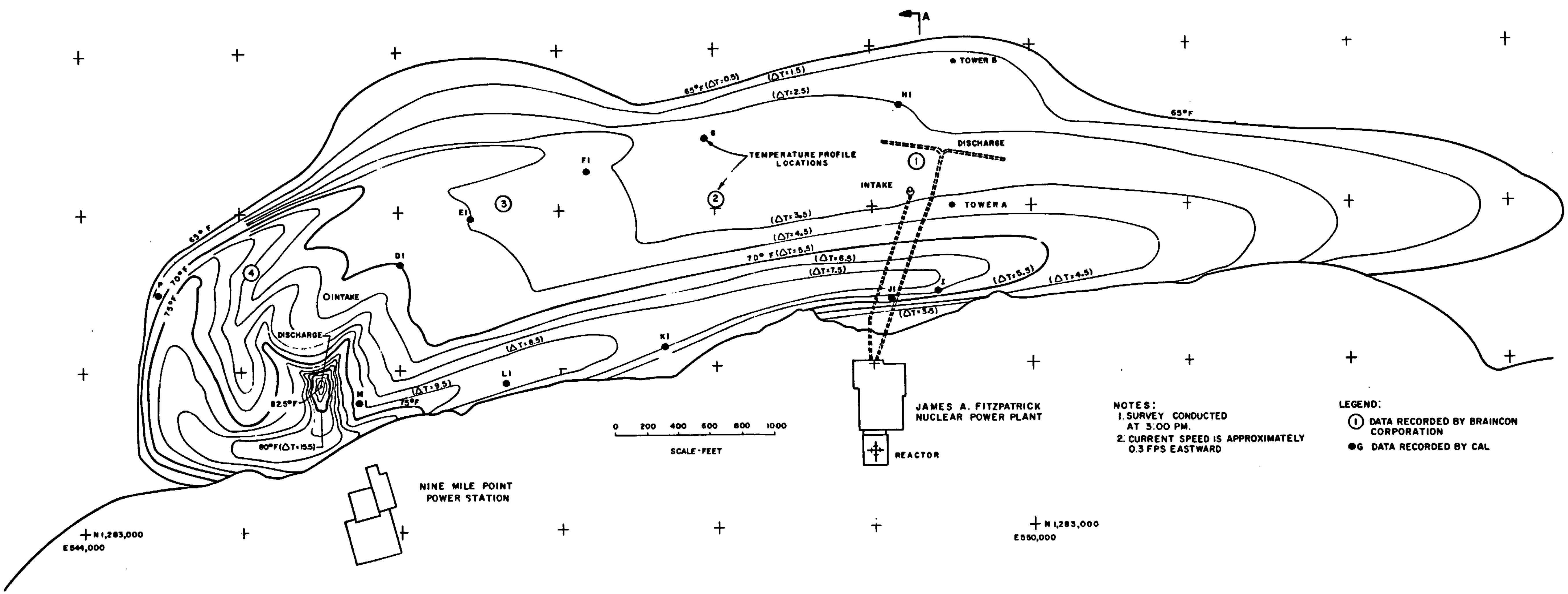


Fig. 3.16. Water Surface Temperatures Recorded from Infrared Radiation July 22, 1970. From Ref. 6.

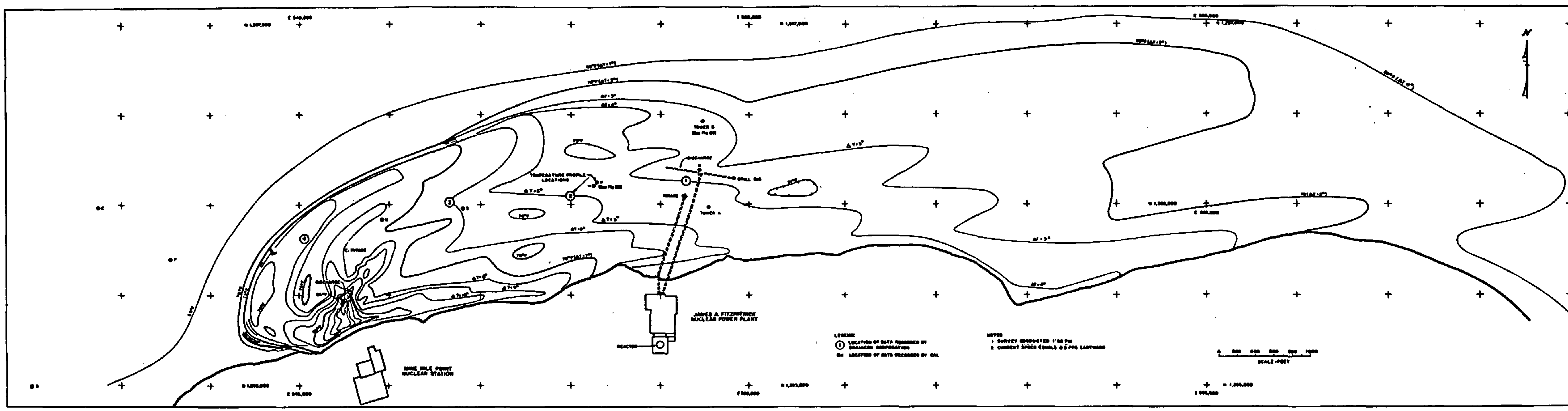
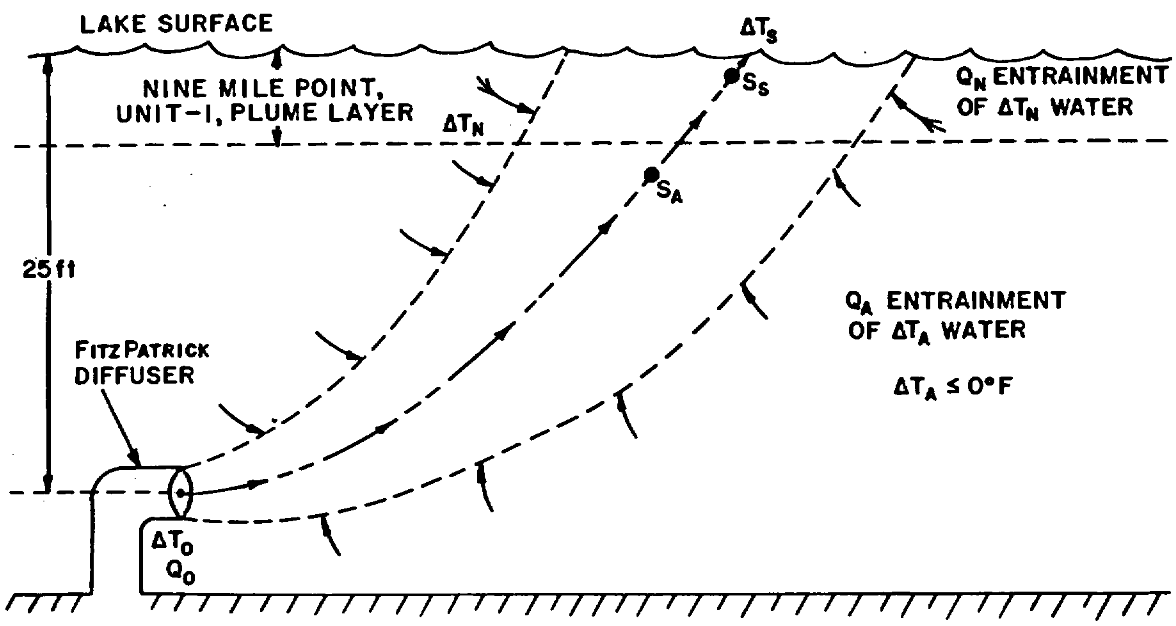


Fig. 3.17. Water Surface Temperatures Recorded from Infrared Radiation September 23, 1970. From Ref. 6.



ENERGY BALANCE

$$Q_0 \times \Delta T_0 + Q_A \Delta T_A + Q_N \Delta T_N = Q_S \Delta T_S$$

$$Q_A = Q_0(S_A - 1);\ Q_N = Q_0(S_S - S_A);\ Q_S = Q_0 S_S;$$

$$\boxed{\Delta T_S = \frac{\Delta T_0}{S_S} + \frac{(S_A - 1)}{S_S} \Delta T_A + \frac{S_S - S_A}{S_S} \Delta T_N}$$

Q_0 = FITZPATRICK VOLUMETRIC DISCHARGE RATE

ΔT_0 = EXCESS TEMP. OF FITZPATRICK DISCHARGE (31.5°F)

Q_A = VOLUMETRIC ENTRAINMENT RATE OF SUBSURFACE WATER

ΔT_A = EXCESS TEMP. OF SUBSURFACE WATER (0.0; -1.0°; -2.0°; -3.0°F)

Q_N = VOLUMETRIC ENTRAINMENT RATE OF NINE MILE POINT, UNIT-1, PLUME LAYER

ΔT_N = EXCESS TEMP. OF NINE MILE POINT, UNIT-1, PLUME LAYER (3.0°; 4.0°F)

Q_S = VOLUMETRIC FLOW RATE OF FITZPATRICK EFFLUENT AT LAKE SURFACE

ΔT_S = EXCESS TEMP. OF FITZPATRICK EFFLUENT AT LAKE SURFACE (COMPUTED)

S_A = DILUTION FACTOR UP TO BOTTOM OF NINE MILE POINT, UNIT-1, PLUME LAYER (FROM TABLE)

S_S = DILUTION FACTOR UP TO LAKE SURFACE (FROM TABLE)

Fig. 3.18. Estimated Cumulative Plume Surface Temperatures.

TABLE 3.2 Staff's Calculations of Differences between Surface and Ambient Lake Temperatures

Assumptions Used for the Calculations:

Current speed, fps	0.0	0.2	0.4	0.6	0.8
Dilution at surface, S_s	11.6	10.0	8.5	7.9	7.6
Dilution at bottom of Nine Mile Point, Unit 1, layer, S_A	9.3	8.3	6.9	6.5	6.3
Assumed thickness of Nine Mile Point, Unit 1, layer, ft	11.5	10.2	9.6	9.4	9.4

Results from Calculations: Cumulative Surface Temperature, ΔTs, °F

Ambient shoreline current speed	0.0		0.2		0.4		0.6		0.8	
ΔT_N, °F	3	4	3	4	3	4	3	4	3	4
ΔT_A, °F										
0	3.3	3.5	3.7	3.8	4.3	4.5	4.5	4.7	4.7	4.8
-1	2.6	2.8	2.0	3.1	3.6	3.8	3.8	4.0	4.0	4.1
-2	1.9	2.1	2.2	2.4	2.9	3.1	3.1	3.3	3.3	3.4
-3	1.2	1.4	1.5	1.6	2.2	2.4	2.4	2.6	2.6	2.7

Table 3.2 also indicates that if the subsurface water temperature averages at least one or two degrees below the ambient surface temperature, the FitzPatrick discharge will meet the New York State temperature criteria for current speeds less than about 0.3 fps. For easterly currents greater than 0.3 fps it is likely that the FitzPatrick discharge will exceed New York State temperature criteria.

In summary, the Staff's analysis indicates that under certain conditions FitzPatrick discharge could exceed the New York State thermal criteria. The Staff will require the Applicant to institute a thermal discharge monitoring program, considered by the Staff to be satisfactory, to demonstrate that the plant is operating within limits of the State's thermal criteria. The Staff will further require the Applicant to prepare and submit a proposed positive course of corrective action to be taken, considered satisfactory to the Staff, to ensure operation of the plant in compliance with the New York State thermal criteria.

3.4 RADIOACTIVE WASTE SYSTEMS

During the operation of the Plant, radioactive material will be produced by fission and by neutron activation reactions of metals and materials in the reactor system. Small amounts of gaseous and liquid radioactive wastes will enter the effluent streams, which will be processed and monitored within the Plant to minimize the radioactive nuclides that will ultimately be released to the atmosphere and into Lake Ontario. The radioactivity released during operation of the plant will be in accordance with the Commission's regulations as set forth in 10 CFR Part 20 and Part 50 and will be as low as practicable.

The waste handling and treatment systems being installed at the Plant are discussed in the Final Safety Analysis Report and its amendments, and in the Applicant's Environmental Report and Supplements.

3.4.1 Liquid Wastes

The liquid radwaste system is designed to collect, monitor, process, store and dispose of radioactive liquid wastes. These wastes are classified, collected, and treated as high purity, low purity, chemical, detergent, and sludge wastes. Cross connections between the subsystems provide flexibility for processing by alternate methods. A schematic of the system is shown in Fig. 3.19.

High purity liquid wastes (low conductivity) from the reactor coolant cleanup system, the residual heat removal system, equipment drains in

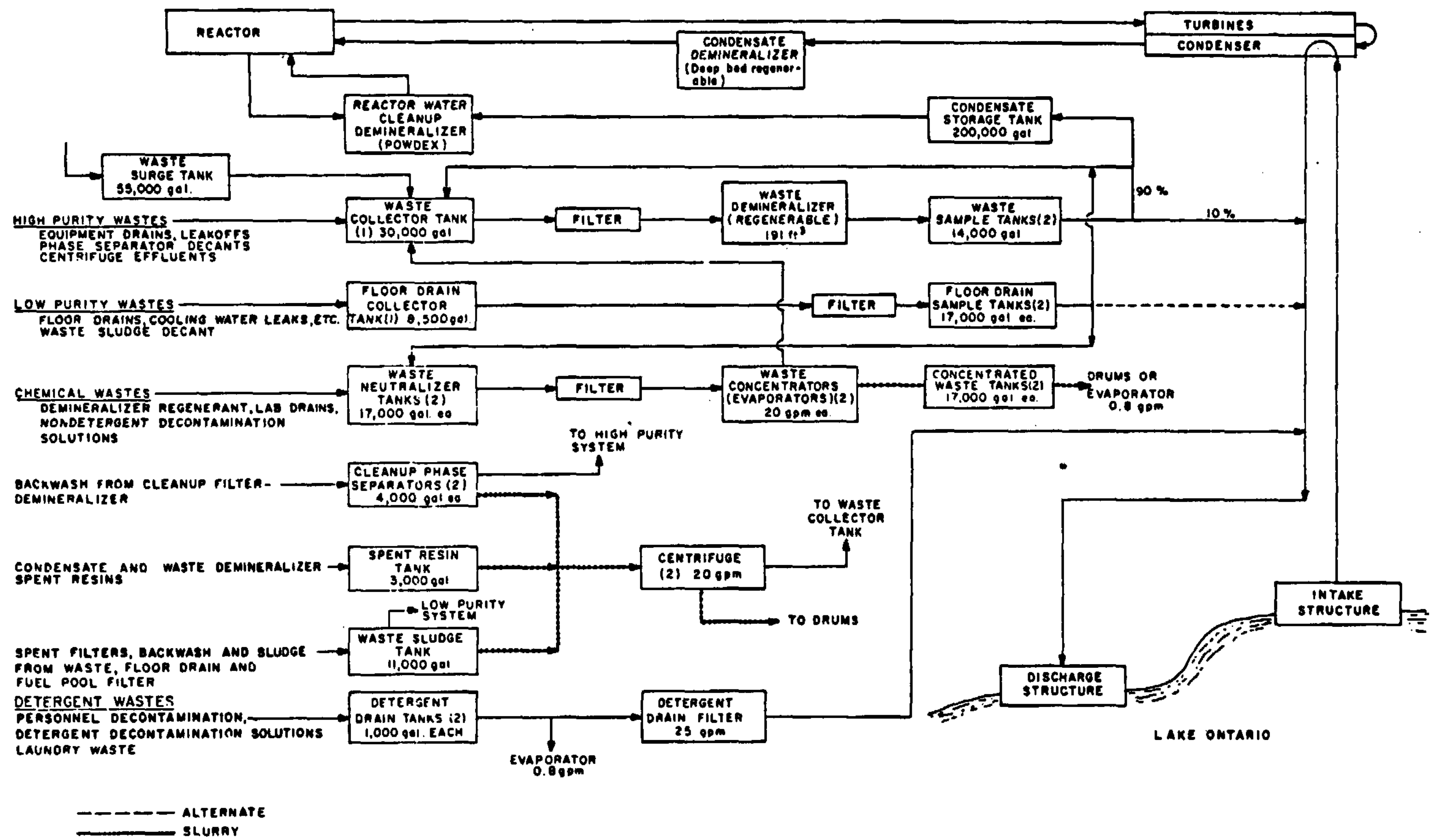


Fig. 3.19. Flow Chart of the Liquid Waste System.

the dry-well, reactor, radwaste and turbine buildings, decantates from resin phase separator tanks, and centrifuge effluents will be collected in a waste collector tank (30,000 gal). These wastes will be processed by filtration and deep-bed demineralization. After processing they will be sent to two waste sample tanks (14,000 gal each), sampled and analyzed, and if satisfactory for reuse they will be transferred to a condensate storage tank (200,000 gal). If the water does not meet specifications for reuse, it will be returned to the system for additional treatment or, if the activity is sufficiently low, discharged to Lake Ontario via dilution in the circulating and service water discharge canal. The Staff estimates that 26,000 gallons per day will be processed through this system and that 10% of this water will be discharged and diluted with the 370,000-gpm flow in the discharge canal.

Low purity (high conductivity) liquid wastes from the drywell, reactor, radwaste, and turbine building floor drains will be collected in a floor drain tank (8,500 gal). These wastes will be processed through a floor drain filter and transferred to one of two floor drain sample tanks (17,000 gal each) for sampling and analysis. If the concentration of radioactive contaminants is sufficiently low, the batch may be sent to the discharge canal. If the waste needs further treatment, depending on its quality, it will be sent to the chemical waste system for evaporation or to the high purity system for demineralization. The Staff assumed that 5,700 gallons per day will be processed through this system and sent to the chemical waste system for evaporative treatment.

The chemical wastes from condensate demineralizer regeneration solutions, non-detergent decontamination solutions, and laboratory drains will be collected and neutralized in the waste neutralizer tanks of which there are two with each having a capacity of 17,000 gal. After neutralization, these liquids will be evaporated in one of two 20-gpm waste concentrators. The distillate will be sent to the waste collector tank in the high purity system for reuse and the concentrates will be sent to one of the two 17,000-gal waste tanks and either be packaged as solid waste or sent to a 0.8-gpm evaporator for further concentrating. The Staff calculated that 8,400 gallons per day of chemical wastes will be evaporated (in addition to the low-purity wastes) with the condensate being sent to the high-purity system for demineralization and reuse. From this system 10% will be discharged and diluted via the discharge canal.

A detergent system will collect laundry, personnel decontamination, and other detergent washdown wastes. These wastes will normally be low in radioactivity and after sampling and analysis will be discharged through a filter. However, if activity levels are above those anticipated, the 0.8-gpm evaporator may be used to concentrate these wastes also. The Staff assumed that all detergent wastes will be discharged without treatment and that activities will be negligible.

A waste sludge tank (11,000 gal) will collect waste filter, floor drain filter, and fuel-pool filter backwash and sludge. After settling and decanting to the low-purity system, the sludge will be sent to the centrifuges. Two phase separator tanks (each with a 4,000-gal capacity) will collect backwash from the reactor water cleanup filter demineralizer precoat, decant the wastes to the high-purity system and send the sludge to the centrifuges. Spent resins from the condensate demineralizer and waste demineralizer will be collected in a 3000-gal tank prior to being directed to the centrifuges. An ultrasonic resin cleaner will be used to clean the condensate demineralizer during operation and is expected to result in lower regeneration processing solutions than are now estimated. Excess water from the centrifuges will be sent to the high-purity system and sludges to a drumming station for solid waste disposal.

In addition to the waste treatment systems described above, the Reactor Water Cleanup System continually processes a portion of the coolant to maintain its purity and thus lower the activity in the liquid waste by removing radioactive materials through a Powdex system. The Condensate Cleanup System maintains feedwater purity by directing the full reactor condensate flow through deep-bed demineralizers.

The Staff's estimate of the releases of effluents from the liquid source are listed in Table 3.3. Conditions considered in the evaluation of the waste treatment systems are given in Table 3.4. The Staff estimated that less than 5 Ci per year excluding tritium will be discharged. The Staff also estimated that 20 Ci of tritium will be discharged per year based on discharge data from presently operating reactors. The Applicant has analyzed the environmental impact using 16 Ci of liquid radwaste excluding tritium and 4 Ci of tritium.

3.4.2 Gaseous Wastes

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

TABLE 3.3 Anticipated Annual Release of Radioactivity in Liquid Effluents

Nuclide	Ci/yr	Nuclide	Ci/yr
Rb-86	0.000046	I-130	0.0035
Rb-88	0.30	I-131	0.12
Rb-89	0.14	I-132	0.50
Sr-89	0.021	I-133	0.50
Sr-90	0.0013	I-134	0.11
Sr-91	0.080	I-135	0.39
Y-90	0.013	Cs-134	0.022
Y-91m	0.54	Cs-136	0.0076
Y-91	0.16	Cs-137	0.016
Y-92	0.60	Cs-138	0.41
Y-93	0.44	Cs-139	0.12
Zr-95	0.00023	Ba-137m	0.0015
Zr-97	0.00042	Ba-140	0.039
Nb-95	0.00020	La-140	0.0093
Nb-97m	0.00040	Ce-141	0.00071
Nb-97	0.00053	Ce-143	0.0010
Mo-99	0.046	Ce-144	0.00014
Te-99m	0.032	Pr-143	0.00022
Ru-103	0.00015	Pr-144	0.00014
Ru-106	0.000048	Nd-147	0.000084
Rh-103m	0.00020	Pm-147	0.000017
Rh-105	0.00024	Np-239	0.0045
Rh-106	0.000048	Cr-51	0.0040
Sn-125	0.0000014	Mn-54	0.00030
Sb-125	0.00000076	Fe-55	0.020
Sb-127	0.000014	Fe-59	0.00060
Te-125	0.0000065	Co-58	0.040
Te-127m	0.000042	Zn-65	0.000010
Te-127	0.00041	Zn-69m	0.00020
Te-129m	0.00041	W-187	0.00020
Te-129	0.00064	Na-24	0.020
Te-131m	0.00087	P-32	0.00020
Te-131	0.00039	Co-60	0.0040
Te-132	0.0062		
		Total*	∿4.4 Ci/yr
		Tritium	20 Ci/yr

*Excluding H-3

TABLE 3.4 Conditions Used in Determining Release of Radioactive Effluents

Thermal power					2550 MWt
Plant factor					0.8
Total steam flow					1.1×10^7 lb/hr
Cleanup demineralizer flow					1×10^5 lb/hr
Liquid and gas activities released as normalized for failed fuel condition yielding 100,000 μCi/sec off-gas after 30-min holdup from a 3400 MWt reactor.					
Leaks:					
Reactor Bldg.					480 lb/hr-liquid
Turbine Bldg.					1700 lb/hr-steam
Condenser Inleakage					20 cfm-air
Partition coefficients (Iodine):					
Liquid/steam in reactor					0.012
Reactor Bldg. liquid leak					0.001
Turbine Bldg. steam leak					1.0
Air ejector					0.005
Decontamination factors	I	Cs	Mo-Tc	Y	Others
High purity system (demineralization)	10^2	10	1	1	10^2
Low purity & chemical system (evaporation & demineralization)	10^5	10^5	10^4	10^4	10^6
Removal factor (plateout, etc. for all systems)	1	1	10^2	10	1
Holdup times before discharge:					
High purity system	1 day				
Low purity & chemical system	2 days				

The major source of gaseous wastes activity during normal station operation will be the off-gas from the main steam condenser air ejectors. Other sources of gaseous waste include off-gases from the mechanical vacuum pump, ventilation air released from the radwaste, reactor, and turbine building exhaust systems, and purging of the drywell and suppression chamber. The turbine gland seal system will use a clean source of steam and is not expected to be a source of gaseous activity. A schematic of the gaseous waste system is shown in Fig. 3.20.

Off-gases from the main condenser air ejector will be processed through catalytic recombiners where the hydrogen and oxygen gases are recombined to form steam, thereby reducing the volume of gases which must be treated. The steam will be condensed and the condensate will be discharged to the main condenser. The noncondensible gases will be delayed for five hours in a holdup pipe to allow for the decay of short-lived radioactive noble gases and activation products, filtered through high efficiency particulate filters and held up for further decay in an ambient temperature charcoal adsorber system consisting of 17.4 tons of charcoal in twelve beds. Prior to discharge through the main stack, the off-gases will again be filtered through high efficiency filters to remove particulates formed by the decay of noble gases and any charcoal fines which may be carried over in the vent stream. The Staff calculates that this charcoal adsorber system will provide a 7.5-hour interval for the decay of krypton and 4.4 days for the decay of xenon. It is assumed that essentially all of the radioiodine which may be present in the off-gases from the main condensers will be removed in the charcoal beds.

The mechanical vacuum pump, which will be used during startup, will exhaust air and radioactive gases from the main steam condenser. Off-gases from this system will be discharged to the gland seal holdup line and released through the main stack.

The turbine building, reactor building and radwaste building will have once-through ventilation with the air passing from clean areas to those with a higher potential for radioactivity. In the event of abnormal levels of activity in the air of the reactor building the air will be recirculated and exhausted through the standby gas treatment system (prefilter, HEPA, charcoal adsorber, and HEPA in series) prior to being released to the atmosphere

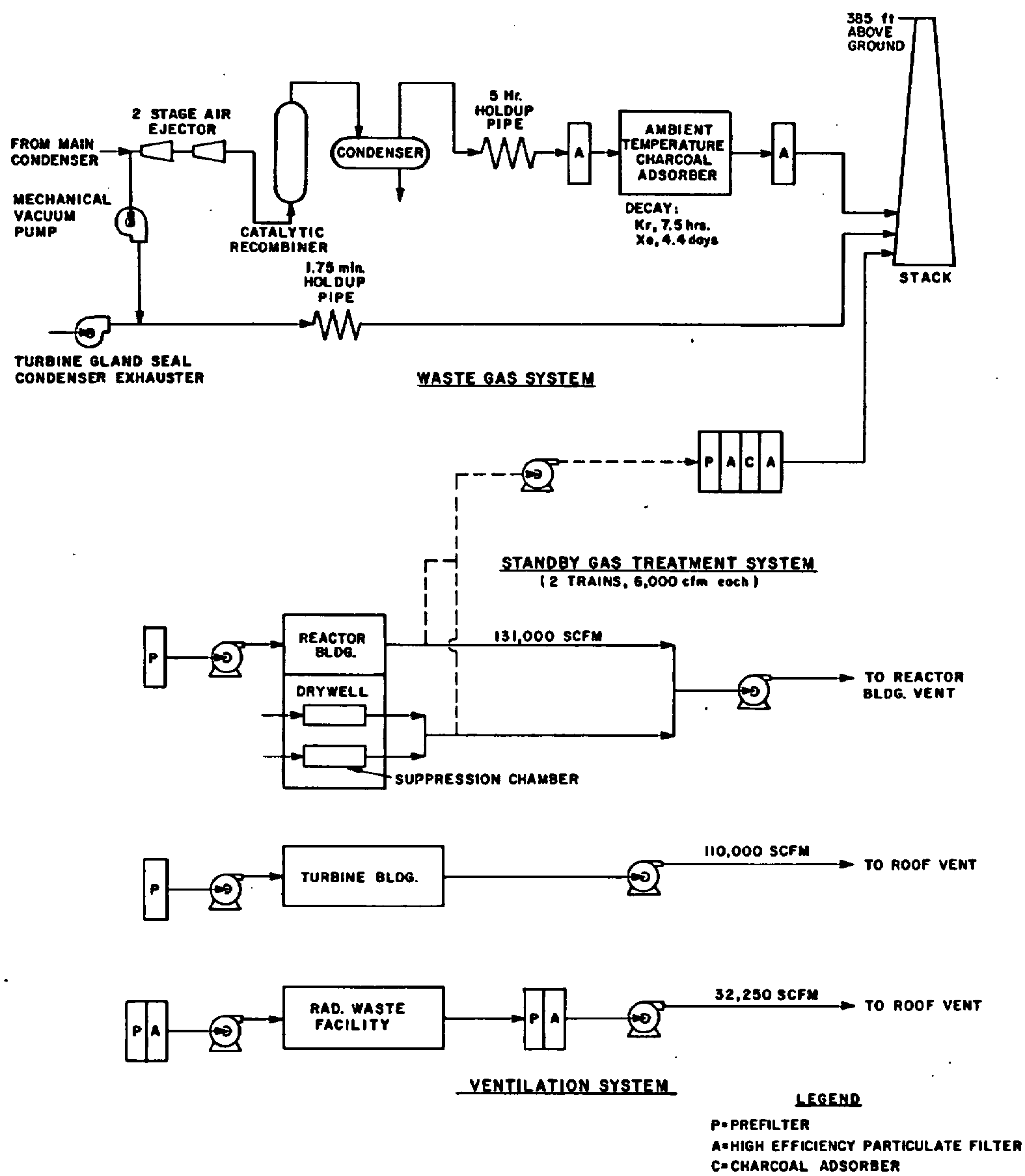


Fig. 3.20. Diagram of the Gaseous Waste System.

through the main stack. Normally this air will be discharged through the reactor building vent. The radwaste building will be exhausted through prefilters and HEPA filters and released via roof mounted fans. The releases from the radwaste building are expected to be small. Ventilation air from the turbine building will be exhausted to the atmosphere without treatment.

The primary containment (drywell) is normally a sealed volume. However, during periods of refueling, operation, and maintenance, it will be necessary to purge the drywell and suppression chamber and, at this time, the potential will exist for the release of airbone radioactivity to the environment. However, the system will be arranged so that the purged exhaust can be directed to the standby gas treatment system if significant radioactivity is detected. The releases through this system are expected to be small.

The Staff's estimate of the release of effluents from the gaseous source is listed in Table 3.5. The Applicant estimates that on the average 13,000 Ci of noble gases will be discharged each year, whereas the Staff's estimate is 200,000 Ci of noble gases and 0.9 Ci of iodine-131. The Staff's estimate is higher than the Applicant's because the Staff assumed a higher rate of gas release from leaking fuel, a lower holdup time in the off-gas charcoal beds, and allowed for 10 days per year when there would be no off-gas treatment because there is no redundant recombiner system. The Applicant did not estimate iodine-131 releases in its Environmental Report.

3.4.3 Solid Wastes

Solid wastes from the Plant's operation will be composed primarily of spent resins from the various demineralizers, tank sludges, evaporator concentrates, and precipitates or insoluble matter that comes from the backwashing of filters. After being centrifuged, the wastes will be mixed with concrete and placed in drums. Dry solid waste consisting of filters and miscellaneous paper and rags will be compacted and then placed in drums. All solid wastes will remain in a storage area for a decay period of 180 days before they are shipped to a licensed burial ground in accordance with AEC and Department of Transportation regulations.

TABLE 3.5 Anticipated Annual Release of Radioactive Nuclides in Gaseous Effluents

	Ci/yr				
	Reactor Building	Turbine Building	Air Ejector*	Air Ejector**	Total
^{83m}Kr	Nil	10	640	1,650	2,300
^{85m}Kr	Nil	17	15,000	3,000	18,000
^{85}Kr	Nil	0.09	560	19	580
^{87}Kr	Nil	50	360	7,500	7,900
^{88}Kr	Nil	54	16,000	9,000	25,000
^{89}Kr	Nil	220	Nil	56	280
^{131m}Xe	Nil	0.08	370	15	390
^{133m}Xe	Nil	1.1	1,700	23	1,700
^{133}Xe	Nil	30	100,000	5,800	110,000
^{135m}Xe	Nil	90	Nil	4,500	4,600
^{135}Xe	Nil	85	130	16,000	16,000
^{137}Xe	Nil	370	Nil	290	660
^{138}Xe	Nil	280	Nil	16,000	16,000
^{131}I	0.013	0.57	Nil	0.3	0.9
^{133}I	0.048	3.0	Nil	1.5	4.6
				Total	∿200,000

An estimated 1500 Ci of Xe-133 and 200 Ci of Xe-135 will be released per year through operation of the mechanical vacuum pump during startups.

*Considers recombiner and charcoal delay system in operation

**Considers 20 days every other year with only 30 minutes hold-up to account for recombiner system downtime for maintenance.

The Staff anticipates that 900 drums of resins, filters, and evaporator bottoms, and 600 drums of dry and compacted waste will be produced yearly. The total activity at the time of shipment is expected to be 4000 Ci/yr.

3.5 CHEMICAL AND BIOCIDE SYSTEMS

The principal chemicals expected to be used in the routine operation of the Plant include sulphuric acid and sodium hydroxide for regeneration of resins used in the condensate demineralizer and makeup water demineralizer; ferric sulphate, lime, and chlorine for makeup water clarification; and sodium sulfite and trisodium phosphate for the inhibition of corrosion and scale formation in the auxiliary power systems. Wastes from all of these systems except the condensate demineralizer regeneration will be added to the circulating water before it is discharged into the lake. By far the largest quantity of chemical waste will result from the regeneration of the makeup demineralizers. Radioactive chemical wastes will be disposed of in a manner discussed in Section 3.4.

Ferric sulphate, lime, and sodium hypochlorite will be added to the lake water in the makeup system to produce a clear sediment-free supply of water to be demineralized and used in the primary system. Any hypochlorite not reduced to chloride in the clarification process will be removed in the makeup demineralizer. Sulfuric acid and sodium hydroxide will be used to regenerate the demineralizer. Wastes will be neutralized in tanks, and discharged into the circulating water tunnel for a period of about 10 hours once every 4 days. The average quantities of chemicals expected to be used in the makeup water system per day and their expected incremental concentrations in the circulating water discharged to Lake Ontario (825 cfs) are shown in Table 3.6. Also shown in the tables are the expected quantities of chemical constituents that will be originally removed from the lake water during the demineralization process and discharged as part of the regeneration wastes. When added to the circulating water the chemicals originally removed from the lake water will increase the dissolved solids content by 0.1%, and the sodium sulfate from regeneration will increase the content of dissolved solids by about 2%. In all cases, the incremental concentrations shown are those expected for the periods of actual discharge.

TABLE 3.6. Chemicals Discharged from Makeup Water System

Ion (or TDS)	Source of Ion	Quality Discharged		Conc. in Lake Ontario, ppm	Percent Increase
		Pounds/Day	Incremental Conc. in Effluent, ppm*		
Ca^{++}	Lime for clarification Lake water**	40 26	0.14	44	0.3
Fe^{+++}	Ferric sulfate for clarification	4.9	0.01	0.09	11.1
Na^{+}	Sodium hydroxide for regeneration Lake water**	135 10	0.31	17	1.6
Mg^{++}	Lake water**	5.0	0.01	8.9	0.1
K^{+}	Lake water**	.1	0.002	1.6	0.1
Mn^{++}	Lake water**	.01	0.00002	0.01	0.2
Cl^{-}	Sodium Hypochlorite Lake water**	18 18	0.08	30	0.3
$SO_4^{=}$	Sulfuric acid for regeneration Lake water**	283 14	0.64	30	2.1
HCO_3^{-}	Lake water**	69	0.15	115	0.1
$PO_4^{\equiv}$	Lake water**	0.11	0.0002	0.19	0.1
NO_3^{-}	Lake water**	0.37	0.0008	0.62	0.1
TDS	Lake water**	140	0.30	233	0.1

*Calculated as the sum of the contributions from two sources where appropriate. Dissolved in 825-cfs circulating water plus service water during 10-hour periods of chemical discharge once every four days. Concentrations during actual discharge.

**Collected from lake water on ion exchange resins, then released during regeneration.

The plant condensate will continuously pass through a separate demineralizer to remove impurities. Chemical solutions (and suspensions) resulting from the regeneration of condensate demineralizers will be concentrated in an evaporator. Evaporator bottoms will be shipped offsite, perhaps after additional evaporation; the distillate will be sent to the water collector tank for reuse.

Two oil fired boilers will provide steam for the Plant, primarily for space heating. Approximately 0.2 lbs of sodium sulfite and 0.6 lb of trisodium phosphate will be added monthly to these auxiliary boilers to prevent corrosion and scale formation. The auxiliary boilers will be blown down once per month to limit the concentration of total solids in the boiler to 3500 ppm. The blowdown will contain 300 ppm of suspended solids and 700 ppm of total alkalinity. When the sulfite is oxidized to sulfate, the average incremental concentrations of sodium sulfate and sodium phosphate discharged into the lake via the discharge tunnel are 2×10^{-6} and 4×10^{-6} ppm, respectively.

The boilers will burn No. 6 fuel oil which contains a maximum of 2.8% sulfur and less than 0.1% ash. The Applicant calculated, using a mathematical dispersion model, that the one hour maximum ground level concentration of sulfur dioxide will be 0.12 ppm, below the State's maximum hourly value of 0.5 ppm. The maximum particulate concentration is calculated to be 6.3 mg/m^3, well below the 24 hour standard of 55 mg/m^3.

The Applicant does not expect any significant fouling of heat transfer surface because of the scouring action of silt that will be entrained with the inlet lake water. Accordingly, the circulating water system for condenser cooling does not have provisions for chemical addition of water treatment other than straining. Operating experience at the nearby Nine Mile Point Nuclear Station Unit 1 (3 years) and at the Oswego Steam Station (over thirty years) support this contention. If condenser cleaning becomes necessary the Applicant plans to use mechanical methods.

3.6 SANITARY AND OTHER WASTE SYSTEMS

All sanitary wastes from the administration building will be collected in the plant's sewer and transferred to the sewage treatment plant about 200 feet from the lake. The wastes will receive primary

and secondary treatment and then be discharged to the lake via a 24-in storm-water line. The secondary waste treatment system consists of extended aeration and filtration of the septic tank effluent in two 2,600 square feet sand filtration beds. The distribution pipe grids are vented to support the growth and action of aerobic bacteria. The filtration system has been designed to accommodate a maximum population of 160 people (during refueling). The expected normal population of operating personnel is 69 people and the remitting inflow is 2,100 gal/day. The design capacity of the system is 5600 gallons per day with 12 hours minimum detention in the septic tank. Plans for the system were approved by the New York State Department of Health. The effluent will receive continuous chlorination, with the residual free chlorine concentration maintained in the range 0.1 - 1 ppm. Any free chlorine reaching the lake (e.g., at times when there is no storm-water flow) is expected to be completely converted to chlorine ion in less than a minute by reaction with the available inorganic constituents of the "chlorine demand" of the lake water. In the absence of a determination, a conservative level of 0.1 ppm for this quick-acting "chlorine demand" can be assumed, based on experience with other waters and the measured chemical oxygen demand. Thus at 1 ppm residual free chlorine, ten volumes of lake water is expected to eliminate the free chlorine from each volume of treated sewage added to the lake. At an inflow rate of 2100 gal/day (3 oz/sec) this dilution is expected to occur in an area less than one foot in radius. The chloramines and other possible toxic reaction products of chlorine in the sewage will not be lost so quickly, and will lead to the existence of a small area in which their effect may be felt. Because of the rapid dilution of the small inlet stream of sewage, by storm water or in the lake, this area will be small.

Trash and other objects collected on the preliminary screens and traveling screens will be removed and shipped offsite. The remainder of the plant nonradioactive waste, i.e., trash, shop and laboratory wastes, is expected to be processed using normal industrial techniques for solid waste disposal by commercial scavenger service.

3.7 TRANSMISSION FACILITIES

The Applicant is constructing a 345-kV single circuit transmission line from the Plant to the Edic Substation of Niagara Mohawk near Utica, New York. The line runs in an easterly direction through Oswego and Oneida counties for approximately 70 miles. The transmission system that is being constructed will be part of the network which serves the New York State power market and interconnects with the Pennsylvania, New England and Ontario, Canada transmission systems. This transmission line will have the capability of delivering power for pumping to the Blenheim-Gilboa Pumped Storage

Power Project near Gilboa, New York. The interconnections of the different transmission line are shown in Fig. 3.21.

Figure 3.22 shows a route map for the new line. The Applicant has acquired rights to a 400 foot right-of-way for the line of which 150 feet are cleared with the remaining right-of-way reserved for the possible addition of future circuits.

A 345-kV backup transmission line will be constructed between the switch yards of the Plant and the Nine Mile Point, Unit 1, which is approximately 3000 feet west of the Plant. This line will be totally within properties already owned by the Applicant or Niagara Mohawk Power Corporation. A 115-kV line will also be constructed from an existing Niagara Mohawk line to provide back-up power to the Plant.

Towers for the 345-kV FitzPatrick Edic transmission line will be of the self-supporting lattice type made of high strength ASTM A 588 weathering steel which oxidizes to a russet brown color and requires no painting or other preservative measures will be used. The towers will be approximately 1200 feet apart. The complete line will require 322 towers.

The complete right-of-way involves approximately 3394 acres. Approximately 1273 acres will be required for the FitzPatrick-Edic line with the remainder reserved for future use. Approximately 29% of the line area, or 369 acres, passes through land currently used for agriculture either as cropland or pasture. About 65% or 801 acres is in forest cover and 8% or 102 acres is classified as wetlands. These acreages refer to the area required for the FitzPatrick-Edic line only (i.e., the 150-ft-wide corridor) and not to the full right-of-way. The right-of-way also includes recreational areas, residential areas, highways, etc., each individually constituting less than 1% of the area of the whole right-of-way.

The line will pass through 13 towns having a combined population of 432,689 (1970 census). It will cross 3 Federal highways, 8 State highways, 21 county roads and 46 town roads. The line will cross 70 streams of which seven are classified by the New York State Water Resources Commission as suitable for water supplies, and 27 as suitable for agriculture and industry.

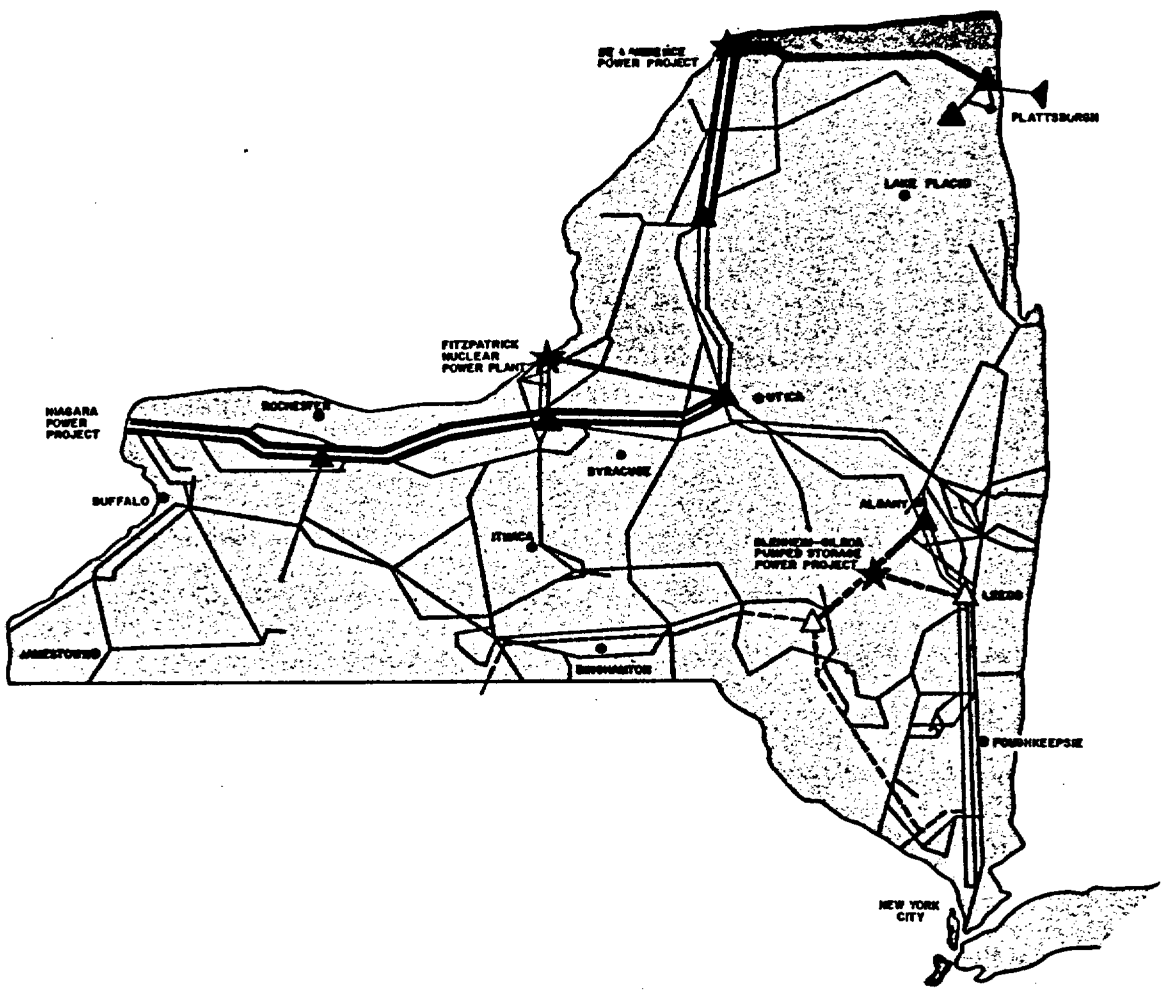


Fig. 3.21. Major Transmission Lines in New York State. From Applicant's Environmental Report.

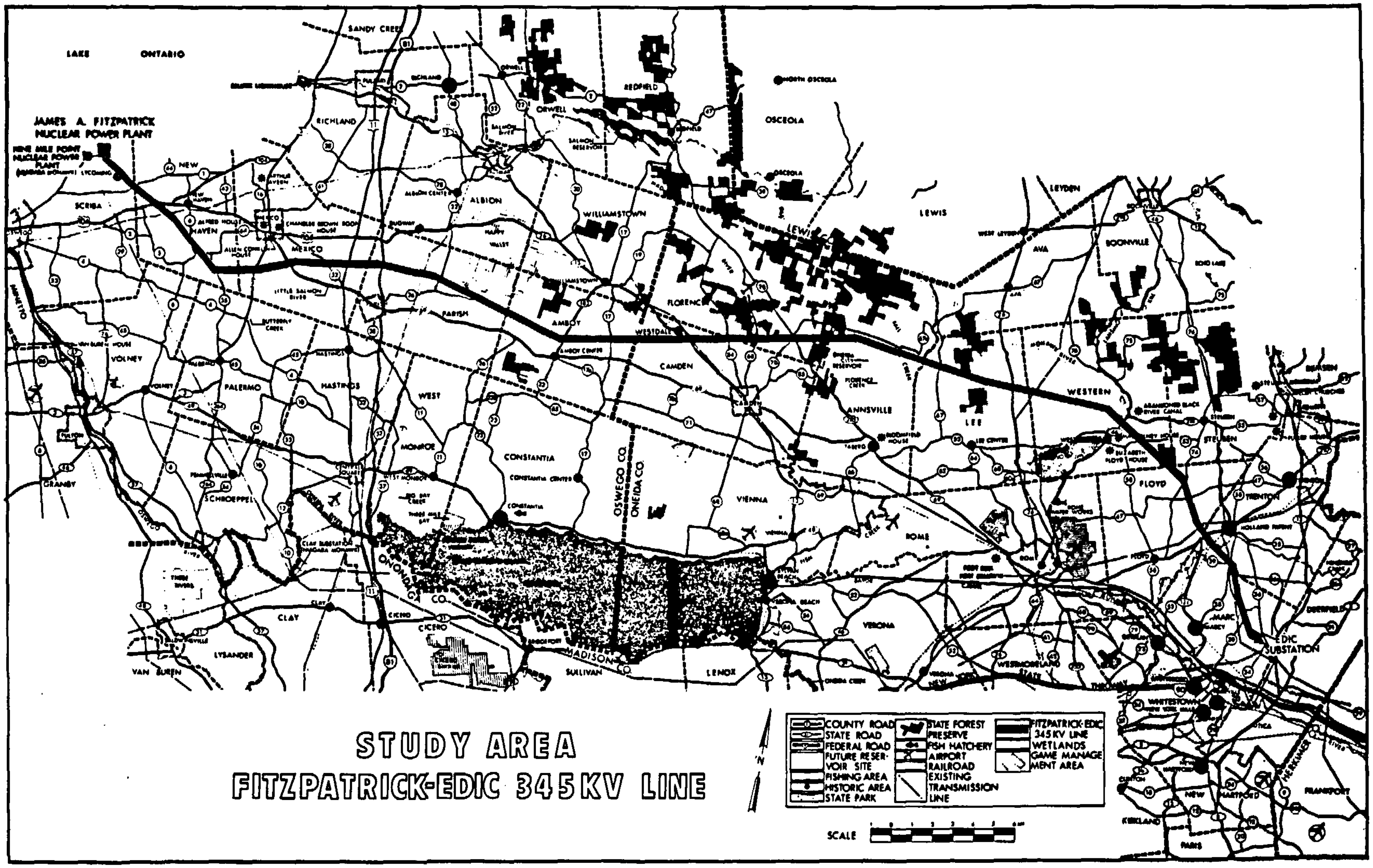


Fig. 3.22. Route Map of the Transmission Line. From Applicant's Environmental Report.

According to the Applicant only one permanent residence, a house trailer in the Town of Trenton, was displaced. Also displaced were two hunting camps, one in the Town of New Haven and one in the Town of Mexico, and a vacation cottage in the Town of Florence. All property easements and construction rights have already been obtained by the Applicant.

Over 97% of the land in the corridor has 15% or less slope and only 1% of the corridor covers land of greater than 30% slope.

The line will be inspected periodically by both ground and aerial reconnaissance. Access roads will be required along the full length of the corridor for routine maintenance and emergency repair. They generally will follow the tower bases and will be unimproved, suitable for passage of off-the-road vehicles (tracked, or four-wheel drive). Entrance to these roads will not be from main highways, but from smaller town and county roads.

Maintenance of the right-of-way will take place on a 5 to 7 year schedule.[7] To control the growth of vegetation herbicides will be used on a spot application basis. A general broadcast application of herbicides will not be utilized. Other maintenance will involve the trimming of trees and shrubs to provide minimum line to ground clearances.

References

1. New York State Thermal Standards, Department of Health, Tech. Bull. No. 36; 6NYCRR, paragraph 704.

2. E. Silberman and H. Stefan, "Physical (Hydraulic) Modeling of Heat Dispersion in Large Lakes: A Review of the State-of-the-Art," ANL/ES-2, Argonne National Laboratory, August 17, 1970.

3. A. J. Policastro and J. V. Tokar, "Heated-Effluent Dispersion In Large Lakes: State-of-the-Art of Analytical Modeling. Part 1. Critique of Model Formulations," ANL/ES-11, Argonne National Laboratory, January, 1972.

4. "Environmental Report on the James A. FitzPatrick Nuclear Power Plant. Appendix I." Power Authority of the State of New York.

5. "Engineering and Ecological Studies for Design of Intake and Discharge Structure," Jan. 1970 and its addendum March 1970, Stone & Webster Report to the Power Authority of New York, p. 7.

6. 1970 Lake Temperature and Current Studies, Stone and Webster Report to the Power Authority of New York, June 1971. Figs. 12 and 24.

7. "Environmental Report on the James A. FitzPatrick Nuclear Power Plant," Appendix J. Power Authority of the State of New York.

4. ENVIRONMENTAL EFFECTS OF SITE PREPARATION AND TRANSMISSION LINE CONSTRUCTION

4.1 EFFECT ON LAND USE

4.1.1 Plant Site

The Plant occupies a site of 702 acres of which 600 will remain in the original condition. Approximately 100 acres have been drastically altered by plant construction and about 22 acres will be permanently occupied by the physical facilities including buildings, roads, parking lots, etc. The construction of the Plant is nearing completion and, therefore, most of the temporary impacts of site preparation and Plant construction have been incurred.

The Staff has inspected the site and has noted no undue impacts on neighboring lands resulting from construction. Although there has been both increased traffic made up of construction vehicles and the private cars of workers, and noise associated with construction, there seems to be little effect of either on neighboring lands, particularly since the nearest farm is located 3700 feet southeast of the Plant.

4.1.2 Transmission Lines

The 345-kV transmission line required a 70 mile right-of-way running mostly through forests and fields. The corridor for the lines has been cleared. All tower foundations have been installed and about 40 percent of the towers erected. The Staff has viewed the corridor both from the ground and from the air and concludes that it has a minor impact on the region. Most of the right-of-way remains in the hands of the original owners and is suitable for whatever compatible use they choose to make of it. The only areas not suitable for multiple use are those occupied by the towers, of which there will be only about six per mile. Although some wildlife habitat has been destroyed in clearing the corridor, the amount of land so affected, in comparison to similar habitat available in this part of New York, is small and in the Staff's estimation, insignificant in its effect on wildlife.

The Staff has inspected the corridor itself to determine environmental impact. It is the Staff's view that the corridor, taken in its entirety, is environmentally acceptable. There are, however, several instances where appropriate State and Federal guidelines have not been fully followed.[1,2,3] These instances occur primarily in localized problem areas rather than throughout the corridor. Contrary to guideline suggestions there are several portions of the line which follow long straight pathways rather than turning occasionally to break up the "tunneling" effect. These are primarily in densely forested areas and not always visible to the general public at ground level, although they are clearly visible from the air. The Staff considers that any tunneling effect present has only a minor aesthetic impact.

Most of the corridor which passes through forested areas has straight vertical sides rather than feathered borders as suggested by the guidelines. These add to the "tunneling" effect especially in long straight sections of the corridor.

The major stream crossings have some vegetative screening. Where, as in many locations, screening is excessively thin, additional plantings should be made.

The screening on road crossings is variable, ranging from nonexistent to adequate. In general, Interstate, U. S., and major State highways have been screened, wherever possible, while local, county and town roads have not. There are several cases where screening vegetation has been penetrated by the line access road thereby negating to some extent the purpose of the screen. This permits an undesirable view of the entire corridor behind the screen.

There are several road crossings where the corridor crosses at right angles rather than obliquely. The angle of approach was in most cases determined by whatever pathway the corridor happened to be taking prior to the crossings and apparently no specific attention was given to this consideration. There are, especially along minor roads, several instances where towers placed quite close to the road are prominently visible.

Much of the corridor passes through gently rolling country and gives the impression of blending with the topography in most cases. There are some instances, however, where towers on hilltops are silhouetted against the sky.

The management of vegetation in the cleared corridor has been good in most instances. The Staff estimates that in excess of 95% of the corridor area has adequate grassy or shrubby vegetation to provide almost complete ground cover and soil stabilization. Cut trees have been stacked in piles along the edges of the corridor in most cases. There is no visible evidence of log or brush burning nor is there evidence of the use of herbicides.

Access roads running along the corridor are quite prominent with considerable rutting and flooding in many places. These roads will require some restorative effort such as the elimination of deep ruts when construction is completed. There are occasional areas, particularly in steep topography, where access roads run straight up and down hills. These access roads and others subject to erosion should be stabilized as soon as possible.

There is minor and unavoidable scarring and soil exposure around tower bases. Although these usually present practically no soil erosion problem, restoration should nevertheless be done promptly with the appropriate vegetation.

At intervals along the line are vehicle-parking or turn-around areas on which vegetation has been completely destroyed. These areas are deeply rutted and require cleanup, elimination of ruts and reseeding. Also, various kinds of trash are scattered around and cleanup will be required upon completion of construction.

We have viewed several instances in state reforestation areas where all trees which were cut were run through a chipping machine and the chips disposed of by spreading over the cleared right-of-way. The chipping and spreading operation has resulted in several areas being completely covered to a depth of one to three feet, or more, with chips.

The depth of the chip layer appears to be preventing revegetation of the area. The Staff estimates that it will take several years for the chip layer to decay sufficiently to permit natural revegetation. If chipping is judged to be necessary, adequate dispersal of the chips is vital.

In the construction and maintenance of the transmission line, care should be taken to preserve the natural integrity of the wetlands. Whenever possible, construction or maintenance equipment should not pass through these marshes. Care should also be taken not to disturb the tall grass and other vegetation surrounding the marshes.

4.2 EFFECT ON WATER USE

The intake and discharge structures are located offshore and are connected to the shore facilities via underground tunnels 1150 and 1380-ft long, respectively.

Construction was initiated on these structures during the summer of 1969. A barge slip, excavated out of the rocky shore, was constructed for hauling and unloading the reactor vessel and for use in building the intake and discharge tunnels.

Six diffusers for the discharge were installed on the lake bottom by drilling and grouting-in of a large diffuser pipe. This procedure obviated the necessity for blasting and consequently produced minimum disturbance of the lake bottom.

The intake tunnel was constructed within a steel caisson using controlled blasting techniques. Excavated material was deposited on land and was used as fill in other construction activities or in final grading of the site.

Most construction activities in the lake were associated with intake and discharge structures. Considering the rocky nature of the lake bed and that the benthic communities along Nine Mile Point are concentrated along and within a 10 foot depth, benthic losses were probably minimal. Disturbed areas are expected to be repopulated by organisms moving from adjacent areas.

4.3 EFFECTS ON THE COMMUNITY

Since the Plant is isolated from nearby residential communities, construction activities have not created any undue effects in the area. Dust, noise and heavy equipment have been confined to the site.

Construction activities have had no significant impact on schools, hospitals or housing requirements since nearly all craftsmen and laborers are drawn from nearby communities. Inasmuch as the Plant provides its own potable water, sanitary sewage disposal facilities and security personnel, there is no impact on existing community services.

References

1. Environmental Criteria for Electric Transmission Systems, U. S. Department of the Interior.

2. Electric Power Transmission and the Environment, Federal Power Commission.

3. Environmental Guidelines for Electric Transmission Lines, New York State Department of Environmental Conservation.

5. ENVIRONMENTAL EFFECTS OF PLANT OPERATION

5.1 EFFECT ON LAND USE

5.1.1 Plant Environs

Structures and ancillary facilities have been designed to conform with contemporary architectural practices. The Staff believes that the clean line color scheme (brown and concrete) and landscaping will present a pleasant view. The most prominent view will be from the Lake Ontario. The stack is the only part of the Plant visible from the nearest public road which is one-half mile from the Plant.

The presence of the Plant will not limit access to the lake shore. The Plant site has not traditionally been used by the local residents for access either for boating or bathing. The lake shore at this point is steep and stony and does not represent a potentially valuable recreational resource. Prior to acquisition by the Applicant, the site was used as an artillery range. It is concluded that the land use of the site and its immediate environs will not be adversely affected by the presence and operation of the Plant.

5.1.2 Transmission Line Environs

The transmission system uses relatively low-profile, weathering-steel, lattice-type towers. The Applicant selected this design to reduce long distance visibility. This objective has been achieved to the extent possible with an overhead transmission system. The Staff believes that the tower system will still have a strong visual impact.

Weathering steel towers are relatively maintenance free and painting or other preservative measures are not required. Therefore, fewer passages along the access roads will be required for maintenance than if the towers were constructed of some other material.

The transmission lines will not interfere with any present airport in the vicinity of the line. Also, the use of the line for power transmission during plant operation is not expected to interfere with water uses. The line passage through the countryside interferes in only a minor way with prior land use. Most of the corridor is suitable for multiple use including agriculture, forest recreation,

and wildlife habitat. The only land removed from multiple use is that on which the tower bases have or will be placed. This is an insignificant area compared to the total land area which the transmission line traverses.

Line maintenance and inspection will require 1 to 2 ground passages per year along the transmission corridor with tracked or 4-wheel-drive vehicles. This travel will maintain an identifiable unimproved two track road along the corridor but will probably not cause erodable scars on the landscape. Where heavier vehicles are brought in to perform actual repair work on the line, restoration may be necessary.

Maintenance of the corridor will involve selective tree and branch cutting to maintain safe line clearances, and the selective spot application of herbicides on a 5-7 year schedule. A general broadcast application of herbicide is not recommended and is not expected to be used.

5.2 EFFECT ON WATER USE

5.2.1 Chemical Effluents

Chemicals proposed for use in the Plant and their expected discharge concentrations are given in Table 3.6. The major chemical waste (excluding liquid radioactive wastes and treated sewage) will be a neutralized solution of sodium sulfate and other salts (originally removed from lake water) from the makeup demineralizer regeneration. This solution will be discharged during a 10-hour period once every 4 days along with the heated condenser cooling water. After being discharged the solution is expected to be further diluted with lake water; dilution is expected to be approximately 10 fold at the boundary of a three-acre surface. At this boundary the intermittent chemical concentrations will be close to lake water concentrations.

The nearest lake water intake for a public water supply is in the city of Oswego, about eight miles west of the site. The nearest recreational area on Lake Ontario is Selkirk Shores State Park, ten miles east of the site. The Applicant's model studies have shown that for a typical velocity of 0.4 fps for the lake current, the discharged water will be diluted 165 and 195 times respectively by the time it reaches the Oswego intake and the State Park. In view of the expected low discharge concentrations of chemicals (see Section 3.6) and radioactive effluents (see Sections 3.4 and 5.5) and the additional dilution when the effluents reach these points, no impact on the consumptive or recreational use of the water is expected. Appendix M contains detail evaluation of chemical effluents with regard to Water Quality Standards.

Private water supplies in the area utilize groundwater. The nearest operating well is located approximately 3500 feet from the Plant. Since the water table in the vicinity of the Plant slopes toward the lake, the possibility of groundwater contamination is extremely remote and no impact on the use of groundwater is anticipated.

5.2.2 Water Consumption

All water for the Plant (for cooling, for make up, and for plant operation) will be taken from the lake and essentially all of it will be returned to the lake. It is expected that water consumption will be principally due to evaporation. The Staff has calculated that the increase in evaporation due to the heat rejection of the Plant to the lake will result in an increase of 0.1 percent of natural evaporation from the lake. Therefore, no measurable impact is expected on the existing overall water balance.

5.3 EFFECT ON TERRESTRIAL ENVIRONMENT

The Plant will not be a major obstruction to the free movement of terrestrial animals. The wildlife habitat on 102 of the site's 702 acres has been lost as a result of construction activities. Some forest animals and much of the flora formerly inhabiting the transmission line corridor have been or will also undoubtedly be lost. However, other forms of wildlife which inhabit forest edge areas will probably colonize the rights-of-way. The loss of animals will be relatively small because of the large amount of similar habitat available in this part of New York.

Almost all of the waste heat will be released to the lake via the condenser cooling water. The heat will eventually be dissipated into the atmosphere. Wispy steam fog over the thermal plume may occur, depending on the vapor pressure of moisture in the air and the temperature isotherm of the plume. A study has indicated that steam fog will form if the vapor pressure difference between air and water is 5 millibars or more and the air temperature is below freezing.[1] Observations of occasional steam fog which occurs over thermal discharges indicate that it will be thin and wispy and because of air turbulence will rarely penetrate more than 10-50 feet inland before disappearing. The density of the steam fog is not expected to be sufficient to interfere with shipping or other modes of transportation on the lake or on land. Based on many years of observation[2] at other power stations no serious atmospheric effects are expected from waste heat released to the lake via the once-through cooling system.

The Applicant has stated that the sound of the operating Plant will not be audible offsite. This statement is in accord with the results

of measurements of sound intensity made at six nearby locations while the Nine Mile Point Nuclear Station Unit 1 was operating.[22] During those measurements, the maximum sound produced at the site boundaries was from the main transformer; at all locations, sound intensity from the transformer was equal to or less than the background noise [23-29 dB(A)]. It is likely that the transformer is inaudible at nearly all locations outside the property line.

The Staff expects that the operation of the Plant will not have a measurable effect on the terrestrial environment.

5.4 EFFECT ON AQUATIC ENVIRONMENT

Possible major environmental impacts on the aquatic ecosystem of Lake Ontario due to the operation of the Plant include fish losses at the cooling water intake screens, entrainment of unscreened organisms through the condensers, and effects of thermal and chemical discharges.

5.4.1 Intake Effects

Studies conducted by the Applicant have shown a general tendency for fish to concentrate along the 25-foot depth contour where the intake is situated or in slightly deeper waters. It is evident that fish which are present in the vicinity of the intake when the Plant is operated will be subject to entrapment in the intake structures and to impingement on the traveling screens.

The intake structure has been described in Section 3.3. The average intake velocity of 1.2 fps at the face of the bar racks and 1.4 fps through the bar racks cannot be considered low enough for the protection of fish, especially during late fall, winter, and early spring when the water temperatures are low and fish are limited in their capacity to perform extra work and to withstand environmental stress.[3] Once fish come under the influence of the intake flow, there is nothing to prevent them from being carried into the intake tunnel and the forebay at the shore facility. Once in the forebay, the 4.7 fps water velocity in the tunnel would prevent fish from returning to the lake. Impingement on the traveling screens in the intake bays will be the ultimate fate of any entrapped fish. When traveling screens are rotated for cleaning, impinged fish along with debris will collect in the trash pit. Although the trash pit is below the water level, fish and debris cannot be removed from the pit without lifting the trash basket and thus exposing any fish still alive to additional stress. Survival of fish impinged on the traveling screen for any length of time is questionable. The "ecological death" of such stressed or disabled fish appears inevitable.

The Applicant proposes to install in the screen-well, if necessary, pumps suitable for removal of fish. Fish would then be collected from in front of the screens near the surface (by suction troughs to be located behind the curtain wall) and would be returned to the lake via a pipeline or collected in a holding basin and trucked to the lake.

Such measures are likely to be inadequate for the following reasons: (1) No survival data on passage through the pumps are available for fishes abundant in Nine Mile Point area. Mortality of white perch passing through the pump could be very high as this fish will not survive any appreciable handling. (2) The suction trough as proposed will be located behind the curtain wall, near the top of the traveling screen. Consequently, only the free swimming fish in front of the traveling screen near the surface would be collected. Moreover, the intake velocity in front of and behind the curtain wall would be much higher than the average intake velocity thus forcing fish onto the screen rather than allowing them to remain free so that they may be sucked up by the pumps. (3) Finally, the fate of these fish in the lake after being subjected to all the stress and handling will be dubious. They will be easy prey for predators and likely victims of disease.

Data on fish killed on the intake screens of Niagara Mohawk's Nine Mile Point Nuclear Station, Unit 1 are being collected. Because of the similarity in the design of the FitzPatrick and Nine Mile Point Unit 1 intake structures these data can be used as a first approximation to assess the potential for loss of fish at FitzPatrick intake. The data are summarized in Tables 5.1 and 5.2. Table 5.1 contains data on total fish killed and Table 5.2 summarizes the rates in number of fish killed per hour (during the hours of sampling). Of the species collected, 83% were alewives and smelt, most of which were collected on sampling days in May, June, and July. The fish were collected 4 to 13 hours per day on 11 days during the period of 161 days between May 30 and November 7, 1972. A total of 11,572 fish were collected in the 88-1/2 hours of sampling.

The data available thus far are not sufficient to permit quantitative assessment of fish impingement at the two units with reasonable confidence to predict the impact on fish populations in the Nine Mile Point area. This is especially true in view of the absence of information of losses on trash racks, winter losses, and justifications for the sampling procedures at Nine Mile Point Unit 1. Moreover, only preliminary field sampling data for fishes have been obtained to

provide a descriptive basis for examining important questions regarding effects of such fish losses on dynamics of local fish populations. Given the difficulties of characterizing compensatory population responses in Lake Ontario with any sampling program, in addition to the difficulties in resolving catch-per-unit effort data into components which identify differential influences of migratory patterns and population dynamics, it must be recognized that a considerably increased sampling program would be required even to begin the characterization of effects of fish impingement at both units on the lake's fish populations.

The Applicant has not presented sufficient data to demonstrate that the FitzPatrick Unit intake, as designed, precludes possibilities of substantial fish kills due to impingement at the intake structures. In the Staff's assessment of the fish impingement at this site, fish kills at FitzPatrick Plant may become unacceptable when added to the fish killed at Nine Mile Point Unit 1.

The Staff does not imply the possibility that fish impingement at the Plant will produce significant adverse effects on lake-wide fish populations. The concern expressed by the Staff, however, is that the possibilities of excessive fish kills at the two plants largely are uncertain and may not be adequately manageable without design changes.

Under the circumstances, therefore, the Staff will require that the Applicant perform intensive monitoring (diel and seasonal) to determine the number, species, and size of fish killed at Unit 1 and the FitzPatrick plants and relate these data to the intake design and field sampling program as outlined in Section 6. When this information is available, the Staff will evaluate the seriousness of the fish-kill problem relative to the benefits of plant operation. Further, the Applicant will be required to develop and submit for review contingent intake modifications designed to reduce fish entrainment and be prepared to make such modifications, within a reasonably specified time period, if postoperational monitoring indicates such is warranted.

5.4.2 Entrainment Effects

The organisms which are not removed by 3/8-in.-square wire mesh of the traveling screens will pass through the Plant's cooling system. The entrained organisms include small fish, fish eggs and larvae, zoo- and phytoplankton, etc. Damage to these organisms can occur from one or more of the following causes: a) physical impact in the pump and condenser tubing, b) pressure changes across the condensers, and c) thermal shock in the condenser and the discharge tunnel.

TABLE 5.1 Total Fish Impingement Catch at Nine Mile Point, Unit 1
May 30 to Nov. 8, 1972

Species	Number	Percent of Total
Alewife	5834	50.41
Rainbow smelt	3784	32.70
Three-spine stickleback	742	6.41
Johnny darter	354	3.06
Mottled sculpin	267	2.31
Spottail shiner	223	1.93
Yellow perch	142	1.23
Trout-perch	127	1.10
Emerald shiner	28	0.24
White perch	17	0.15
Sunfish	12	0.10
Smallmouth bass	7	0.06
American eel	7	0.06
Common shiner	5	
Carp	4	
White sucker	4	
Brown bullhead	3	
Gizzard shad	3	
Lamprey eel	3	
Rock bass	2	
Mud minnow	1	
Five-spine stickleback	1	
Long-nose dace	1	
Northern Logperch	1	
	11,572	99.76

From Niagara Mohawk's Environmental Report for Nine Mile Point, Unit 2, Supplement 3.

TABLE 5.2 Fish Impingement Rates at Nine Mile Point, Unit 1
Number of Fish per Hour

Study Date	All Species		Alewives		Rainbow Smelt		Other	
	Max.	Ave.	Max.	Ave.	Max.	Ave.	Max.	Ave.
5/30/72	490	144	304	94	144	35	42	14
6/22/72	1459	629	747	287	544	245	230	97
7/14/72	121	85	75	56	31	17	21	12
8/1/72	13	11	9	7	0	0	5	3
8/9/72	135	77	79	29	6	3	68	44
8/24/72	2	1	1	0	0	0	2	1
9/7/72	19	7	13	5	6	2	2	1
9/25/72	4	1	3	1	0	0	1	0
10/12/72	26	12	22	9	7	2	4	1
10/17/72	30	20	5	4	11	8	17	8
11/7/72	3	1	1	0	1	0	3	1
Average	209	90	114	45	68	28	36	17

From Niagara Mohawk's Environmental Report for Nine Mile Point, Unit 2. Supplement 3.

The extent of damage to the entrained organisms is mainly a function of two variables. One is the "residence time," the period from intake to discharge, which can be subdivided further into (i) the duration of mechanical-injury hazards, and (ii) the duration of thermal exposure in addition to mechanical injury. The other is the temperature rise in the condensers.

The total residence time for the entrained organisms is expected to vary from 12.0 to 15.8 minutes depending upon which way they pass through the condenser and the diffuser system. The residence time in the condensers will be approximately 7.7 sec. From the point of entry into the condensers to the discharge at the end of tunnel, the organisms will be exposed to a temperature increase for over 5 minutes. At maximum anticipated output, the Plant will require a total flow of 825 cfs which will be discharged at ΔT of 31.5°F (the ΔT through the condensers is 32.4°F). The flow rate and the temperature rise will remain essentially the same throughout the year. The seasonal temperature variation of the cooling water flow at the intake is approximately 32°F to 77°F. As there will be no mixing or cooling of the discharge water prior to the jet outlets at the end of the discharge tunnel, the entrained organisms will be exposed for over five minutes to approximately 63.5°F and 108.5°F during extreme winter and summer conditions, respectively.

Fish larvae, and small fish that may be entrained will suffer from thermal shock and high mortality is expected to occur when ambient water temperature is 65°F or above. Laboratory studies show that juvenile white perch at ambient river temperature below 80°F will survive 15 minute exposure to a 15°F temperature increase.[4] However, these fish exhibited some indications of thermal stress during exposure.[4] In another study conducted at a power plant, survival was nil for young fishes exposed to 96°F for 93 sec (ambient = 75°F, ΔT = 21°F).[5] Fishes in this study included 7 species found in the Nine Mile Point area. Conclusions concerning adverse effects of 31.5°F ΔT on juvenile fish at low ambient water temperatures should await proper investigations.

Results of several studies on entrainment of zoo- and phytoplankton have been reported.[6] In Green River, Ky., 100% mortality was reported for zooplankton when ambient water was raised from 82°F to 98.6°F.[7] With a temperature rise of 14.4°F to 21.0°F (from 50°F to 51.8°F ambient) 17% to 19% of the copepods and cladocera were killed at a station on Cayuga Lake, N. Y.[8] High mortality of zooplankton is expected at the Plant when discharge temperature exceeds 95°F.

Results obtained from studies conducted at a station on York River, Va., indicate that at ambient temperatures of 32°F to 50°F, temperature

rise increased biological production; however, at summer ambient temperatures of 50°F to 68°F and a ΔT of about 10°F and above depressed production.[9] In studies conducted at the Chalk Point Plant on the Chesapeake Bay, a temperature rise of about 14.5°F stimulated photosynthesis when the natural water temperature was 57.6°F or below and inhibited photosynthesis when the temperature was 68°F or above.[10] No reasonable predictions can be made of the possibility of increased production in entrained phytoplankton during low ambient temperatures. However, it is quite likely that photosynthesis will be inhibited when the discharge temperature exceeds 95°F.

The Applicant has made limited observations at Nine Mile Point Unit 1 (ΔT = 31.2°F) to assess the damage to plankton due to entrainment and has reported an overall level of less than 10% mortality. However, no reference was made to plankton abundance in the lake. The results of these limited observations are not corroborated by the above referenced studies.

Effects on entrained organisms are expected to be severe because of the high ΔT(31.5°F) and the high residence time in the heated water (over 5 minutes). Small fish, fish eggs and larvae are not expected to survive passage through the Plant, and high mortality of zooplankton is expected during the summer. Although this impact is expected to be localized and not measurable in the lake as a whole, comprehensive onsite studies are necessary for a realistic assessment of long-term damage to the lake ecosystem.

5.4.3 Thermal Discharge Effects

As described in Section 3.3, large amounts of heat will be discharged to Lake Ontario during Plant operations. The method of heat dissipation, the Applicant's analytical and hydraulic modeling and the Staff's assessment were also discussed in Section 3.3. In assessing the impact of thermal discharge on aquatic biota the Staff has used the Applicant's predictions pertaining to plume temperature and area as a guide, with the recognition (as discussed in Section 3.3) that these predictions are more likely to be qualitatively than quantitatively correct.

In the absence of lake currents, the plume area with a surface temperature greater than 1°F above ambient is expected to be 129 acres. For an eastward current of 0.8 fps (eastward currents prevail during most of the year) the plume area with a surface temperature greater than 1°F above ambient is expected to cover about 442 acres. However, the plume area with a surface temperature greater than 3°F above ambient is expected to cover only about 7 acres under all conditions.

a. Fishes

Because of the high velocity (14 fps) and turbulence at the discharge jets, fishes are not expected to come close to the discharge. The response of fishes to the thermal plume may be preference, avoidance, or merely a physiological adjustment. The preferred temperatures for many species are equal to or higher than the ambient acclimation temperatures. Studies[4] have shown that white perch (a species found in the Nine Mile Point area) preferred 90°F when ambient acclimation was 75°F, and 88°F when ambient acclimation was 86°F. At low ambient temperatures, 41°F was preferred when acclimation was at 34°F or 35°F. Similar response was observed[11] for yellow perch and other species. It is, therefore, quite likely that fishes in the area will be attracted to the plume and as a behavioral response will prefer its slightly higher temperature. An increased abundance of fishes can also be expected in and around the plume because of the availability of dead or dying organisms in the discharged water.

A preference for higher than the ambient temperature as discussed above does not continue indefinitely. A final preferendum is reached beyond which an avoidance response can be expected to occur. This has been noted[4] to occur at 44°F for white perch acclimated to 34°F and at 95°F for white perch acclimated to 77°F. Therefore, although fish will be attracted to and will reside in the plume, they will avoid temperatures that may be higher than their final preferendum. An occasional fish, however, may travel into areas where temperatures would be lethal--such as the small zone near the Plant's discharge.

Some fish, particularly when small, do not respond predictably to temperature gradients during low ambient conditions (low thermal responsiveness). Due to this low thermal responsiveness, which has been known to occur in white perch and yellow perch[4,11] (species found near the Nine Mile Point area), it is probable that during winter some small fish may swim into high temperature areas in the plume. These fish may die from thermal shock or may only suffer from acute thermal stress and survive on return to ambient or less heated water.

Although outages will not be scheduled for winter months, should the Plant be shut down during winter due to unavoidable circumstances, fishes residing in the plume may die from thermal shock. However, because of the relatively small temperature increment expected outside the small mixing zone of about 300 ft radius or equivalent area from the point of discharge and the avoidance response of fishes to higher than the final preferred temperatures, the likelihood of significant "cold kill" at the FitzPatrick facility is small.

b. Plankton

It is unlikely that any measurable algal bloom will occur as a result of increased temperatures in the FitzPatrick plume. During summer, except for a relatively small mixing zone, the surface temperature for most of the plume is not expected to be appreciably above 80°F. These temperatures should not unduly stimulate growth of blue-green algae. A temperature range of 95°F to 104°F is best for growth of blue-green algae.[23]

Studies on zoo- and phytoplankton should be conducted to determine seasonal variations in the abundance and diversity of organisms. An assessment should then be made on overall implications of suppressed or enhanced productivity rates during various seasons. Nonetheless, in view of the total volume and area of the lake, the Staff believes that any effects that may ensue will be localized.

c. Benthos

The species structure and abundance of the benthic community that may inhabit the loose overburden beyond the 20-foot depth is not known. Benthic organisms in the immediate vicinity of the discharge may be affected. However, organisms under the plume are unlikely to be affected since the plume will rise rather than sink. The entrained organisms that die in the condensers will tend to settle and provide food to the benthos under the plume area. The effects of such deposition on interspecific competition is subject to speculation.

The Staff expects that due to rapid dilution of hot water the thermal discharge will not have any significant deleterious effects on the biota. Some juvenile fish may travel into the heated effluent and die, but their number will be relatively small. No shifts in algal populations from abundance of diatoms and green algae to blue-green algae are expected. Although no scheduled plant outages are planned for winter, should the Plant be shut down during winter due to unavoidable circumstances, fishes residing in the plume may suffer mortality. Considering the small area of impact, such fish kills, if any, are not expected to have a measurable effect on the ecosystem.

5.4.4 Chemical Discharge Effects

The chemicals to be discharged from the Plant and their expected concentrations in the discharge tunnel are given in Table 3.6. The chemicals will not be discharged continuously as noted in Section 3.4. The FitzPatrick Plant will be discharging an estimated 615 lbs/day of chemicals at a location about a thousand yards away from the point

where 202 lbs/day of chemicals from the Nine Mile Point, Unit 1 are discharged. The two discharges combined would increase the concentration of dissolved solids in the water of Lake Ontario (400 cu. mi.) by 0.008 ppm per century. The contribution of the FitzPatrick Plant alone is 0.006 ppm per century. Such quantities are not expected to have any detectable impact on the lake. The average concentration of dissolved solids in the circulating water discharged from FitzPatrick would be increased by 0.14 ppm* while that discharged from Nine Mile Point, Unit 1 would be increased by 0.06 ppm. These quantities are much smaller than the variations in the concentration of solids under ambient conditions (total solids ranged from 148 to 533 ppm in the data of Table 2.2). No detectable effect on inshore waters is expected. Concentrations of lime, ferric sulfate, and sodium sulfate, and chloride are expected to be extremely low and are not expected to have any adverse effects on aquatic life.[12]

The dissolved oxygen in Lake Ontario in the vicinity of Nine Mile Point is near or above saturation. At saturation, the heated water contains less oxygen (in mg/ℓ) than at the ambient temperature. Such a reduction in the amount of oxygen might be compensated to a certain extent by redissolution of bubbles in the discharged water as it cools. Any small decrease in the oxygen content that may occur in the discharged water will not be significant.

5.4.5 Summary

The Applicant's preoperational ecological studies do not provide an adequate data base which can be used to quantitatively predict the effects of Plant operation on the aquatic ecosystem of the lake. However, operational effects are expected to be localized. Long-term adverse effects on the lake, if any, cannot be predicted at this time. The Applicant, therefore, should collect and analyze adequate relevant data in order that the magnitude and significance of long term operational effects may be evaluated quantitatively.

5.5 RADIOLOGICAL EFFECTS ON BIOTA OTHER THAN MAN

No guidelines have been established for radiation exposures to species other than man. It is generally agreed, however, that the limits established for man may also be considered to be conservative in relation to other species.[13] Terrestrial organisms surrounding the Plant will receive approximately the same radiation doses as those calculated for man (See Fig. 5.1). Of the lower organisms that live near the

*These concentrations will be further reduced by about a factor of 10 due to operation of the diffuser discharge.

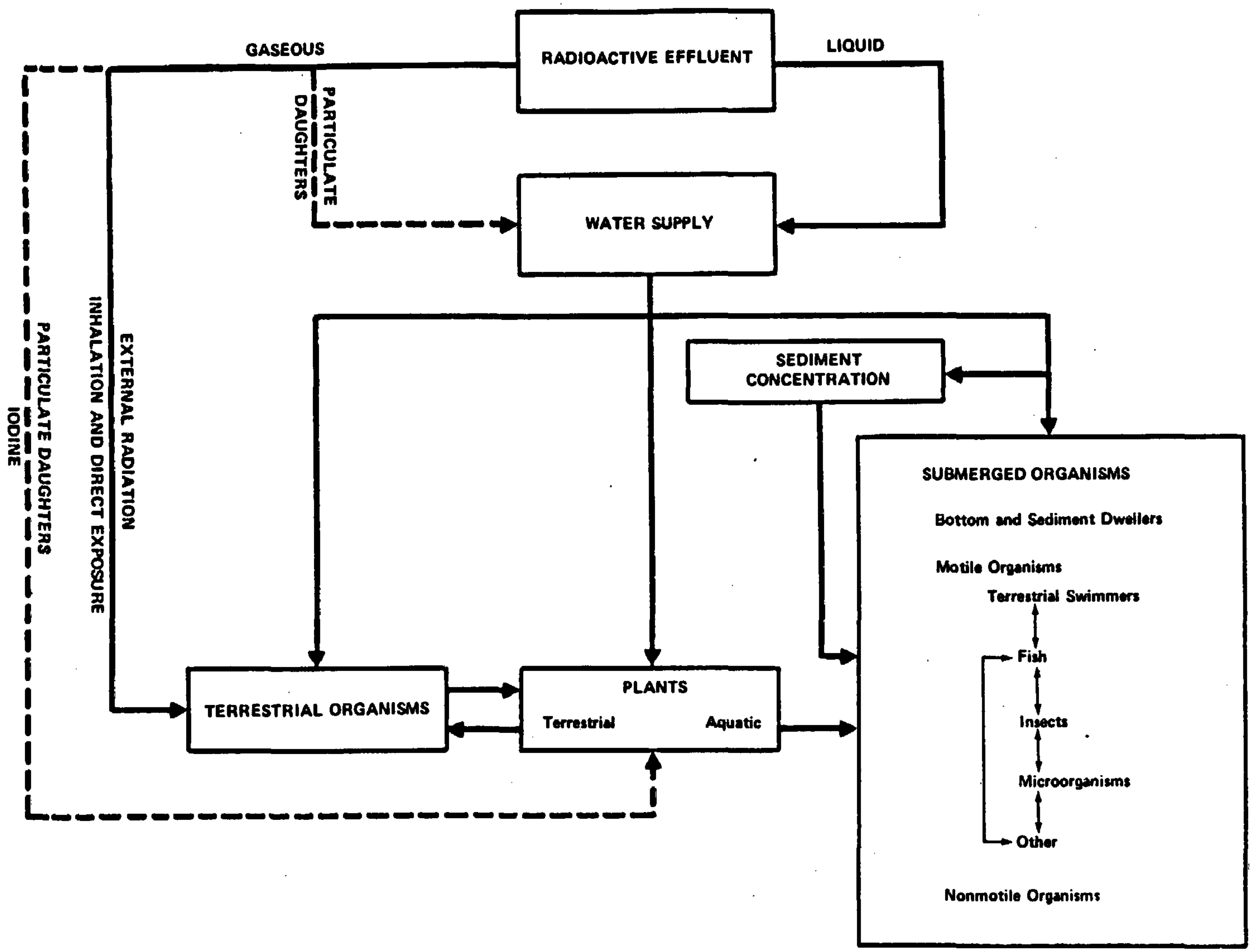


Fig. 5.1. Generalized Exposure Pathways for Organisms Other than Man.

FitzPatrick and Nine Mile Point, Unit 1, plants, those that will receive the most significant doses will be the terrestrial species that form permanent communities near the power plants.

Terrestrial organisms located on the FitzPatrick or the adjoining Nine Mile Point, Unit 1, sites could receive doses of about 100 mrads/yr if they reside at distances closer than 600 feet from the high-pressure turbines of either plant.

Aquatic species that are likely to inhabit the FitzPatrick and Nine Mile Point, Unit 1, coolant water discharges will receive the highest radiation doses within the marine environment. The average annual contribution of the FitzPatrick Plant to the radiation dose in the near neighborhood of its discharge will be 0.21 and 0.46 millirads per year to fish and aquatic invertebrates, respectively. The determinations of these values are based upon the estimated radioactive discharges as given in Table 3.3 and bioaccumulation factors as given in Table 5.3. Assuming that no further significant dilution of Nine Mile Point-1 discharge occurs, its contribution to the average annual dose in its release neighborhood results in deliveries of 0.10 and 0.66 rads per year to fish and aquatic invertebrates, respectively. These values are calculated using the data presented in Table 5.4 after adjusting release levels to an assumed 80% level of Nine Mile Point Unit 1 operation. These dose levels will decrease approximately linearly with distance from the lake effluent mixing zone. At distances of between 8 to 9 miles from the source, they will be decreased by about a factor of 15.

5.6 RADIOLOGICAL EFFECT ON MAN

During routine operation of the Plant at power, small quantities of fission products and induced activities will be released to the environment. The AEC licensing and inspection procedures will insure that the radiation doses received by persons living near the Plant and beyond, as a result of these releases and of direct irradiation, will be as low as practicable and will be well within the limits imposed by 10 CFR Part 20. The Staff has estimated probable release rates of radionuclides from the Plant based upon engineering evaluations of the Plant including procedures, equipment and proposed modes of operation.

Additionally, measurements of the performance of Nine Mile Point, Unit 1, have been used to estimate the expected future radiological characteristics of FitzPatrick effluents.

The Staff has calculated the potential radiation doses to individuals located at areas within a 50-mile radius of the Plant from the releases

presented in Table 3.3, Table 3.5 and in Table 5.4. The calculations are conservative in the assumptions used to estimate dilution, biological accumulation of radionuclides in food chains leading to man, and use factors for people.

The pathway by which man becomes subjected to radiation through his own physiological mechanisms and those of his food are illustrated in Fig. 5.2.

In estimating the radiation doses that the human may receive by ingestion of fish and other aquatic species, capacity of the food species to accumulate selectively a number of waterborne elements must be accounted. (See Table 5.3).

The resulting calculated annual radiation dose estimates are presented in Tables 5.5 (FitzPatrick) and 5.6 (Nine Mile Point, Unit 1) as annual doses under equilibrium conditions.

In the calculations the improved gaseous effluent treatment system proposed for Nine Mile Point, Unit 1 has not been considered.

5.6.1 Radioactive Materials Released In Liquid Effluents

The liquid effluent from the FitzPatrick Plant will be discharged into Lake Ontario at a rate of about 825 cfs under normal operating conditions. Exclusive of tritium activity, the average gross concentration of activity expected in the Plant effluent is 6.0×10^{-9} μCi/cc. This value is based upon the anticipated annual total activity releases provided in Table 3.3. The effluent from the Plant will be discharged into Lake Ontario via a diffuser system that generates an overall 9000-cfs lakeward flow and, as a consequence, further dilutes the discharge by about a factor of ten, to about 6.0×10^{-10} μCi/cc.

Nine Mile Point, Unit 1 discharges its coolant water into Lake Ontario about 3000 feet to the west of the FitzPatrick outflow. Measured effluent activities discharged into the lake by Nine Mile Point, Unit 1 over the course of 1971 are presented in Table 5.4. Since Unit 1 operated at approximately 56% of its total license capacity during 1971, the measured effluents were increased by the factor 0.80/0.56 = 1.43 to approximate a full year of normal (80%) operation. Based upon the above and Nine Mile Point, Unit 1 coolant discharge rate of 600 cfs, the average gross concentration of activity in the effluent discharge was 1.07×10^{-7} μCi/cc during 1971. It is estimated that a dilution of the coolant by threefold will occur in the immediate vicinity of discharge. This results in an initial gross activity concentration of about 3.6×10^{-8} μCi/cc in the immediate neighborhood of discharge.

TABLE 5.3 Bioaccumulation Factors for Radioelements

Element	Fresh Water Fish	Fresh Water Invertebrates	Element	Fresh Water Fish	Fresh Water Invertebrates
Cr	2×10^{2}	2×10^{3}	Ru	1×10^{2}	2×10^{3}
Mn	2.5×10^{1}	4×10^{4}	Rh	1×10^{2}	2×10^{3}
Fe	3×10^{2}	3.2×10^{3}	Sb	4×10^{1}	1.6×10^{4}
Co	5×10^{2}	1.5×10^{3}	Te	4×10^{2}	1.5×10^{2}
Ni	4×10^{1}	1×10^{2}	I	1.0×10^{0}	2.5×10^{1}
Zn	1×10^{3}	4×10^{4}	Cs	1×10^{3}	1×10^{3}
Ag	3.1×10^{3}	3.1×10^{3}	Ba	1×10^{1}	2×10^{2}
W	1×10^{0}	3×10^{1}	Ce	1×10^{2}	1×10^{3}
Rb	2×10^{3}	2×10^{3}	Pr	1×10^{2}	1×10^{3}
Sr	4×10^{1}	7×10^{2}	Nd	1×10^{2}	1×10^{3}
Y	1×10^{2}	1×10^{3}	Pm	1×10^{2}	1×10^{3}
Zr	1×10^{2}	1×10^{3}	Np	1×10^{4}	2.9×10^{2}
Nb	3×10^{4}	1×10^{2}	Pu	1×10^{1}	2.9×10^{2}
Mo	1×10^{2}	1×10^{2}			

From W. H. Chapman, et al., "Concentration Factors of Chemical Elements in Edible Aquatic Organisms," UCRL-50564, Dec. 30, 1968.

TABLE 5.4 1971 Effluent Releases from Nine Mile Point, Unit 1*

Liquid	Ci	Gas	Ci
CR-51	8.57 (12.25)	Xe-138	22,414 (32,100)
Mn-54	5.91 (8.45)	Kr-87	35,868 (51,300)
Co-58	3.30 (4.72)	Kr-88	33,483 (47,900)
Fe-59	2.92 (4.18)	Kr-85m	20,287 (29,000)
Co-60	6.50 (9.30)	Xe-135	75,588 (108,000)
Sr-89	0.17 (0.24)	Xe-133	42,718 (61,100)
Mo & Tc-99	0.23 (0.33)		
I-131	1.34 (1.92)		
I-133	0.26 (0.37)		
Cs-134	0.49 (0.70)		
Cs-137	1.47 (2.10)		
Ba-La-140	0.05 (0.07)		
Np-239	0.33 (0.47)		
Na-24	0.09 (0.13)		
Total identified and unidentified noble gas releases			253,240 (362,000) Ci
Total identified and unidentified liquid releases			32.2 (46.0) Ci
Total iodines and particulates in gaseous streams			0.8 (1.14) Ci

* From operation experience of Nine Mile Point.

( ) Numbers in parentheses are extrapolations to 80% annual operating time.

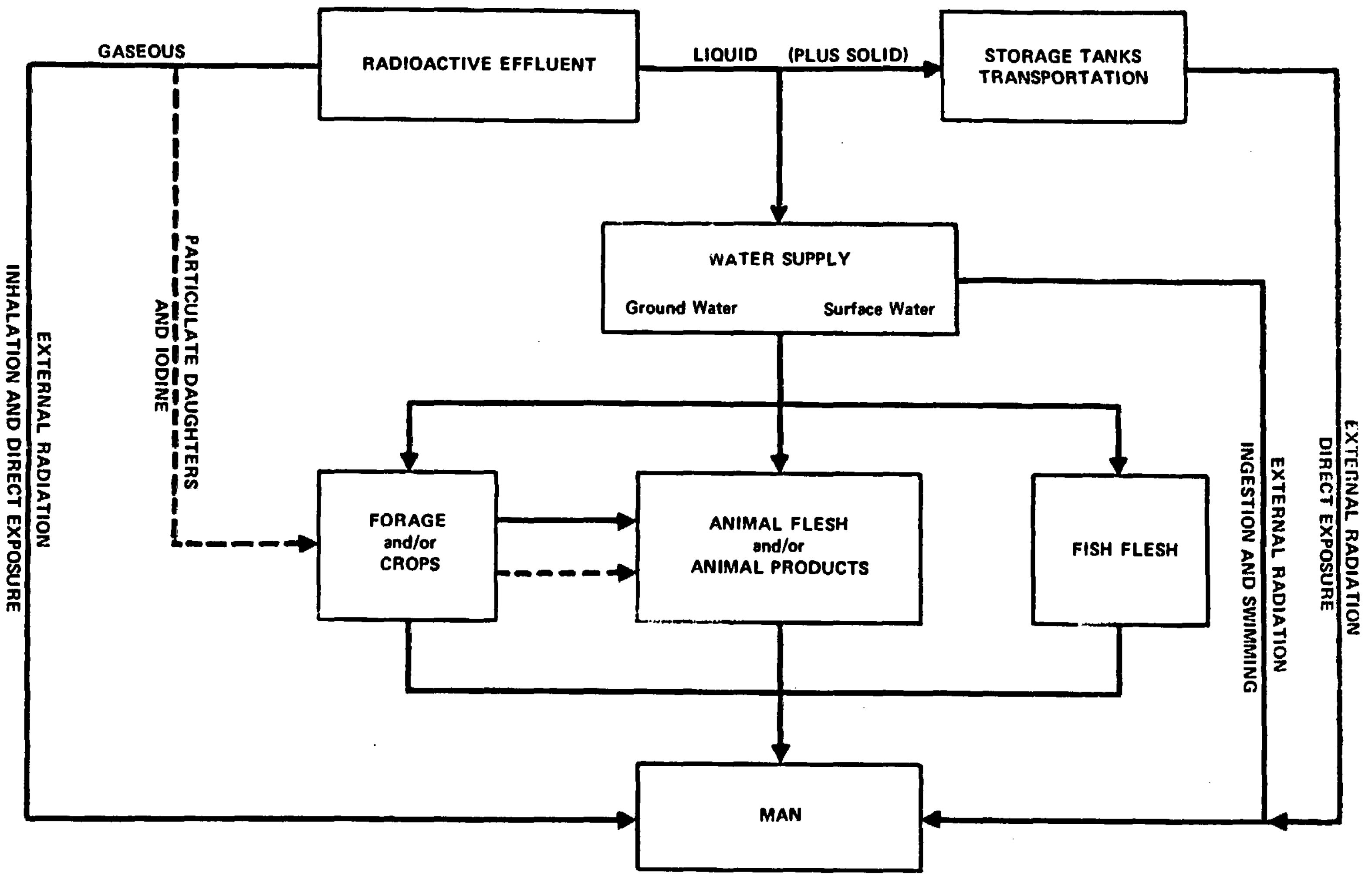


Fig. 5.2. Generalized Exposure Pathways to Man.

TABLE 5.5 Annual Doses under Equilibrium Conditions To Individuals at Various Locations[a] (FitzPatrick)

Location	Pathway	Total Body Dose, mrem/yr	Thyroid Dose, mrem/yr	GI Tract Dose, mrem/yr	Bone Dose mrem/yr
Boundary dose 0.6 mi. E	Cloud	3.3	3.8	(3.3)[d]	(3.3)
Nearest dairy farm (1.2 mi. WSW)	Cloud	0.67	13[b]	(0.67)	(0.67)
Visitor Center (0.85 mi. W)[c]	Cloud	0.17	0.25	(0.17)	(0.17)
Lake Ontario (public water supplies, 8 mi.)	Ingestion of 1.2 liters/day	3.1×10^{-5}	1.2×10^{-3}	6.4×10^{-5}	8.5×10^{-5}
Lake Ontario (near discharge)	Ingestion of 20 gm fish/day	2.1×10^{-3}	3.3×10^{-4}	3.1×10^{-3}	3.1×10^{-3}
Lake Ontario (near discharge)	Ingestion of 5 gm aquatic invertebrates/day	7.9×10^{-4}	2.0×10^{-3}	3.6×10^{-3}	4.1×10^{-3}
	Swimming (100 hr/yr)	9.0×10^{-6}			
	Boating (100 hr/yr)	4.5×10^{-6}			

[a]Exclusive of Nine Mile Point, Unit 1, Station.

[b]Dose to child from a daily intake of 1 liter of milk derived from cows grazing for 5 months per year plus an annual ingestion of 18 Kgm of leafy vegetables grown on the farm.

[c]Assumes an annual occupational dwell-time of 2000 hours.

[d]Values in parenthesis refer to internal dose resulting from external sources.

TABLE 5.6 Annual Doses under Equilibrium Conditions to Individuals at Various Locations[a] (Nine Mile Point, Unit 1)

Location	Pathway	Total Body Dose, mrem/yr	Thyroid Dose, mrem/yr	GI Tract Dose, mrem/yr	Bone Dose mrem/yr
FitzPatrick boundary dose[b] (1.2 mi.E)	Cloud	5.0	(5.0)[e]	(5.0)	(5.0)
Nearest dairy farm	Cloud	6.5	0.79[c]	(6.5)	(6.5)
Visitors Center (0.25 mi. W)[d]	Cloud	2.0	(2.0)	(2.0)	(2.0)
Lake Ontario (public water supplies 7-1/2 mi.)	Ingestion of 1.2 liters/day	4.3×10^{-3}	6.2×10^{-2}	1.5×10^{-2}	1.0×10^{-2}
Lake Ontario (near discharge	Ingestion of 20 gm fish/day	0.68	1.7×10^{-2}	1.7	0.94
Lake Ontario (near discharge	Ingestion of 5 gm aquatic invetebrate/ day	0.61	9.6×10^{-2}	8.4	0.58
	Swimming (100 hr/yr)	5.4×10^{-4}			
	Boating (100 hr/yr)	2.7×10^{-4}			

[a]Exclusive of FitzPatrick Plant.

[b]Calculated at the point of the maximum boundary dose from FitzPatrick Plant (0.6 miles east of FitzPatrick).

[c]Dose to child from a daily intake of 1 liter of milk derived from cows grazing at this site for 5 months per year plus an annual ingestion of 18 Kgm of leafy vegetables grown on the farm.

[d]Assumes an annual occupational dwell-time of 2000 hours.

[e]Values in parenthesis refer to internal dose resulting from external sources.

In normal reactor operations, a fraction of the noble gases produced will be entrained or dissolved in the coolant water and will be discharged into the lake.

According to AEC studies of operating reactor coolant discharge waters, the highest annual average noble gas concentrations in the discharge water do not result in significant doses being delivered to humans.

The closest users of Lake Ontario for potable water are the Onondaga County Water District and the Oswego municipal water supply. The closest potable water intake to the cooling water discharge (Nine Mile Point, Unit 1) is approximately 8 miles. Over the distance, a conservative estimate of lake dilution is a factor of 15. Under these assumptions, the total body dose to an individual drinking 1.2 liter per day would be about 4.3×10^{-3} mrem/yr. The dose to an individual's thyroid would be 6.2×10^{-2} mrem/yr. Doses to other organs are provided in Tables 5.5 and 5.6.

An individual fishing from shore directly north of the reactor for 500 hr/yr would receive an external exposure to the whole body of approximately 6.6×10^{-2} mrem/yr. The external total body dose to a person swimming and boating for 100 hr/yr at each activity in diluted reactor coolant discharge is calculated to be 8.1×10^{-4} mrem/yr.

5.6.2 Radioactive Materials Released to the Atmosphere

The most significant radiation dose delivered to the public will result from the release of gaseous effluents from the plant. The principal radioactive materials released to the atmosphere will be the fission product noble gases, krypton and xenon. The engineering estimates of gaseous effluent releases from the FitzPatrick Plant and the measured releases obtained from Nine Mile Point Unit 1 plant are given in Section 3. The Staff has calculated the potential doses using annual averages for site meteorological conditions and assuming that releases of the listed radionuclides occur at a constant rate.

During normal plant operation at full power, the maximum total body dose due to the radioactive cloud is at a point at the FitzPatrick eastern site boundary (0.6 miles E) and is calculated to be about 3.3 mrem/yr. The contribution to dose at that point from Nine Mile Point, Unit 1 is about 5.0 mrem/yr. At a nearby summer camp facility (The Ontario Bible Conference Summer Camp) located about 1.5 miles west southwest of the plant, the annual total body dose to an individual in residence for three months would be the sum of FitzPatrick contribution of 0.17 mrem/yr and that of the Nine Mile Point Unit 1 plant of 0.50 mrem/yr.

The Niagara Mohawk Power Corporation maintains a visitor center approximately 0.85 miles west of the FitzPatrick Plant and about 0.25 miles west of Nine Mile Point, Unit 1. The doses from gaseous effluents of the Fitzpatrick and Nine Mile Point, Unit 1, plants to visitors are expected to be very low. Those total body doses delivered from gaseous effluents of both plants to center employees is expected to be about 2.1 mrem/yr.

Radioactive iodine may be ingested by milk cows after its deposition in grazing areas. Human thyroids can be exposed to radiation as a result of ingesting milk from these cows. Using the estimated FitzPatrick Plant release rates as given in Table 3.3, the dose to an infant's thyroid which would result from consuming one liter of milk daily from a cow grazing five months per year at the nearest dairy farm (about 1.2 miles WSW; stack $\chi/Q = 5.8 \times 10^{-9}$ sec/m^3; vent $\chi/Q = 4.0 \times 10^{-7}$ sec/m^3) would be approximately 11 mrem/yr. With the same conditions and location resulting from operations of Nine Mile Point, Unit 1 (0.6 miles SW; stack $\chi/Q = 1.4 \times 10^{-8}$ sec/m^3) the dose would be <0.7 mrem/yr to an infant's thyroid.

Leafy vegetables grown on this same farm could also contain deposited radioiodines. Thus, the dose to a child's thyroid resulting from an annual consumption of 18 kgm of leafy vegetables produced during the three month growing period was also calculated. The dose via this pathway was found to be about 2 mrem/yr based upon the FitzPatrick releases and <0.12 mrem/yr based upon the Nine Mile Point-1 releases. The above are calculated doses. The Applicant will be required to operate the Plant and monitor the Plant and its environs in accordance with the Technical Specifications which will be commitment with the criteria of the proposed Appendix I to 10 CFR Part 50.36a.

5.6.3 Direct Radiation

Both the FitzPatrick and Nine Mile Point, Unit 1 Plants are boiling water reactors. As a consequence of nuclear reactions occurring in the primary heat loop of these systems (particularly the O^{16} (n,p) N^{16} reaction), energetic gamma rays are produced. In their passage through the shielding and the atmosphere, the flux is attenuated and the gamma energy is degraded. Estimates of direct dose are made based upon values measured at other sites.[15] The distance to the shoreline from the FitzPatrick Plant turbine is about 455 feet. It is estimated that a person boating for 100 hours per year at this location would receive about 2.7 mrem/yr due to direct radiation from the plant. The direct radiation dose at the nearest property line (0.7 miles) would be about 4×10^{-2} mrem/yr.

5.6.4 Transportation of Nuclear Fuel and Solid Radioactive Waste

The nuclear fuel for the James A. FitzPatrick Nuclear Power Plant will be slightly enriched uranium in the form of sintered uranium oxide pellets encapsulated in Zircaloy fuel rods. Each year in normal operation, about 140 fuel elements will be replaced.

a. Transport of New Fuel

The Applicant has indicated[16] that new fuel and four reload batches will be transported either by truck or by rail from the fuel fabrication plant in Wilmington, North Carolina. The Applicant has also indicated that new fuel will be shipped in AEC-DOT approved containers which hold two fuel elements per container. About 18 truckloads will be required for the initial loading and about five truckloads of 16 containers each will be required each year to meet the needs for replacement fuel. The Staff estimates that new fuel will be shipped a distance of 800 miles.

b. Transport of Irradiated Fuel

The Applicant lists the irradiated fuel reprocessing facilities in West Valley, New York; Morris, Illinois; or Barnwell, South Carolina, as destinations for spent fuel.[17]

Fuel elements removed from the reactor will be unchanged in appearance and will contain some of the original U-235 (which is recoverable). However, as a result of the fissioning of the uranium, the fuel element will be highly radioactive and contain large amounts of fission products and some plutonium. As the radioactivity decays, it produces radiation and "decay heat." Thus after being discharged from a reactor, the fuel elements are stored under water in a storage pool to allow time for cooling and decay 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 a storage period of at least 100 days,[17] in AEC-DOT approved transport casks designed for truck or rail shipment.

Casks designed for truck shipment will hold two spent fuel elements and weigh about 26 tons each. Approximately 70 such shipments, each estimated to be 1000 miles in distance, would be required per year.

If shipment is made by rail a cask holding 32 spent fuel elements will weigh approximately 110 tons. The Staff estimates that 5 such shipments of approximately 1000 miles shipping distance per year would be required.

An equal number of shipments would be required to return empty casks.

c. Transport of Solid Radioactive Wastes

The Applicant states[18] that all radioactive material shipped offsite will be in solid form and estimates 20 truckload shipments or 8 rail shipments per year during normal operation of the Plant. Startup operations may double the above estimated waste shipment requirements. The disposal sites identified by the Applicant are West Valley, New York; Aiken, South Carolina; or Moorehead, Kentucky. The Staff estimates the shipping distance to be about 1000 miles.

d. Principles of Safety in Transport

The transportation of radioactive material is regulated by the Department of Transportation and the Atomic Energy Commission.[19] The regulations provide protection of the public and transport workers from radiation. This protection is achieved by a combination of standards and requirements applicable to packaging, limitations on the contents of packages and radiation coming from packages, and procedures to limit the exposure of persons normally and after accidents.

Primary reliance for safety in the transport of radioactive material is placed on the packaging. The packaging must meet regulatory standards[20] established according to the type and form of material for containment, shielding, nuclear criticality, and heat dissipation. The standards provide that the packaging shall prevent the loss or dispersal of the radioactive contents, retain shielding efficiency, assure nuclear criticality safety, and provide adequate heat dissipation under normal conditions of transport and under specified accident damage test conditions. The contents of packages not designed to withstand accidents are limited, thereby limiting the risk of hazards arising from an accident. The contents of the package also must be limited so that the standards for external radiation levels, temperature, pressure, and containment are met.

Procedures applicable to the shipment of packages or radioactive material require that the package be labeled with a unique radioactive materials label. In transport the carrier is required to exercise control over radioactive material packages including loading and storage in areas separated from persons and limit the aggregation of packages to limit the exposure of persons. The procedures the carrier must follow in case of accident include segregation of damaged and leaking packages and the notification of the shipper and

the Department of Transportation. Radiological assistance teams are available through an inter-governmental program to provide equipment and trained personnel, if necessary, in such emergencies.

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

Safety in transportation is provided by the package design and limitations on the contents and external radiation level and does not depend on controls over routing. Although regulations require all carriers of hazardous materials to avoid congested areas[21] whenever practical to do so, in general, carriers choose the most direct and fastest route. Routing restrictions which require use of secondary highways or other than the most direct route may increase the overall environmental impact of transportation as a result of increased accident frequency or severity. Any attempt to specify routing would involve continued analysis of routes in view of the changing local conditions as well as changing of sources of material and delivery points.

e. Exposure during Normal (No Accident) Conditions

(1) New Fuel

Since the amounts of radiation and heat emitted by new fuel are small, or insignificant, there will be essentially no effect on the environment during its transport under normal conditions. Exposure of individual transport workers is estimated to be less than 1 millirem (mrem) per shipment. For 5 shipments, with two drivers for each vehicle, the total dose would be about 0.01 man-rem per year.* The

*Man-rem is a measure of the total dose absorbed by a population. It is the product of the number of persons in that population multiplied by the average dose in rem absorbed by each member of that population.

radiation level associated with each truckload of new 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. The dose to others along the shipping route would be extremely small.

(2) Irradiated Fuel

Based on actual radiation levels associated with shipments of irradiated fuel elements, the Staff has estimated that the radiation level at 3 feet from a rail car transporting irradiated fuel would be about 25 mrem/hr.

Under normal conditions, the average radiation dose received by the individual truck driver in a 1,000 mile shipment of irradiated fuel is estimated to be 15 mrem. With two drivers in each vehicle, the annual cumulative dose resulting from about 70 truck shipments would be approximately 2.1 man-rem.

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 annual cumulative dose for 5 shipments during the year is estimated to be about 0.03 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 annual cumulative dose would be about 0.07 man-rem. Approximately 300,000 persons who reside along the 1,000-mile route over which the irradiated fuel is transported might receive an annual cumulative dose of about 0.09 man-rem if shipped by rail and 1.3 man-rem if shipped by truck. The regulatory radiation level limit of 10 mrem/hr at a distance of 6 feet from the vehicle was used to calculate the integrated dose to persons in an area between 100 feet and 1/2 mile on both sides of the shipping route. It was assumed that the shipment would travel 200 miles per day and the population density would average 330 persons per square mile along the route.

The amount of heat released to the air from each cask will be about 250,000 Btu/hr. For comparison, 115,000 Btu/hr is about equal to the heat output from the furnace in an average size home. Although the temperature of the air which contacts the loaded cask may be increased a few degrees, because the amount of heat is small and is being released over the entire transportation route, no appreciable thermal effects on the environment will result.

(3) Solid Radioactive Wastes

Under normal conditions, an individual truck driver might receive as much as 15 mrem per shipment. If the same driver were to drive 20 truckloads in a year, he could receive an estimated dose of about 300 mrem during the year. The cumulative dose to all drivers for the year, assuming 2 drivers per vehicle, might be about 0.6 man-rem.

Train brakemen might spend a few minutes in the vicinity of the car for an average exposure of about 0.5 millirem per shipment. With 10 different brakemen involved along the route, the annual 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 truck might receive a dose of as much as 1.3 mrem. If 10 persons were so exposed per shipment, the annual cumulative dose would be about 0.3 man-rem. Approximately 300,000 persons who reside along the 1,000 mile route over which the solid radioactive waste is transported might receive an annual cumulative dose of about 0.4 man-rem if shipped by truck and 0.1 man-rem if shipped by rail. 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.

5.6.5 Population Dose from All Sources

The Regulatory Staff has made calculations of radiation doses using estimates of release rates relative to dilution, biological reconcentration in food chains, and use factors for people. The calculations are meant to apply to the average individual. Radiation doses to specific persons may be higher or lower, depending on the individual's living habits, food preferences, or recreational activities.

The combined dose due to gaseous effluents to all individuals living within a fifty-mile radius of the plants was calculated using 1980 population data.

In estimating the combined doses resulting from the consumption of fish and aquatic invertebrates harvested from Lake Ontario, 1970 reports of fish landings (3,235,000 lb) from the lake in the United States and Canada were used. It was estimated that the harvest weight of aquatic invertebrates from Lake Ontario was less than the fish catch by a factor of 100. In addition, the coolant water discharges were assumed to be diluted by a factor of 20 over those concentrations in

the immediate regions of the outlet at both power plants. The edible weight of both fish and aquatic invertebrates was further assumed to represent half of their gross weights.

The exposed fishing and boating population was estimated to represent 25% of the total population within a fifty-mile radius and each person was assumed to be exposed during 5 hr/yr of swimming and 5 hr/yr of boating.

The combined annual population dose for both plants via fish and aquatic invertebrate consumption, recreation and transportation of FitzPatrick plant nuclear fuel and radioactive wastes is estimated to be 20.4 man-rem. This value includes an assumed transportation value of 0.7 man-rem for Nine Mile Point, Unit 1.

The combined dose to all individuals living within a 50-mile radius of the plants, calculated on the basis of exposure to radioactive gaseous effluents, is estimated to be 35.9 man-rem per year. Values for the man-rem dose for the 1980 population at various distances from the plants are listed in Tables 5.7 and 5.8.

The population dose from all sources including cloud immersion, consumption of fish and aquatic invertebrates, recreation, and transportation is summarized in Tables 5.9 and 5.10.

5.6.6 Evaluation of Radiological Impact

Based on conservative estimates, the total man-rem from all effluent pathways, which would be received by the approximately 1,000,000 persons who are expected to live within a fifty-mile radius of the FitzPatrick and Nine Mile Point, Unit 1, plants in 1980, would be about 56 man-rem per year. By comparison, the average natural background dose rate of 0.125 rem[22] per year in the vicinity of the FitzPatrick site, would result in a dose of 125,000 man-rem to the same population.

Operation of the FitzPatrick plant will be an extremely minor contributor to the radiation dose that persons living in the area normally receive from natural background radiation. Fluctuations in the natural background dose may be expected to exceed the small dose increment contributed by the FitzPatrick Plant. Thus, the incremental increase will be immeasurable in itself and will constitute no meaningful risk.

TABLE 5.7 Cumulative Population, Annual man-rem Dose, and Average Annual Dose in Selected Annuli around the FitzPatrick Plant

Cumulative Radius, miles	Cumulative Population* 1980	Annual Cumulative Dose, man-rem 1980	Average Annual Dose, millirem
1	3	0.00	0.96
2	337	0.29	0.85
3	1,004	0.60	0.60
4	2,314	1.04	0.45
5	5,287	1.96	0.37
10	43,125	4.74	0.11
20	101,828	6.82	0.067
30	216,621	7.58	0.035
40	677,741	10.8	0.016
50	1,056,106	12.7	0.012

*Population based upon the estimate given in Applicant's Final Safety Analysis Report, Supplement 9, Aug. 7, 1972.

TABLE 5.8 Cumulative Population, Annual man-rem Dose, and Average Annual Dose in Selected Annuli around the Nine Mile Point, Unit 1, Station

Cumulative Radius, miles	Cumulative Population* 1980	Annual Cumulative Dose, man-rem 1980	Average Annual Dose, millirem
5	5,287	3.5	0.67
10	43,125	8.6	0.20
20	101,828	12.2	0.12
30	216,621	13.6	0.063
40	677,741	19.7	0.029
50	1,056,106	23.2	0.022

*Population based upon the estimate given in Applicant's Final Safety Analysis Report, Supplement 9, Aug. 7, 1972.

TABLE 5.9 Annual Dose to the General Population from Operation of the FitzPatrick Plant

	Exposed Population	Dose, man-rem
Cloud (immersion)	1,056,106	12.7
Fish (ingestion)		0.4
Other aquatic species (ingestion)		0.0002
Recreation (fishing, boating)	264,000	0.0001
Transportation of nuclear fuel and radioactive wastes		0.71
Estimated Total	About	13

TABLE 5.10 Annual Dose to the General Population from Operation of the Nine Mile Point, Unit 1, Station

	Exposed Population	Dose, man-rem
Cloud (immersion)	1,056,106	23.2
Fish (ingestion)		17
Other aquatic species (ingestion)		2.0
Recreation (fishing, boating)	264,000	0.008
Transportation of nuclear fuel and radioactive wastes		(0.7) Assumed
Estimated total		43

References

1. P. E. Church, Trans. Am. Geophysical Union, 26, 353-357 (1945), 27 575-578 (1946).

2. J. E. Carson, "Some Comments on the Atmospheric Consequences of Thermal Enrichment from Power Generating Stations on a Large Lake." Presented at 65th An. Mtg. of Air Pollution Control Ass'n., Atlantic City, June 27-July 1, 1971.

3. "Environmental Report on Indian Point Unit 3," Appendix S, Consolidated Edison Co., New York.

4. J. W. Meldrim and J. J. Giff, "Temperature Preference, Avoidance, and Shock Experiments with Estuarine Fishes," Bull. No. 7 Ichthyol. Association, Middletown, Del., 1971.

5. B. C. Marcy, "Survival of Young Fish in the Discharge Canal of a Nuclear Power Plant," J. Fish. Res. Bd., Canada, 28, 1057-1060, 1971.

6. C. C. Coutant and A. J. Brook, "Biological Aspects of Thermal Pollution: I Entrainment and Discharge Canal Effects," CRC Critical Review, pp. 341-381, 1970.

7. M. A. Churchill and T. A. Wojtalik, Nuclear News, 80, 1969. (Cited in Ref. 6).

8. W. D. Youngs, in "Ecology of Cayuga Lake and the Proposed Bell Station (Nuclear Powered)," R. T. Oglesby and D. J. Allee, Eds. Publ. No. 27, Water Resources and Marine Sciences Center, Cornell Univ., Ithaca, N. Y., 1969. (Cited in Ref. 6).

9. J. E. Warinner and M. L. Brehmer. Air Water Pollution Int. J. 10, 277. (Cited in Ref. 6).

10. R. P. Morgan and R. G. Stross, Chesapeake Sci. 10, 165, 1969. (Cited in Ref. 6).

11. R. G. Ferguson, "The Preferred Temperature of Fish and their Midsummer Distribution in Temperate Lakes and Streams." J. Fish. Res. Bd., Canada. 15(4), 607-624, 1958.

12. J. E. McKee and H. W. Wolf. "Water Quality Criteria," 2nd Ed. The Resources Agency of California, State Water Quality Control Board, Publ. No. 3-A, 1963.

13. S. I. Auerbach, "Ecological Considerations in Siting Nuclear Power Plants: The Long Term Biota Effects Problems," Nuclear Safety 12, 25, 1971.

14. "Report on Releases of Radioactivities from Power Reactors in Effluents during 1971" (Draft). Regulatory Operations, Atomic Energy Commission, 1972.

15. W. M. Lowder, et. al., "Environmental Gamma Radiation from Nitrogen-16 Decay in the Turbines of a Large Boiling Water Reactor," HASL TM 72-1, Feb. 1972.

16. Supplement "Environmental Report on the John A. FitzPatrick Nuclear Power Plant," Section 3.7.5.1, Power Authority of the State of New York, Nov. 1971.

17. Ibid. Sect. 3.7.5.2.

18. Ibid. Sect. 3.7.5.3.

19. 10 CFR Parts 70 and 71; 49 CFR Parts 170-179.

20. 10 CFR Part 71; 49 CFR Parts 173 and 178.

21. 49 CFR §397.1(d).

22. "Environmental Report on the Nine Mile Point Station, Unit 1." Niagara Mohawk Power Corp., Syracuse, N.Y., June 1972.

23. J. Cairns, Jr., "Effects of Increased Temperature on Aquatic Organisms," Industrial Wastes, 1 (4) 150-152, 1956.

6. ENVIRONMENTAL MONITORING PROGRAM

6.1 AQUATIC MONITORING PROGRAM

Preoperational ecological studies have been conducted since 1968 in the vicinity of the Nine Mile Point Nuclear Station, Unit 1. Included are studies on fish distributions, fish food preference, abundance of benthic organisms, entrainment of plankton and analysis of water samples for nitrates and total phosphorous. These investigations were extended in 1969 to include preoperational studies for the FitzPatrick Plant. These investigations will be continued when the Plant becomes operational. The Staff has concluded that the studies as they have been proposed and are being conducted by the Applicant will not provide adequate information to assess the operational effects of the Plant on aquatic biota. The Staff will require that the environmental monitoring program be revised and additional studies be implemented so that proper and adequate data can be collected for a relevant statistical analysis of the results. The following is a description of the Applicant's environmental monitoring program together with the Staff's requirements.

a. Sampling Transects

Twelve north-south transects covering a stretch of over three miles and extending offshore of the site were established by the Applicant for sampling purposes. The transects farthest east and west of the site are presumably located outside of the Plant's influence and serve as controls. The data collected in these areas provide the means of assessing natural fluctuations for comparison with data collected at other transects. The length of the transects is not specified; however the length varies from transect to transect depending on the depth contour.

The number of transects should be reduced and the length of each should be increased to include water to the 40- to 50-foot depth so that if a larger area is affected by the plume it could be included. The length of the transects in the vicinities of the discharge and the intake should be increased in order that possible fish concentrations that may occur as a result of thermal discharge could be recorded. Sampling stations along the expected path of water movement should be established.

b. Sampling Duration

The Applicant's sampling periods and duration in any year were not synchronized for fish, benthos and water quality studies. The fish surveys were conducted four times during the year (May-June, July, August and October), the benthic survey twice during the year (June

and August) and water quality studies once during the year (August in 1969 and May in 1970). The entrainment studies were conducted periodically during summer and fall of 1971.

Field sampling should be extended to cover spring, summer, and fall seasons to the extent that weather permits. The frequency of sampling should be adequate to statistically evaluate seasonal variability. Studies on entrainment and fish collection at the intake should be conducted throughout the year.

c. Fishes

The number, location, species and distribution of fish at the site have been determined by the Applicant by netting. The surveys from a boat were made using a fine line fathometer. During each sampling period, tracings were made along two transects every four hours during a 24-hour period to obtain a diurnal pattern of movement. The vertical location and relative size of each fish were recorded. Interpretation of the tracings were based on the netting studies and size distribution of fishes. Five experimental gill nets were used to determine species distribution offshore. One net was placed at the surface near shore and the other nets were placed at the surface and bottom at 15- and 30-foot depths. During each sampling period, nets were lowered in the afternoon and removed the next morning for 4 or 5 consecutive days. Fishes were identified, measured and counted.

In order to obtain a complete inventory and to determine the distribution and relative abundance of fishes in the Nine Mile Point area other means of sampling should be used in addition to gill nets. These may include seines and surface, mid-depth and bottom trawls. Since the relative abundance of various species may not be estimated with reasonable confidence by correlating gill net and fathometric data, quantification of qualitative changes would be almost impossible. Use of a fathometer, therefore, should be limited to sampling locations where quantitative information is desired; e.g., to learn the extent of the aggregation of fish near the intake or discharge areas.

Food preference surveys were initiated in 1970 to determine the feeding habits of the major fishes in the area. The yellow perch was selected as the primary species for these investigations because of its abundance near the site and availability throughout the year. However, other fish were also examined. Fish samples for these studies were obtained with gill nets.

The food preference survey should be focused on certain "key" species. These may be selected on the basis of their relationship to warm or cold water, seasonal abundance, shallow or deep water, commercial importance, etc. These data will provide information not only on the feeding habits of important fishes and on the forage species in the area but also will aid in developing a general concept of food chain relationships in the Nine Mile Point area. Analysis of gut contents of fishes collected in the plume will provide a measure for changes in food habits due to attraction to the plume. Age-growth studies of the commercially important species should also be conducted to determine changes in year class strength and survival rates due to plant operation.

d. Benthos and Periphyton

During June and August samples of benthic organisms were collected at 5, 10, 15 and 20 foot depths along each of the transects. Three samples were scraped from rocks at each of the stations by a diver. The size of the area scraped is not mentioned. In the laboratory each sample was separated into plant and animal material. Plant material was dried, ashed and weighed. Animal species were separated and counted.

Sampling for benthos should be extended to cover the area of the lake under the plume where the overburden increases and disturbance due to wave activity is minimal. Sampling near the intake and discharge structures should be conducted prior to operation so that operational affects may be evaluated.

Sampling procedure should be such that the results can be reported in terms of biomass per unit area. The Applicant should develop a seasonal pattern of benthos with emphasis on certain key species.

No periphyton studies have been conducted in the area by the Applicant. Since flow characteristics in the vicinity of the plant are expected to be altered, the periphyton community may be affected and the food chain relationships in the area altered. Therefore, studies on periphyton should be initiated during the preoperational phase and continued in the operational phase to assess any changes that may occur.

e. Plankton

No specific program for plankton sampling was outlined by the Applicant except for reference to an earlier study conducted during 1964. Zoo- and phytoplankton samples at various depths should be collected at stations in all transects to determine the diurnal distribution of

plankton. Sampling should also be conducted in various seasons to determine seasonal changes in the distribution. Proper sampling gear should be used to collect samples for phytoplankton, zooplankton, fish eggs and larvae.

f. Entrainment Studies

The Applicant has conducted entrainment studies to determine the effects on microorganisms passing through condensers at other plants on Lake Ontario. The conditions under which these experiments were conducted do not approach the operational conditions (temperature change and exposure times) that will prevail when the FitzPatrick Plant is operated. These studies are, therefore, of little value in evaluating effects of entrainment at the Plant.

Studies on entrainment effects should be conducted throughout the year if possible. For meaningful results, samples should be collected both close to the inlet and at the discharge before mixing occurs. Since it may not be feasible to correctly sample the discharge, simulated laboratory studies should also be conducted. Entrainment studies (exposure to ΔT of 31.5°F for over 5 minutes) should include determination of effects on plankton, small fish, fish eggs and larvae.

g. Intake Screen Monitoring for Fishes

The Applicant reports that few fishes, mostly alewives, have been collected at the Nine Mile Point Unit 1. No details of this sampling program were provided.

Fishes collected at the intake screens should be identified, measured and counted. Monitoring should be frequent enough to provide reasonable estimates of the total number of fish collected on the screens during each month of the year. The relevant details of the plant operation, e.g., amount of flow, intake velocity, ambient and discharge temperatures, change of temperature, etc., should be recorded. Sampling should be designed to reflect diurnal and seasonal affects.

h. Water Quality Studies

The water quality studies consisted of sampling for nitrates and total phosphorous in August 1969 and May 1970. The samples were collected offshore of the Plant site at various depths in 30 and 100 feet of water. Methods used in analyzing the samples are not mentioned. The Applicant's studies did not include measuring various physico-chemical parameters of the lake water in the vicinity of the plant and consequently biological data has not been correlated with these parameters.

Water quality-studies should be made an integral part of the biological survey program. The study should include sampling for such parameters as temperature, dissolved oxygen, BOD, COD, pH, nitrates, total phosphorous, chlorophyll, bacterial counts, turbidity, etc.

i. Analysis and Interpretation of Results

The data should be collected in accordance with relevant sampling and experimental techniques such that a proper statistical analysis can be made. Sampling for biota and water quality parameters should be synchronized in order that interpretation of data may yield meaningful information.

6.2 THERMAL MONITORING PROGRAM

Field investigations of the thermal plume should be undertaken to delineate the configuration of the plume in order that the data obtained from the aquatic environmental program discussed above may be correlated to the elevated temperatures of the discharge. These investigations should be made for the different seasons using a variety of measuring techniques.

6.3 RADIOLOGICAL MONITORING PROGRAM

The Nine Mile Point area has been subject to substantial radiological environmental study since 1967, two years prior to the startup of Nine Mile Point, Unit 1. The Applicant proposes to use the preoperational studies carried out for Nine Mile Point, Unit 1, as well as its operational environmental studies to provide information on the radiological environment of the FitzPatrick Plant prior to its startup. The operation of environmental monitoring will be an augmented joint effort of the two adjoining plants with a level of effort graded to ensure adequate sampling and measurement of contained and released radioactivities.

Applicant's proposed radiological monitoring program did not specify the frequency of environmental sampling, the locations where samples will be taken, the radionuclides to be measured in the samples, the type of field samples to be examined, nor a description of data recording and analysis.

Applicant's sampling and monitoring programs should be designed to establish the quantities and species of radionuclides released from both plants and from the FitzPatrick Plant in particular. The programs should further be designed so that the measurements provide reliable estimates of dose deliveries by all pathways to man and biota other than man.

The Staff concludes that the radiological monitoring program as proposed by the Applicant is not adequate and that a minimum radiological monitoring program for the Plant should include the following:

a. Determination and monitoring of the critical species, trophic chains, and pathways and establishment of sampling locations and protocols based on an analysis of local environmental parameters. In addition to the present symmetric ring of sampling stations, at least 15 more stations are needed to intercept critical pathways to local biota and to man. Sampling protocols must be clearly defined, at least for the first few years.

b. All methodology should be fully described and/or documented, along with descriptions of redundancies built into the overall system to prevent loss of critical data. Sampling stations should be capable of collecting data on halogens, fission products, and activation products, in both gas and liquid phase, for both soluble and particulate forms, and be able to discriminate between all of the above. Complete reliance on a single method or device should be avoided, and a protocol for restandardization of devices in use should be given.

7. ENVIRONMENTAL EFFECTS OF ACCIDENTS

7.1 PLANT ACCIDENTS

Protection against the occurrence of postulated design basis accidents in the James A. FitzPatrick Nuclear Power Plant is provided through correct design, manufacture, and operation, and a quality assurance program used to provide and maintain the necessary high integrity of the reactor system. These aspects were considered in the Staff's safety evaluation for the FitzPatrick facility. Deviations that may occur are handled by protective systems to place and hold the plant in a safe condition. Notwithstanding this, the conservative postulate is made that serious accidents might occur, 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 Staff 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 to be presented in the Staff 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 Environmental Report," dated November 19, 1971.

The Applicant's report has been evaluated, using the standard accident assumptions and guidance issued by the Commission as a proposed Annex to Appendix D of 10 CFR Part 50 on December 1, 1971 (36 F.R. 22851). 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 low occurrence rate; and those on the low potential consequence end are characterized by a higher occurrence rate. The Applicant's examples for these classes of accidents are shown in Table 7.1. The examples given are reasonably homogeneous in terms of probability within each class.

TABLE 7.1 Classification of Postulated Accidents and Occurrences Considered by the Power Authority of the State of New York (PASNY)

No. of Class	AEC Description	PASNY Examples
1	Trivial incidents	Not considered
2	Small releases outside containment	Small continuous steam leak in turbine building
3	Radwaste system failures	Inadvertent pumping of liquid waste tank. Gaseous release through drain lines assuming lost water seal
4	Fission products to primary system (BWR)	Fuel cladding defects Transient events
5	Fission products to primary & secondary	Considered RHR heat exchanger leaks
6	Refueling accidents inside containment	Dropped fuel assembly onto core. (Design basis refueling accident)
7	Spent fuel handling accident	Movement of spent fuel outside containment and onsite
8	Accident initiation events considered in design basis evaluation in the Safety Analysis Report	Design basis LOCA, design basis steamline break outside containment, design basis control rod drop accident, liquid radwaste tank accident, and offgas system accident
9	Hypothetical sequences of failures more severe than Class 8	Not considered

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 the Staff's view, are optimistic; but the use of alternative assumptions does not significantly affect the overall environmental risk.

The Staff estimates of the dose which might be received by an assumed individual standing at the site boundary in the downwind direction, using the assumptions in the proposed Annex to Appendix D, are presented in Table 7.2. The Staff 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 7.2. These man-rem estimates were based on 2010 population data.

To rigorously establish a realistic annual risk, the calculated doses in Table 7.2 would have to be multiplied by estimated probabilities. The events in Classes 1 and 2 represent occurrences which are anticipated during plant operation and their consequences, which are very small, are considered within the framework of routine effluents from the plant. Except for a limited amount of fuel failures, 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 Class 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 7.2 are weighed by probabilities, the environmental risk is very low. The postulated occurrences 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 low in probability that the environmental risk is extremely low.

The information given in Table 7.2 indicates that the realistically estimated radiological consequences of the postulated accidents would result in exposures of an assumed individual at the site boundary to concentrations of radioactive materials within the Maximum Permissible Concentrations (MPC) of 10 CFR Part 20. The tabulated information also shows that the estimated integrated exposure of the projected population within 50 miles of the Plant from each postulated accident would

TABLE 7.2 Summary of Radiological Consequences of Postulated Accidents[a]

Class	Event	Estimated Fraction of 10 CFR Part 20 Limit at Site Boundary[b]	Estimated Dose to Population within 50-mile Radius, man-rem
1.0	Trivial incidents	c	c
2.0	Small releases outside	c	c
3.0	Radwaste system failures		
	3.1 Equipment leakage or malfunction	0.06	5.1
	3.2 Release of waste gas storage tank contents	0.24	20
	3.3 Release of liquid waste storage tank contents	<0.001	<0.1
4.0	Fission products to primary system (BWR)		
	4.1 Fuel cladding defects	c	c
	4.2 Off-design transients that induce fuel failures above those expected	0.002	0.52
5.0	Fission products to primary and secondary systems (PWR)	N.A.	N.A.
6.0	Refueling accidents		
	6.1 Fuel assembly drop into core	<0.001	<0.1
	6.2 Heavy object drop onto fuel in core	<0.001	0.46
7.0	Spent fuel handling accident		
	7.1 Fuel assembly drop in fuel storage pool	<0.001	0.10
	7.2 Heavy object drop fuel rack	<0.001	0.19
	7.3 Fuel cask drop	0.088	7.5

TABLE 7.2 (Contd.)

Class	Event	Estimated Fraction of 10 CFR Part 20 Limit at Site Boundary[b]	Estimated Dose to Population within 50-mile Radius, man-rem
8.0	Accident initiation events considered in design basis evaluation in the safety analysis report		
	8.1 Loss-of-coolant accidents inside containment		
	Small break	<0.001	<0.1
	Large break	<0.001	6.3
	8.1(a) Break in instrument line outside reactor building	<0.001	<0.1
	8.2(a) Rod ejection accident (PWR)	N.A.	N.A.
	8.2(b) Rod drop accident (BWR)	0.003	0.62
	8.3(a) Steamline break (PWR-outside containment)	N.A.	N.A.
	8.3(b) Steamline breaks (BWR)		
	Small break	0.002	0.18
	Large break	0.011	0.90

[a]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. The Staff 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.

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

[c]These releases will be comparable to the design objective indicated in the proposed Appendix I to 10 CFR Part 50 (36 F.R. 11113) for routine effluents (i.e., 5 mrem/yr to an individual from either gaseous or liquid effluent).

be orders of magnitude smaller than that from the naturally occurring radioactivity. The exposure from naturally occurring radioactivity corresponds to approximately 1200 man-rem per year within a five mile radius and 200,000 man-rem/yr within a 50 mile radius of the site. These estimates are based on a natural background level of 0.135 rem/yr. When considered with the probability of occurrence, the annual potential radiation exposure of the population from all the postulated accidents is an even smaller fraction of the exposure from natural background radiation and, in fact, is well within naturally occurring variations in the natural background. It is concluded from the results of the realistic analysis that the environmental risks due to postulated radiological accidents at the James A. FitzPatrick Nuclear Power Plant are exceedingly small and need not be considered further.

7.2 TRANSPORTATION ACCIDENTS

Exposures Resulting from Postulated Accidents

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

7.2.1 New Fuel

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

The packaging is designed to prevent criticality as a result of normal and severe accident conditions. The release of 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.

If criticality were to occur in a transportation accident, persons within a radius of about 16 feet from the accident would receive a fatal or near-fatal exposure unless shielded by intervening material. Exposure levels drop off rapidly with distance, (exposure is approximately 20 rem at a radius of 50 ft), and are of the order of 100 mrem at a radius of 100 ft from the accident. 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 nor to recur. Residual radiation levels due to induced radioactivity in the fuel elements might reach a few roentgens per hour at 3 feet and there would be very little dispersion of solid radioactive material.

7.2.2 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 the situation where gases and coolant are released.

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 millirem and only a very few people would receive such exposures.

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 decontamination would be required in accordance with Environmental Protection Agency standards.[3]

7.2.3 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, 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.

7.2.4 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 those reasons, more severe accidents have not been included in the analysis.

References

1. Federal Highway Administration, "1969 Accidents of Large Motor Carriers of Property," December 1970; Federal Railroad Administration Accident Bulletin No. 138, "Summary and Analysis of Accidents on Railroads in the U. S.," 1969; U. S. Coast Guard, "Statistical Summary of Casualties to Commercial Vessels," December 1970.

2. Department of Transportation Regulations, 49 CFR, § 171.15, § 174.566, and § 177.861.

3. Federal Radiation Council Report No. 7, "Background Material for the Development of Radiation Protection Standards; Protective Action Guides for Strontium 89, Strontium 90, and Cesium 137," May 1965.

8. EVALUATION OF PROPOSED ACTION

8.1 NEED FOR POWER

8.1.1 Current Status

The Applicant, an agency of the State of New York, operates hydroelectric power projects at Niagara Falls (2400 MWe) and Massena, New York (800 MWe). The Applicant is authorized by New York law to construct throughout its area of service (a) such hydroelectric pumped-storage projects as it deems necessary or desirable to supplement the supply of electric power and (b) such baseload nuclear generating facilities as in its judgement are necessary (i) to supply sufficient supplemental power to make possible optimum use of the generating capacity of the Applicant's St. Lawrence and Niagara hydroelectric projects, (ii) to supply low-cost power to high load factor manufacturers who will build new facilities in the Applicant's area of service or expand existing facilities provided such power is made available to them, and (iii) to supply the future needs of the Applicant's existing municipal electric and rural electric cooperative customers.[1]

In addition to the FitzPatrick Plant, the Applicant is currently building a pumped-storage power project (Blenheim-Gilboa Project, 1000 MWe) in Schoharie County, New York. The Applicant is also conducting geologic and engineering studies for a second pumped-storage power facility (1000 MWe), which may be built on a site a few miles north of the Blenheim-Gilboa Project site. If plans for this facility are approved, additional power from this source may be available in 1978.

The Applicant's primary service area is upstate New York (Power Supply Area 3, Region 1), but power is also supplied to wholesale purchasers in other parts of the State and in Vermont and Pennsylvania. Power is currently supplied to 3 industrial plants at Massena, 3 utility companies (Niagara Mohawk Power Corporation, New York State Electric and Gas Corporation, and Rochester Gas and Electric Corporation), 42 municipalities and electric cooperatives in New York State, Plattsburgh Air Force Base, the State of Vermont, and a group of rural cooperatives in Pennsylvania.

The Applicant is a member of the New York Power Pool (NYPP), together with 7 private electric utilities (Table 8.1). NYPP coordinates the hour to hour operation of the State's entire generating capacity to meet demand reliably and economically. NYPP standard operating procedures and New York Public Service Commission orders require that all areas of the State assist any area where there is a power shortage. Since upstate New York is a winter-peaking area and downstate New York

TABLE 8.1 New York Power Pool Members

Central Hudson Gas and Electric Corporation
Consolidated Edison Company of New York, Inc.
Long Island Lighting Company
New York State Electric and Gas Corporation
Niagara Mohawk Power Corporation
Orange and Rockland Utilities, Inc.
Rochester Gas and Electric Corporation
Power Authority of the State of New York
*Jamestown Municipal Electric System
*Long Sault, Inc.
*Village of Freeport

*New York State Companies that are not members of the New York Power Pool but report their load and capability as part of the New York State Interconnected Systems.

is a summer-peaking area, this coordination of generation by NYPP insures that reserve capacity is used with maximum efficiency for the benefit of customers throughout the State.

8.1.2 Past and Future Requirements for Power

The total area served by the New York Power Pool is designated as Coordinated Study Area B, Region 1, by the Federal Power Commission. Power requirements of this area increased from 8,536 MWe in 1955 to 10,074 MWe in 1960 and 13,019 MWe in 1965 (peak demands). In 1970 the peak demand was 17,037 MWe. In 1970 the projected demands for 1975 and 1980 were 22,040 MWe and 28,470 MWe, respectively.[2] However, these projected figures are now considered to be too low because of the increased use of power for air conditioning and other purposes. More recent data for power requirements of New York State which have been compiled by the Northeast Power Coordinating Council[3] are shown in Tables 8.2 and 8.3.

The chief factors used in forecasting regional power requirements are population growth and power consumption growth. From 1950 to 1960 the population of New York State increased by 13.2%, and from 1960 to 1970 it increased by 8.4%.[4] The growth rate has declined appreciably since 1965, as the population increased only 2.6% in the 5-year interval from 1965 to 1970. Peak summer loads have increased from year to year by amounts ranging from 2% to 10%. Peak winter loads have also increased in most years, although in 1969 the peak winter load declined by 0.6% from that of the preceding year. The current annual increase rate is 7% based on summer peaks and 6% based on winter peaks.[5]

The Applicant has stated that about 75 megawatts of the capacity of the Plant will be required by the Applicant's industrial customers as of May 31, 1973 (estimate based on recent market analysis). The remaining capacity of the Plant, about 746 megawatts, will be sold to other members of the New York Power Pool. Present plans are to allocate this capacity on a seasonal basis between upstate and downstate members of NYPP in the ratio of 5 to 2, with the preponderance of the delivery in each six-month period directed toward the area having the greatest seasonal need.[6] Thus during the summer of 1974 upwards of 500 megawatts will be available for the metropolitan New York City area.

The Applicant has stated that FitzPatrick will be a base-load plant with a very economical fuel cost of less than 2 mills/kwh. The Applicant plans to operate the Plant continuously at full capacity except when taken out of service for refueling purposes. Normal

TABLE 8.2 Capabilities, Peak Loads and Margins of New York State Interconnected Systems (MWe), Summer Periods, 1970-1981

Year	Installed Capability	Net Purchases	Adjusted Capacity	Peak Load	Margin	Percent Reserve
1970	21,744	145	21,889*	17,037*	4,852	28.5
1971	22,000	100	22,100*	18,146*	3,954	21.8
1972	24,660	-60	24,600	19,510	5,090	26.1
1973	27,512	-22	27,490	20,840	6,650	31.9
1974	29,060	-23	29,037	22,290	6,747	30.3
1975	30,756	-23	30,733	23,570	7,163	30.4
1976	32,079	-25	32,054	24,870	7,184	28.9
1977	33,230	430	33,660	26,280	7,380	28.1
1978	35,225	428	35,653	27,740	7,913	28.5
1979	38,173	426	38,599	29,200	9,399	32.2
1980	38,925	424	39,349	30,730	8,619	28.0
1981	39,605	422	40,027	32,280	7,747	24.0

*Actual data for year listed.

Source: Load and capacity Report, Northeast Power Coordinating Council Task Force on Load and Capacity, March 1972.

TABLE 8.3 Capabilities, Peak Loads and Margins of New York State Interconnected Systems (MWe), Winter Periods, 1970-1981

Year	Installed Capability	Net Purchases	Adjusted Capability	Peak Load	Margin	Percent Reserve
1970	22,616	-280	22,336*	16,675*	5,661	33.9
1971	23,402	-64	23,338*	16,774*	6,564	39.1
1972	26,705	-24	26,681	18,540	8,141	43.9
1973	28,430	-26	28,404	19,790	8,614	43.5
1974	31,877	-27	31,850	21,000	10,850	51.7
1975	31,706	-27	31,679	22,180	9,499	42.8
1976	33,218	-72	33,146	23,390	9,756	41.7
1977	34,368	-74	34,294	24,700	9,594	38.8
1978	37,184	-76	37,108	26,060	11,048	42.4
1979	39,231	-78	39,243	27,480	11,763	42.8
1980	40,112	-80	40,032	28,970	11,062	38.2
1981	41,885	-82	41,803	30,490	11,313	37.1

*Actual data for year listed.

Source: Load and Capacity Report, Northeast Power Coordinating Council Task Force on Load and Capacity, March 1972.

maintenance, testing and repair will be accomplished during refueling periods. The Plant is designed to produce 5 1/2 to 6 billion killowatt-hours per year and is capable of operating at a plant factor of about 85%. The Plant will add about 3% to New York State's total generating capacity and about 10% to its economical base load capacity.[5]

8.1.3 Reserve Margins

The Federal Power Commission has recommended that, as a general rule, a minimum of 20% reserve margin capacity be maintained for large power pools whose capacity is predominantly from thermal stations.[7] This includes allowance for scheduled maintenance, forced outages, errors in load forecasting, and spinning reserve requirements. The Northeast Power Coordinating Council, of which New York Power Pool is a member, has established reliability criteria for NYPP and other systems which require that a pool or systems generating supply equal or exceed area load at least 99.9615% of the time.[8] This is equivalent to a loss of load probability of one day in 10 years.

To maintain reliable service, the New York Power Pool also requires that generating reserves equal to the output of the two largest units operating in the system be available to replace possible sudden loss of fully loaded units. The reserves must be available partly in unloaded spinning generators and partly in others capable of picking up load within 30 minutes. At present 1500 megawatts of such reserves are required for the State. The required reserves will rise to 2000 megawatts by 1974 as larger units come into operation in the system.

Although the reserves of the New York power system shown in Table 8.2 and Table 8.3 appear more than adequate to meet reserve margin requirements, in recent years they have in reality been inadequate due to unusual circumstances prevailing in the New York City area. The largest member of NYPP is the Consolidated Edison Company of New York, which supplies power to the five boroughs of New York City and most of Westchester County, New York. In March 1972 the company operated plants with a total rated capacity of 9427 megawatts (approximately 40% of NYPP capacity).[3] The company has recently experienced great difficulty in finding sites for new power plants in the congested New York City area and has continued to operate plants which are old and obsolescent. Many of these plants no longer produce their rated power. Because of the heavy demand for power, the company has had to defer maintenance on some of its largest units, and as a consequence, has had many forced outages. Moreover, it has been compelled to operate certain units at reduced power levels to reduce atmospheric emissions. As a result of these and other problems, the Consolidated Edison

Company has become highly dependent upon NYPP for assistance in meeting its peak power loads.

In 1970 there were 17 days on which voltage had to be reduced in New York State so that the available power supply would not be exceeded.[5] Despite voltage reduction, there was also one day in which residential and commercial load had to be disconnected. In the summer of 1971 power demand was lower than anticipated as the result of moderate summer weather, poor economic conditions, and appeals to the public to conserve electricity. Nevertheless there were 20 days on which voltage had to be reduced prior to November.

Analysis of the New York Power Pool reserves for the summers of 1969, 1970, and 1971 indicates that actual operating reserve margins were only 6.0, 4.4, and 10.9%, respectively, after accounting for maintenance, unscheduled outages, and forced unit-capacity derating. Low margins such as these are inadequate and threaten system reliability.

A number of new generating units will have to be installed and a number of older ones retired before system reliability improves markedly. Therefore, system reliability problems can be expected to continue for at least several more years and possibly for the remainder of this decade.

The disparity between projected reserve margins (gross margins) and actual reserve margins can be partly eliminated by basing forecasts upon dependable generating capacity rather than total generating capacity. On May 10, 1972 the Federal Power Commission estimated[9] that dependable resources of the New York Power Pool would be 22,474 MWe on June 1, 1972, with an estimated reserve margin of 2,964 MWe or 15.2%, based on the expected peak demand of 19,510 MWe. This margin can be compared with that listed in Table 8.2 for the summer period (5,090 MWe or 26.1%), which was obtained from total resources. The Applicant has estimated that 16.5% of the Pool's generating capacity will remain unavailable in 1973 and 1974 and has subtracted this fraction from the Pool's total resources in a forecast of power requirements.[5] It is the Staff's opinion that correction of the reserve margin for unavailable capacity is justified in view of the present condition of the New York Power Pool. It is expected that the need for such correction will diminish as the reliability of the generating units inventory of the New York Power Pool improves with time.

8.1.4 Estimated Peak Load Situations in 1973, 1974, and 1975

Nuclear and non-nuclear generating units that are scheduled to begin service or to be uprated in the New York Interconnected System in 1973, 1974, and 1975 are listed in Table 8.4. If all plans are implemented on schedule, the capacity of the system will increase by 5,185 megawatts in this 3-year period (6,099 MWe additions; 914 MWe deductions).[3] In the longer interval from March 1, 1972 to November 30, 1981, the capacity is expected to increase by approximately 18,200 MWe, with total additions of 20,200 MWe and deductions of about 2,000 MWe.[3]

Many delays in bringing new generating units into service have occurred in recent years, both for nuclear and non-nuclear units. Five large units of New York Power Pool members have been delayed from 12 to 36 months during the past 5 years and four units have been delayed from one to three months.[5] As a result of such delays, reserve margins of generating capacity have often been less than anticipated.

Table 8.5 shows the projected summer peak demand and supply situation in the New York Interconnected System in 1973, 1974, and 1975 with and without the capacity of the FitzPatrick Plant. The Power Division of the New York State Department of Public Service has estimated that two nuclear plants (FitzPatrick and Indian Point No. 3) and one fossil plant (Astoria No. 6) may be delayed in the New York system during these 3 years.[10] Table 8.6 shows the combined effect of such delays.

If the FitzPatrick Plant is not in service during 1973 and 1974, the reserve margin is expected to be lowest in the summer of 1974 (26.6%). If the Indian Point No. 3 and Astoria No. 6 Plants also are not in service during 1974 and 1975, the summer reserve margins are expected to drop to values of 18.7% and 22.9% for 1974 and 1975, respectively.

It should be borne in mind that all three above mentioned plants are designed to supply power to the New York City area, the most critical power-supply problem in the system. It should also be noted that actual reserve margins will be lower than those cited above after deductions are made for unavailable generating capacity. The total generating capacity listed in Tables 8.5 and 8.6 cannot be relied upon to be available because many of the existing generating units are beyond normal retirement age (Section 8.1.3). In 1971 a median of 3056 MWe of forced outages and deratings was experienced by the New York Power Pool for the 15 week summer period.[9] The Consolidated Edison Company, which operates most of the overaged units, has estimated that as much as 3250 MWe of its rated capacity may be presently unavailable on any

TABLE 8.4 Scheduled Generating Capacity Additions, New York Power System, 1973-1975

	Expected Capacity (Summer Rating, MWe)	Proposed Date of Service
Nuclear Units		
Indian Point No. 2 (uprate)	92	May 1973
FitzPatrick	821	Nov. 1973*
Indian Point No. 2 (uprate)	35	Spring 1974
Indian Point No. 3	965	Fall 1974
Indian Point No. 2 (uprate)	33	Spring 1975
Non-Nuclear Units		
Blenheim-Gilboa Nos. 3 & 4	500	May 1973
Freeport Village Gas Turbine	18	May 1973
Roseton No. 2	600	May 1973
Consolidated Edison Gas Turbine	44	May 1973
Astoria No. 6	800	Spring 1974
Consolidated Edison Gas Turbine	44	Spring 1974
Long Island Lighting Gas Turbine	286	May 1974
Bowline Point No. 2	600	May 1974
Oswego No. 5	875	Oct. 1974
Northport No. 4	386	May 1975

*Originally scheduled for service in June 1973.

Source: Load and Capacity Report, Northeast Power Coordinating Council Task Force on Load and Capacity, March 1972.

TABLE 8.5 Projected 1973, 1974, and 1975 Summer Peak Demands, New York State Interconnected Systems

	1973	1974	1975
Conditions with FitzPatrick Plant			
Total Capability,[a] MWe	27,490	29,037	30,733
Peak Load, MWe	20,840	22,290	23,570
Margin, MWe	6,650	6,747	7,163
Reserve, %	31.9	30.3	30.4
Reserve with allowance for operating unavailability,[b] %	22.3	21.3	21.9
Conditions without FitzPatrick Plant			
Total Capability,[a] MWe	26,669	28,216	29,912
Peak Load, MWe	20,840	22,290	23,570
Margin, MWe	5,829	5,926	6,342
Reserve, %	28.0	26.6	26.9
Reserve with allowance for operating unavailability,[b] %	18.4	17.6	18.4

[a]Includes net of sales transactions.

[b]Assuming that 2,000 MWe of generating capacity remains unavailable each year.

Primary Source of data: Load and Capacity Report, Northeast Power Coordinating Council Task Force on Load and Capacity, March 1972.

TABLE 8.6 Effect of Delayed Operation of Nuclear and Non-nuclear Plants on Reserve Margins of the New York Power System, 1973-1975

	Capability, MWe	Peak Load, MWe	Margin, MWe	Percent Reserve	Contingency, MWe	Resulting Margin, MWe	Resulting Percent Reserve	Percent Reserve with Allowance for Operating Unavailability[d]
1973								
S	27,490	20,840	6,650	31.9	- 821[a]	5,829	28.0	18.4
W	28,404	19,790	8,614	43.5	- 821[a]	7,793	39.4	29.3
1974								
S	29,037	22,290	6,747	30.3	- 2,586[a,b,c]	4,161	18.7	9.7
W	31,850	21,000	10,850	51.7	- 2,586[a,b,c]	8,264	39.4	29.8
1975								
S	30,733	23,570	7,163	30.4	- 1,765[b,c]	5,398	22.9	14.4
W	31,679	22,180	9,499	42.8	- 1,765[b,c]	7,734	34.9	25.9

[a]Delay of FitzPatrick (821 MWe).
[b]Delay of Indian Point No. 3 (965 MWe).
[c]Delay of Astoria No. 6 (800 MWe).
[d]Assuming that 2,000 MWe of generating capacity remains unavailable each year.

given day during peak summer periods.[11] In the May 10, 1972 FPC estimate[9] (see Section 8.1.3), an allowance of approximately 2100 MWe was made for unavailable generating capacity in the New York Power Pool as of June 1, 1972. If 2000 MWe or more of generating capacity remains unavailable during 1973, 1974, and 1975, reserve margins are expected to fall below the FPC's recommended margin of 20% during peak summer periods as a result of each of the contingencies shown in Table 8.6.

8.1.5 Conclusion

Additional generating capacity will be needed in New York State to meet the projected demand for power from 1972 through 1980 and to permit the retirement of old, unreliable generating units. Base load capacity of the FitzPatrick Plant will be needed as part of this expansion and modernization program. Capacity is expected to exceed peak load by the narrowest margin during the summer of 1974; therefore, the supply situation could be improved markedly if the FitzPatrick Plant is in operation before July 1974.

8.2 ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

The following are the major impacts of the construction and operation of the Plant as it is currently designed.

8.2.1 Land Effects

Construction activities have disturbed about 100 acres of the 702 acre site. The remainder of the site will be left in the original state, predominantly abandoned farmland. Clearing of the transmission line corridor has involved the removal of vegetation along the 70-mile right-of-way. As a result of this clearing some wildlife in the area has been lost or displaced. However, recolonization will occur in the new habitat on completion of construction activities.

Of the 1273 acres of land required for the transmission line, approximately 29% is agricultural land, 63% is forest and about 8% is wetlands. The only land removed from multiple use is land occupied by the transmission towers.

Construction of the transmission line has resulted in several instances which require restoration. These occur at a few stream and road crossings and hilly areas (see Section 4.1.2).

8.2.2 Aquatic Effects

Dredging activities within the lake and on the shore reduced or eliminated benthic organisms and displaced the fauna in the area. However, since the disturbed area was small and the benthic populations were low because of heavy wave activity, the effects of construction on the pre-construction aquatic communities were minimal.

The entrapment of fishes in the intake structure and their subsequent impingement on the traveling screens will occur. The Applicant has not presented sufficient evidence to demonstrate that the FitzPatrick intake precludes the possibility of substantial fish kills due to impingement at the intake structures. Fish kills at FitzPatrick when added to the fish killed at the Nine Mile Point, Unit 1 may adversely affect the fish population in the Nine Mile Point area. The Applicant will be required to sample and monitor the intake structures at FitzPatrick and Nine Mile Point, Unit 1 and should the fish kill prove to be a serious problem, the Applicant will be required to prepare, submit for the Staff's review, and implement necessary modifications to alleviate the problem.

Because of a high ΔT (31.5°F) and a residence time of over nine minutes duration in the heated water, small fish and fish larvae are not expected to survive passage through the Plant and high mortality of zooplankton is expected in summer. Considering the small fraction of the lake water in the vicinity of the site to be used by the two plants, the impact of entrainment will not be measurable in the area even if 100% mortality of entrained organisms is assumed. This assessment, however, is not applicable to entrainable forms of fish life which do not have the short generation time like the plankton.

Due to rapid dissipation of heat, no significant deleterious effects on the biota are expected from the thermal discharge. Some small fish may travel into the heated effluent and die, but their number will be relatively small. No shifts in algae populations from abundance of diatoms and green algae to blue-green algae are expected.

8.2.3 Radiological Effects

Based on normal operation of the FitzPatrick and Nine Mile Point, Unit 1 Plants, the estimated radioactive releases at these Plants could result in total body doses to individuals of 8.3 mrem/yr near the site boundary. The total man-rem dose from all effluent pathways, received by the approximately 1,000,000 persons who will live within a fifty mile radius of the FitzPatrick and Nine Mile Point Unit 1 plants would be

about 56 man-rem. By comparison, an annual total of about 125,000 man-rem is delivered to the same population as a result of the average natural radiation background. The FitzPatrick Plant will be a minor contributor to the total radiation dose that persons living in the area normally receive. Fluctuations in the natural background dose may be expected to exceed the small dose increment contributed by the operations of FitzPatrick and Nine Mile Point Unit 1 plants.

Transportation to and from the Plant of nonirradiated and irradiated fuel and solid radioactive wastes which are packaged and shipped in federally approved containers and shielded casks will be subject to both the Commission's regulations in 10 CFR 70 and 71 and the Department of Transportations (DOT) regulations in 49 CFR 170-179. The probability of accidental release of any radioactivity during transport is sufficiently small, considering the form of the transported material and its packaging, that the likelihood of significant radiation exposure is remote. With use of proper containers, continued surveillance and testing of packages, and conservative design of containers, the environmental risk is small.

The potential exposures to the population from postulated accidents during operation of the Plant will depend on the type and magnitude of the accident. As indicated in Section 7.1, the different types of accidents when multiplied by their respective probabilities of occurrence, result in a very small annual radiation exposure risk to the population. In fact, the potential exposure from all the postulated accidents is well within the naturally occurring variations in the background radiation. From the results of the realistic analysis it is concluded that the environmental risks due to postulated accidents involving abnormal releases of radioactivity during operation of FitzPatrick Plant are exceedingly small.

8.3 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Land use in the vicinity of the site is becoming strongly committed for power production. The area is neither particularly suitable for recreational activities nor for farming. The site's most recent use was that of an artillery range. Thus, a power plant will not interfere with existing land use.

The short term use of the site as a power plant would not restrict the long term productivity, since after the projected 40 year operating life of the Plant, most of the 22 acres which now are occupied by the Plant's buildings could be restored to their original condition.

The discharge of heat and chemicals to the lake has been considered in Section 5.4, where it was concluded that the incremental discharge of chemicals and heat is not expected to have an overall adverse effect on the biota. A variety of environmental monitoring methods will be utilized to detect and evaluate any radiological, chemical, or thermal impact. The aim of this monitoring program is to ensure that the construction and operation of the Plant will not jeopardize the long-term productivity of the environment.

No significant commitment of water for consumption or use will have been made, since in the foreseeable future Lake Ontario will continue to be seasonally renewed. No deterioration of water quality is anticipated to occur due to the Plant effluents.

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

The Commission's current regulations contemplate detailed consideration of decommissioning near the end of a reactor's useful life. The licensee initiates such considerations by preparing a proposed decommissioning plan which will be submitted to the AEC for review. The licensee will be required to comply with Commission regulations then in effect and decommissioning of the facility may not commence without authorization from the AEC. The Applicant has outlined a basis for costs estimates.[12]

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

There are several alternatives which can be and have been used in the decommissioning of reactors: (1) Remove the fuel (possibly followed by decontamination procedures); seal and cap the pipes; and establish an exclusion area around the facility. The Piqua decommissioning operation was typical of this approach. (2) In addition to the steps

outlined in (1), remove the superstructure and encase in concrete all radioactive portions which remain above ground. The Hallam decommissioning operation was of this type. (3) Remove the fuel, all superstructure, the reactor vessel and all contaminated equipment and facilities, and finally fill all cavities with clean rubble topped with earth to grade level. This last procedure is being applied in decommissioning the Elk River Reactor. Alternative decommissioning procedures (1) and (2) would require long-term surveillance of the reactor site. After a final check to assure that all reactor-produced radioactivity has been removed, alternative (3) would not require any subsequent surveillance. Possible effects of erosion or flooding will be included in these considerations.

The Applicant's plan is of Type 1, as described above. The estimated cost in 1972 dollars is $7 million plus $150,000 annually for perpetual inspection, maintenance, and 24-hour surveillance. Capitalizing the continuing costs at an assumed 6% discount rate leads to an equivalent total cost of $9.5 million.

For Type 3 decommissioning of the Plant, the Staff estimates the cost at $30 million (1972 dollars). This figure is based on adjustment to a single unit of the estimate[13] prepared by the Staff for the Consumers Power Company Midland Plants Units 1 and 2. The Midland estimate was made by careful scaling of the detailed estimates for the Elk River Reactor.

On a scale of time reaching into the future through several generations, the life span of the Plant would be considered a short-term use of the natural resources of land and water. The resource which will have been dedicated exclusively to the production of electrical power during the 40 years anticipated operating life span of the Plant will be the land itself.

In conclusion, the benefits derived from the Plant in serving the electrical needs of the State outweigh the short-term uses of the environment in the vicinity of the Plant.

8.4 IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS OF RESOURCES

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

Major resources to be committed irreversibly and irretrievably due to the operation of the FitzPatrick Plant are essentially the land (during the life of the Plant) and the uranium consumed by the reactor. Only that portion of the nuclear fuel which is burned up or not recovered in reprocessing is irretrievably lost to other uses. This will amount to approximately 19 metric tons of uranium 235 assuming a 40-year life-time for the Plant. Most other resources are either left undisturbed, or committed only temporarily as during construction or during the life of the FitzPatrick Plant, and are not irreversibly or irretrievably lost.

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

The use of the environment (air, water, land) by the Plant does not represent significant irreversible or irretrievable resource commitments, but rather a relatively short-term investment. The impacts of construction and the probable impacts of operation of the Plant have been presented in Sections 4 and 5. In essence, no significant short-term damage or loss to the biota of the region has occurred or is anticipated. Should an unanticipated significant detrimental effect to any of the biotic communities appear, the monitoring programs will be designed to detect it, and corrective measures would then be taken by the Applicant.

The Staff concludes that the irreversible and irretrievable commitments are appropriate for the benefits to be gained.

References

1. The Power Authority Act of the New York State Legislature, L.1939, c. 870, eff. June 15, 1939.

2. "The 1970 National Power Survey," Federal Power Commission, Washington, D. C., Part II.

3. "Load and Capacity Report," Northeast Power Coordinating Council, Task Force on Load and Capacity, March 1972.

4. "1971 Statistical Abstract of the United States," U. S. Department of Commerce, Bureau of the Census, Washington, D. C.

5. Supplement No. 3 of the "Environmental Report for the James A. FitzPatrick Nuclear Power Plant," AEC Docket No. 50-333, Power Authority of the State of New York, August 1972.

6. Supplement No. 2 of the "Environmental Report for the James A. FitzPatrick Nuclear Power Plant," AEC Docket No. 50-333, Power Authority of the State of New York, May 1972.

7. Letter from John N. Nassikas, Chairman of the Federal Power Commission, to Glenn T. Seaborg, Chairman of the Atomic Energy Commission, September 24, 1970.

8. Northeast Power Coordinating Council, Basic Criteria for Design and Operation of Interconnected Power Systems. Adopted by members September 20, 1967 and revised July 31, 1970.

9. Letter from T. A. Phillips, Federal Power Commission, to L. R. Rogers, Atomic Energy Commission, May 10, 1972.

10. The New York Power System Generation and Transmission Plans, 1971-1980; Report of the Power Division, New York State Department of Public Service, Albany, New York, December 1971.

11. Comments of the New York State Department of Environmental Conservation on the Draft Detailed Environmental Statement of the Indian Point Nuclear Generating Plant, Unit No. 2, June 1, 1972.

12. Amendment No. 12 to Amended and Substituted Application for Licenses, Power Authority of the State of New York, Docket No. 50-333.

13. Transcript of the ASLB Hearing, June 12, 1972, In the Matter of Consumers Power Company (Midland Plant Units 1 and 2) Docket Nos. 50-329 and 50-330, pp. 7822-7836.

9. ALTERNATIVE ENERGY SOURCES AND SITES

The need for additional power within the State of New York is considered in detail in Section 8.1. It is shown there that the 821 MWe expected from the FitzPatrick Plant is an important element in the program of the New York Power Pool (NYPP), which is to add 1000 to 2000 MWe each year through 1980 (at least) in order to meet the growing demand for power within the State and to improve reliability. Three possible alternative sources of power are considered here:

1. The purchase of power from companies in neighboring states;

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

3. The construction of a non-nuclear plant at the Plant site.

Acceptance of any one of these alternatives would imply that the existing Plant should be abandoned. In that event, little of the sunk economic costs (money already spent or irrevocably committed) could be recovered. The Staff estimates the loss which would be incurred by abandonment of the Plant as of year-end 1972 at about $250 million. Similarly, most of the environmental impacts associated with construction (but not operation) of the Plant have already occurred and are sunk.

9.1 PURCHASE OF POWER

Because the neighboring power pools, the New England Power Pool and the Pennsylvania-Jersey-Maryland Interconnection, are facing shortages of power and needs for augmented generating capacity similar to NYPP, the possibility of purchasing substantial summer-peak power is limited to the Ontario Hydro and Quebec Power Systems. Since the Canadian systems have loads which are predominantly winter-peaking, several hundred additional megawatts of summer power may be available. At present, however, the necessary transmission capability is not available either within NYPP or in the New York/Ontario interconnections. New transmission facilities are under consideration by the three systems but their achievement is not expected for several years. In any case, the projected annual increase in summer peak load for NYPP, according to Table 8.2 and 8.3, exceeds 1200 MWe for each year through 1981 so that the purchase of as much as 1000 MWe would postpone the need for new capacity by no more than a year.

The Staff, therefore, concludes that the purchase of power is not a reasonable alternative to the completion and operation of the Plant.

9.2 ALTERNATIVE SITES

The Oswego County lakeside site on which the Plant is being constructed was acquired by the Applicant from Niagara Mohawk Power Corporation, which operates the Nine Mile Point Nuclear Station, Unit 1, 3000 feet to the west. In the Applicant's view, the merits of the site were sufficiently clear so that no extensive consideration of other possible sites was justified (see Section 2.1). In its Environmental Report, the Applicant states[1]

> "The site chosen is particularly suitable for a Power Authority base-load plant on both an environmental and a system requirement basis. The site was already devoted to power use and the only industrial sites in the vicinity are nearby. Atmospheric and geological conditions are quite suitable for a nuclear plant. The proximity of a large body of cold water permits economical cooling of the plant with no adverse environmental effect. The only comparable body of fresh water which the Power Authority might have utilized is Lake Erie, but this is much farther from the loads that are to be supplied by this plant.
>
> If the plant were located farther west or north on the shore of Lake Ontario it would also be farther from load centers. The present site is virtually at the east end of the lake. Any attempt to locate it farther east would bring it closer to the Selkirk Shores State Park and to dune areas near the park which have great potential for future recreational development. The actual plant site has much less recreational potential.
>
> The plant is near the Power Authority's cross-state 345 kV transmission lines which extend from Niagara Falls to Utica and is approximately equi-distant from the Power Authority's existing hydroelectric plants and its Blenheim-Gilboa pumped storage plant now under construction. This makes possible an economic, efficient and reliable transmission network connecting Power Authority's plants and load centers where the power generated is most needed."

In its consideration of alternative sites, the Staff considered that the environmental impacts expected from the Plant would occur in some degree at any other site. In many respects, any alternative site would have similar characteristics to the reference (Nine Mile Point) site.

For example, any type of base load power plant which could be built at present in New York would require either large flows of water for once-through cooling (the order of 500,000 gpm for an 872-MWe nuclear plant) or a smaller but substantial flow of makeup water for closed-cycle evaporative cooling (the order of 10,000 gpm for an 872-MWe nuclear plant). A hydroelectric plant or the use of dry cooling towers would be exceptions to the preceding statement but each is ruled out for reasons discussed in Section 9.3 (hydro plants) and 10.1 (dry towers). Therefore, any usable site would have to be situated close to at least a fairly large lake or river if closed-cycle cooling is used or to a large lake or river if once-through cooling is used.

Had the Applicant considered alternative sites more deeply in 1967 and 1968, almost certainly only Lake Ontario sites would have been considered because of the economic advantages of once-through cooling (discussed in Section 10.1). As discussed in Sections 4 and 5, the environmental impacts for the reference site are relatively small because the land is not uniquely valuable in any identified sense and large amounts of roughly equivalent land in the region remain unused by man. Similarly, damage to the relatively sparse lake fauna near the Plant associated with water intake and discharge has less impact on overall Lake Ontario ecology than would be the case at another site where lake biota may be more abundant, for example in a shallow bay area. The Staff judges that no other Lake Ontario site would have predictable overall environmental impact sufficiently lower than that of the reference site; i.e., the uncertainty in the prediction of comparative impacts would exceed any apparent difference between the reference site and the apparently best alternative site.

Had the design included some form of closed-cycle cooling, such as cooling towers or a cooling pond, the reduced water requirement would have allowed consideration of many alternative sites remote from Lake Ontario. However, the terrestrial environmental impacts for the reference site are so small that the comparative overall impact of the hypothetical best alternative site would be dominated by the impact on aquatic biota. The latter impact will tend to be greater in importance (for fixed plant

throughput and evaporative consumption of water) for smaller bodies of water. It is therefore improbable that any site (in New York) not on Lake Ontario would be preferable to the reference site with respect to impact on aquatic life for either closed-cycle or once-through cooling of a large power plant.

Since the terrestrial impacts expected from the construction and operation of a large power plant at the reference site are very small, and since the aquatic impacts expected would be worse or no better at any other New York site, the Staff concludes that the reference site is a close approximation to the hypothetical best site which might be found by extended investigation.

9.3 ALTERNATIVE MEANS OF POWER GENERATION

As mentioned in Section 8.2, the Applicant is authorized under New York law to build and operate only hydroelectric and nuclear plants. Although the Applicant sells power directly to some large industrial consumers (19 percent of its energy output in 1971), most of its power is sold to utility companies and cooperatives for resale. Since no substantial conventional hydroelectric sites remain undeveloped within New York,[2] the only type of baseload generating plant which the Applicant has legal authority to construct and operate is a nuclear plant. Therefore, consideration of alternative types of plants carries the implication of different ownership, presumably by an investor-owned power company.

The only well-developed and economical prime movers for electrical generation at present are water, gas, and steam-driven turbines. New conventional hydro (water-driven) plants in New York are ruled out because all suitable sites are in use.

Pumped storage hydro plants are used in conjunction with a base-load plant to store energy generated during off-peak hours and return it during hours of peak load or when a base-load generator fails. Their function is to "flatten peaks" at the expense of some additional total energy generation, since the overall efficiency of the storage and return process is only about two thirds of the efficiency of the prime mover.

Very good reliability and short startup times make pumped-storage plants valuable for reserve and peaking capacity. As shown in Table 9-1, the

costs are particularly favorable when nuclear baseload capacity is available for off-peak pumping power. However, pumped-storage capacity is in no sense a substitute for baseload capacity, but rather a valuable adjunct.

Despite the relatively low capital cost, the very high fuel cost of combustion (gas) turbines (see Table 9.1) makes their use for base-load power generation expensive. Based on the data of Table 9.1 and assuming annual fixed costs at 18 percent of capital costs, for base-load operation at 80 percent of rated capacity, total generating costs in mills/kWh are:

nuclear	11.8
oil-fired	13.4
combustion turbine	17.3,

indicating a cost penalty in the range 30 to 45% for combustion turbines as base-load prime movers.

Moreover, combustion turbines (which are very similar to aircraft jet engines) are expected to offer formidable maintenance difficulties in base-load service. Many combustion-turbine plants have been built for peaking and reserve capacity in recent years but such plants are not considered as a practical alternative to steam plants for base-load generation.

Because of relatively low capital costs and short startup times, both combustion-turbine and pumped-storage plants are valuable for reserve and peaking capacity.

The heat input required for steam-driven plants may be obtained either from the combustion of fossil fuel or from nuclear fission. Natural gas, by far the cleanest-burning of fossil fuels, is not available for generating plants on the Eastern Seaboard. Uncertainty as to the cost and feasibility of in-plant sulfur dioxide removal as well as the high cost and uncertain supply of low-sulfur coal in New York and New England has resulted in the virtual exclusion from consideration of coal as a fuel for new plants in the Northeast. Emission of dust, sulfur dioxide, and nitrogen oxides by new plants are limited to levels well below those typical of existing coal-fired plants.[3] Consequently almost all new plants in this region are either nuclear or oil-fired.

TABLE 9.1 New York Generating-Plant Costs for the Mid 1970's

Unit Type	Unit Size	Capital Cost, dollar/kW	Production Cost,[a] mills/kWh
Nuclear	800 MW	$350	2.8
Fossil-oil[b]	800 MW	$250	7.0
Gas turbines[c]	800 MW	$120	14.2
Pumped storage[d]	800 MW	$175	10.0 (Pumped with Fossil) 3.5 (Pumped with Nuclear)

From New York State Department of Public Service, "The New York Power System Generation and Transmission Plans 1971-1980, Table VII, p. 31.

[a]Includes fuel, operating labor and maintenance.

[b]Burning low sulfur oil costing 0.70/million Btu and with a heat rate of 9,300 Btu/kWh.

[c]Sixteen 50-MW gas turbines burning No. 2 distillate fuel costing 0.90/million Btu and with a heat rate of 13,000 Btu/kWh.

[d]Four 200-MW units - fuel cost based on 3:2 power ratio between base loaded unit providing pumping power during off peak hours and pumped storage output. A heat rate of 9,300 Btu/kWh was assumed for the pumping unit using oil costing 0.70/million Btu.

Modern fossil-fueled plants operate at higher thermal efficiency than most current nuclear plants* and thus release less waste heat to the environment. Because some of the heat is discharged with other combustion products through the stack directly to the atmosphere, the heat release to cooling water for an oil-fired plant is further reduced to about 70% of that for a nuclear plant of the same electrical capacity. Since very little natural radioactivity occurs in fuel oils, the release of radioactivity by oil-fired plants is almost nil. However, the release of radioactivity from modern nuclear plants is also very small and is practically undetectable outside of the exclusion area.

Substantial quantities of sulfur dioxide and nitrogen oxides are emitted by oil-fired plants and contribute to air pollution. An indirect environmental impact associated with the burning of oil is the need for transportation and storage of very large quantities of fuel, about 9 million barrels per year for a plant with output equal to that of the proposed FitzPatrick Plant. The environmental impacts expected from the Plant and from an oil-fired plant of equal output are compared in Table 9.2. Emissions from oil-fired plants are assumed to just meet the applicable EPA requirements.[6]

The estimated economic costs for the reference plant (the FitzPatrick Plant) and for an alternative oil-fired plant of the same output are given in Table 9.3. Costs for the reference plant are based on statements by the Applicant,[4] while those for the alternative plant are taken from a study by the New York State Department of Public Service.[5]

The Applicant's estimate of total construction cost is $251.4 million. This figure includes basic construction ($211.5 million), interest cost to completion, financing expense, training of personnel, spare parts, and other costs necessary to the achievement of an operating plant.

No detailed study has been made of the cost of abandonment. Since construction is near completion (85 percent) with all major components in place, the Staff assumes that contract termination and other costs associated with the hypothesized abandonment would roughly cancel what saving might result if the remaining construction work were not carried out, i.e., the entire $251.4 million is considered sunk.

Total initial fuel costs are $44 million, according to the Applicant, of which $39.1 million is the direct cost. The remainder ($4.9 million) includes interest to initial operation and financing costs as well as consulting services and other technical costs. This $4.9 million is also

*The high-temperature gas-cooled reactor (HTGR) operates at about the same efficiency as fossil-fired plants. A few HTGRs are in use or under construction.

TABLE 9.2 Comparative Environmental Impacts for Reference and Alternate Plants

Impact	821-MWe Reference (nuclear) Plant	821-MWe Alternative (oil-fired) Plant
Land use	100 acres (without exclusion area)	Similar to reference but exclusion area not required
Releases to air:[a]		
Radioactivity	51 curies/day	None
Dust	None	7 tons/day
Sulfur dioxide	None	52 tons/day
Nitrogen oxide	None	22 tons/day
Release to water:[a]		
Heat	110 billion Btu/day	82 billion Btu/day
Radioactivity:		
Tritium	51 millicuries/day	None
Other	11 millicuries/day	None
Chemical:		
Total dissolved solids	615 pounds/day[b]	Similar to reference plant
Water consumed (evaporated)	10 million gallons/day	7 million gallons/day
Fuel:		
Consumed[a]	450 kilograms/year (U-235)[c]	10 million barrels/year
Transported	5 truck loads/year	10 million barrels/year
Waste:	70 truck loads/year	Small
Esthetic	Inoffensive	Similar to reference Plant except for large tank farm, 600-foot stack

[a]Based on 80% capacity factor.

[b]About 140 pounds/day of the total is salts already present in the intake lake water.

[c]Partly offset by production of 137 kilograms/year of plutonium.

TABLE 9.3. Comparative Economic Costs for Reference and Alternative Plants (in millions of dollars).

	821-MWe Reference (nuclear) Plant First Operation October 1, 1973			821-MWe Alternative (oil-fired) Plant First Operation October 1, 1977		
	When Incurred	Present Worth (6 percent)	Incremental Subtotal (Present worth)	When Incurred	Incremental Subtotal (Present Worth) (6 percent)	(8.75 percent)
Construction Cost:						
Total		251.4		205		
Sunk		251.4		0		
Incremental		0		205		
Salvage allowance		0		-60		
Net			0	145	114	102
Initial Fuel Cost:						
Total		44				
Sunk		4.9				
Incremental		39	39			
Allowance for loss of power		0	0		143	134
Decommissioning allowance	30	5	5	5	1	1
Annual operating cost:						
Fuel	6.5[a]			39		
Other	3.5			3		
Total	10.0			42		
Capitalized operating cost:[b]		120	120		584	441
Life of plant cost:						
Total		420				
Incremental		164			842	678
Annualized equivalent during operation of life-of-plant cost:						
Total	30.2					
Incremental	11.8			66(6%), 74(8.75%)		

[a] after first three years

[b] adjusted for lower fuel cost during first three years

considered sunk. About $19.1 million (present worth at time of first operation, 6% discount rate) of the total may be regarded as prepayment of fuel costs during early operation; i.e., replacement fuel costs during the first three years of operation will be substantially less than in later years. In Table 9.3, the total initial fuel cost is shown as a capital expenditure but the capitalized operating cost is reduced by $19.1 million to reflect the prepayment.

In order to achieve comparability among costs which would be incurred at different times, all costs are reduced to present worth* at the assumed time of first operation, October 1973. The discount rate used is 6.0 percent which is representative of current interest rates for tax-exempt bonds. The Applicant's construction costs include "interest during construction" so no present-worth adjustment need be made. To compute the present worth of the stream of payments for fuel and other operation costs, a life of 30 years is postulated. Because the Applicant is authorized by law to construct and operate only hydro or nuclear plants, if the alternative plant were actually built, it probably would be by an investor-owned power company for which a discount rate of 8.75 percent is more appropriate. In order to give a cost comparison between the reference and alternative plants which is not distorted by different rates and also to show the effect of the probable higher rate for the alternative plant, present worths based on both rates are given.

In order to assess the comparative costs of completing the reference plant or constructing the alternative coal-fired plant, only the costs incurred after the hypothetical time of decision should be considered. The costs which would be incurred after the assumed decision point, January 1, 1973, are labeled incremental costs in the table.

Since the alternative plant probably could not be operational until October 1977, the cost of providing power for four years from other sources should be charged against it. An estimated rate of 8 mills per kilowatt hour is used. However, the postulated combination of four years purchase and 30 years plant life provides power for 34 years. To correct this, the value of the last 4 years of power (discounted 30 years) is subtracted from the cost. In the hypothetical case that the reference plant were abandoned and the alternative plant constructed at the same site, an appreciable cost saving would result and is shown in Table 9.3 as a "salvage allowance". Similarly, the eventual decommissioning of the plant and restoration of the site to other use would be

*The present worth at a given time of a future payment is equal to the sum which, drawing interest from the given time at the assumed discount rate, would just suffice to meet the payment when due.

more costly for the nuclear plant as reflected by the entries called "decommissioning allowance". The Staff estimates of these allowances are very rough since the postulated events have seldom occurred and because the future standards applicable to decommissioning are unknown. (Decommissioning is discussed in Section 8.3). However, because of the applicable discount factor (0.1653), decommissioning costs have relatively little effect on the present worth of plant costs.

From Table 9.3, at the 8.75 percent discount rate (which gives the smaller penalty) the estimated incremental cost penalty (present worth) attached to the alternative plant is 514 million or 122 percent of the total life-of-plant cost of the reference plant. On the 8.75 percent incremental analyzed basis, the penalty is about $62 million per year during the postulated 30 years of operation or about 120 percent of the total annualized cost for the reference plant.

The oil-fired plant would discharge less heat to Lake Ontario and less radioactivity to the atmosphere than the reference plant. However, as assessed in Sections 5 and 8, the impacts of these discharges are small for the reference plant. The Staff judgment is that their effects are outweighed by the air pollution associated with the oil-fired plant; therefore, on balance, the reference plant is the better with respect to environmental impact. Considering the loss of reliability to the New York Power Pool that would be caused by a four-year delay and the large economic penalty to the Applicant, which would ultimately be paid by the public, it is concluded that the reference plant is the preferred alternative.

9.4 SUMMARY

Three alternatives to the completion and operation of the proposed Plant have been considered. Purchase of power is not a reasonable alternative action because all of the possible vendors of power face the same need for new generating capacity as the Applicant and the New York Power Pool. The construction of an equivalent plant at a different site offers no promise of significant environmental gains to balance either the large economic penalty or the threatened delay to a reliable supply of electric power. The most reasonable alternative means of power generation, an oil-fired steam plant, would impose more serious environmental costs than the proposed plant as well as a severe economic penalty and a loss of reliability for several years within the New York Power Pool. Therefore, completion and operation of the FitzPatrick Plant is the recommended action. Possible modifications of the proposed design are considered in the following section.

References

1. "Environmental Report on the James A. FitzPatrick Nuclear Power Plant," Power Authority of the State of New York, pp. 67-68. Docket No. 50-333.

2. "The 1970 National Power Survey," Federal Power Commission, p. II-1-95.

3. "The New York Power System Generation and Transmission Plants 1971-1980," New York State Dept. of Public Service, p. 29.

4. "Environmental Report on the James A. FitzPatrick Nuclear Power Plant," Supplement 2 "Benefit/Cost Analysis" May 1972, pp. 4-5, Docket No. 50-333.

5. Ref. 3, pp. 27-25.

6. Environmental Protection Agency Regulation on Standards of Performance for New Stationary Sources (40 CFR 60; 36 F.R. 24876; December 23, 1971).

10. PLANT DESIGN ALTERNATIVES

This section considers possible modifications to the Applicant's system which, if implemented, might change significantly the balance between economic and environmental costs.

10.1 COOLING SYSTEM

Modern thermal electric generating plants (fossil-fueled or nuclear) discharge from 5100 to 7000 Btu waste heat for each kilowatt hour of electrical energy sold, the higher figure being typical of current nuclear plants.[1] The established methods of large-scale cooling involve either (a) the transfer of heat to the atmosphere by direct evaporation of water in "wet" cooling towers, spray ponds, or canals, or (b) the discharge of heat to a body of water. Even in the latter the heat is eventually transferred to the atmosphere. Depending on climatic conditions, this heat is released chiefly by evaporation or by radiation and convection. Another means of heat transfer, the "dry" cooling tower, serves to transfer heat directly to the atmosphere without evaporation of a coolant (in the same manner as an automobile radiator). Dry towers have been used for relatively small thermal electric plants in arid regions, particularly abroad, but the high coolant-return temperature in hot weather results in a condenser back-pressure which is too high for any large (over 300-MWe) steam turbine currently available.[2] Thus dry cooling towers are not considered a practical alternative for this Plant.

The Applicant's choice of a cooling system is a once-through circulating water system, in which the waste heat is discharged to Lake Ontario. This system minimizes the environmental effects of the heat dissipation on the land and air, but it maximizes the effects on Lake Ontario. The alternative cooling systems considered here involve the use of a recirculating water stream, with the heat discharged by an evaporative cooling tower (either natural draft or forced-draft), a cooling pond, or spray pond. Since the once-through cooling system has essentially been completed, any such alternative would require backfitting, which would add to the cost of the Plant. For purposes of comparison, the Applicant's currently installed, once-through system is called the "reference system."

10.1.1 The Reference System

In the once-through plant, virtually the entire heat load, 5.7×10^9 Btu/hr, is discharged into Lake Ontario in the form of a stream of heated water from the condenser. Among the advantages of this system are the following: a) Installation and operating costs are lower than those of any known alternative; b) No modification or control of the chemistry of

the cooling water is required; c) This system provides the maximum efficiency because the coolant will enter the condenser at a temperature lower than that of any of the alternatives. This leads to the lowest condensate pressure and the most efficient turbine operation; d) The full flow of the once-through cooling stream provides a means of discarding chemicals from demineralizer regeneration, laboratory wastes, and radionuclides, with minimum impact because of the large dilution before discharge.

The known and predicted impacts of the reference system, particularly the adverse aspects, are evaluated in detail in Section 5.

10.1.2 Possible Alternatives

The alternative systems considered here share the common feature of having a recirculating cooling water circuit. Such a circuit would greatly reduce or eliminate the discharge of heat to Lake Ontario. Since only about 2-1/2% of the recirculating cooling water would be discharged as blowdown, only 2-1/2% or less (depending on the temperature of the blowdown) of the total heat would be dissipated to the lake. There would also be a reduction in the damage to organisms in the lake water diverted through the cooling system since makeup water required for the recirculating system is about 6% of the flow in the once-through system.

A number of disadvantages are also inherent in the recirculating systems. Because of evaporation in the closed system, the dissolved solids content of the water increases. The increased concentration of chemicals leads to increased corrosion and the formation of carbonate scales. To control these problems, the water system is refreshed and blown down to limit the total dissolved solids to a level two and a half times that of the makeup water. Although additives are often added to recirculating systems to control scaling and algal growth, the Applicant's preliminary design for an alternative evaporative cooling tower did not include the use of additives to control scaling or algal growth. In the event that scaling became a problem, the Applicant proposed to use a nontoxic nonphosphate inhibitor that would conform to Food and Drug Administration criteria. Algal growths would be controlled, if necessary, by the addition of an algicide in quantities that would conform to New York State Water Quality Standards. Any nonvolatile chemicals added to the cooling tower circuit would slightly increase the level of dissolved solids in the blowdown and would be discharged to the lake.

Evaporation of relatively large quantities of water from a cooling tower leads to the formation of clouds or (infrequently) fog or deposits of ice on nearby ground, depending on climatic conditions. This effect would

be substantially greater than the fogging over the lake that would be caused by the discharge of heated water to the lake in the once-through cooling system. Figure 10.1 provides a graphic comparison of the extent to which condensed water vapor characteristically produces clouds or fog for the two cases. Although the lower photograph shows a cooling pond, the situation would be comparable for a lake with the same air and surface water temperatures. The high visibility of hyperbolic cooling towers is evident; some people object to their use on aesthetic grounds.

Water spray escaping from the top of the tower would fall on the surrounding ground. This "drift" would result in the accumulation of the dissolved solids content of the water droplets on the ground in the vicinity of the cooling tower. Assuming the drift to be 0.005% of the circulating water flow rate (370,000 gpm) the 18.5 gpm of drift would contain 129 lb/day of dissolved solids (concentration 581 ppm). The Applicant estimated that solids deposition rates would be approximately one pound/acre/year at a distance of 1200 feet, the approximate distance from the tower to the closest site boundary. The deposition rate was estimated to decrease to about one half pound/acre/year at a distance of one mile.

These estimates are uncertain, as judged by comparison with deposition rates calculated with detailed models for the Forked River Nuclear Station[3] and the Chalk Point coal power plant.[4] For a drift of 15.3 gpm of 45,000 ppm solution (concentrated sea water), the calculated maximum average deposition rate at Forked River was 3.3 pounds of salt/acre/year, at a position about five miles in the predominant downstream direction. Prorating proportional to drift rate and the dissolved solids content of the water, equivalent maximum deposition rate for the FitzPatrick Plant would be 0.05 lb/acre/yr. The calculated maximum deposition rate for Chalk Point was 36 lb/acre/yr in an annulus 0.9 to 1.4 miles from the tower. Prorating (from 5.2 gpm of 14,000 ppm drift) in the same way, a maximum of 5 lb/acre/yr can be predicted for the FitzPatrick Plant. The factor of one hundred difference in the prorated numbers from the two plants indicates that there is considerable uncertainty in estimated rates of drift deposition.

Even at the largest of the three maximum deposition rates considered, the rate of deposition of salts in cooling tower drift would be only about one-ninth that in normal rainfall, as shown in Table 10.1. Only bicarbonate is indicated to be greater in cooling tower drift than in rainfall, and the estimates for this ion are the least reliable. No adverse impact would be expected from the cooling tower drift, on the basis of the comparison given.

Fig. 10.1

Atmospheric Condensed Moisture at Cooling Towers and at Surface of a Warmed Body of Water. Top - 'Cooling towers at Paradise, Ky., Jan. 28, 1971. Bottom - Cooling pond at Dresden Nuclear Plants 2 and 3, Mar. 5, 1972, air 11.5°F, water 43-50°F.

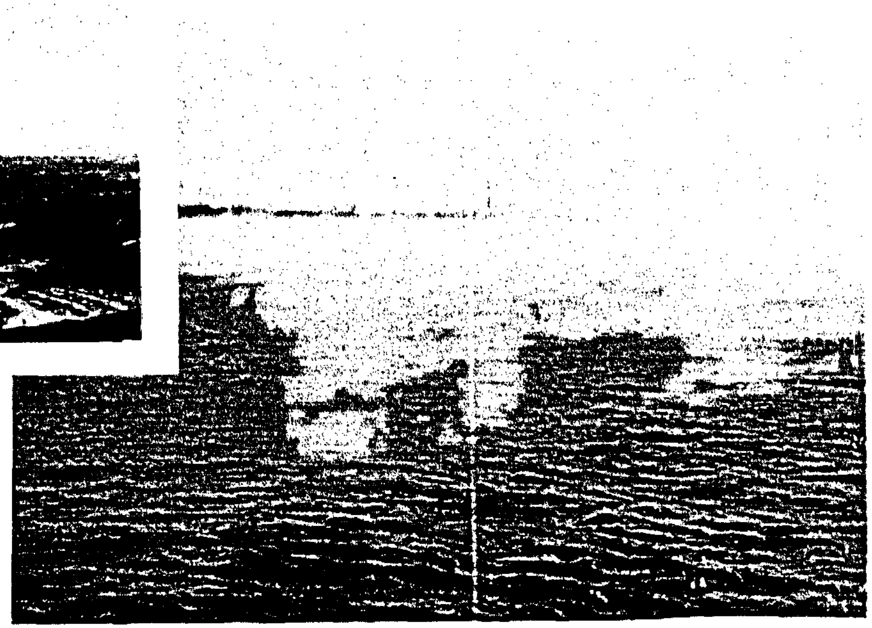


Table 10.1 Estimated Deposition at the FitzPatrick Site from Rainfall and Cooling Tower Drift

	Ions from rainwater				Deposition from cooling tower drift[d]
	Average Concentration		ppm	Deposition rate[c]	
	Wolaver[a]	Carroll[b]	Average	lb/acre-year	lb/acre-year
Ca^{++}	0.62	1.35	0.99	7.5	0.9
Na^{++}	.40	.39	.40	3.0	.3
K^{+}	.24	.16	.20	1.5	.03
NH_4^{+}	.20	.34	.27	2.1[g]	
NO_3^{-}	.40	2.93	1.67	12.7[g]	.01
$SO_4^{=}$	(e)	1.64	1.64	12.5[g]	.6
Cl^{-}	.67	.26	.47	3.6	.6
HCO_3^{-}			.15[f]	1.1	2.3
				44.0	4.8

[a]Calculation from equations of Wolaver[5] for natural sources.

[b]Average for 8 U. S. locations deemed best (of those given by Carroll[6]) to approximate the FitzPatrick site in location and rainfall.

[c]Using 33.6 inches per year average rainfall.[7]

[d]For the 5 lb/acre-year largest estimate of the maximum deposition rate.

[e]Wolaver did not develop an equation for sulfate because of the variability in the quantities of this substance deposited.

[f]Calculated concentration in a H_2O-CO_2 solution at the pH (5.7) quoted by Carroll[2] as in equilibrium with the CO_2 in the atmosphere.

[g]Fried and Broeshart[8] give values for N and S deposition in rain that are in accord with the present values.

The Applicant has made a specific design study of natural and forced-draft cooling towers. In the study a forced-draft tower had the advantage of a smaller size and a lower "approach" (the temperature of the water leaving the tower, in excess of the ambient atmospheric windblown temperature), compared to a natural-draft evaporative cooling tower. Because of the lower approach, the forced-draft tower offers the opportunity for a lower condenser pressure and increased turbine efficiency. The disadvantages are more noise, more fogging, more ground level drift (the Applicant estimated an increase in salt deposition rate at the property boundary by a factor of 200 over that for the natural-draft cooling tower), higher costs, and the loss of output due to the use of power for the blowers. The relative noise levels for the reference plant, natural-draft and forced-draft cooling tower systems are illustrated in Fig. 10.2. The 45 dBA level shown is classed as "quiet," appropriate for offices.[9] Incremental costs developed by the Applicant for the use of a forced-draft cooling tower are given in Table 10.2.

A cooling pond uses the large surface area of a body of stored water to reject heat to the atmosphere by the transfer of sensible and latent heat. The use of such a pond would have the advantages of no noise or aesthetic disturbance. As a disadvantage, it would require the acquisition of an estimated 1070 acres of additional land (see below) for an evaporative surface of about 900 acres. The Applicant presented two conceptual cooling pond systems, the first in the First Supplement to the Environment Report and the second in the Second Supplement to the Environmental Report. In the first concept, the pond was largely located on the currently owned property. Because of the slope of the land, the surface of the water would have been 40 feet above the grade elevation of the plant, and a spillway would have been required to discharge safely the surface storm water that would drain into the pond. Construction of restraining dikes would have required an estimated three million cubic yards of fill (not readily available in the area). Because of the anticipated prohibitive cost (an estimated $36 million for the dikes alone) and concern over the flooding potential of the pond, this concept was abandoned.

In the second concept, the pond was located 5 miles away. Approximately 200,000 cubic yards pervious and impervious fill material would be required to construct restraining dikes for the more nearly level site chosen. The circulating water would have to be pumped a distance of five miles and lifted against a static head of about 160 feet. Rock excavation would be required for three miles if the pipes carrying the water to and from the pond were buried for temperature protection and uniformity. The costs and possible loss of reliability argue against selection of the cooling pond alternative. Incremental costs developed by the Applicant for the cooling pond system are given in Table 10.2.

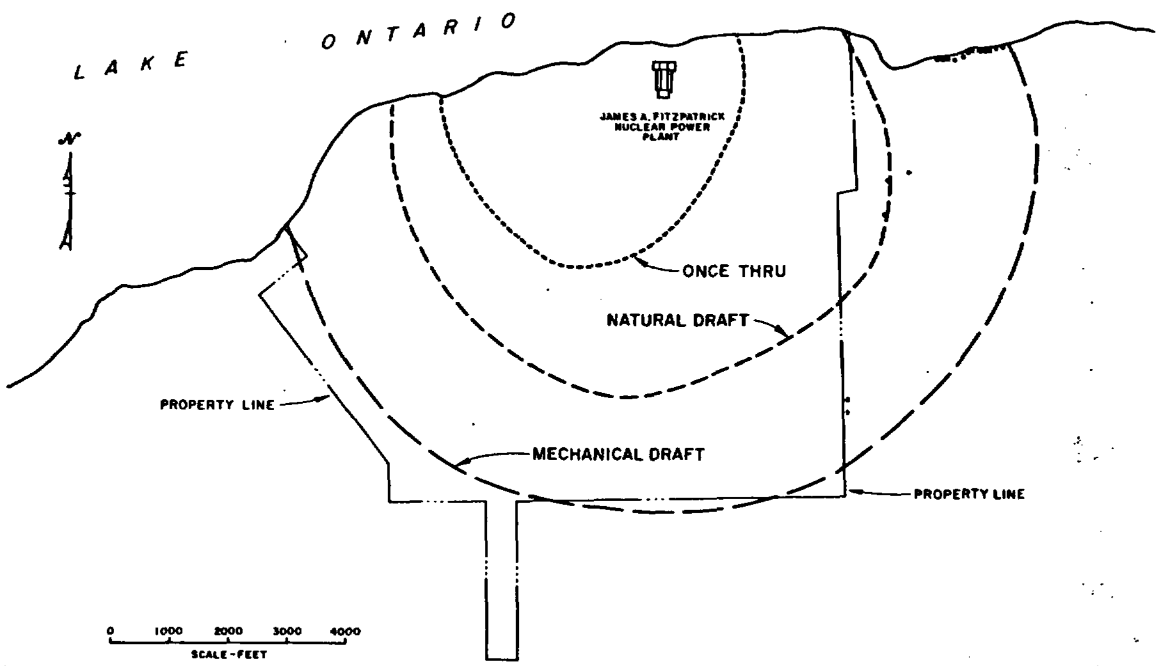


Fig. 10.2. Calculated 45-dBA Sound Level Contours for Alternate Cooling Systems. From Applicant's Environmental Report, Supplement 2.

The final alternative considered was a spray pond system to dissipate the bulk of the waste heat. A pond having one-tenth the area of the cooling pond discussed above would be fitted with spray nozzles which provide extensive aeration; the loss of heat is primarily by evaporation. By virtue of its small size, such a spray pond would probably fit safely on the site, whereas the cooling pond would not. Potential environmental problems related to spray system include drift of water droplets and vapor, fog formation, and icing. Experience with a spray canal at the Dresden Nuclear Station[10] has not been favorable in terms of reliability of operation, a factor which argues against the use of this alternative with the FitzPatrick Plant.

The Applicant did not consider spray ponds extensively because experience is quite limited. Costs were not provided. The Staff has estimated construction and equipment costs by prorating those from the Quad Cities unit.[11] It was assumed that 30% of the costs of the Quad Cities unit was due to preparation of the canal, and that the pond construction costs per acre at the FitzPatrick site would be the same as those for the canal at Quad Cities. In this way, the pond construction cost was estimated to be $13.6 million (0.30 x $30.2 M x 90/60). Costs of equipment and backfitting were assumed proportional to the net electrical output of the plants, in this way estimated to be $10.7 million (0.70 x $30.2 M x 821/1618). Total construction costs were thus $24.3 million. Operating costs were estimated to be equal to those for the other alternatives.

Estimated costs for the four alternative cooling systems considered above, given in Table 10.2, indicate that backfitting and construction of any one would add substantially to the cost of the Plant. The forced-draft cooling tower option would be the least expensive.

Backfitting a cooling tower, or any of the alternative cooling systems would lead to a delay in power production. The extent of the delay would depend upon the system chosen, and on the date on which the choice was made. The Applicant estimates that a natural-draft tower would delay operation by about two years, if selected in 1972. The delay for the other alternatives would be nearly as long.

In view of the lack of significant identified environmental disadvantages of the once-through cooling system and the additional costs that would be incurred by adoption of any of the alternative cooling systems, the reference once-through system is preferred.

TABLE 10.2 Incremental Costs[a] for Alternative Cooling

	Natural-Draft Tower	Forced-Draft Tower	Cooling Pond	Spray Pond
Additional construction, $M	18.1	11.5	70[c]	24.3
Increased annual operating costs, $M	1.5	1.5	1.5	1.5
Capitalization of op. costs, 1975,[b] $M	20.1	20.1	20.1	20.1
Total construction plus capitalized operating costs, $M	38.2	31.6	90.1	44.4
Total, 1973 value, $M	34.0	28.1	80.2	39.5
% Increase in total cost[d]	8.1	6.7	19.0	9.4
Value of energy used annually by alternative, $M	3.552	3.686	not determined but "substantial"	not determined
Capitalization of energy value,[b] 1973 value, $M	42.4	44.0		
% Reduction in energy benefit[e]	2.3	2.4		

[a]For the first three alternatives, costs are from the Applicant; costs for the final alternative were estimated by the Staff.

[b]"Present value" in 1975, calculated for 28 years remaining lifetime at 6% annual cost of capital and present worth value of 13.4062; or value in 1973, 11.00% smaller than 1975 value.

[c]Not including the cost of acquisition of additional land that would be required.

[d]Based on $422 million cost of once-through plant calculated by Staff for Applicant's costs; 6%, 30-yr life used to calculate present value of annual fuel, operation, and maintenance costs.

[e]Based on $1.833 billion total power benefit of once-through plant.

10.2 CHEMICAL DISCHARGE SYSTEM

Lime, ferric sulfate, and chlorine are utilized in the reactor makeup water system for clarification, and sulfuric acid and sodium hydroxide are used to regenerate the ion exchanger resins. The use of these chemicals leads to the discharge of salts to the lake. In addition, the salts originally present in the lake water and removed in the ion exchanger, are discharged back to the lake at the time of regeneration. The total of the dissolved solids (see Table 3.6) discharged, incremental to those already in the circulating water is about 615 lb/day. About 23% of this material originated in the lake water.

As an alternative, the quantity of demineralizer regeneration wastes discharged to the lake could be substantially reduced by employing the Applicant's alternate scheme, illustrated in Fig. 10.3. Before demineralization, lake water is partially purified by passing it through a reverse osmosis unit. In this unit 90% of the dissolved solids are concentrated in a waste stream comprising 20% of the inlet water. The waste stream is added to the Plant circulating water. On the average, this would increase the total dissolved solids in the circulating water effluent by 0.016 ppm, a change of 0.007% in the typical value of about 233 ppm. The total solids added to the lake water in this way would be 123 lb/day, 20% of that added in the reference design. The partially purified water from the reverse osmosis unit is fed to the demineralizer, which would need regeneration once each 11 days. Neutralized regeneration wastes are removed from the water by filtration and evaporation (at the rate of 0.4 gpm) and the solids shipped offsite.

The 80% reduction in the rate of release of regeneration waste chemicals is thus achieved chiefly by not discharging the products of the acid and alkaline resin regeneration chemicals. This reduction is estimated by the Applicant to entail an additional $300,000 direct cost and $2700 annual operating and maintenance costs. The 1973 value of the latter figure, assuming a 6% cost of capital, a 30-year plant life, and a present worth factor of 13.7648 is $37,000. The total 1973 value of the additional costs due to this alternative is thus $337,000.

The Staff believes that the small increase in the chemical content of Lake Ontario water caused by the proposed FitzPatrick Plant will have no measurable effect on the aquatic biota. The 615 lb/day discharge rate from the proposed FitzPatrick reference system is calculated to increase the total dissolved solids content of the 400 cubic miles of water in the lake by only 0.006 ppm, or 0.003%, per century. The Staff therefore believes the institution of an alternative system for removing regeneration chemicals is unnecessary.

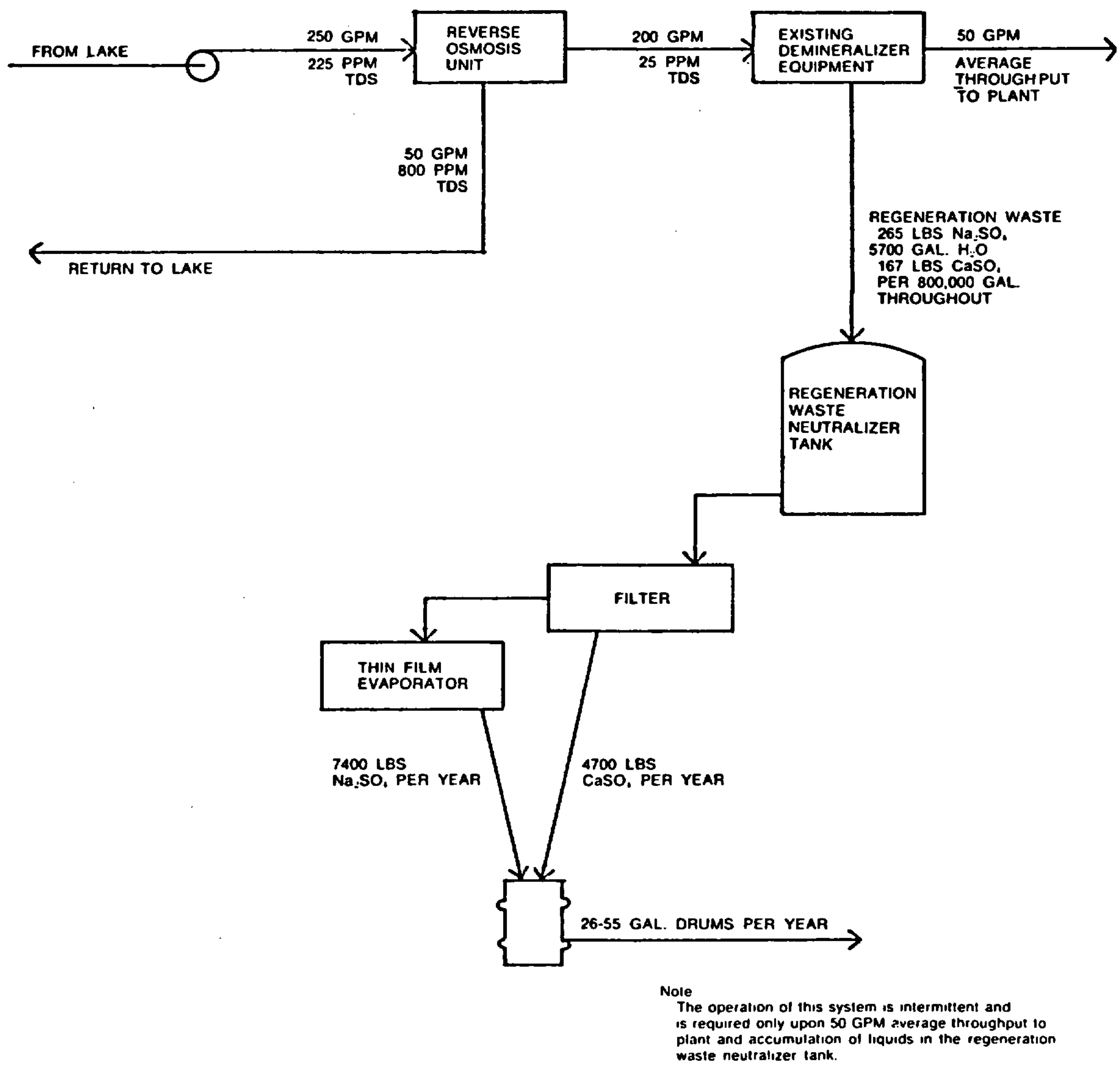


Fig. 10.3. Alternate Water-Treatment Scheme Involving Reverse Osmosis and Evaporation of Regenerative Wastes. From Applicant's Environmental Report, Supplement 2.

No chemicals are discharged as a consequence of regeneration of the condensate demineralizer, acid cleaning of the Plant, or laboratory and decontamination operations, so alternatives are not considered for these operations. Also, no alternatives are considered for the small fractions of a pound per day of phosphate and sulfate discharged from the auxiliary heating boilers on the basis that these quantities of these chemicals are undetectable.

10.3 BIOCIDE SYSTEM

The Plant will use no biocides in its water systems; if it becomes necessary to make special provision for the removal of fouling deposits in the condenser, a mechanical cleaning system will be installed.[12]

10.4 SANITARY WASTE SYSTEM

Plant sanitary wastes are given a two-stage treatment; the effluent is chlorinated and discharged to the lake from a 24-inch storm-water drain line leaving the bank on the edge of the lake. The normal sewage load is expected to be 2100 gallons per day.

An alternative method of waste disposal would be to run a sewer line some 400 feet to discharge the chlorinated sewage into the water discharge tunnel. This would offer the advantage of dilution by an average factor of 2.5×10^5 before contact with the lake. The oxygen demand and toxic chlorinated products would then be so dilute as to have a negligible effect on the local lake water. Since the adverse environmental impact of the present system is considered by the Staff to be minor, requiring the Applicant to revise the system is not considered justified.

10.5 TRANSPORTATION PROCEDURES

Alternatives such as special routing of shipments, providing escorts in separate vehicles, adding shielding to the containers, and constructing a fuel recovery and fabrication plant on the site rather than shipping fuel to and from the Plant, have been generically examined by the Staff. 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.

10.6 WATER DISCHARGE SYSTEM

Construction of the Applicant's diffuser type jet discharge has essentially been completed. The Staff believes that the proposed discharge method will not produce a significant environmental impact and, therefore, consideration of alternative discharge methods is not warranted.

10.7 WATER INTAKE SYSTEM

Data from the fish entrainment monitoring program being conducted at Nine Mile Point, Unit 1, which has an intake similar to the one being constructed for FitzPatrick, indicates that the intake as designed may cause fish kills. Consequently, the Staff, in order to guard against this from occurring, is requiring that the Applicant investigate the possibility of modifying the intake structure or employing fish diversionary techniques. The Applicant should consider the following: design modifications of the intake to achieve low average intake velocity by increasing the area of intake; use of a traveling band screen;* use of bar racks with smaller spacing to prevent entry of a large fish in the intake tunnel; use of air bubble curtain or electric fish screen for repelling fish at the intake; and use of fish guiding techniques to guide fish away from area of impingement.

References

1. TID-8200 (26th Rev.) "Nuclear Reactors Built, Being Built, or Planned in the U. S. as of June 30, 1972," U. S. Atomic Energy Commission.

2. J. P. Rossie et al., TID-26007, "Cost Comparison of Dry-Type and Conventional Cooling Systems for Representative Nuclear Generating Costs," USAEC Report.

3. Forked River Nuclear Station Environmental Report, Appendix B, Attachment 5, Jersey Central Power and Light Co., AEC Docket No. 50-363, Jan. 1972.

4. Record of the Maryland Power Plant Siting Act, Vol. 1, No. 3, Maryland Department of Natural Resources, Aug. 1972.

*Similar to one scheduled for installation by Central Power and Light Company at its Barney M. Davis Power Plant in Corpus Christi, Texas.

5. Thomas G. Wolaver, "The Distribution of Natural and Anthropogenic Elements and Compounds in Precipitation Across the U.S.: Theory and Quantitative Models," University of North Carolina, Chapel Hill, North Carolina, October 1972; distributed through courtesy of Division of Ecological Research, Environmental Protection Agency, National Environmental Research Center, Research Triangle Park, North Carolina 27711.

6. Dorothy Carroll, "Rainwater as a Chemical Agent of Geologic Processes -- A Review," Geological Survey Water-Supply Paper 1535-G, U. S. Government Printing Office, 1962.

7. See Section 2.6 of this statement.

8. Maurice Fried and Hans Broeshart, "The Soil-Plant System in Relation to Inorganic Nutrition," pp. 143, 145, Academic Press, New York and London, 1967.

9. L. L. Berenek et al., "Preferred Noise Criterion Curves and their Application to Rooms," J. Acoustical Soc. of America, 50, 1223-1228 (1971).

10. "Draft Environmental Statement for LaSalle County Nuclear Station," AEC Docket Nos. 50-373 and 50-384, U. S. Atomic Energy Commission July 1972.

11. Final Environmental Statement for Quad-Cities Nuclear Power Station, U. S. Atomic Energy Commission, September, 1972, AEC Docket No's 50-254 and 50-265.

12. "Environmental Report for James A. FitzPatrick Nuclear Power Plant," Supplement No. 3, page 10, Power Authority for the State of New York. Docket No. 50-333.

11. BENEFIT-COST SUMMARY

11.1 BENEFITS

The primary benefits from completion and operation of the Plant will be the generation of about 6 billion kilowatt hours per year of electrical energy and the improvement of reliability of service within the State of New York because of 821-MWe additional generating capacity. Most of the power will be sold to other members of the New York Power Pool for resale to consumers with only about 75 MWe or 9 percent being sold directly to industrial users.

An indirect regional benefit will be the injection of a substantial block of low-cost power into the economy of New York, which is likely to have a stimulating effect. Operation of the Plant will create about 65 permanent jobs in the area, injecting about $1.5 million per year into the local economy.

11.2 ENVIRONMENTAL COSTS

11.2.1 Land Use

The Plant is located in an area of declining agricultural use and no other significant human use. No prior use other than unplanned wildlife habitat was arrested by the construction of the Plant on 100 acres of the site. Since the Applicant plans to make the remaining 600 acres available as a managed wildlife refuge, the overall environmental impact associated with land use may be favorable. Since no ecological uniqueness is associated with the land and since thousands of acres of comparable land in the area remain unused by man, any negative impact is certainly small. As discussed in Section 5.1.1, the recreational potential of the area is meager; thus the use of the site for recreational purposes is not compromised by the presence of the Plant. The aesthetic impact of the complex is considered minor by the Staff.

The impacts due to offsite transmission lines are chiefly aesthetic and appear to be close to the minimum level consistent with effective transmission. Where the 70-mile transmission line corridor passes through agricultural land, only the land at the base of each tower is removed from cultivation, less than 0.5 acres per mile of line. In passage through wooded country, the removal of shrubs and large trees imposes greater ecological change. The change is not necessarily adverse since the creation of a new "edge" habitat may allow new species to populate the area.

11.2.2 Water Use

Operation of the Plant will introduce about 42 trillion Btu per year into Lake Ontario. A calculation based on Asbury's treatment[1] gives

the estimated increase in mean surface temperature of about 0.003°F. The increase in evaporation will be about 3 billion gallons per year or 0.1 percent of natural evaporation.[2] Since total outflow through the St. Lawrence River is 13-fold greater than natural evaporation, no detectable change in lake level will occur.

Chemical discharges from the Plant will increase the dissolved salt content of Lake Ontario by about 600 pounds per day of ions already present in substantial concentration in lake water (Section 2.5). Considering the conservative assumption that the only effective process of removal of chemicals from the lake waters is dilution by Niagara River flow-through, these discharges would in several centuries increase the dissolved-salt level of the Lake by about 0.006 ppm. Since the present level is about 230 ppm (Table 3.6), the increase would be undetectable.

11.2.3 Biological Effects

Significant effects on terrestrial biota are confined to those due to the removal of 102 acres from available wildlife habitat and to the change in type of habitat imposed by transmission line construction through wooded areas. Relative to available habitat within the region, these are very small perturbations and their effects are detectable only in the immediate vicinity of the affected areas.

Virtually all fishes and fish larvae entering the cooling-water intake structure will be killed. As discussed in Section 5.4.1, present data are inadequate for assessment of the resulting damage to the aquatic life at the Nine Mile Point area. If further data indicate that the impact is excessive, modification of the intake as discussed in Section 10 will be required.

The damage to planktonic life (other than fish larvae) from entrainment in the cooling water is not expected to lead to detectable changes in lake populations except in the immediate vicinity of the discharge stream.

Nearly all fish and fish larvae entrained in the intake water will be killed by passage through the cooling circuit. Because of the short generation time of the plankton and the sparsity of fishes in the area, only localized effects on the lake ecosystem are expected.

11.2.4 Radiological Effects

The total dose from normal operation of the FitzPatrick Plant and the existing Nine Mile Point Unit No. 1 plant to the entire population within 50 miles is estimated to be about 56 man-rem per year, distributed among about 1 million individuals in this area (based on 1980 population projections). The dose to individuals in areas near the plant will be less than 9% of that due to natural background. This dose is well within the limits imposed by 10 CFR Part 20.

11.3 BENEFIT-COST BALANCE

The Plant as designed is expected to have only a small impact on the environment except with respect to fish populations in the Nine Mile Point area, for which new data must be developed before a satisfactory assessment can be made. When the impact can be assessed, design changes may be required. The identified benefits and costs are listed in Table 11.1. The Staff has considered these benefits and costs in detail. With resolution of the question of impact on fish populations in the Nine Mile Point area, by additional data and/or modification of the intake design, the Staff judges that the overall benefits to be expected from construction and operation of the Plant will substantially outweigh the economic and environmental costs incurred. Except as noted with respect to impact on fish populations (where the benefit-cost balance for alternative intake systems is uncertain), the effects of the different alternatives considered do not change the balance of benefits relative to costs in favor of the alternatives.

<u>References</u>

1. J. G. Asbury, "Effects of Thermal Discharge on the Mass/Energy Balance of Lake Michigan," ANL/ES-1, Argonne National Laboratory, June, 1970.

2. "A Report on Chemical, Biological, and Physical Findings in Lake Ontario," U. S. Dept. of the Interior, Federal Water Pollution Control Administration, Great Lakes Region, Rochester Program Office, Rochester, N. Y., December 1967.

TABLE 11.1 Benefit-Cost Summary for the FitzPatrick Nuclear Power Plant

Benefits	
Primary benefits:	
Electrical energy to be generated	6 billion kWh/year
Generating capacity contributing to reliability of electrical power in New York	821,000 kilowatts
Secondary local benefits:	
Employment of operating staff	65 persons
Environmental Costs	
Land use:	
Previously unused land for the Plant	102 acres
Transmission line right-of-way	1273 acres
Water use:	
Water evaporated	5500 gallons per minute (average)
Lake Ontario surface area within 3°F excess isotherm of thermal plume	6.5 acres
Chemicals discharged to lake	615 pounds per day of salts occurring naturally in lake water
Radiological impact:	
Normal operation:	
Cumulative population dose (50-mile radius)	56 man-rem per year
Whole-body dose to nearby residents	Less than 9% of natural background
Biological impact:	Insufficient data to assess fish kills at intake screens. Possibility of excessive fish kills at intake of two plants. This may adversely affect fish population in the area, but not on a lakewide basis.

12. 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 Environmental Statement (DES) was transmitted to and comments received from the Federal, State and local agencies listed on page S-2 and S-3. In addition, the AEC requested comments on the DES from interested persons by a notice published in the Federal Register (37 F.R. 24378) on November 16, 1972. All of these comments are reproduced as Appendices in the order of their arrival.

The Staff's consideration of comments received is reflected in part by revised text in other sections of this Statement and in part by the following discussions:

BACKGROUND RADIATION, New York State Department of Environmental Conservation (G-5, G-6)

A comment was made requesting breakdown of the background dose into the various contributions by sources of radiation. The 125 mrem dose has been measured and reported by the Applicant. The average contributions of the background radiation from the various sources are: cosmic - 32%; terrestrial - 46%; weapons - 3%; other (internal) - 19%.

A comment indicated that data from the early 1960's contain a large contribution from weapon's fallout. The two decades of records reach back into the 1950's before the large weapons testing programs were in operation.

HYDROTHERMAL ANALYSIS, Power Authority of the State of New York (C-3 to C-6, C-13 to C-24); New York State Department of Environmental Conservation (G-6 to G-9); Department of the Interior (I-3); EPA (J-14)

A number of comments were received with regard to the Staff's hydrothermal analysis. The Staff has considered all the comments and is still of the opinion that there is insufficient evidence to conclude that the maximum temperature rise in the flow away region due to the FitzPatrick Plant under any current condition will be less than 3°F. While this may be true during a significant portion of the Plant's routine operation throughout the year, it is expected that on occasion the Plant's discharge will exceed the 3°F - 300 foot radius mixing zone limitation. The Staff believes that this will be caused by the

proximity and influence of the Nine Mile Point Unit 1 discharge. No significant biological effects are anticipated as a result of this expected potential violation. Nevertheless, the Applicant will be required to operate the Plant to meet the New York State's thermal criteria at all times. The Applicant will also be required to conduct a detailed monitoring program to demonstrate operation of the Plant within limits of the State's thermal criteria.

Two comments took issue with the Staff's conclusion that the model results could be in error "by a few degrees." The Staff's statement that the model results could be in error by a few degrees was intended to describe the uncertain correlation between hydraulic modeling results with actual conditions observed at power plant sites; i.e., temperatures observed in the field may differ from those observed in the model by a few degrees. The Staff was not criticizing the modeling study but was merely commenting on the state-of-the-art of hydraulic modeling. The Staff based its conclusion on the following observations:

First, the near field model predictions presented by the Applicant represent a hybrid of hydraulic and analytical modeling efforts. There appear to be only four references available where power plant thermal hydraulic model predictions have actually been compared to prototype field situations.[1,2,3,4] Without exception, these four references point to the fact that hydraulic modeling has not progressed to the point where accurate quantitative results are possible.

Secondly, the Applicant modified the hydraulic model results to account for (a) a change in the Plant's discharge rate, (b) differences in turbulent mixing between model and expected ambient lake conditions, (c) the manner in which currents are generated in the model as compared to that generated in the field, (d) an alignment factor between the discharge and easterly flowing currents and (e) the possible entrainment of Nine Mile Point, Unit 1 plume under easterly flowing current conditions. Except possibly for the arguments given for modification (a) listed above, the other corrections, while they may be plausible and reasonable, are relatively undefinable and represent engineering judgments. A certain amount of error is to be expected in making these corrective assessments.

A comment was made by the State of New York implying that consideration should be given to the direction taken by the entire plume, not the surface distribution. The Staff did not take this into consideration because the State's thermal criteria refer specifically to "the water temperature at the surface of a lake..."

A comment took issue with the Staff's assumption that the plume originating from the Nine Mile Point, Unit 1 would be in excess of 3°F and have a 10 foot depth. While the comment is correct in stating that under most conditions the three degree excess isotherm created by the Nine Mile Point, Unit 1 plume will not exceed a depth of 3 to 4 feet in the vicinity of FitzPatrick discharge structure, the Applicant's data for July 22, 1970 does show a three degree 10 ft plume depth at the Tower A measurement station location (FitzPatrick discharge).[5] It should be noted that on this occasion the Nine Mile Point, Unit 1 was operating at approximately 80% of plant capacity. Moreover, it is not uncommon for the Nine Mile Point, Unit 1 plume to create conditions resulting in temperatures greater than 3°F at the location of the FitzPatrick discharge structures. In fact, on August 14, 1970[6] and again on July 23, 1971[7], the excess temperature at the location of the FitzPatrick lake structures exceeded 5°F.

A comment was made that some perspective should be given to the duration and persistence of lake current. The Staff is in full agreement with this view. Unfortunately, the New York State thermal criteria makes no allowance for such considerations.

The Staff does not agree with the comment that currents in excess of 0.3 ft/sec from the west occur less than 5% of the time. Data supplied by the Applicant from instruments located in 17 feet and 31 feet of water indicate that currents greater than 0.3 ft/sec vary from about 8% to about 22% of the time of record.[5,8,9] Since nearshore currents are predominantly wind induced, it is probable that had the surface currents been measured, they would be greater than the ones recorded. It should be noted that the current studies were not conducted over the entire year and, therefore, the above mentioned current behavior may not reflect the current behavior throughout the entire year. Regarding the duration of current speeds from the west with speeds greater than 0.3 ft/sec the Staff would agree with the New York State comment in that a factor somewhat less than one-half would be appropriate to multiply the previously mentioned frequencies to account for current speed persistence of 6 hours or more.

The New York State comment suggests a recomputation of the cumulative surface temperature rise using a 3 ft-3°F excess surface temperature and a dilution factor of 11.5 to the bottom of the Nine Mile Point, Unit 1 thermal layer. In the Staff's opinion this suggestion does not address itself to the real issues, which are the uncertainties in the required assumptions and the crudeness of the mathematical model. Any pretense otherwise is unjustified. Therefore, the near approach to the 3 degree limit predicted by both the Applicant and the Staff,

while based on the same experimental material, suggests that one cannot absolutely state that the FitzPatrick Plant will meet the New York State thermal criteria under all current conditions.

A comment was made that a consideration should be given to closed cycle cooling. The Staff has found no evidence that occasional increase of the surface temperature beyond the ΔT of 3°F or that occasional increase of the mixing zone of 300 foot radius would result in any adverse environmental effect. The Staff concludes that closed cycle cooling is neither justified or necessary as a plant modification for meeting the State's thermal criteria since the Applicant will be required to operate the Plant within the limits of the State's criteria.

RADIOLOGICAL WASTE TREATMENT SYSTEM, Power Authority of the State of New York (C-6); New York Department of Environmental Conservation (G-10); EPA (J-6, J-7)

A comment was made concerning the use in the Statement of 7.5 hours and 4.4 hours for holdup times in the charcoal absorber system for krypton and xenon, respectively. In the calculations the Staff used a value of 4.4 days for xenon holdup time. The text has accordingly been corrected.

With regard to Table 3.3 a comment was made indicating that the table omits noble gases although noble gases will be present as stated on page 5-17 of the Draft. The Staff has analyzed reactor coolant discharge water for the noble gas content and has determined that even at times of the highest annual average noble gas concentrations in the discharge water, no significant doses would be delivered to humans and accordingly the Staff has omitted noble gases from the list of isotopes.

A comment was made that the report should contain a discussion of the basis for using a gas release rate from leaking fuel and the holdup time in the off-gas charcoal beds different from those assumed by the Applicant. The Staff's assumption for failed fuel as given in Table 3.4 is based on a review of available data from operating power plants and represents Staff's estimate of a realistic average value for releases during the lifetime of the Plant.

The Staff's assumptions for holdup time in the charcoal beds are based on a condenser in-leakage of 20 cfm and charcoal adsorption coefficients of 16 cc/g for krypton and 225 cc/g for xenon. These values are also based on operational experience.

A comment was made that Table 3.5, which lists anticipated releases of radionuclides in gaseous effluents, omits the contribution from the radwaste building. Based on operating experience releases from radwaste buildings have been measured and determined to be negligible and therefore the Staff does not estimate a source term from this building.

A comment was made that FitzPatrick discharges cannot be considered "as low as practicable." The FitzPatrick Nuclear Power Plant will discharge its condenser off-gases through charcoal delay beds in conjunction with a 385 foot stack. Plants which use more charcoal for delay may have a roof vent, a lower stack, or less favorable atmospheric dilution. The Staff has determined that the amount of charcoal used in FitzPatrick delay beds and the dilution obtained from the stack releases should result in effluents which can be considered as low as practicable (see reference to proposed Appendix I to 10 CFR 50.36a in Section 5.6.2).

A comment requested clarification of the basis for the assumed recombiner downtime. The Staff assumed that the recombiner system will require maintenance once every other year. Based on the radiation levels of the equipment, the Staff estimated that it will take three weeks to perform the maintenance. This results in the average downtime of 10 days per year.

A comment suggested inclusion of an evaluation of the annual discharge from the automatic purge system of the off-gas system. The automatic purge system will supply air to the off-gas holdup line at 200 cfm to remove the gases in the event of a turbine trip. The holdup line will normally provide about a five hour holdup. The five hours of accumulated gases will be purged through the charcoal beds and stack in about 30 minutes when the automatic purge system is actuated. The Staff estimates that less than 100 curies of noble gases and negligible amounts of iodine will be released per turbine trip. Because a turbine trip is an infrequent occurrence and because the release is negligible when compared with the source term, the Staff has not included it in the source term.

TRANSMISSION LINE, Power Authority of the State of New York (C-7); Department of Agriculture (F-2, F-3); New York State Department of Environmental Conservation (G-11); Department of the Interior (I-3)

Comments were made concerning erosion, restoration efforts and revegetating measures. The restoration program along the transmission line is not yet complete. The Applicant has stated that it has contracts in force which will be implemented in accordance with the applicable criteria of the U. S. Department of the Interior Publication "Environmental Criteria for Electric Transmission Systems," issued in 1970.

A comment was made that presence of bog turtles be considered in construction and maintenance of the transmission line. The Staff concludes that the effect of the transmission facilities on the bog turtle population will be minor because the amount of habitat impacted in comparison to that available is minor and because the line passes through relatively few areas where the animal might be found. There are currently no instances where potential bog turtle habitats have been drained for the purposes of transmission line construction.

A comment suggested that screening of all road and stream crossings be considered. The Staff has recommended that where natural screening was removed or unacceptably thinned during construction, the screening be restored by planting appropriate vegetation. This is particularly true at stream crossings where it is important to prevent excessive runoff of silts and dissolved substances into the stream. In cases of road crossings where no screening was present prior to corridor preparation the transmission line will be visible from the road. The Staff regards this as a minor unavoidable effect of line construction but does not feel that planting of screening where none formerly existed is justified.

With regard to a comment about the public off-road vehicle use for hunting and recreation the Applicant has stated that the right-of-way use is dictated by the ownership. The Applicant's easement allows present owners to retain fee title to the property and they continue to use the right-of-way for any purpose that does not interfere with the operation and maintenance of the line.

A comment inquired into the possible multiple use of the corridor. The Power Authority of the State of New York has stated that it will cooperate with State, regional, county and local agencies in establishing any beneficial secondary use programs by acquiring specific portions of the right-of-way in fee, providing such agencies assume responsibility for establishing, operating and maintaining any programs that result from such cooperative effects.

AQUATIC EFFECTS OF PLANT OPERATION; Ecology Action (D-1 to D-3); Power Authority of the State of New York (C-7 to C-10); New York State Department of Environmental Conservation (G-5, G-12); Department of the Interior (I-3); EPA (J-11 to J-13)

Comments were made as to the basis for the Staff's conclusion that the effect of the Plant's operation will be localized. A comment was also made that the use of once-through cooling at the FitzPatrick Plant amounts to "experimentation with the environment." In evaluating the operational effects of the Plant on the aquatic ecosystem of the lake, the Staff considered three possible areas of major impact-intake,

entrainment, and discharge effects. Within these generally recognized areas of probable major impact, the Staff's analysis did not discover any special problems that were site specific.

Since the preoperational ecological studies relating to aquatic effects conducted by the Applicant were inadequate to evaluate the operational impacts of the Plant quantitatively, the Staff made a qualitative assessment based on - (a) the qualitative information on ecology of the site provided by the Applicant and available in literature, and (b) the favorable morphometric and limnological features of the site for a power plant. In addition, in the general absence of more detailed information, the Staff took an extreme approach and assumed that the impacts on all exposed organisms will be severe. Thus, fishes entrapped in the intake structure were assumed to be lost and plankton passing through the condensers and exposed to 31.2°F temperature rise for over 9 minutes were assumed to suffer 100% mortality. However, when these individual impacts on organisms were considered in the perspective of (a) the amount of water present in the immediate vicinity of the plant relative to the amount of water to be used by the plant, (b) the surrounding habitat that can replenish depletion of the biotic components, and (c) the compensatory mechanisms that most of the natural populations have to offset higher mortality rates, the Staff was convinced that the impacts will be minimal and localized except with respect to fish population in the Nine Mile Point area and entrainment effects on larval fishes. For these new data must be developed before a more satisfactory assessment can be made.

In the Staff's assessment of the operational impacts of the Plant, the quantitative limitations of the existing data and the need for additional information were recognized. Much of these data can only be obtained by a monitoring program when the Plant is in operation. The data will be evaluated simultaneously with the operation of the Plant and if any unacceptable biological damage is found, corrective measures will be required to be taken within a specified time period. Since adverse effects, if any, are expected to be chronic, deviations from natural fluctuations of species amounting to irreversible damage are not expected to occur in a relatively short period of time. Thus, there will be sufficient time to evaluate the operational effects and to take corrective action if necessary. For these reasons, the Staff is of the opinion that the operation of the Plant with once through cooling will not amount to "experimentation" with the environment.

The Applicant did not agree with the Staff's conclusion that the provisions for future fish handling facilities are not adequate. The Staff has considered this comment carefully and is still of the opinion that the Applicant has not shown that the fish can be rescued successfully from the forebay area. The Staff recommends, however, that

an adequate testing program be undertaken (in an experimental flume or possibly in one of the intake forebays of Nine Mile Point, Unit 1 Nuclear Station) before proceeding with a major installation at the FitzPatrick Plant. The Staff also recommends that other methods of preserving fish or preventing their entry in the intake structures should be explored concurrently.

The Applicant has neglected to consider a number of important problems related to the use of pumps for transferring fish from the screenwell. The following are some of the major problems relating to the proposed fish handling facilities:

1. Behavioral response and stress reactions in fish are highly species specific.

Kerr in his study observed marked differences in percent recovery and percent survival rates of striped bass and of all species combined together.[10] Two other studies have also emphasized the importance of this point.[11,12]

2. Relative location of suction trough in conjunction with high concentrations of fish is extremely important.

There is increasing emphasis on concentrating fish near the suction area for an efficient operation of the pump. A number of studies have emphasized this point.[10,11,12,13,14,15,16,17] The Applicant has not considered how the problem of concentrating or crowding fish into the suction will be overcome in their proposed rescue scheme.

Kerr observed that screen channel approach velocity has a bearing on the recovery rate of the collectors.[10] Low approach velocities resulted in low collector recovery rate; on the other hand, high approach velocities decreased the number of fish surviving. With a rigid intake system at the FitzPatrick Plant, it is obvious that the Applicant cannot attain a balance between collector rate and survival as was achieved by Kerr.

3. Fish losses through the pumps and other indirect effects could become a problem.

High survival has been noted for such single species transfers as catfish, king salmon, gizzard shad, carp and striped bass. However, Kerr lost about 27% of all species of fish when using an 8" vertical pump for a 12' lift.[10] Another study gives a detailed account of possible and observed injuries to fishes

> when passed through pumps. This study reported erratic swimming behavior of fish upon passing through the pump. When such erratically swimming fish are discharged into the lake, they will be severely stressed and subject to disease or predation.

The Applicant's comment that the maximum temperature rather than temperature rise through the condensers is the major factor in the entrainment effects is not substantiated by currently available information. The Staff is not aware of any reliable studies conducted at Lake Ontario plants that have attempted to identify damage to plankton exposed to a ΔT of over 30°F for times longer than 9 minutes at various ambient temperatures including 32°F.

Based on the data available at present, the Staff is not in a position to conclude that the entrainment mortality of organisms is only a seasonal rather than year-round problem.

A question was raised concerning the fish impingement data from the Nine Mile Point, Unit 1 for evaluating the magnitude of the fish kill problem at the power plants in the Nine Mile Point area. Such data were not available to the Staff during preparation of the Draft Environmental Statement. However, these data are now available and are included in Section 5.0.

A comment was made that alternate intake and discharge designs be considered. Section 10.6 and 10.7 have been added to reflect this additional information.

ASSESSMENT OF RADIOLOGICAL IMPACTS: Ecology Action (D-6); New York State Department of Environmental Conservation (G-12, G-13); EPA (J-8, J-17)

A statement was made that although the Draft Environmental Statement treated the aggregate releases of radioactive materials and their radiological consequences expected from FitzPatrick Plant and those observed from Nine Mile Point, Unit 1, the Draft did not consider the radiological effects of Nine Mile Point, Unit 2 or other nuclear and non-nuclear power plants planned for operation during the 40-year licensing period of FitzPatrick Plant.

The Staff considers radiological effects of plants in order of their licensing sequence. The radiological impact of a given plant is considered in light of the aggregate radiological consequences of its operation in the presence of its existing and scheduled operational precursor plants. As a consequence of this procedure, the

environmental impacts of releases of radioactivity from each nuclear power plant are treated in its respective environmental statement.

A comment was made that "Population Dose from All Sources," in 1980 should include contributions from Nine Mile Point, Unit 2 (scheduled for operation before 1980) and from R. E. Ginna plant which is presently operating within 50 miles of the FitzPatrick Plant.

The response to this comment has been covered in part by the discussion above; in addition, the Staff does not evaluate quantitatively the radiological impact of the superimposition of sites in a region unless the sites are contiguous.

This does not mean to imply that the AEC is not cognizant of, or is unwilling to examine, the potential impact of multiple plants in the same region. This is evidenced by considerations upon which proposed Appendix I to 10 CFR Part 50 is based. The proposed site boundary dose of 5 mrem per year was developed on the basis that, from the standpoint of radiation exposure to humans and projected U. S. power needs to the year 2000, regional effects would be minimal.

A comment was made that the bioaccumulation factors given in Table 5.1 are based on data from one author and they do not indicate the magnitude of biological variability present in nature. The bioaccumulation factors listed in Table 5.1 represent, in the Staff's judgment, the best data which are available at this time. These values are subject to revision whenever a more suitable study is completed.

Due to the somewhat large variation in bioaccumulation factors reported in the literature, it is difficult at this time to determine the natural variability in these factors.

A comment was made that the Draft did not report dose estimates via a vegetable consumption pathway. Potential doses via consumption of vegetables contaminated by plume fallout have been calculated and appropriate changes have been made in Section 5.6. Doses resulting from the irrigation pathway were also evaluated and found to be insignificant.

A comment was made with regard to the evaluation of the thyroid dose at the nearest farm. The dose to a child's thyroid via the iodine-cow-milk pathway was evaluated at the nearest dairy farm. This farm has fields which border the FitzPatrick-Nine Mile Point property. In the southeast direction from the Plant, the property line is more than 3800 feet away.

A comment suggested that an estimated dose from potential direct radiation from the outside waste surge condensate storage tank be included. All potential direct radiation doses were evaluated. Only the turbine building component was significant.

INCREMENTAL ENVIRONMENTAL EFFECTS, Ecology Action (D-6)

A comment was made suggesting that the Environmental Statement should evaluate environmental impacts of mining, processing and reprocessing of fuel, and the impacts resulting from long-term storage of radioactive wastes. Recognizing the virtually boundless range of considerations which could conceivably be relevant to the environmental review of this facility, the AEC regulatory staff has endeavored to apply a "rule of reason" in determining the scope of its review. Therefore, this statement addresses the environmental impact of only those activities in the uranium fuel cycle which are considered proximate to the proposed action. The impact of activities such as the mining and manufacturing of nuclear fuel needed for the facility and the reprocessing of the irradiated nuclear fuel which the facility will produce, the disposal of wastes resulting from such reprocessing and the disposal of low and high level solid radioactive wastes which the facility will produce - which are remote in time and place from the licensed activity, beyond the licensee's control, and to which the licensee contributes only fractionally - are matters appropriate for consideration in a generic fashion through the rule making process and are not here discussed. This scope is consistent with current Commission policy. See, e.g., In the Matter of Vermont Yankee Nuclear Power Corporation, Docket No. 50-271, ALAB-56 (June 6, 1972); In the Matter of Vermont Yankee Nuclear Power Corporation, Docket No. 50-271, ALAB-73 (October 11, 1972).

In this regard, the Staff notes that on November 15, 1972, the Commission published in the Federal Register (37 F.R. 24191) a notice of proposed rulemaking concerning possible amendments to Appendix D of 10 CFR Part 50, that would deal specifically with the environmental effects associated with the uranium fuel cycle in the individual cost-benefit analyses for light water-cooled nuclear power reactors. In connection with this proposed rulemaking action, the staff has prepared a report entitled, "Environmental Survey of the Nuclear Fuel Cycle," dated November 6, 1972, which provides a basis for an informed rulemaking consideration of the extent to which the environmental impacts associated with the uranium fuel cycle should be considered in individual nuclear power reactor environmental statements and licensing proceedings.

MONITORING PROGRAMS, Power Authority of the State of New York (C-11); New York State Department of Environmental Conservation (G-14); Department of the Interior (I-4).

Several comments were received with regard to the ecological monitoring program. The ecological monitoring program will be carefully designed and outlined in detail in the Technical Specifications using the basis provided in this Statement. The Applicant will be required to conduct an extensively revised monitoring program which will be designed to obtain pertinent data to assess the impacts of once-through cooling. The recommendations included in the comments will be carefully considered by the Staff in formulation of the operating Technical Specifications for the FitzPatrick Plant.

A comment was made concerning the justification for a requirement for broadening and extending of the radiological environmental monitoring. The Staff draws attention to the current EPA Environmental Radioactivity Surveillance Guide (ORP/SID-72-2). This is considered, both by EPA and the Staff, to constitute a minimum level of environmental radiation surveillance outside the plant site boundary of a light water power reactor. The program presently outlined does not meet this minimum.

A comment was made with regard to the objectivity of the operational monitoring programs. While the Staff agrees that data collection and evaluation must be objective to ensure adequate environmental protection, the Staff does not believe that requisite objectivity would be compromised by entrusting the operational monitoring program to the Applicant. In addition, the Applicant has stated that it plans to use outside organizations for carrying out the monitoring programs.

PLANT ACCIDENTS, Ecology Action (D-4); New York State Department of Environmental Conservation (G-15); Department of the Interior (I-5); EPA (J-9)

A comment was made concerning the probabilities of accidents. The consequences of the plant accidents considered in Table 7.2 of the Draft Environmental Statement (DES) for the James A. FitzPatrick Nuclear Power Plant are not weighted by probability but assume each to occur. As indicated in the DES, the environmental risk is small even assuming the occurrence of the accidents listed. As stated on page 7-3 of the DES, to rigorously quantify an environmental risk, the specified numerical consequences would have to be multiplied by numerical values for probabilities. However, because of the absence of significant radiological accidents in the nuclear power industry to date and because of the extensive precautions taken in the design, construction and operation to assure a low probability of accidents in the future, definitive estimates of accident occurrence probabilities

are not available. One of the principal features of the safety review process for nuclear power facilities is that if an accident mechanism is identified which could lead to significant radiological consequences, measures are required to be implemented to reduce the probability of a significant release of radioactivity. These measures can include safety features to reduce both the probability of the initiating event and the resulting radiological consequences given the event. Because the measures taken are evaluated in a conservative manner in the safety review the subsequent environmental risk, when realistically evaluated, is extremely small. Qualitative estimates of probabilities of the various events are given in paragraph 2, page 7-3 of the DES.

A comment was made concerning an apparent discrepancy in estimated doses for a large loss of coolant accident between the DES (prepared by the Staff) and the Final Safety Analysis Report (prepared by the Applicant). The Staff performs its own computation of doses during the safety review which are presented in the Safety Evaluation and which are based on very conservative assumptions as to the source available for leakage and the effectiveness of the engineered safety features. The consequences presented in the DES are based on more realistic assumptions of source released and effectiveness of engineered safety features as discussed in the proposed Annex to Appendix D, 10 CFR Part 50.

A comment was made that clarification was required of the possible dose to an individual that is presented in Table 7-2. All consequences in Table 7-2 are for the course of the accidents as specified in the proposed Annex to Appendix D, 10 CFR Part 50. Footnote (b) to Table 7.2 addresses the question of the type of dose received.

A comment was made concerning the consideration of doses due to airborne transport of radioactive material. Each accident considers different sources. Some accident sources may consist largely of noble gases resulting in a direct dose, and some may consist largely of iodine resulting mainly in a thyroid dose. Even in those accidents where both forms of radioactive material were considered a part of the source, the iodine concentrations may be sufficiently low so that the potential thyroid doses may not be limiting. The fraction of Part 20 limits presented in Table 7-2 could apply equally to a thyroid organ dose or a direct exposure dose. The detection of the presence of accidental releases of radioactivity by the Applicant's in-plant monitoring program should be sufficient to apprise the Applicant, within a very short time period, of any need to implement emergency procedures.

A comment was made that releases to water should be considered. 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. The Staff's evaluation of the doses resulting from accidents 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.

TRANSPORTATION ACCIDENTS, Ecology Action (D-4); New York State Department of Environmental Conservation (G-16); EPA (J-9)

A comment was made that the nature of transportation accidents analyzed or the bases for conclusions were not identified. The Commission has analyzed on a generic basis, problems relating to the transportation of nuclear materials for power reactors under the present regulatory standards. The results of this analysis were made available in a recent publication "Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants" (Directorate of Regulatory Standards, USAEC, December 1972). Pages 30, 31, 44-48, 54, 55 and Appendix B of the above mentioned Environmental Survey treat transportation accidents in greater detail and provide the basis for calculation of doses.

A comment was made that the Draft Statement did not mention training, monitoring or availability of instrumentation for truck drivers or selected railroad personnel and that there was no indication that they are radiation workers. Surveys and analyses indicate that transport workers such as truck drivers, cargo handlers, air crews, barge operators, train crewmen, etc., receive only small doses of radiation in the course of transporting radioactive materials. In a few cases, however, persons who are continually handling radioactive material shipments may receive exposures exceeding that which the average transport worker receives, in some cases approaching and, in some cases, exceeding the limit recommended for individuals in the general population. Therefore, some transport workers are considered to be radiation workers. It is apparent that the exposure transport workers receive is "occupational" as defined in 10 CFR Part 20, § 20.3(a)(10) in that "in the course of employment,...the individual's duties involve exposure to radiation."

All transport workers are given instructions and provided with equipment commensurate with the extent of the radiation exposure, pursuant to 10 CFR § 19.2. With respect to instruction, Department

of Transportation (DOT) regulations require that the carrier inform workers of the precautions to be taken in transporting and handling the hazardous goods. The DOT regulations also specify safety precautions to limit the radiation exposure in terms of conditions of transport, specifying separation distances from occupied areas (49 CFR § 175.655, 177.842), radiation levels in the driver's compartment (49 CFR 173.393), radiation levels in occupied areas in ships (46 CFR § 146.25), and placing limits on the accumulation of packages in any one vehicle or area (49 CFR § 175.655, 177.842) to limit the total radiation levels. In addition, the Department of Transportation regulations, 49 CFR § 173.393(i), specify a maximum radiation level on the surface of packages to limit the radiation exposure to transport workers (including cargo handlers).

Radiation levels on the outside of packages exceeding the general requirements in the DOT regulations (49 CFR 173.393(i)) are permitted (§ 173.393(j)), provided the shipment is transported as an exclusive use or "full load" shipment. In such cases, (for example, irradiated fuel and solid wastes from nuclear power plants) the shipments must be loaded by the consignor and unloaded by the consignee in accordance with the regulatory requirements. In such cases the loading and unloading is carried out by plant personnel, in most cases under an AEC or Agreement State license, and exposure of transport workers is at a minimum.

The DOT regulations also provide specific instructions to the carrier for dealing with emergency situations involving leaking packages or damaged packages of radioactive material, which include measures to control the exposure of the worker and the general public and to require reporting of such incidents to the shipper and to DOT (49 CFR § 171.15, 175.655, 177.861).

Transport workers are informed of the occurrence of radioactive material or presence of radioactive material in storage areas or on vehicles by notations made on waybills as required by DOT regulations (49 CFR §§ 174.510, 175.652(a), 177.817) and by labels required to be placed on the packages under the DOT regulations (§ 173.399). The labels are of a unique design and bear the trefoil, an internationally accepted symbol for radiation. All packages having significant external radiation levels are identified by a label with a yellow background in the upper half, whereas the label for radioactive packages with no significant external radiation levels has a white background. Also, vehicles carrying packages requiring attention to the radiation levels on the outside or special limitations on the stowage, are required to be placarded on the outside of the vehicle (49 CFR §§ 174.541, 177.823) to further aid in informing the transport worker of the presence of these packages.

With regard to personnel monitoring for transport workers, studies and analyses indicate that the exposures in most cases are well below those requiring individual monitoring under § 20.202(a)(1). Personnel monitoring normally is not required for the individual transport worker except in those unusual circumstances where the transport worker is assigned to a particular series of shipments involving long periods or unusual levels of exposure. In those exceptional cases, (for example, drivers of trucks transporting truck loads of packages from sources of radiopharmaceuticals such as Abbott Laboratories or from sources of radioactive material such as Oak Ridge Laboratory or specialized haulers hauling irradiated fuel such as Tri-State) personnel monitoring badges are issued to drivers. In most cases even then the radiation exposures during transportation are small. For the general case, as a result of the limits on radiation levels on the outside of packages and studies which make possible estimating the time of exposure, the average dose to transport workers can be estimated sufficiently closely to satisfy a need for identifying the doses which transport workers have received in the course of their employment and under normal circumstances, personnel monitoring is not required for transport workers.

NEED FOR POWER, Ecology Action (D-5)

A comment was made that the need for power has not been evaluated independently by the Staff and that all of the relevant factors have not been considered. The detailed explanation given on pages 8-1 through 8-11 of the Draft Statement and the data on which it was based contradicts the first point of the comment. The Staff relied on historical statistics and other information gathered by industry groups in cooperation with the Federal Power Commission (FPC). The Staff knows of no reason to doubt the substantial accuracy of these data. After careful independent analysis of the available information, the Staff arrived at the evaluation and conclusion presented in Section 8.

In preparing the Environmental Statement the Staff does give serious consideration to the judgments of industry groups, State regulatory bodies, and the FPC, as reflecting the most expert opinion concerning future demand for power. However, it does not accept these judgments blindly and it does examine the probable consequences of errors in such quantitative estimates as proper reserve margins and forecasts of future demand. Typically, such probable consequences have a minor environmental impact since the operation of generating plants is governed by actual demand, not by some earlier forecast nor by an accepted level of reserve capacity. If a plant were built, say, one year earlier than economic considerations based on perfect knowledge

would require, the net environmental impact would in most cases be favorable. The incremental generating cost (capital costs having been sunk) of the new plant would normally be lower than that of some older plant. The resulting displacement of the older plant would be favorable with respect to the environment since current new plants have been designed with greater attention to reduction of environmental effects than was the case in the past.

The Staff believes that an analysis of PASNY's daily variations in power demand is not necessary for a meaningful analysis of the need for power because the system is primarily a "base load" system.

The Staff also believes that it is appropriate to consider the Applicant's need for power with reference to the load of the entire New York Power Pool because with the exception of approximately 75 MW the balance of the capacity will be available to the New York Power Pool to satisfy power needs anywhere in the State.

ALTERNATIVES TO PROPOSED ACTION, Ecology Action (D-7); New York State Department of Environmental Conservation (G-16)

A comment was received suggesting that the Final Environmental Statement discuss placing constraints upon demand as an alternative to the proposed action of satisfying a "need for power" by the continued construction and operation of the facility. The statement discusses the subject of demand for energy from the standpoint of actual anticipated demand, and not from the standpoint of what the relevant demand should or should not be upon consideration of the desirability or utility of the uses of the energy produced by the Plant. Applying a "rule of reason" in determining the scope of its environmental review of this facility, the Staff concluded that a discussion of these alternatives, which involve matters of Congressional policy, would be inappropriate.

A comment was made that, in the comparison of available alternatives, there should be a discussion of the complete fuel cycles of the various fuels, that a basic study has been performed for nuclear fuels in the Commission's "Environmental Survey of the Nuclear Fuel Cycle," and a similar environmental study has not been performed for fossil fuels. Attention is called to a draft report WASH-1250 of December 1972 on "The Safety of Nuclear Power Reactors (Light Water-Cooled) and Related Facilities." Chapter 6 of that report on "Benefits and Risks" contains two sections, 6.3 and 6.4, which compare various aspects of the nuclear-fuel cycle and the fossil-fuel cycle.

COST-BENEFIT ANALYSIS, Ecology Action (D-7, D-8); Department of the Interior (I-5); EPA (J-16)

A comment from Ecology Action mentions two costs that it says have been ignored, the costs borne by the public through the limitation of liability for radiation damage provided by the Price-Anderson Act and the costs of fines for fish kills which the New York State Attorney General is empowered to collect. On the first point, the following testimony by the then AEC Commissioner Palfrey at a hearing of the Joint Committee on Atomic Energy of the Congress on "Proposed Extension of AEC Indemnity Legislation" on June 22-24, 1965, is pertinent:

> "Representative Price. Now some people charge that the Price-Anderson Act constitutes a subsidy to atomic power. Mr. Palfrey, do you agree that the act does afford a subsidy?
>
> "Mr. Palfrey. Mr. Price, in the traditional sense the term subsidy connotes payments, payments of something, and thus far there have been no payments. On the other hand, there is no doubt that this constitutes something of value. It is a contingent promise to pay upon the happening of an event. Of course it is of value to the licensee. But you have the situation where the likelihood of the Government ever having to take this action is so remote that it is almost impossible to give a dollar value to this thing that they are undertaking to do."

Regarding any fines which may be paid to the State of New York by the Applicant in connection with possible fish kills, the Staff considers such potential fines as transfer payments and without any significance in the benefit-cost analysis.

Several comments stated that the assumption that the FitzPatrick Plant will operate at a plant factor of 85% is unrealistically optimistic. In most of the AEC Environmental Statements, a plant factor of 80% has been used. However, a number of utilities have assumed 85% in their Environmental Reports and some operating plants have attained levels of 85% or higher in certain years, namely, Yankee in 1966, 1967, and 1971, San Onofre in 1971, and Oyster Creek in 1969 (AEC Report WASH-1203-71 on "Operating History of U.S. Nuclear Power Reactors"). Plant factors tend to be lower during early years of operation. The environmental impacts of plant operation are mainly proportional to hours of operation so that the resulting environmental costs and value of the Plant's output will tend to stay in a fixed relationship regardless of plant factor. The Staff has concluded, however, that 80% is a preferable estimate and appropriate changes have been made in Sections 8.1 and 11.

A comment mentions the "utter failure to quantify the costs and benefits." This is contradicted by Tables 9.1, 9.2, 9.3, 10.1, and 11.1 of the Draft Environmental Statement, which contain many quantifications. The Staff has not attempted to attain commensurability among benefits and costs of different character, for example, by measuring kilowatt-hour in units of the worth of live fish or by assigning dollar value to esthetic impacts. The Staff believes that such attempts are meaningless and damaging to the general understanding of the issues involved, unless and until a scale of units appropriate to denoting the value of such different entities is developed and becomes generally accepted. Most of the environmental costs were quantified in such units as acres of thermal plume, gallons per minute of water evaporated, pounds per day of chemicals discharged, or man-rems per year of radiation dose and could not be expressed in terms of dollars.

A comment was made that "the annual production of aquatic organisms killed by impingement, entrainment, and thermal discharge constitutes an irretrievable commitment of resources and should be indicated in this section."

Because this comment implies rejection of the generally accepted concept of aquatic organisms as a renewable resource, the Department of Interior was contacted for clarification. Their Office of Environmental Quality, BSFW, reported that the comment as prepared originally was worded to read: "The production <u>from</u> aquatic ..." and thus had a different implication than the received version. Their intent was to point out that the plant will remove a certain number of organisms from the food chain and act as an additional source of predator pressure, and that the progeny that might have ensued from each organism so killed is irreversibly and irretrievably lost.

There is no question that this is indeed the case, but the point at issue is whether the <u>resource</u> is irreversibly committed and not that of individuals being so committed. Obviously, for each aquatic organism (and all potential offspring) killed by impingement, entrainment, or thermal discharge, the effect is irreversible and irretrievable, but the overall effect on the populations so impacted is not irreversible unless the species of concern is being subjected to extinction. There might be cases wherein the effects of plant operation are postulated to have such an effect, but these cases are rare and quite specific as to species and site.

The concept of irretrievable or irreversible commitment of resources is meant to apply to non-renewable resources and hence the consideration of increased predation of aquatic organisms should not be considered in this Section unless there is a possibility of extinction.

The degree and permanency of impairment of annual productivity of fisheries is a matter involving economic and technological forecasting and needs to be dealt with only when such impacts would appear to reach socially significant proportions.

LOCATION OF PRINCIPAL CHANGES IN THIS STATEMENT IN RESPONSE TO COMMENTS

Topic Commented Upon	Section Where Topic is Addressed
Wildlife management (G-3, I-3)	2.2
Earthquakes (A-1, G-4, I-2)	2.4
Topography (G-4, I-2)	2.4
Historical Landmarks (B-1, I-1)	2.6
Meteorology (A-1, A-2, J-17)	2.6
Background Radiation (G-5)	2.8
Bog Turtle (G-11)	2.7.1
Migratory birds (I-2)	2.7.1
Hydrothermal Analysis (C-3 to C-6, G-6 to G-9, I-3, J-14)	3.3.2
Radioactive Waste Treatment (C-6)	3.4.2
Sanitary Waste Treatment (J-15)	3.6
Transmission Lines (F-2, F-3, G-11)	4.1.2
Effect of Transmission Lines on Airports (E-1)	5.1.2
Noise (G-17)	5.3
Fish impingement at Nine Mile Point, Unit 1 (C-7, G-5, G-12)	5.4.1
Demersal fish eggs (C-10)	5.4.2
Growth of algae (A-1)	5.4.3
Chemical discharges (J-15)	5.4.4
Load factor in Nine Mile Point, Unit 1 releases (G-12)	5.6
Contribution of vegetables to radiation dose (J-8)	5.6
Fish entrapment (C-7)	8.2.2
Radiological Effects (G-16)	8.2.3
Sulfur content of oil (I-5)	9.3
85% Plant factor (D-8, J-16)	9.3
Salt drift (G-16)	10.1.2
Alternative water discharge system (G-16)	10.6
Alternative water intake system (G-16)	10.7

References

1. Edward Siberman and Heinz Stefan, "Physical (Hydraulic) Modeling of Heat Dispersion in Large Lakes: A Review of the State-of-the-Art," Argonne National Laboratory Report ANL/ES-2, August 17, 1970.

2. Peter Ackers, "Modeling of Heated Water Discharges," Chapter 6 within Engineering Aspects of Thermal Pollution, Vanderbilt University Press, 1969 Frank Parker and Peter Krendel, eds.

3. L. C. Neale and G. E. Hecker, "Model Versus Field Data on Thermal Plumes From Power Stations," International Symposium on Stratified Flows, Novosibirsk, Paper 18, 1972.

4. Peter D. Hindley, Russell M. Miner, and Raymond F. Cayot, "Thermal Discharge: A Model-Prototype Comparison," Proceedings of the American Society of Civil Engineers, Power Division, Page 783, December 1971.

5. Stone and Webster Engineering Corporation, "1970 Lake Temperature and Current Studies," prepared by the Environmental Engineering Division for the Power Authority of the State of New York, June 1971.

6. J. V. Tokar, "Thermal Plumes in Lakes: Compilations of Field Experience," Argonne National Laboratory, ANL/ES-3, August 1971.

7. John F. Storr, Memo to Mr. R. Clancy, Manager, Environmental Engineering, Niagara Mohawk Power Corp. Re: Three Dimensional Thermal Studies, 1971. February 15, 1972.

8. Stone and Webster Engineering Corporation, "Engineering and Ecological Studies for Design of Intake and Discharge Structures, James A. FitzPatrick Nuclear Power Plant," prepared by the Hydraulic Division for the Power Authority of the State of New York, January 1970.

9. John F. Storr, "Limnology Nine Mine Point, Lake Ontario," Appendix B of Nine Mile Point Environmental Report.

10. Kerr, J. E., "Studies in Fish Preservation at the Contra Costa Steam Plant of the Pacific Gas and Electric Company," State of California, Department of Fish and Game, Fish Bulletin No. 92, 1953.

11. Robinson, J. B., "Efforts of Passing Juvenile King Salmon Through a Pump," California Department of Fish and Game, Anadromous Fisheries Administration, Report No. 69-1, 1969.

12. Riesbol, R. S. and P. J. L. Gear, "Application of Mechanical Systems to Alleviation of Intake Entrapment Problems", Presented at the Atomic Industrial Forum Conference on Water Quality Consideration, Washington, D.C., October 2, 1972.

13. Dethloff, J., "Problems of Electrofishing and their Solutions," Modern Fishing Gear of the World, Vol. II, pp. 551-556, Fishing News (Books) Ltd., London.

14. Nikonorov, I.V., "Pump Fishing with Light and Electric Current," Modern Fishing Gear of the World, Vol. II, pp. 557-579, Fishing News (Books) Ltd., London.

15. Grinstead, B.G., "A Fish Pump as a Means of Harvesting Gizzard Shad From Tail Waters of TVA Reservoirs," The Progressive Fish Culturist, Vol. 31, No. 4, pp. 236-238, 1969.

16. Bedell, G. W. and P. D. Flint, "Pumping Fish in California," The Progressive Fish Culturist, Vol. 31, No. 4, pp. 233-235, 1969.

17. "Live Fish Transfer Pump Reduces Harvesting Cost," The American Fish Farmer and World Aquaculture News, Vol. 2, pp. 12-14, 1971.

A-1

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

50-333

December 27, 1972

APPENDIX A

RECEIVED
DEC 29 1972
U.S. ATOMIC ENERGY COMMISSION
Regulatory Mail Section

Mr. Daniel R. Muller
Assistant Director for
Environmental Projects
Directorate of Licensing
U.S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Muller:

The draft environmental impact statement for the "James A. Fitzpatrick Nuclear Power Plant, Docket No. 50-333", which accompanied your letter of November 14, 1972, has been received by the Department of Commerce for review and comment.

The Department of Commerce has reviewed the draft environmental statement and has the following comments to offer for your consideration.

In Section 2.4, the last line, additional information could be presented on actual earthquake intensities observed in the area.

The last paragraph of Section 2.6 could be expanded to include reference to tornado probabilities for the area computed from the procedure outlined by H.C.S. Thom in the Monthly Weather Review, October-December 1963.

In Section 5.4.3, Thermal Discharge Effects, subsections (b), (c) on plankton and benthos should be expanded to substantiate the conclusions reached. The section on plankton concludes that no shift is expected in the dominant groups of algae from the present diatom and green phytoplankton populations toward dominance of blue-green algae. This conclusion should

perhaps be justified by itemizing and evaluating, for each species of concern, such factors as temperature tolerances, nutrient requirements, and seasonality, and relating these factors to the expected population trends for these species in Lake Ontario. Species diversity should be considered both in this justification and in the development of the work outline for the benthos and periphyton studies portion of the Environmental Monitoring Program discussed in Section 6.

Since neither the applicant's Environmental Report or the Preliminary Safety Analysis Report contains a joint frequency distribution of wind speed, direction and atmospheric stability, we are unable to verify the staff's average annual relative concentration values as found on page 5-18. Also the staff does not indicate the meteorological data upon which these estimates were made nor what the maximum value might be at the nearest site boundary.

In the same vein, we are unable to evaluate the environmental effect of the accidental release of gaseous effluents because of the lack of appropriate meteorological frequency data.

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

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

50-333

December 22, 1972

APPENDIX B

Mr. Daniel R. Muller
Assistant Director for Environmental Projects
Directorate of Licensing
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Muller:

In response to your request of November 14, 1972 for comments on the environmental statement for the James A. FitzPatrick Nuclear Power Plant, and pursuant to its responsibilities under Section 102(2)(C) of the National Environmental Policy Act of 1969, the Advisory Council on Historic Preservation has determined that your draft environmental statement appears procedurally adequate, however we have the following substantive comment to make:

> To insure as comprehensive a review of historical, cultural, archeological, and architectural resources as possible, the Advisory Council suggests that the draft environmental statement contain evidence of contact with the State Historic Preservation Officer and that a copy of his comments concerning the effect of the undertaking upon these resources be included in the environmental statement. The State Liaison Officer for Historic Preservation for New York is Mr. Alexander Aldrich, Commissioner of Parks & Recreation, Room 303, South Swan Street Building, Albany, New York 12223.

Should you have any questions on this comment or require any additional assistance, please contact Mr. Jordan Tannenbaum of the Advisory Council staff.

Sincerely yours,

Robert R. Garvey, Jr.
Executive Secretary

APPENDIX C

POWER AUTHORITY OF THE STATE OF NEW YORK

10 COLUMBUS CIRCLE NEW YORK, N.Y. 10019
(212) 265-6510

December 29, 1972

Mr. A. Giambusso
Deputy Director for Reactor Projects
Directorate of Licensing
U. S. Atomic Energy Commission
Washington, D. C. 20545

Subject: James A. FitzPatrick Nuclear Power Plant - Draft Environmental Statement AEC Docket No. 50-333

Dear Mr. Giambusso:

By notice in the Federal Register of November 16, 1972 [37 Fed. Reg. 24378] opportunity was given to comment upon the Draft Environmental Statement prepared by the Directorate of Licensing in this proceeding. We submit herewith ten (10) copies of Applicants' comments on that document.

Very truly yours,

Asa George

Asa George
General Manager

Att. -10

cc: See attached list

cc: w/ enc.

Mark R. Haflich, Esq.
Bernard M. Bordenick, Esq.
Counsel for AEC Regulatory Staff
U. S. Atomic Energy Commission
Washington, D. C. 20545

J. Bruce MacDonald, Esq.
Counsel
New York State Department of Commerce
99 Washington Avenue
Albany, New York 1210

Miss Suzanne Weber
78 West Seneca Street
Oswego, New York 13126

Ecology Action
c/o Richard Goldsmith
Syracuse University
College of Law
E. I. White Hall, Campus
Syracuse, New York 13210

December 29, 1972

JAMES A. FITZPATRICK NUCLEAR POWER PLANT
AEC DOCKET NO. 50-333
APPLICANT'S COMMENTS ON
DRAFT ENVIRONMENTAL STATEMENT
BY
DIRECTORATE OF LICENSING
U. S. ATOMIC ENERGY COMMISSION

SUMMARY AND CONCLUSIONS

Page S-1, Item 2

Reference is made to the issuance of an operating license for the Power Authority of the State of New York, and other places later in the report refer to a single applicant. These should be corrected to recognize that Niagara Mohawk Power Corporation is a co-applicant for the operating license.

1. INTRODUCTION

Page 1-3 Table 1.1 - Licenses, Permits and Approvals, etc.

Table 1.1 should be updated as follows:

Department of the Army Permit to operate a water discharge	Application Not Filed
New York State DEC Permit to operate the intake and discharge structures	Issued Nov. 27, 1972
New York State DEC Permit to install and operate auxiliary steam boilers for plant heating	Issued Feb. 22, 1972

Page 3-20, last two paragraphs

The dilution along the centerline of a submerged buoyant jet has been developed by several investigators in various hydraulic laboratories across the country (References 1-16). The interference of multiple jets has also been investigated in detail. Accordingly, it is in our judgment that it is inconceivable "to expect the model results to be in error by a few

degrees" as stated in Section 3. 2. 2 of the AEC Draft Environmental Statement. It should be pointed out that an error of even 1 F in excess of the predicted 3 F temperature rise would represent an error of 30 percent in the diffuser dilution ratio. Such an error would be inconsistent with the present state-of-the-art in submerged jet modeling.

We concur with the staff's opinion that "hydraulic modeling is particularly suitable for studying the region close to the diffuser," since it is in this region close to the diffuser, or near-field, that the model results and associated hydrothermal analyses have shown that the New York State temperature criteria are met by the diffuser.

REFERENCES

1. Abraham, G., "Jet Diffusion in Stagnant Ambient Fluid," Delft Hydraulics Laboratory 1963, Publ. No. 29, July 1963.

2. Abraham, G., "The Flow of Round Buoyant Jets Issuing Vertically into Ambient Fluid Flowing in a Horizontal Direction," Proc. of the 5th International Conference of Water Pollution Research, San Francisco, 1970.

3. Albertson, M.L., et. al., "Diffusion of Submerged Jets," Trans. ASCE, Vol. 115, 1950, Pp. 639-664.

4. Anwar, H.O., "Behavior of Buoyant Jet in Calm Fluid," HY4, 1969, ASCE.

5. Cederwall, K., "Hydraulics of Marine Waste Water Disposal," Hydraulics Division, Chalmers Institute of Technology, Report No. 42, 1968.

6. Ditmars, J.D. "Computer Program for Round Buoyant Jets into Stratified Ambient Environments," W. M. Keck Laboratory, California Institute of Technology, Tech. Memo. 69-1, 1969.

7. Fan, L.N., "Turbulent Buoyant Jets into Stratified Ambient Fluids," W.M. Keck Laboratory, California Institute of Technology, Report No. KH-R-15, July 1967.

8. Fan, L.N. and Brooks, N.H., Discussion of "Horizontal Jets in Stagnant Fluid of Other Density," by Gerrit Abraham, J. of Hydraulics Division, ASCE, Volume 92, HY2, March 1960, Pp. 423-429.

9. Fan, L.H. and Brooks, N.H., "Numerical Solution of Turbulent Buoyant Jet Problems," W. M. Keck Laboratory, California Institute of Technology, Report No. KH-R-18, January 1969.

10. Harleman, D.R.F., Jiska, G. and Stalzenbach, K.D., "A Study of Submerged Multiport Diffusers for Condenser Water Discharge with Application to the Shoreham Nuclear Power Station," Ralph M. Parsons Laboratory, Report No. 139, Massachusetts Institute of Technology, Cambridge, Massachusetts, July, 1971.

11. Hayashi, T. "Turbulent Buoyant Jets of Effluent Discharged Vertically Upwards from an Orifice in a Cross Current in the Ocean, Volume 1, 14th Congress of the International Association for Hyd. Resources.

12. Jain, S.C., Sayre, W.W., Akyeampong, Y.A., McDougall, D. and Kennedy, J.F., "Model Studies and Design of Thermal Outfall Structural. Quad. Cities Nuclear Plant," IIHR Report No. 135, Iowa Institute of Hydraulic Research, the University of Iowa, Iowa City, Iowa, September, 1971.

13. Koh, R.C.Y. and Chang, Y.C., "Mathematical Model for Prediction of Dispersion and Settling in Buoyed Ocean Dispersal of Wastes," Report prepared for Office of Research and Monitoring, EPA, Tetra Tech. No. TC232, Tetra Tech., Inc., Pasadena, California, July 1972.

14. Morton, B.R., Taylor, G.I. and Turner, J.S., "Turbulent Gravitational Convection from Maintained and Instantaneous Sources," Proc. Reg., Section A, Volume 234, Pp. 1-23, 1956.

15. Rawn, Bowerman and Brooks, "Diffusers for Disposal of Sewage on Sea Water," ASCE Journal of Sanitary Engineering Division, March 1960.

16. Turner, J.S., "Jets and Plumes With Negative or Reversing Buoyancy," J. of Fluid Mechanics, Volume 26, Pt. 4, Pp. 779-792, 1966.

<u>Page 3-22 to 3-24</u>

The cumulative surface temperature rises listed in Table 3.2 of the AEC Draft Environmental Statement are based on a Nine Mile Point, Unit 1, plume of more than 3 F temperature rise and 10 ft. in depth over the FitzPatrick diffuser area for all current conditions. Post-operational surveys conducted in 1970 have shown that the Nine Mile Point, Unit 1, discharge plume over the FitzPatrick Plant discharge area is, in general, stratified in a very thin layer. Ambient temperatures at a depth of 5 ft.

over the FitzPatrick Plant discharge area are rarely affected by the Nine Mile Point, Unit 1, discharge. A temperature rise of 3 F or more due to the Nine Mile Point, Unit 1, discharge, is found only at the surface in the FitzPatrick Plant discharge area.

Based on the post-operational measurements, a depth of 3 ft. with an average temperature rise of 3 or 4 deg would be more realistic to predict the cumulative surface temperature rise.

The minimum dilution factor or dilution at the surface, S_A, in Table 3. 2 should be corrected according to the modified hydraulic model test results as described in the March 23, 1970 letter from Stone & Webster Engineering Corporation to Mr. Thomas E. Quinn of the New York State Department of Environmental Conservation a copy of which is attached. The dilution factor at the surface based on the modified test results with the most critical current would then be 12 as compared to 7. 6. Under this critical condition, the dilution of the FitzPatrick Plant jet at the bottom of the Nine Mile Point Station layer (3 ft.), S_A, will be 11. 5 based on extrapolation of theoretical analysis and experimental data. (References 4, 5 and 15).

The cumulative surface temperature rise as outlined on page 3-27 of the AEC Draft Environmental Statement, assuming an excess subsurface temperature of $\Delta T_A = 0$ F, would then be 2. 8 F (see calculation below).

$$\Delta T_S = \frac{\Delta T_O}{S_S} + \frac{(S_A - 1)}{S_S}\Delta T_A \pm \frac{S_S - S_A}{S_S}\Delta T_n$$

$$= \frac{31.5}{12} + \left(\frac{11.5-1}{12}\right) 0 + \left(\frac{12-11.5}{12}\right) 4 = 2.8 \text{ F}$$

Page 3-28, 1st paragraph

The AEC Draft Environmental Statement states that the studies conducted are not adequate to support the Applicants' conclusions on compliance with New York State thermal discharge criteria. It is the opinion of the Authority and its consultants that these statements are in error.

Page 3-33, Section 3. 4. 2, 3rd paragraph

The AEC statement gives 7. 5 hours and 4. 4 hours for holdup times on the charcoal absorber system for krypton and xenon respectively. The

latter figure for xenon must be in error. Charcoal is a far better absorber of xenon than krypton. The holdup times should be more like 18 hours for krypton and 245 hours (10 days) for xenon. The use of a 4.4 hour holdup time for xenon would give erroneous gaseous dose estimates in subsequent sections.

Page 3-34, paragraph 3

Estimates for gaseous releases have been presented in the Environmental Report which Applicants consider to be fully supported by operating experience to date in BWR plants. Applicants have not, on the basis of this paragraph and other parts of the Draft Environmental Statement, been able to understand fully the basis for the Staff's estimates or to account completely for the differences between the Applicant's and the Staff's estimates.

4. ENVIRONMENTAL EFFECTS OF SITE PREPARATION AND TRANSMISSION LINE CONSTRUCTION

Page 4-1, Section 4.1.2

A number of statements appear in this section about the degree of restoration of the transmission right-of-way. It should be pointed out that restoration efforts are not yet complete. Contracts are presently in force which call for a greater degree of clean-up than have been completed to date. These activities, in general, have been delayed by the unusually large amount of rainfall which has occurred during the last year. The clean-up, restoration and maintenance of the right-of-way will be in accordance with the applicable criteria of the U.S. Department of Interior Publications "Environmental Criteria for Electric Transmission Systems" - 1970.

5. ENVIRONMENTAL EFFECTS OF PLANT OPERATION

Page 5-4

We do not agree with Staff's conclusion that the provisions for future fish handling facilities are not adequate. Although survival data through pumps are not available for many of the species in the vicinity of Nine Mile Point, there are several literature sources discussing mortality of fish in pumps. The following is a brief review of this literature with respect to the provisions at the FitzPatrick Plant:

> Provisions have been incorporated in the screenwell for future installation of fish removal facilities, should significant numbers of fish enter the offshore intake. The necessity of providing fish

removal facilities will be determined by monitoring the numbers of fish collected from the traveling water screens. The provisions which have been included during the initial stages of construction and operation include a room for future location of fish handling pumps and sleeve blockouts for the future installations of transfer piping, if necessary.

If fish removal facilities are required, a system similar to that described by Kerr (Ref. 1), Adams (Ref. 2), and Hicks and Edwards (Ref. 3), which is presently being used at the Contra Costa Steam Station, could be installed. This system consists of suction troughs extending across the upper portion of each traveling screen. The troughs would be positioned behind a fabricated curtain wall extending below extreme low water. The troughs would be connected to pumps capable of handling fish with minimum stress. The pumps and troughs would be appropriately sized depending on the numbers and size of fish being observed during the monitoring program. The pumps would also be located to minimize the amount of lift on the suction side of the pump. It is generally accepted that negative pressures cause more severe stress to fish than positive pressures. Piping on the discharge side of the fish handling pumps would extend directly back to the lake or a holding facility.

Several researchers have studied the feasibility of transferring live fish with pumps. Kerr (Ref. 1) discusses the experiments conducted to determine the best type of pump for handling fish at Contra Costa. Two types of pumps proved successful: one, a 5 inch bladeless impeller type centrifugal pump, and the other an 8 inch open impeller type centrifugal pump. The 8 inch pump appeared more satisfactory for handling fish up to 22 inches long and was more effective in keeping the screenwell area clear of fish during periods of rapid buildup. The conclusion of these studies suggested that the pumps can safely handle hundreds of fish per hour in sizes from the smallest to 14 inches long with a survival of 98 percent or more. Bedell and Flint (Ref. 4) discuss the use of a centrifugal pump to move fish from hatchery ponds to trucks and holding tanks. The pump was originally designed as a food handling pump with a special impeller to eliminate sharp contours and any obstructions that would bruise or deform the product being pumped. It has been operated successfully and is used to pump fish ranging in size from 2 to 12 inches to heights up to 15 feet above the water. They mentioned that California hatcheries are being equipped with these pumps to eliminate the mortality

from hand netting. Crinstead (Ref. 5) also describes a pumping facility used to harvest gizzard shad from the tailwaters of TVA reservoirs.

The American Fish Farmer and World Aquaculture News (Ref. 6, 7) describes the use of pumps for transferring fish from hatchery raceways to collecting trucks. A specially designed clogless centrifugal pump is presently being used by the California Department of Fish and Game, Oregon State Fish Commission, the Washington State Department of Game, and the U.S. Bureau of Sport Fisheries and Wildlife. The pumps are considered to be faster in handling fish and have also been shown to cause less stress than conventional netting techniques. Several private concerns are also using pumps to handle live fish up to 19 inches long. The pumps have been demonstrated to handle up to 500 pounds of fish per minute with little mortality. The species most commonly handled in these facilities include catfish and various salmonids.

In summary, it is the Applicants' opinion that fish can be rescued from the screenwell. In any event, the installation of a system similar to that proposed above would certainly not rule out the utilization of other means to repel fish at the intake entrance. However, finer bar spacings at the intake structures would be impractical due to maintenance problems.

REFERENCES

1. Kerr, J.E. "Studies in Fish Preservation at the Contra Costa Steam Plant of The Pacific Gas and Electric Company," State of California, Department of Fish and Game, Fish Bulletin No. 92, 66 pp. (1953).

2. Adams, J.R. "Thermal Effects and Other Considerations of Steam Electric Plants," Pacific Gas and Electric Company, August 10, 1968, 34 pp. (1968).

3. Hicks, T.G., and T.W. Edwards, "Pump Application Engineering," McGraw Hill Inc., New York, New York (1971).

4. Bedell, G.W. and P.D. Flint. "Pumping Fish in California," Progressive Fish Culturist, 31 (4): 233-235 (1969).

5. Crinstead, E.G. "A Fish Pump as a Means of Harvesting Gizzard Shad from Tailwaters of TVA Reservoirs," Progressive Fish Culturist 31 (4): 236-238 (1969).

6. "Tests Show Pump Facilities' Transfer of Fish at High Speed," The American Fish Farmer 1 (8): 25 (1970).

7. "Live Fish Transfer Pump Reduces Harvesting Costs," The American Fish Farmer, 2 (2): 12-14 (1971).

Page 5-5

Studies carried out at Nine Mile Point and elsewhere on Lake Ontario seem to indicate that maximum temperature rather than temperature rise through the condenser is the major factor in entrainment effects. The condenser temperature rise is not of itself the controlling factor. Further it is not clearly brought out in the AEC Draft Environmental Statement that the effect is a seasonal rather than year-round problem.

Page 5-6, 1st paragraph

The statement that "Fish eggs and larvae, and small fish that may be entrained will suffer from thermal shock and high mortality will occur when ambient water temperature is 65 F or above" should be put in proper perspective. The discussion should state that the species of fish found in the region of the Lake have demersal eggs which will generally not be subject to entrainment.

Page 5-17

The differences between the radiological doses calculated by the Staff and the Applicants result from differences in:

a) Source Term assumptions

b) Isotope spectrums

c) Equipment performance and operation

d) Assumptions on fish, water and invertibrate consumption rates

e) Mixing zone dilution

Further, it is probable that the dose models used in the computations may also be different.

If reasons for the differences are to be evaluated as to significance, the rationale behind AEC source term assumptions should be refined more precisely and that dose calculation models should be described in detail. In any event, the radiation dose levels calculated by either method are of no public health consequence.

Page 5-18, Section 5.6.3

The Applicants cannot at this time comment on the findings of the

Staff with regard to direct radiation. A study is currently being made to determine the expected annual average radiation levels on and adjacent to the Plant Site due to direct radiation. If this study should indicate that radiation needs to be reduced an engineering evaluation of methods of accomplishing this will be undertaken.

6. ENVIRONMENTAL MONITORING PROGRAM

Page 6-1, Section 6.1

It is the opinion of the Authority that the aquatic monitoring programs carried out to date and planned for the future coupled with experience at operating stations are adequate to predict and verify the effects of operation of the FitzPatrick Plant on the Lake Ontario ecosystem. However, the Staff's proposal for increased statistical quantification of results would require further expansion of existing programs. The need for such work is not apparent to us. Nevertheless, we intend to meet with the Staff and establish with them a suitable monitoring program.

Page 6-5, Section 6.3

The critical paths of exposure for releases from the FitzPatrick and Nine Mile Point Stations include the milk chain, submersion in a cloud and ingestion of fish and invertibrates which result in doses to the thyroid, whole body, and the GI tract respectively. All other pathways are far less significant. The relative ordering of these pathways is consistent with the results of studies recently completed at the Dresden and Yankee Rowe nuclear stations by the Environmental Protection Agency.

All of these critical pathways will be monitored around the FitzPatrick Plant by the monitoring program as currently operated. A complete description of the environmental sampling, the locations, radionuclide measured, etc. is found in Volume IX, Question 2.18 of the FitzPatrick Plant FSAR.

The value of 1/30 the 10CFR-20 limits (not 1/3) is based on an analysis presented in Appendix D of the Nine Mile Point FSAR that indicates that even when all the uncertainties are taken into account, it is highly improbable that any radioactivity would be detected in the environs of Nine Mile Point. Therefore, emphasis was placed on in-plant monitoring i.e. at the stack and in the off-gas line. It seems pointless to measure various environmental media when there is little, if any, chance of detecting radioactivity. For this reason, only the most critical and sensitive media are measured. These include the various aquatic species listed in Tables 3.6.3-1 and 3.6.3-2 of the FitzPatrick Environmental Report and milk, air particulates, and

precipitation rain/snow samples and TLD measurements. Thus the most sensitive indicators on the critical pathways are measured.

It is our opinion that the program as outlined is adequate. We can see no apparent scientific logic to justify the addition of 15 monitoring stations as is suggested in the Draft Environmental Statement. We would, therefore, expect to meet with the Staff to discuss the basis of their recommendations.

ANSWERS TO QUESTIONS REGARDING "ENGINEERING AND ECOLOGICAL STUDIES" REPORT

Contained in a letter to Mr. E. Brodfeld dated, March 13, 1970

HYDROTHERMAL ANALYSIS

A. Path of Discharge Plume

The center line of the plume from the diffuser structure with lake currents was computed using an equation from Abramovich, "The Theory of Turbulent Jets," based on experiments using a single jet completely surrounded by a deflecting flow with a uniform velocity field. In the case of the FitzPatrick plume, buoyancy forces have no effect on the plume trajectory since these forces act at right angles to the jet momentum and water surface. When the mass density of the ambient and jet fluid are set equal in Abramovich's equation, gravity or buoyancy forces also have no effect on the path of a horizontally discharged submerged jet.

The trajectory of a horizontally discharged submerged jet will not be affected if a very thin horizontal plate is inserted along the jet axis. The plate has no effect since the result of half the ambient momentum interacting with half the jet momentum is the same as the entire ambient momentum interacting with the entire jet. The center line of the plume from the FitzPatrick diffuser was computed by assuming the horizontal plate is the lake water surface and the plume below the water surface is one-half of a jet, the other half being its mirror image above the water surface. The initial equivalent diameter of the jet was determined using the actual and mirror image plumes as one jet with dimensions determined from the model studies at a point approximately 300 ft downstream from the diffuser structure. The model data indicated that the plume width and depth at this at this distance, where a uniform line source was produced, were 1,080 ft and 25 ft, respectively and that the average velocity in the plume was approximatoly 0.5 ft/sec.

As evident from the above, Abramovich's equation can be applied to compute the trajectory of a surface jet after the proper equivalent jet diameter is determined and the mass density of the jet and ambient deflecting fluid is taken to be equal. For example, to compute the plume center line with a lake current of 0.5 ft/sec from the west, the terms in Abramovich's equation become:

$$d = 4R_H = 4\,\frac{1{,}080 \times 50}{2{,}160 + 100} = 95.5 \text{ ft}$$

$$\frac{\rho V^2}{\rho V_0^2} = \frac{0.5^2}{0.5^2} = 1.0$$

$$\cot\alpha = \cot 84^\circ = 0.105$$

B. Lateral Spread of Flow Field

The lateral spread of the flow field from the plume center line was determined using a technique developed by Brooks, "Diffusion of Sewage Effluent in an Ocean Current." As stated in the reference, "The analysis which follows deals with this lateral mixing occurring in the open ocean after the sewage field has been formed." That is, the initial dilution from a submerged discharge must be known, and the starting point for Brooks' technique is a continuous line source of known width at the water surface with an essentially constant concentration. Although the technique was intended for sewage effluent in the ocean, the solution of only physical dilution was given for which case the apparent coliform dicoff constant K was set equal to zero. In addition, vertical mixing is neglected to simulate the stability induced by the relative buoyancy of the effluent compared to the ambient fluid. Longitudinal mixing is also neglected since no ambient fluid is available within the plume and the concentration gradient along the plume is very small. All mixing is assumed to occur laterally, reducing the concentration at the plume edges to a greater extent than in the plume center, thus producing a normal or Gaussian concentration profile at a given distance. The diffusion coefficient was taken to be a function of the plume width, as recommended by Brooks, and the initial diffusion coefficient was obtained from a summary of available data given in the reference.

To illustrate the application of Brooks' equations in predicting temperature patterns, the plume width and center line temperature for a current of 0.2 ft/sec from the east will be computed at a distance of 3,000 ft from the point where the model indicated a uniform temperature field was produced, approximately 300 ft from the diffuser.

Initial conditions: $L_o = b = 1{,}080 \text{ ft} = 3.3 \times 10^4 \text{ cm}$

Diffusivity $E_o = 7.5 \times 10^3 \text{ cm}^2/\text{sec} = 8.1 \text{ ft}^2/\text{sec}$ (Fig. 1

$$B = \frac{12E_o}{UL_o} = \frac{12 \times 8.1}{0.2 \times 1{,}080} = 0.45$$

for X = 3,000 ft

$$B\frac{X}{L_o} = 0.45\,\frac{3{,}000}{1{,}080} = 1.25$$

$$L = L_o\left(1 + \frac{2}{3}B\frac{X}{L_o}\right)^{3/2} = 2{,}680 \text{ ft}$$

$$C_o/C_{\text{℄}} = 1.9 \qquad \text{(Fig. 4)}$$

or $\Delta T_{\text{℄}} = \Delta T_o/1.9 = 2.5/1.9 = 1.3$ F

The total plume width of 2,680 ft and the center line temperature are used to draw a Gaussian temperature rise profile at 3,000 ft from the point of initial diffuser mixing. Similar computations are made for other distances, and points of equal temperature are connected to form isotherms.

MODEL STUDIES

The hydraulic model studies used a total circulating water flow of 780 cfs with a temperature rise of 32.4 F above an ambient lake temperature of 72 F. Prototype flow will be 825 cfs with a temperature rise of 31.5 F. As will be shown, the higher prototype flow and corresponding increase of initial discharge velocity, in conjunction with a lower temperature rise, will produce prototype temperature rises that are lower than those measured in the model.

The minimum dilution factor S_o of submerged buoyant jets has been shown by many investigators to be dependent on the relative submergency of the jet center line below the water surface, y/d, and the initial densimetric Froude number of the jet F_o, where:

$S = \Delta T_o / \Delta T_{℄}$ = minimum dilution factor

ΔT_o = initial temperature rise

$\Delta T_{℄}$ = temperature rise at center line

y = distance from water surface to jet center line

$F_o = V_o / \sqrt{g \frac{\Delta \rho}{\rho} d}$

V_o = initial jet velocity

g = acceleration of gravity

$\Delta \rho$ = difference in mass density between jet and ambient fluid

ρ = mass density of ambient fluid

For a given relative submergence, greater dilution will be achieved at higher initial densimetric Froude numbers. The densimetric Froude number may be increased by either (a) an increase in initial jet velocity, or (b) a decrease in initial density or temperature difference, or (c) a combination of both factors. This is illustrated in the enclosed figure from Rawn, Bowerman and Brooks, "Diffusers for Disposal of Sewage in Sea Water." To demonstrate the extent that the higher prototype flow and lower temperature rise will decrease

the temperature relative to the model data, the dilution factor for each case is computed below:

Using the average jet submergence of 25 ft

$y/d = 25/2.5 = 10$

$T_{Lake} = 70$ F

Model

$V_o = 13.25$ ft/sec
$\Delta T_o = 32.4$ F

$F = 20.0$

$S_{\mathbb{C}} = 11.5$

$\Delta T_{\mathbb{C}} = 32.4/11.5 = 2.82$ F

Prototype

$V_o = 14.0$ ft/sec
$T_o = 31.5$ F

$F = 21.6$

$S_{\mathbb{C}} = 12.5$

$\Delta T_{\mathbb{C}} = 31.5/12.5 = 2.52$

Since the fully mixed temperature rise after the jets have reached the surface is directly proportional to the center line temperature, prototype temperatures will be reduced by 2.52/2.82, or by a factor of 0.89.

SURFACE TEMPERATURE PATTERNS

As stated in the "Engineering and Ecological Studies" report, the adopted design of intake and discharge structures will produce field conditions which comply with the New York State criteria governing thermal discharges. This prediction is based on a model study and analyses as to the effects of flow from the Nine Mile Point station, and on a thorough evaluation of field and model studies regarding the performance of the FitzPatrick diffuser structure. As will be shown below, there were a number of conservative factors in the model used to measure temperature rises with lake currents which will lead to lower field temperature rises than indicated by the model. These differences were

evaluated, and were predicted to have effects sufficient to produce acceptable field temperature patterns. Temperature patterns with lake currents shown in the report in Appendix D were based directly on model data, and therefore illustrated temperature rises in excess of those predicted for field conditions. This factor was pointed out by a note on the figures.

To compute the attached temperature rise patterns predicted for field conditions, including the effects of the Nine Mile Point station, a list of the conservative model differences from field conditions is given together with the expected decrease in field temperatures ascribed to each. It should be noted, as stated on page 15 of the report, that the operating point of 825 cfs with a 31.5 F temperature rise is the most critical combination of discharge and temperature. Usually, the temperature rise will be somewhat lower and/or the flow will be higher. In addition, the ambient lake temperatures used in the model studies simulated maximum summer temperatures. Lower ambient lake temperatures will lead to more dilution and lower temperatures.

Cooling Water Flow and Temperature Rise

All model testing was conducted using a cooling water flow of 780 cfs with a temperature rise of 32.4 F. Prototype flow will be 825 cfs with a rise of 31.5 F. As shown previously under "Model Studies," the higher flow and lower temperature will result in more jet dilution in the prototype. Using published data on jet dilution as a function of relative submergence and initial densimetric Froude number, it was shown that field temperature rises would be reduced by a factor of 0.89.

Low Turbulence Level

As stated in the model report, "It is generally agreed that the jet behavior is independent of Reynolds number for sufficiently high Reynolds number, i.e., R_e greater than 8,000 to 10,000." A high Reynolds number implies high turbulence, and if the Reynolds number is sufficiently low, all turbulence will be damped out by viscous forces and the flow is said to be laminar. Between the laminar and turbulent states, there is a mixed or transition flow regime. In the 1/81 scale model, which was used to measure hydrothermal patterns with lake currents, the Reynolds number of the jet was approximately 6,000 or somewhat lower than desirable.

As distinct from simulating conditions of no natural lake currents, simulating jet entrainment with currents also depends to some extent on the turbulence level of the current. Chow, "Open Channel Hydraulics," indicates that for practical purposes, the transitional range between laminar and turbulent flows for open channels may be assumed to be 2,000 to 8,000 using $4R_H$ as the length parameter in the Reynolds number. Chow points out that the upper value is

somewhat arbitrary since it depends on the flow conditions of each case. For a typical lake current of 0.5 ft/sec and using the depth of 30 ft at the diffuser as the hydraulic radius, the lake current Reynolds number in the model was 8,000. Since the Reynolds number at smaller depths shoreward of the diffuser is less, this portion of the flow was in the transition and laminar regime and would tend to damp out turbulence of the adjacent deeper flows.

It is estimated that the effect of higher prototype turbulence levels will decrease the field temperature rises by approximately a few tenths of a degree, certainly at least 0.1 F.

<u>Velocity Profile</u>

Model lake currents were established by a relative increase in water surface at the upstream end of the model. This produced a gravity flow in the model with the typical velocity profile of gradually decreasing velocities with depth found in open channels. Field measurements at the site show that actual lake currents have the rapidly decreasing velocity with depth profile characteristic of wind induced currents. For a given simulated average lake current, the model flow therefore had more momentum near the depth of the discharge jets with the result that the entrainment mechanism of the jets was not able to deflect the flow in the direction of the jets as readily as will be possible in the prototype. Since the prototype jets will deflect the flow required for entrainment more easily, prototype entrainment of ambient lake water will be enhanced, leading to lower temperature rises. It is estimated that this factor will decrease field temperatures by a few tenths of a degree, certainly at least 0.1 F.

<u>Direction of Lake Current</u>

The model lake bottom was constructed as a plane surface at the average prototype bottom slope. Lake currents were therefore parallel to the shore line. Current measurements in the field, approximately 350 ft shoreward of the diffuser structure, showed that on the average, the flow is approximately 20 degrees offshore for currents to the east. This is due to the shore line and bottom topography in this vicinity. Flow to the west is essentially parallel with the shore line. The effect of an offshore current in the field compared to the more parallel model flow can be approximately determined by analogy to model tests in which the angle between the line of diffusers and the current was changed. A clockwise rotation of the line of diffusers of 15 degrees with a current to the east reduced the model temperatures by a factor of 0.75 or more. It is therefore predicted that field temperatures for currents to the east will be reduced by a factor of 0.75 or more due to the offshore current direction in the field as compared to the model.

The factors mentioned above and their predicted effects on reducing field temperatures from those obtained in the 1/81 model are summarized in the following table. This table also indicates the predicted field temperature rises within 300 ft from the diffuser including the effects of cooling water flows from the Nine Mile Point Nuclear Station. The predicted cumulative field temperatures within 300 ft from the diffuser were used as the starting conditions to develop the attached figures of predicted temperature patterns.

PREDICTED CUMULATIVE TEMPERATURE RISES
WITHIN 300 FT FROM DIFFUSER

A.	Current from West to East				
	Current speeds, ft/sec		0.2	0.5	0.8
	Maximum ΔT in 1/81 model, F		3.0	3.5	3.4
	Factors	Effect			
1.	Cooling water flow and temperature rise	x0.89	2.7	3.1	3.0
2.	Low turbulence level	-0.1 F	2.6	3.0	2.9
3.	Velocity profile	-0.1 F	2.5	2.9	2.8
4.	Direction of lake current	x0.75	1.9	2.2	2.1
	EFFECT OF NINE MILE, F		+0.4	+0.5	+0.5
	CUMULATIVE TEMPERATURE RISE, F		2.3	2.7	2.6
B.	Current from East to West				
	Current speeds, ft/sec		0.2	0.5	0.7
	Maximum ΔT in 1/81 model, F		3.0	3.5	3.6
	Factors				
1.	Cooling water flow and temperature rise	x0.89	2.7	3.1	3.2
2.	Low turbulence level	-0.1	2.6	3.0	3.1
3.	Velocity profile	-0.1	2.5	2.9	3.0
	NO NINE MILE EFFECT		0	0	0
	CUMULATIVE TEMPERATURE RISE, F		2.5	2.9	3.0

EFFECTS OF NINE MILE POINT DISCHARGE

The effects of cooling water flows from the Nine Mile Point Nuclear Station reaching the site of the James A. FitzPatrick Nuclear Power Plant were determined by a combination of model and analytic studies. A model of the Nine Mile discharge structure was tested to determine the hydrothermal patterns within 100 ft of the structure under conditions of no lake currents. Analyses were made to determine the characteristics of the surface layer of diluted Nine Mile cooling water at the FitzPatrick site, and to determine the resulting incremental temperature rise this layer will produce in the FitzPatrick discharge plume.

Analyses to determine the characteristics of the surface layer used data obtained from the model study as initial conditions. The basic equations governing the mechanism of a radial flow of a warm surface layer and the underlying layer of colder water are the equations of hydrostatic pressure, conservations of momentum and energy, mass and heat. These basic equations are:

Hydrostatic pressure: $$\frac{1}{\rho}\frac{\partial p}{\partial z} = g \qquad (1)$$

Momentum in the radial direction: $$u_r\frac{\partial u_r}{\partial r} + u_z\frac{\partial u_r}{\partial z} = -\frac{1}{\rho}\frac{\partial p}{\partial r} + \frac{1}{\rho}\frac{\partial \tau_{rz}}{\partial r} \qquad (2)$$

Mass conservation: $$\frac{\partial u_r}{\partial r} + \frac{\partial u_z}{\partial z} = 0 \qquad (3)$$

Heat conservation: $$u_r\frac{\partial T}{\partial r} + u_z\frac{\partial T}{\partial z} = 0 \qquad (4)$$

Where ρ = the density of the surface water

p = the hydrostatic pressure

r, z = radial and vertical coordinates

g = gravitational constant

u_r = velocity of the surface flow in r direction

u_z = velocity of the surface flow in z direction, or the rate of entrained flow

τ_{rz} = shearing stress between two-layer flow

T = temperature of the surface water

Equations (1) through (4) for both layers were transformed to the dimensionless equation in terms of the variables u/u_1, h/h_1, r/r_1, $\Delta T/\Delta T_1$, etc., in which u, h and ΔT are the velocity, depth and temperature rise of the flow at distance r, and u_1, h_1 and ΔT_1 are the corresponding initial conditions at the distance r_1.

The dimensionless equations are solved simultaneously for u, h and ΔT to any point between Nine Mile Station and the FitzPatrick site by the method of finite difference. Conditions at the end of each finite Δr are used as the given conditions for the next Δr. Heat transfer from the water surface to the atmosphere is considered in addition to equation (4) at each finite interval. The numerical integral steps yielded the temperature rise decay of the radial Nine Mile surface flow for no lake currents.

With eastward currents, the travel time of the diluted Nine Mile surface flow from the Nine Mile Station to the FitzPatrick site would decrease with increasing current speed. A shorter travel time will result in a higher temperature rise at the FitzPatrick site. The isotherms computed for the no-current condition as described above will be moved in the direction of the current as determined by the vector addition of the Nine Mile surface flow velocity with the current speed. The resulting temperature rises and flow depths at the FitzPatrick site are shown in Fig. D-14 of the report.

To compute the incremental temperature rise in the FitzPatrick plume due to the layer of diluted cooling water from Nine Mile reaching the FitzPatrick site, computations were made as to the cumulative effects produced by:

a. Some flow from Nine Mile being pulled into the FitzPatrick intake

b. Some flow from Nine Mile being entrained in the jet dilution process

The increase in the initial FitzPatrick temperature rise above ambient due to pulling some Nine Mile flow into the intake was computer with up to 30 per cent of the FitzPatrick intake flow being that of Nine Mile. The additional increase in FitzPatrick plume temperatures due to Nine Mile flows entering in the jet entrainment process was computed using the difference in dilution factors at the water surface as compared to that of the bottom of the flow layer from Nine Mile. The equations derived to numerically determine these two effects, as shown below, are based on continuity of mass and heat.

The difference in the jet dilution factors at the water surface and at the bottom of the Nine Mile flow layer indicated how much flow from the entire layer is entrained in the FitzPatrick jets. To determine the variation in dilution factors along the center

line of a jet with free surface effects, analogy was made to available theoretical and experimental information on the variation in center line dilution of jets before they reach the free surface. This information was plotted to obtain the general shape of the relationship between dilution and distance along the center line. Using the model test data on center line dilution of the FitzPatrick jets at the free surface for no lake current and various current speeds, curves of dilution versus center line distance were drawn using the determined general shape of the relationship as a guide. The following table summarizes the obtained center line dilution factors at the free surface and at the bottom of the Nine Mile flow layer:

<u>MINIMUM DILUTION FACTORS, S</u>

Current speed (ft/sec)	0.0	0.2	0.4	0.6	0.8
Dilution at surface (S_o)	11.6	10.0	8.5	7.9	7.6
Dilution at bottom of Nine Mile layer (S_L)	9.3	8.3	6.9	6.5	6.3

Applying the continuity equation to the entrainment process with these data provided information on the increase in maximum temperature at the point where the FitzPatrick plume intersects the water surface. To obtain the increase in mixed or "flow away" temperature, model data on the relative drop in temperature, and therefore increase in dilution, of the flow-away area versus the maximum temperature area was used. This ratio was a function of the current speed.

The equation of continuity for the FitzPatrick intake flow is:

$$Q_A \Delta T_A + Q_L \Delta T_L = Q_o \Delta T_o{}^1$$

Where Q_A = ambient flow from lake

ΔT_A = ambient temperature rise = 0.0

Q_L = flow from Nine Mile layer

ΔT_L = temperature rise in layer above ambient

Q_o = total cooling water flow

$T_o{}^1$ = temperature rise of <u>intake</u> flow above ambient

Using $Q_L = 0.30\ Q_o$

and since $\Delta T_A = 0$

$$0.30\ Q_o \Delta T_L = Q_o \Delta T_o{}^1$$

or $\Delta T_o{}^1 = 0.30\ \Delta T_L$

The equation of continuity for the jet entrainment mechanism is:

$$Q_O\Delta T_O + Q_A\Delta T_A + Q_L\Delta T_L = Q\Delta T$$

Where ΔT_O = temperature rise of <u>discharge</u> flow above ambient

Q = total flow after dilution process

ΔT = temperature rise above ambient after dilution process

Since $Q_L = Q_o (S_o - S_L)$

$Q = S_o Q_o$ (by definition

and $\Delta T_A = 0$

$$\Delta T = \frac{\Delta T_O}{S_O} + \frac{\Delta T_L (S_O - S_L)}{S_O} \quad (6)$$

To illustrate the application of equations (5) and (6), the incremental temperature rise in the FitzPatrick plume for an eastward current of 0.8 fps will be computed. Note that since the above technique requires model data on dilution, it is necessary to use the actual temperature rises measured in the model. For this current, ΔT_L = 3.3 and the ratio between the temperature in the flow-away zone to the minimum jet dilution at the water surface was determined to be 3.4/4.3 from the model data. From equation (5):

$$\Delta T_o^1 = 0.30 \times 3.3 = 1.0 \text{ F}$$

Therefore,

$$\Delta T_o = 32.4 + 1.0 = 33.4 \text{ F}$$

From the above table,

S_O = 7.6 and S_L = 6.3

Using equation (6)

$$\Delta T = \frac{33.4}{7.6} + \frac{3.3(7.6 - 6.3)}{7.6} = 4.96$$

Flow-away temperature is 4.96(3.4/4.3)= 3.92

Actual measured flow-away temperature in model was 3.4 F

Therefore, incremental increase is 3.92 - 3.4 = 0.52 F

ADVERSE WIND CONDITIONS

The effects of onshore winds must be considered in light of (a) the measured site characteristics, (b) the flow patterns produced by the discharge structure and (c) the probability and duration of such winds.

Measurements of lake currents at the site showed that the percentage of time an onshore current exists is negligible for speeds greater than 0.05 knots. This is reasonable, since continuity of water mass implies it is impossible to have surface flow onto the shore line except in relatively thin layers. Hydrothermal patterns with lake currents essentially parallel to the shore have been investigated. Onshore winds could deflect the discharge plume to some extent, but no recirculation would be produced. Onshore winds are therefore of interest primarily under conditions of no natural lake currents.

Flow patterns induced by the diffuser structure under conditions of no natural lake current are shown in Fig. 10 of the model test report. The maximum surface velocity in the discharge plume is 1.0 ft/sec, and the average plume velocity is approximately 0.5 ft/sec. Flow induced for the jet dilution process moves from the shore line toward the diffuser at approximately 0.5 ft/sec. It is evident, therefore, that an induced flow at 0.5 ft/sec is moving lakeward even under conditions of no natural lake currents. To force a wind driven surface layer of this flow pattern shoreward requires a wind strong enough to produce a surface water velocity of at least 0.5 ft/sec, and have a duration sufficiently long so as to overcome the induced flow momentum. Hutchinson, "A Treatise on Limnology" p. 278 and p. 291, indicates a number of investigators have determined that the wind driven surface water velocity is from 1 to 2 per cent of the wind velocity. Using an average of 1.5 per cent, a persistent onshore wind of approximately 35 ft/sec, or 25 mph, would be required to overcome the lakeward velocity of 0.5 ft/sec at the water surface. Since the wind induced water velocity decreases rapidly with depth, only a thin surface layer is affected.

An analysis of 20 years of wind data from Main Duck Island, an exposed recording station at the northeast portion of Lake Ontario, indicates that the maximum hourly average wind from the north which can be expected once each year is approximately 30 mph. Therefore, the required wind of 25 mph will only occur a few times in any given year and will last for only a few hours. It is important to note that winds of this speed with longer durations will produce lake currents of such magnitudes that currents parallel to the shore will be produced, and the condition of no natural lake currents will no longer exist. The possibility of a surface layer of wind driven diluted cooling water shoreward of the diffuser is therefore a transient phenomenon, with this flow being removed when lake currents are established.

COLLEGE OF LAW
SYRACUSE UNIVERSITY

APPENDIX D

RECEIVED
JAN 8 1973
50-333

January 3, 1973

Deputy Director for Reactor Projects
Directorate of Licensing
U.S. Atomic Energy Commission
Washington, D.C. 20545

Re: Draft Environmental Statement for the James A. FitzPatrick Nuclear Power Plant (Docket No. 50 - 333)

Dear Sir:

This letter constitutesthe comments by Ecology Action on the Draft Environmental Statement issued by the Directorate of Licensing in November, 1972 concerning the proposed continuation of a Construction Permit and issuance of an Operating License to the Power Authority of the State of New York for the operation of the James A. FitzPatrick Nuclear Power Plant (JAFNPP) in the Town of Scriba, County of Oswego, State of New York.

Ecology Action is an unincorporated association of private citizens residing in the area of Oswego, New York, formed to conserve and to protect the natural resources and physical environment of the region, including Lake Ontario. In pursuance of this objective, Ecology Action has petitioned to intervene in the within proceeding in order to raise and assure appropriate consideration of issues of radiological health and safety and environmental quality which are presented. Not all of these issues are addressed in this letter, which treats only some of what Ecology Action believes to be serious in/adequacies of the Draft Environmental Statement (DES).

A. The Environmental Effects of Plant Operation on Aquatic Environment (DES §§ 5.4, 5.5)

We believe that the ecological studies referred to by the Staff do not provide an adequate data base for evaluating the effects to date on Lake biota of the operation

January 3, 1973
Page 2

of Nine Mile Point, Unit 1, nor for predicting the effects of operation of an additional plant (JAFNPP) at the site. The Staff apparently agrees since it ends its discussion of the effects of Plant operation on the aquatic environment by concluding (DES p.5-9):

> "The Applicant's preoperational ecological studies do not provide an adequate data base which can be used to quantitatively predict the effects of Plant operation on aquatic ecosystem of the lake.

Although in the very next sentence the Staff expresses its view that "the operational effects are expected to be localized", the basis for such an expectation is nowhere explained. Accordingly, we believe that the Staff's rejection of cooling systems alternative to the "once through" cooling system proposed by PASNY (DES §10.1) is not justifiable. It rests, implicity, on the assumption that PASNY should not bear the monetary costs of closed cycle cooling unless and until the environmental costs of once through cooling can be specifically identified. The command of the National Environmental Policy Act (NEPA) is to the contrary.

Section 101 of the Act declares the policy of the United States to include the recognition that "each generation" acts "as trustee of the environment for succeeding generations," with the obligations to "assure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings...[and]... to attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences." Section 102 of the Act directs that "to the fullest extent possible...the policies, regulations and public laws of the United States shall be interpreted and administered in accordance with the policies set forth in [§ 101]". If this mandate is to be

obeyed-if the AEC is, "to the fullest extent possible," to administer its licensing responsibilities "as trustee of the environment for succeeding generations" - then PASNY should be required to bear the monetary costs of closed cycle cooling unless and until it can demonstrate sufficiently small environmental risks and costs to justify once through cooling. In short, the burden of being unable to predict the effects on the environment of the operation of the JAFNPP should be borne by the operation of the JAFNPP, not by the environment.

Nor do we believe that the aquatic montoring program suggested by the Staff (DES §6.1) justifies further experimentation upon the environment with a "once through" cooling system. Firstly, the licensing of such experimentation is inconsistent with the AEC's obligations under §101 of the NEPA. Secondly, we do not believe that the suggested monitoring program is sufficiently rigorous to assure the timely detection of all adverse environmental effects of the proposed once through cooling system. Among the major defects in the proposed monitoring regimen which have been identified by Dr. Daniel F. Jackson (a consultant to Ecology Action whose published research has been relied upon by the Staff here), are the following:

1. The size of the sampling area is inadequate. Mobile sampling stations should be utilized within a five mile radius of the discharge. This is necessary for random sampling of sufficient breadth.

2. The proposed sampling technique is inadequate. Provision should be made for sampling for <u>all</u> relevant parameters at the <u>same</u> time. Furthermore, the frequency of such sampling should be increased to at least once a month throughout the year and to at least three times a month during the critical period from Spring through early Summer.

3. The monitoring program should be conducted by an independent laboratory rather than by PASNY, Niagara Mohawk or governmental personnel. Data collection and

evaluation must be objective. Such objectivity is unnecessarily compromised by entrusting the monitoring program to employees of the Plant owner or operator or to governmental agencies involved in the initial approval of Plant licensure.

B. The Environmental Effects of Accidents (DES §7)

1. Plant Accidents

The Draft Environmental Statement fails to consider what are termed "class 9" accidents despite the Staff's acknowledgment that "their consequences could be severe" (DES p. 7.3). The stated justification for omitting discussion and evaluation of class 9 accidents is that "the probability of their occurrence is so small that their environmental risk is extremely low" (DES p. 7.3). However, this "justification" rests on the unstated assumption that the Emergency Core Cooling System of the Plant (ECCS) will function effectively in the event of a loss of coolant accident (LOCA). This assumption is arbitrary and does not permit a valid distinction to be drawn between the probability of a LOCA (a class 8 accident which is considered and evaluated in the DES) and a LOCA followed by an ECCS failure - a class 9 accident. The latter is just as possible as the former and unless the environmental effects of its occurrence are evaluated the Environmental Statement will be legally deficient.

In any event, a wealth of responsible scientific opinion in disagreement with the Staff's opinion of the predicted efficacy of the ECCS has emerged during the pending AEC proceedings which question the sufficiency of the Interim Acceptance Criteria for the ECCS (Docket No. RM 50 - 1). This scientific opinion must be included in the Environmental Statement (Committee for Nuclear Responsibility v. Seaborg ___F.2d___3ERC 1126 (D.C.Cir.1971)).

2. Transportation Accidents

The Draft Environmental Statement fails to identify the nature of the accidents analyzed. Furthermore, with respect to those accidents which are

purportedly analyzed, the DES does not identify the basis for the two conclusions drawn:

> (i) "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."
>
> (ii) "If releases occurred, they would be expected to take place in a short period of time. Only a limited area would be affected."

Failure to correct these defects will leave the Environmental Statements incomplete and legally deficient.

C. The Need for Power (DES §8.1)

1. The Need for Power has not been evaluated by the Staff

Under NEPA, it is the AEC which must evaluate the need for power which supposedly justifies the environmental costs of the JAFNPP. The DES reveals that this evaluation has not been made by the AEC Staff but, instead, has been based upon statistics provided and judgments made variously by the Applicant and by other governmental and private agencies such as the FPC and the Northeast Power Coordinating Council (NEPCC), which, in turn, have relied upon figures furnished by the Applicant. While the Applicant and other public and private agencies can provide information helpful to an evaluation of the need for power from the JAFNPP, under NEPA this determination must be made by the AEC, and then, only after an independent analysis of the facts on which that determination is to be made (Greene County Planning Board v. FPC, 455 F.2d 412 (2d Cir.1972)). The Environmental Statement must include that independent analysis.

2. All of the Relevant Factors Have Not Been Considered

The Calculations of the need for power which do appear in the DES assume the validity of reserve margin criteria prescribed by the NEPCC. The basis for this assumption should be explained in the Environmental Statement.

Furthermore, no meaningful calculation of the need for power can be made without analyzing the daily variations in power demand - PASNY's "load factor." Yet, the DES is silent on this subject.

Finally, the Environmental Statement should explain the basis for the assumption that the need for power from the JAFNPP is to be determined with reference to the load of the entire New York Power Pool rather than simply the demand of those 3 categories of customers which PASNY is authorized to serve by virtue of L.1939 C.870.

D. The Environmental Impact of the Proposed Action

Nowhere does the DES discuss, consider or evaluate the following environmental impacts of the proposed licensure of JAFNPP:

1. The incremental effects upon the environment caused by the mining, processing and reprocessing of the fuel needed for the JAFNPP.

2. The incremental burden placed upon facilities for the long-term storage of highly toxic radioactive wastes produced at the JAFNPP.

3. The consequences of a major accident with breach of containment and the release of massive quantities of radiation into the environment (See discussion at B.1, Supra).

4. The impact on the environment of the radiation releases and thermal discharge from the JAFNPP, taking into account the aggregate radiation releases and thermal discharges now projected or reasonably forseeable. While the DES does evaluate the combined impact of the radiation releases and thermal discharges from the JAFNPP and Nine Mile Point, Unit 1, the Applicant has requested a 40 year license for the JAFNPP. If licensed, the JAFNPP will thus be operating in an environment which includes other major power plants in addition to Nine Mile Point, Unit 1 -- among them, Nine Mile Point, Unit 2 (scheduled for 1978); Oswego Steam Station, Unit 5 (scheduled for 1974) and Unit 6 (scheduled for 1976); as well as perhaps a plant at Sterling, N.Y., some few miles west of Oswego and further units at the Nine Mile

Point site. A realistic assessment of the impact of the JAFNPP's operation upon the environment must take the operations of these other plants into account.

E. Alternatives to the Proposed Action (DES §9)

We have already addressed ourselves to certain basic flaws in the Staff's assessment of the need for power from the JAFNPP (see discussion at part C, supra). Assuming (for the sake of argument) the existence of a valid forecast of needed power, the question remains whether that need is to be blindly met by reflexively constructing new sources of supply or whether that need is to be met, in whole or in part, by placing some constraints upon demand. Nowhere does the DES address any of the following measures, all of which are reasonable alternatives to the proposed licensure of the JAFNPP.

1. Selective load shedding("load rippling") during periods of peak demand.
2. Changes in the rate structure which presently encourages the use of electricity by decreasing the magnitude of per unit costs with increased volume.
3. Restraints on wasteful uses of electricity, such as for residential and/or commercial space heating.
4. Changes in advertising practices which promote the uses of electricity and lead to increased demand.

Unless this defect is corrected, the Environmental Statement will be legally deficient. (See Natural Resources Defense Council v. Morton ___ F.2d ___, 3ERC 1558 (D.C. Cir.1972)

F. The Cost-Benefit Analysis (DES §11)

The cost-benefit analysis of the DES is inadéquate because of the Staff's failure to consider fully the environmental effects of the proposed action as well as reasonable alternatives to the proposed action (See discussion at D and E, supra.)

Other relevant cost factors have also been ignored. For example, the costs borne by the public through the limitation of liability for radiation damage provided by the Price-Anderson Act, and the costs of fines for fish kills which the New York State Attorney General is empowered to collect under the New York Conservation Law (see People v. Consolidated Edison Co., 71 M.2d 587 (Sup.Ct.N.Y.Co.1972). In addition, the benefits of the JAFNPP have been overestimated. For example, the assumption that the JAFNPP will operate at a plant factor of 85% (DES p.8.3) is unrealistically optimistic. In any event, it is nowhere explicated in the DES as it should be.

More fundamentally, the cost-benefit analysis of §11 of the DES is almost worthless as an aid to decision making here because of the utter failure to quantify the costs and benefits involved. Such quantifications is required by §102(2)(B) of NEPA and unless the Environmental Statement includes a more complete and quantitative cost-benefit analysis of the proposed action it will be legally deficient.

Conclusion

It is respectfully submitted that unless the Environmental Statement addresses the deficiencies in the Draft Environmental Statement which are discussed above it will fail to comply with §102(2)(c) of NEPA and will not constitute the aid to sound decision making which that Act contemplates

Very truly yours,

Richard I. Goldsmith
Assistant Professor of Law
Attorney for Ecology Action

RIG:am

cc. see attached list

Mark R. Haflich, Esq.
Bernard M. Bordenick, Esq.
Counsel for AEC Regulatory Staff
U. S. Atomic Energy Commission
Washington, D.C. 20545

J. Bruce MacDonald, Esq.
Counsel
New York State Department of
Commerce
99 Washington Avenue
Albany, New York 1210

LeBoeuf, Lamb, Leiby, and MacRae
1821 Jefferson Place, N.W.
Washington, D.C. 20036

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

MAILING ADDRESS:
U.S. COAST GUARD (GWS/83)
400 SEVENTH STREET S.W.
WASHINGTON, D.C. 20590
PHONE: 426-2274

APPENDIX E

8 JAN 1973

50-333

Mr. Daniel R. Muller
Assistant Director for Environmental Projects
Directorate of Licensing
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Muller:

This is in response to your letter of 14 November 1972 addressed to Mr. John E. Hirten, Assistant Secretary for Environment and Urban Systems, concerning the draft environmental impact statement, environmental report and other pertinent material on the James A. Fitzpatrick Nuclear Power Plant, Scriba, Oswego County, New York.

The concerned operating administrations and staff of the Department of Transportation have reviewed the material submitted.

The Federal Aviation Administration noted the following:

"With reference to Part 5.1.2 of the report, we concur with the statement, "The principal potential interference with prior air rights is the effect the line (transmission line) may have on air traffic or the operation of airports. ---". We note that this paragraph is somewhat contradictory to the statement on Page J8 of the report prepared by the Power Authority of the State of New York which says, "The line (transmission line) will not interfere with the operation of any airport."

"We would suggest that an in-depth analysis of this aspect of the statement and/or report be performed to ascertain the precise effect, if any, the transmission line will have on proximal airports.

"We do note that the line passes less than 3 miles of the airport shown just north of Florence - 2 miles to be exact. We feel that this is a matter that warrants further consideration."

The Department of Transportation has no further comments to offer on the draft statement. We have no objection to this nuclear plant project. However, the Federal Aviation Administration, in its comments, have raised a serious issue which must be addressed in the final statement concerning the possible effects of the transmission line on proximal airports. The Department concurs in their suggestion that an in-depth analysis be performed to ascertain precise effects. So as to not unduly delay licensing procedures, it is recommended that this aspect in the final report be coordinated directly with the Federal Aviation Administration as follows:

Administrator, Eastern Region
Federal Aviation Administration
John F. Kennedy International
Airport
Jamaica, New York 11430
Attention: Chief, Planning Staff

The opportunity afforded the Department of Transportation to review and comment on the draft statement for the James A. Fitzpatrick Nuclear Power Plant is appreciated.

Sincerely,

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

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

50-333

APPENDIX F

RECEIVED
JAN 15 1973
U.S. ATOMIC ENERGY COMMISSION
Regulatory Mail Section

January 11, 1973

Mr. Daniel R. Muller
Directorate of Licensing
Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Muller:

We have had the draft environmental statement for the James A. FitzPatrick Nuclear Power Plant, Power Authority of the State of New York, reviewed in the relevant agencies of the Department of Agriculture and comments from Soil Conservation Service and Forest Service, both agencies of the Department, are enclosed.

Sincerely,

T C Byerly

T. C. BYERLY
Coordinator, Environmental
Quality Activities

Enclosures

United States Department of Agriculture
Forest Service

RE: Forest Service Comments on James A. Fitzpatrick Nuclear Power Plant

This draft environmental statement addresses the impact of the continuation of construction period and the issuance of operating license to the Power Authority of New York for the operation of the James A. Fitzpatrick Nuclear Power Plant. The power plant is in place and the 70 mile transmission line right-of-way has been cleared, thus, the major effects on Forest areas have already taken place. We believe the draft statement adequately covers most impacts. One point that is not clear is whether public off-road vehicle use of the right-of-way will be permitted for hunting and other recreational use. This use, if permitted, could lead to erosion problems.

SOIL CONSERVATION SERVICE, USDA

Comments of Draft Environmental Statement prepared by Directorate of Licensing, U. S. Atomic Energy Commission, on the James A. FitzPatrick Nuclear Power Plant

(1) Last paragraph - page 2-1

In the middle of the sentence it says, "The number of farms in the Oneida Plain ....." - should this be Ontario Lake Plain?

(2) Last 2 sentences - page 4-2

Vegetating of access road should be prompt on areas subject to erosion not just those that run straight up and down hills.

(3) First sentence - page 4-3

Restoration of soils exposed and unavoidably scarred in areas around the tower bases should be done promptly and with appropriate vegetation.

(4) Page 8-11 - paragraph 8.2.1 - Land Effects

Wherever construction activities disturb areas or remove vegetation, prompt revegetating measures should be undertaken to prevent erosion.

General Comment

Wherever topsoil needs to be removed for construction, it should be stockpiled, protected and reused in a suitable manner. A sentence or two on this in the environmental statement is desirable.

APPENDIX G

RONALD W. PEDERSEN
FIRST DEPUTY COMMISSIONER

STATE OF NEW YORK
DEPARTMENT OF
ENVIRONMENTAL CONSERVATION
ALBANY

50-333

RECEIVED
JAN 18 1973
U.S. ATOMIC ENERGY COMMISSION
Regulatory Mail Section

January 15, 1973

Dear Sir:

The State of New York has completed its review of the "Draft Environmental Statement Related to the Completion and Proposed Operation of the James A. FitzPatrick Nuclear Power Plant by the Power Authority of the State of New York", (Docket No. 50-333), issued November 1972, which was prepared by the Commission's Directorate of Licensing.

In preparing the attached comments, we have taken into consideration the views of all appropriate State agencies including the New York State Atomic Energy Council. Many of the comments are quite detailed and directed to very specific points in the draft environmental statement with the intent of clarifying and improving the Commission's final environmental statement.

We direct your particular attention to our comments on the water quality aspects, and the applicant's hydrothermal analysis, of the facility. These comments are based on the most recent data available obtained from the applicant's consultants and should be carefully considered by the Commission staff in preparation of the final environmental statement.

The attached comments are illustrative of our concerns and should be given your utmost consideration. Thank you for the opportunity to review this document.

Sincerely,

Enclosure

United States
Atomic Energy Commission
Washington, D. C. 20545

Attention: Deputy Director for Reactor Projects,
Directorate of Licensing

STATE OF NEW YORK

COMMENTS

on the

"Draft Environmental Statement
by the
Directorate of Licensing,
U.S. Atomic Energy Commission
on the
Environmental Considerations Related to the
Completion and Proposed Operation of the
James A. FitzPatrick Nuclear Power Plant
by the Power Authority of the State of
New York" (A.E.C. Docket No. 50-333)

Issued November 1972

1. Page S-3 - Summary and Conclusions, Item 6 - The State of New York has an existing review mechanism for environmental reports and draft statements (for nuclear matters) whereby the State Atomic Energy Council coordinates the review and consolidation of comments of its members, and the State Department of Environmental Conservation coordinates the final State reply (including the comments from the Council, its members, and other State agencies). In the past, the Commission has recognized this mechanism and forwards the appropriate number of copies of each document to the N.Y.S. Atomic Energy Council (for distribution to member agencies), and the Department of Environmental Conservation (for internal review and for State agencies not Council members). In addition, the Commission forwards one copy to the State Clearinghouse in The Office of Planning Services, and they in turn notify all other appropriate State agencies of an opportunity to review.

We, therefore, suggest that the Commission recognize this in the future by appropriately listing the State agencies reviewing the document as follows:

New York State Agencies

Department of Environmental Conservation

Atomic Energy Council

Department of Commerce (Staff of Council)

Department of Health

Department of Labor

Department of Environmental Conservation

Department of Education

Atomic and Space Development Authority

Public Service Commission

New York City Finance Administration

State Clearinghouse, Office of Planning Services

2. Page 2-1 - In the land use section, the statement indicates that the area within five miles of the site is predominantly rural, and that the "vicinity" (undefined) of the site is largely abandoned farm land overgrown with second growth trees and brush. The statement would benefit by the inclusion of a land use map and accompanying discussion, indicating the land uses and ecological characteristics of the site and its immediate environs.

Also, this statement reports that the plant will occupy a 702 acre site, of which 600 acres will remain in its original condition (Page 4.1). There is an indication at the end of the statement (Section 11.2.1 - Benefit Cost Summary - Land Use), that this 200 acres may be used as a wildlife refuge. This plan should be discussed, in more detail, in the initial land use section of the report. There is no indication which part of the site is being considered; no discussion of the nature of its "original condition"; and no

commentary on the habitat or wildlife population of the proposed refuge.

3. Page 2-3 - There is no map showing site topography or the relation of the facility to the site as a whole. There are only two maps in the entire study which show part or all of the site boundaries. One (figure 2.2) is titled "Population Distribution (1971) Within Five Miles of the FitzPatrick Nuclear Plant." This map was taken from an environmental report for a nearby plant, the Nine Mile Point Plant, and does not delineate the area radially five miles around FitzPatrick. The other map (figure 10.2), which shows the whole site, has the FitzPatrick Plant properly located but fails to show the boundary between the FitzPatrick and Nine Mile Point Plants and whether one or two separate sites are involved.

4. Page 2-8 - The following statement is made: "The site is located in an inactive seismic region."

The above statement is an expression of an opinion which is not a fact. From recent studies performed by Lamont-Doherty Geological Institute, with New York State cooperation in some instances, it appears that any site in New York may be seismically active. In order to obtain a more accurate assessment of the seismic activity of a site, a monitoring program for low-energy seismic events in the area should be undertaken. Such a monitoring program has not been performed for the Nine Mile Point Nuclear Plants Nos. 1 and 2 or the James A. FitzPatrick Plant.

Fourteen seismic events have been recorded within about fifty miles of the site, as follows:

1853 - VI near Lowville
1925 - III near Syracuse
1925 - III at Sodus Point
1927 - III near Syracuse
1930 - slight shock at Clinton
1931 - II at Rochester
1941 - II at Watertown
1941 - two slight shocks at Watertown
1945 - III at Auburn
1952 - V in Mohawk Valley near Auburn
1954 - M = 3.3 near Montezuma
1954 - I at Watertown
1963 - M = 3.5 near Lyons Falls

The Unified Building Code has incorporated a seismic risk map prepared by S. T. Algermission which places the James A. FitzPatrick site in seismic risk zone 3, the highest risk possible.

The Commission should revise this statement and include a section on seismology in the draft statement.

5. Page 2-15 - Most of the fish types indicated in Section 2.7.2 have limited home ranges. It is conceivable that the impact of three generating facilities in this area could have a significant adverse effect on local fish populations although the impact on fish in the lake as a whole may be small. In order to assess the magnitude of the potential problem, reference to fish impingement and entrainment data at Nine Mile Point Unit No. 1 should be included as well as data accumulated in testing the condenser at the FitzPatrick Plant.

6. Page 2-20 - The section dealing with natural background radiation states the annual dose rate in the vicinity is 125 mrem. Field measurements around the FitzPatrick site by the State Department of Environmental Conservation give an

6. (continued)

annual dose rate of 70 mrem external penetrating radiation as noted in its annual reports. The background dose rate should be broken down into contributions from the various sources such as, cosmic, terrestrial, weapons fallout and other sources.

7. Page 2-22 - The above mentioned section also indicates there are two decades of monitoring records with which the impact of the plant can be compared. Although there is a large number of data for the vicinity, that data for the early 1960's contains high amounts of weapon's fallout which would mask any effect from the plant.

8. Page 3-2 - The information on the aesthetic effects of the FitzPatrick Plant is incomplete. In particular, the sketches of the Plant omit transmission facilities.

9. Section 3.2.2. Staff's Assessment of the Applicant's Hydrothermal Analysis.

   a. Section 3.2.2 Pg. 3-20 Paragraph 3

   The State does not agree with the AEC staff statement suggesting that it would not be unreasonable to expect model result errors on the order of a magnitude of a few degrees. The weight of the applicant's engineering report, references sited therein, other literature sources, and professional conclusions of eminent researchers refute this suggested conclusion.

   In the State's considered opinion, the applicant's consultants have conducted a rigorous and technically defensible program of investigation and analysis to which can be ascribed a high level of confidence to the conclusions drawn therefrom.

9. (continued)

b. Section 3.2.2b Pg. 3-22

Adjustment of plume trajectory as suggested by AEC staff indicates an assumed shoreward component of the lake current which has not been demonstrated to exist under the referenced lake conditions. The basis for adjustment by the staff is not presented, and it is concluded by the State that there is no demonstrable basis for such changes. Surface infrared may suggest a correction, but this is considered a surface distribution (shear, lateral dispersion) condition, and not direction taken by the entire plume.

c. Section 3.2.2c Pg. 3-23

The combination of circumstances assumed by AEC staff in this section of the report are not considered reasonable. On-site research and investigation by the applicant's consultants verified the 3°F isotherm would not exceed a depth of 3 to 4 feet. This conclusion is verified from two other sources; (1) field investigations done by consultants of Niagara Mohawk Power Corporation in relation to the 9-Mile installation, and (2) hydraulic model studies realizing both near and far field conditions in an integrated hydraulic model which covers both the existing 9-Mile Point #1 discharge and the FitzPatrick discharge. Both of these investigations verified the 3 to 4 foot depth for the 3°F isotherm and offers no support at all for the assumption of a 10 foot depth.

Some perspective should also be applied as to duration and persistence of lake current.

The recent current studies on Lake Ontario provide support for the following conclusions: currents in excess of 0.3 ft./sec. in an easterly direction,would occur less than 5% of the time; currents in excess of 0.5 ft./sec. in an

9. (continued)

easterly direction, would occur less than 1% of the time; currents greater than 0.8 ft./sec. cannot be assigned a probability of occurrence. Applying a persistence factor of greater than 6 hours for any of the above would reduce the probability by more than half.

If AEC staff will re-compute the surface dilution factors, and those at the bottom of the 9-Nine #1 plume, using a 3 foot depth for the 3° temperature, compliance with New York State thermal criteria will be demonstrated. Utilizing the equation on Pg. 3-27 for such conditions, a dilution at the bottom of the 9-Mile plume of 11.5° is achieved, and with an excess surface temperature T_A = 0°F, the comulative surface rise would be 2.8°F.

It should also be recognized that all values so computed are for the center line of the plume at its intersection point with the surface, and do not represent an evaluation of the New York State thermal criteria which has a 300 foot radius or equivalent in which to achieve requisite temperatures.

Therefore, New York State concludes that AEC staff has not taken full recognition of the competence of the investigations, the research which supports them, the reasonableness with which they have been correlated to expected prototype conditions, and negatively, has applied assumptive factors in terms of plume distribution and extent which cannot be supported and, in fact, can be refuted, all of which lead to the conclusion that the summary statement in paragraph 1, page 3-28 indicating non-compliance has neither support nor foundation. Therefore, New York State hereby concludes that its thermal criteria will be satisfied by the proposed project and that AEC statements to the contrary should be rejected.

9. (continued)

It might also be of interest to note that the 9-Mile Point #1 discharge, as it presently exists, (which does not comply with New York State thermal criteria, having been constructed before their existence), will be removed in 1978. At that time, it will be combined with the circulating water discharge from 9-Mile Point #2 in a criteria compliance diffuser which will have minimum (less than 0.5°F) influence in the FitzPatrick discharge area.

10. Page 3-28 Liquid Radioactive Waste - The staff states that the releases during operation of the plant will comply with 10CFR part 20 and part 50 and will be "as low as practicable". The State supports this concept. The staff estimates that less than 5 curies per year, exclusive of tritium, will be discharged. The operating technical specifications should reflect this.

(continued)

10. (continued)

This should clarify the reference to the phrase "if the activity is sufficiently low, discharges are made to Lake Ontario," made throughout this section.

11. Page 3-31 Table 3.3 - The table lists the release of radioactivity in liquids by isotopes. The table omits noble gases although noble gases will be present as stated on page 5-17.

12. Page 3-33 - The statement is made that the gaseous effluents will contain tritium in water vapor among other things. Tritium will also be present in the form of a gas.

13. Page 3-34 - Section 3.4.2 - It is stated that the U.S. AEC staff estimate of the release of noble gases from the plant is higher than PASNY's. The staff estimate is higher than the applicant's because the staff assumed a higher rate of gas release from leaking fuel, a lower holdup time in the off-gas charcoal beds, and allowed for 10 days per year when there would be no off-gas treatment because there is no redundant recombiner system. The report should contain a discussion of the basis for using this rate of gas release from leaking fuel, and the holdup time in the off-gas charcoal beds.

14. Page 3-36 Table 3.5 - This table lists anticipated releases of radionuclides in gaseous effluents, but omits the contribution from the rad waste building. The table shows that approximately one third of the total gaseous releases and one third of the iodine releases will occur during the ten day period the recombiner system is assumed not to be in operation. This fact emphasizes the

14. (continued)

importance of the applicant making every effort to keep this system operable at all times that the reactor is operating. This objective can be approached by scheduling recombiner maintenance when the reactor is down. A redundant system would provide even greater assurance that a recombiner would be operable whenever the reactor was operating.

15. Page 3-39, Transmission Facilities -

A. The potential presence of the Bog Turtle, an endangered species, in the area of the transmission right of way, and the potential detrimental effects of transmission line construction and maintenance on Bog Turtle populations, should be considered.

B. The section dealing with transmission lines should be strengthened. Our knowledge of the area suggests that the following points be considered:

(1) Screening and special environmental precautions at all road and stream crossings.

(2) Manual lopping and stacking of cut vegetation to avoid right-of-way scarification and rutting resulting from over use of heavy machinery.

(3) Contouring of access roads, when feasible, to minimize erosion.

(4) A right-of-way maintenance program that is designed to assure adequate management after construction in the interest of appropriate re-establishment of ecosystems, long term protection of soil and water values, maintaining visually attractive conditions, and providing for appropriate multiple uses.

C. With respect to the multiple use of the right-of-way, it would be valuable if mention was made of the specific program envisioned for the

C. (continued)

resource. This is particularly important when one considers the types of vegetative cover which will occur after construction and the need for a maintenance schedule compatible with the multiple use program proposed.

16. Page 5-4 - When discussing fish entrapment, it is stated that "The magnitude of the problem cannot be accurately predicted at the present time without elaborate intake screen monitoring during plant operation and without a detailed investigation of the population of fishes which may be impinged on the screens." However, Nine Mile Point Unit No. 1 has been operating at this site with a somewhat similar intake system and no reference was made to its operating history in regard to fish entrapment.

17. Page 5-11 - Bioaccumulation factors given in the table are based on data from one author and they do not indicate the magnitude of biological variability present in nature.

18. Page 5-12 - The table lists the effluent releases for Nine Mile Point Unit No. 1 for the year 1971. The data should be identified as being from that year and appropriate load factors should be given since these data are used to predict future releases. The liquid releases for the first six months of 1972 totaled 22 curies, which exceeds the rate of 1971 releases. It is understood that the effluent control system will be upgraded in the future to reduce radioactivity discharges to Lake Ontario.

19. Page 5-18 - The term "radioactive cloud" used in the second paragraph on this page tends to lead one to envision a catastrophic situation. Better phraseology may simply be "gaseous radioactive effluents".

The last paragraph in Section 5.6.2 states that the dose to an infant's thyroid which would result from consuming one liter of milk daily from a cow grazing for five months per year at the nearest dairy farm is 1.9 mrem per year. Table 5.3 states that this value is 11 mrem/year. This apparent discrepancy should be clarified.

20. Page 5-21 to 5-22 - The basis for the assumptions made in calculating population dose from transportation of radioactive material should be discussed and referenced. No mention is made of training, monitoring or the availability of instrumentation for truck drivers and selected railroad personnel to keep the exposure of the population to a minimum. Page 5-21 indicates that the annual cumulative potential dose to truck drivers may exceed those allowable to the general public and there is no indication that they are radiation workers.

21. Page 5-23 and 5-24 - Population doses from all sources for both the FitzPatrick Plant and Nine Mile Point Unit No. 1 have been made for a 1980 population projection. The "Population Dose from All Sources" in 1980 should include contributions from the Nine Mile Point Unit No. 2 Plant expected to be in operation before 1980 and the R. E. Ginna which is within 50 miles of the FitzPatrick Plant.

22. Page 5-28 - The title of reference number 16 should be corrected.

23. Page 6-5 - The State concurs with the staff's conclusion that the proposed radiological monitoring program is not adequate. The environmental monitoring should reflect the Appendix I, 10CFR50 philosophy to ensure that the effluents are indeed as low as practicable. It is noted that 10CFR50 was enacted after the construction permit was issued. In addition, the methods used in sampling and measuring effluents should be clearly spelled out in some publicly available document.

The staff should note that this same program was found "generally acceptable" (with some required modifications) by the U.S. AEC, Directorate of Licensing, on P. 2-18 of its Safety Evaluation for this plant, which was issued in November 1972.

24. Biological Monitoring - Chapter 6 - The State agrees with the recommendations in Chapter 6 for increased biological monitoring. Studies of the plankton including fish eggs and larvae are of particular concern since nearly all such organisms, particularly zooplankton, which go through the cooling water cycle are expected to be killed. It would be desirable to know the actual biomass involved in a year's time. Periphyton studies are not felt to be as necessary as the plankton studies but would be of some interest in view of the rocky bottom and limited benthic organisms.

25. Page 7-1, paragraph 2 - A statement is made that the consequences of radiation accidents have been analyzed using estimates of probability and realistic fission and transport assumptions. It is not possible to relate these consequences of postulated accidents with existing data from the applicant and the U.S. Atomic Energy Commission without knowing the estimate of the probabilities of an accident and the basis for arriving at these results.

26. Page 7-4 -

Table 7.2 shows an estimated dose for a large loss of coolant accident of less than 0.5 mrem. The Final Safety Analysis Report of the FitzPatrick nuclear power reactor shows a two hour off-site whole body dose of 970 mrem and a thyroid dose of 11,400 mrem. This apparent discrepancy should be clarified.

27. Page 7-3,paragraph 1 - The statement is made that an estimate of the dose which might be received by an individual is reported in Table 7.2. Clarification is needed as to whether this is a two hour dose or a course of accident dose and whether whole body or organ dose.

28. Page 7-5 - Footnote (a) indicates that the doses are based on airborne transport of radioactive materials resulting in both direct and inhalation dose. It is believed that in most instances, as a result of an accident, the thyroid organ dose would be limiting rather than the whole body dose. Clarification is needed on this point. Also the footnote states that the applicant's environmental monitoring programs would detect the presence of radioactivity in the environment in a timely manner such that remedial action could be taken from potential pathways to man. There is a need for indicating the basis for this statement and if the time sequence for necessary

28. (continued)

actions will adequately protect the population from contaminated milk, food or water supplies.

29. Page 7-6 - The Section on accidents involving transportation of solid radioactive wastes is not adequately supported by basic studies concerning radioactive materials. References should be presented.

30. Page 7-7 - The Federal Radiation Council Report No. 7 does not refer to contamination levels by ranges but rather uses categories. The statement should be revised on Page 7-7 to read Category I in lieu of Range I.

31. Page 8-12, last paragraph - It is estimated that radioactive releases from the two plants could result in total body doses to individuals of 10.9 mrem/yr near the site boundary. Using the data reported in Tables 5.3 and 5.4, there is difficulty in determining the method for arriving at this figure.

32. Page 9-1 - In the comparison of available alternatives there should be a discussion of the complete fuel cycles of the various fuels. A basic study has been performed for Nuclear Fuels in the Commission's "Environmental Survey of the Nuclear Fuel Cycle". However, to our knowledge, a similar environmental study has not been performed for fossil fuels.

33. Page 10-1 - Section 10 - Consideration should be given to discussing alternate intake designs and alternate discharge designs in this section.

34. Page 10-2 - In the discussion of cooling towers on Page 10-2 through 10-4, the paragraphs dealing with salt "drift" should be expanded to evaluate the ecological or land use effects of salt deposition from cooling towers.

35. Page 10-5 - The Draft Statement fails to show or state what the noise impact of the plant will be. The only place where noise is discussed is to demonstrate that natural and forced draft cooling towers expose a larger land area to sound levels above 45 cB(A).

The Final Environmental Statement should include data on the existing ambient sound level contours near the proposed project, including that contributed by the Nine Mile Point Plant. In addition, the anticipated sound level contours should be shown for the proposed plant when in operation.

36. Page 11-1 - Section 11 - The environmental statement's benefit-cost analysis should be presented in the format prescribed in the Commission's "Guide to the Preparation of Environmental Reports for Nuclear Power Plants."

37. General Comment - In the report the staff indicates that the applicant's environmental studies were ineffective for use in evaluating the plant's potential effect on the environs. It is recommended that, when an application is filed for a construction permit, the Commission review the applicant's environmental program and recommend any necessary changes to ensure that the proper studies are performed prior to consideration of the operating license.

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE 50-333

OFFICE OF THE SECRETARY

WASHINGTON, D.C. 20201

APPENDIX H

JAN 18 1973

RECEIVED JAN 24 1973 U.S. ATOMIC ENERGY COMMISSION Regulatory Mail Section

Mr. Daniel R. Muller,
Assistant Director for
Environmental Projects
Directorate of Licensing
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Muller:

This is in response to your letter dated November 14, 1972, wherein you requested comments on the draft environmental impact statement for the James A. FitzPatrick Nuclear Power Plant, Power Authority of the State of New York, Docket Number 50-333.

The Department of Health, Education, and Welfare has reviewed the health aspects of the above project as presented in the documents submitted. This project does not appear to represent a hazard to public health and safety.

The opportunity to review the draft environmental impact statement is appreciated.

Sincerely yours,

Richard L. Seggel

Richard L. Seggel
Acting Assistant Secretary
for Health

APPENDIX I

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

ER 72/1319

FEB 5 1973

50-333

Dear Mr. Muller:

This is in response to your letter of November 14, 1972, requesting our comments on the Atomic Energy Commission's draft statement, dated November 1972, on environmental considerations for James A. Fitzpatrick Nuclear Power Plant, Oswego County, New York.

Our comments are presented according to the format of the statement or according to specific subjects.

Summary and Conclusions

Paragraph 7, page S-3, should be modified to show that the U. S. Fish and Wildlife Service commented on the applicant's environmental report, supplemental report, application for the operating license and application for the construction permit.

Historical and Natural Landmarks

The statement does not indicate that an archeological survey was made prior to construction. Therefore, the effects of plant and transmission line construction on archeological resources will remain unknown.

The construction of the plant and the transmission line had no effect on any existing or proposed unit of the National Park System, nor any site eligible for registration as a National Historic, Natural or Environmental Education Landmark. However, we suggest that the State Liaison Officer for Historic Preservation be consulted concerning any properties in the project area which may be under consideration for addition to the National Register of Historic Places. He is the Commissioner of Parks and Recreation, Building 2, State Campus, Albany, New York 12226.

Topography and Geology

The brief description of the geology and seismology presented in the draft statement is inadequate for an independent assessment of the geologic environment relevant to the proposed construction of the plant. The data presented are inadequate concerning the physical properties of the geologic materials on which the plant and its appurtenant structures will be founded, and there is no indication of how a knowledge of the physical properties has been used in the design of the facility. The seismic-design criteria and the methods of their derivation should be given.

We think that, as a minimum, a more comprehensive summary of the geologic and seismologic analysis sections of the applicant's preliminary safety analysis report, which covers the geologic and seismologic investigations and analyses, should be included in the final environmental statement to indicate how the data and analyses have been utilized for purposes of design and construction of the facility.

As a result of procedures established between the Geological Survey and AEC, the geologic aspects of the site that are included in the Preliminary Safety Analysis Report have been previously reviewed. Comments on this review were transmitted to the AEC Director of Regulation on January 7, 1970, and were made part of the public record in the AEC licensing procedures.

Hydrology

There are some shallow private wells in the vicinity of the plant; however, water would likely flow northward toward the lake so as to preclude contamination of local wells.

Ecology

The following should be added to the end of the third paragraph on page 2-14. "The southern shore of Lake Ontario is a major migration route used by many waterfowl and other migratory birds. The American osprey and bald eagle use this route also."

Heat Dissipation System

We concur with AEC in that there is likely to be some interaction of the Nine Mile Point heated water with that of this plant. Furthermore, we believe that at certain critical periods there may be recirculation of plant water, since the outlet and intake are separated by only several hundred feet.

We question the ability of jet entrainment to cause such a rapid dilution that will result in water temperatures dropping from 31.5° rise to 3° F rise in the 600-foot diameter surface area indicated. We strongly suspect that thermal plume criteria will be exceeded frequently. As suggested on page 6-4, the thermal plume should be extensively monitored when the plant is operational. In addition, as advised by the AEC, the applicant should consider remedial measures that can be taken to meet New York State thermal standards.

Effect on Land Use

The statement should contain a short discussion on the manner in which the 600 acres of the site, which will remain in the original condition, will be used. It is indicated on page 11.1 that the applicant plans to make this area available as a managed wildlife refuge. Information such as who will administer the wildlife refuge and its availability to the general public should be given.

The possibility of developing certain sections of the transmission line rights-of-way for public trails or other public uses should be discussed.

Effect on Aquatic Environment

It is indicated on page 5-3 that fish may be impinged and killed on the intake screens and that thermal effluents may affect aquatic life adversely. It is also indicated that these impacts are localized and not serious unless the abundance of fish increase in the intake area. The statement should indicate that management techniques to improve habitat conditions and increase fish populations are being applied on a continuing basis. Biologists are currently attempting to establish coho salmon in the lake. It can be assumed that the number

of fish will increase as water quality conditions improve through pollution abatement efforts. Therefore, it should be assumed at this time that larger fish populations than presently exist will be present in the lake during the life of the plant.

Based on this assumption, we suggest that the average velocity of 1.2 fps at the face of the intake bar racks is excessive. Experience at other projects indicate that 0.5 fps at the intake would maintain impingement and entrainment losses to reasonable levels. Facilities for bypassing fish and other organisms subject to entrainment and impingement would minimize these losses.

Significant fish mortality resulting from abrupt temperature changes may result from plant shutdowns during winter months or plant starts after several days shutdown. These damages could be minimized by changing the plant factor gradually. If the temperature change in the effluent is limited to about 2°F per hour, no significant adverse effects are expected.

Environmental Monitoring Program

Since there is presently underway a coho salmon introduction program, the statement should clearly point out that post-operational studies should be continued for as long as necessary to fully assess the impact of the plant on aquatic resources of Lake Ontario with special emphasis on the coho salmon fishery.

Several sections of the statement indicate that the effects of the project on aquatic resources cannot be predicted with certainty at this time and infer that any unacceptable effects that develop during operations and are detected through further special studies or the monitoring program will be eliminated by the applicant. Due to the proximity of Nine Mile Point and Oswego powerplants, there is a possibility that the combined effects of these three plants will have an unacceptable adverse long-range effect on fish and other aquatic organisms. We suggest that the applicant's plans to alleviate such potential damage be developed immediately in order that they can be approved at this time which will in turn allow quicker action if required after operation begins.

Plant Accidents

This section contains an adequate evaluation of impacts resulting from plant accidents through Class 8 for airborne emission. However, the environmental effects of releases to water is lacking. The normal discharge of liquid radioactive wastes into Lake Ontario does not appear excessive, however, due to the slow rate of flushing (15 years according to page 2-9 of the statement) and the wide use of the lake as a water resource, a prime concern at this site should be the potential long-lasting effects of the release of a significant portion of the long-lived radionuclide inventory of the reactor, however remote the possibility.

Class 9 accidents resulting in both air and water releases should be described and the impacts on human life and the remaining environment discussed as long as there is a possibility of occurrence. The consequences of an accident of this severity could have far-reaching effects on land and in the Lake Ontario which could affect millions of people.

Irreversible or Irretrievable Commitments of Resources

The annual production of aquatic organisms killed by impingement, entrainment, and thermal discharge constitutes an irretrievable commitment of resources and should be indicated in this section.

Alternative Means of Power Generation

The sulfur content of the low-sulfur oil considered in table 9.1 should be specified. This would allow reviewers to independently determine the sulfur emissions impact of this alternative fuel.

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

Sincerely yours,

Deputy Assistant Secretary of the Interior

Mr. Daniel R. Muller
Assistant Director for
Environmental Projects
Directorate of Licensing
U.S. Atomic Energy Commission
Washington, D. C. 20545

APPENDIX J

50-333

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

7 FEB 1973

RECEIVED
FEB 8 1973
U.S. ATOMIC ENERGY COMMISSION
Regulatory
Mail Section

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

Dear Mr. Muntzing:

The Environmental Protection Agency has reviewed the draft environmental impact statment for the James A. FitzPatrick Nuclear Power Plant and our detailed comments are enclosed.

The radioactive gaseous releases are not expected to achieve "as low as practicable" levels due to the design of the control systems. However, unusually favorable atmospheric dispersion conditions should result in the achievement of the allowable levels given in proposed Appendix I to 10 CFR Part 50.36a. Since a large fraction of the dose from these releases is due to the bypassing of the charcoal bed holdup system during recombiner downtime, a discussion of the reason for the length of the downtime and the feasibility of providing additional delay time for the gases should be included in the final statement. We also recommend that a dose assessment for the vegetable consumption pathway be included since this pathway may contribute significantly to the total dose resulting from plant operation.

Our analysis of the cooling system indicates that the intake structure, as designed, will preclude the survival of any entrained aquatic organisms. An assessment of the anticipated losses due to the impingement and entrainment of aquatic biota, should be presented and the resultant impact on the total ecosystem estimated. In addition, a biological sampling program should be established by the applicant to gather data that would provide a baseline from which long term trends can be deduced.

Finally, the operation of the FitzPatrick station, when combined with the thermal impact of other generating stations in the vicinity of the site, may result in a violation of New York State's thermal standards. If reanalysis indicates that such a violation will occur, a closed cycle cooling system should be considered for this plant.

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

Sincerely,

Sheldon Meyers

Sheldon Meyers
Director
Office of Federal Activities

Enclosure

ENVIRONMENTAL PROTECTION AGENCY

Washington, D.C. 20450

JANUARY 1973

ENVIRONMENTAL IMPACT STATEMENT COMMENTS

James A. FitzPatrick Nuclear Power Plant

TABLE OF CONTENTS

INTRODUCTION AND CONCLUSIONS

The Environmental Protection Agency (EPA) has reviewed the draft environmental impact statement for the James A. FitzPatrick Nuclear Power Plant prepared by the U.S. Atomic Energy Commission (AEC) and issued on November 14, 1972. The following are our major conclusions:

1. The radioactive gaseous effluent control systems will not achieve discharge levels that are considered "as low as practicable" but are expected to comply with the allowable levels given in the proposed Appendix I to 10 CFR Part 50.36a, due to favorable atmospheric dispersion conditions. A large fraction of the dose from radioactive gaseous effluents results from the bypassing of the charcoal bed holdup system during recombiner downtime. The following information should be included in the final statement:

    a. the basis for assuming a ten day recombiner downtime, and

    b. the feasibility of providing additional delay time for the gases.

2. Dose assessments for the vegetable consumption pathway should be included in the final statement. This pathway needs consideration since it may contribute significantly to the total dose.

3. As designed, the plant's intake structure will preclude the survival of any entrained aquatic organisms. The impact of the anticipated impingement and entrainment losses on the aquatic environment must be accurately assessed in the final statement. In addition, a comprehensive biological sampling program should be established to provide a baseline from which long term trends can be deduced. Such a program must account for the combined effects of

all power plants in the area.

4. Our analysis indicates that the operation of the FitzPatrick plant, when combined with the impacts of the other generating stations in the vicinity of the site, may result in the violation of New York State's thermal standards. If the AEC's reanalysis of this issue confirms our conclusion, then serious consideration should be given to a closed cycle cooling system for the FitzPatrick station.

RADIOLOGICAL ASPECTS

Radioactive Waste Management

The radioactive gaseous effluent control systems at the James A. FitzPatrick Nuclear Power Plant are not capable of reducing the reactor off-gas discharges to levels which can be considered "as low as practicable." However, the annual off-site dose rates from the operation of the FitzPatrick and Nine Mile Point Unit - 1 plants are expected to be approximately at the allowable levels given in the proposed Appendix I to 10 CFR Part 50.36a.

The low doses expected from the gaseous effluent discharges are largely due to the unusually favorable atmospheric dispersion at this site. The release of 200,000 curies/year of radioactive gases from the FitzPatrick plant cannot be considered "as low as practicable" because of the short delay time provided by the ambient temperature charcoal system; 7.5 hours for kryptons and 4.4 days for xenon. Apparently, as indicated by the design provisions of other similar BWR's, it is practicable to provide up to three times as much delay time as has been provided for in the FitzPatrick design. While it is preferable to minimize doses through engineered control at the source, the favorable atmospheric dispersion may justify the use of shorter delay times.

The data in Table 3.5 of the draft statement indicate that a large fraction of the dose from radioactive gaseous effluents is a result of bypassing the charcoal bed holdup system during the assumed ten days of recombiner downtime. Yet, there is no discussion of the basis for the assumed recombiner downtime. The final statement should

discuss this critical assumption. Furthermore, it should provide a discussion of the feasibility of improving the reliability and availability of the off-gas treatment system, and of providing additional delay of the off-gases. The additional margin provided would become more important as additional nuclear capacity is included at the site.

In addition, it would be helpful in determining the impact of the plant if the final statement included an evaluation of the annual discharge of reactor off-gases from the automatic purge system of the off-gas system. This source of gaseous release was not considered in the draft statement. The analysis and presentation should indicate the frequency of such releases, their radionuclide composition, and the resultant off-site doses. The final statement should also include the criteria used for release of untreated contaminated laundry wastes and radioactive liquids to Lake Ontario.

Dose Assessment

Although some vegetable farming takes place in the county (over 4,000 acres according to Appendix C of the environmental report) no dose estimates via a vegetable consumption pathway were given. Vegetables may become contaminated either by exposure to the plume, or by irrigation with water extracted from the lake, which is said to occur to some extent. This potential pathway should be considered, especially since it may contribute significantly to the total dose. It is the total potential dose which is of importance and must be assessed.

Transportation and Reactor Accidents

In its review of nuclear power plants, EPA has identified a need for additional information on two types of accidents which could result in radiation exposure to the public: (1) those involving transportation of spent fuel and radioactive wastes and (2) in-plant accidents. Since these accidents are common to all nuclear power plants, the environmental risk for each type of accident is amenable to a general analysis. Although the AEC has done considerable work for a number of years on the safety aspects of such accidents, we believe that a thorough analysis of the probabilities of occurrence and the expected consequences of such accidents would result in a better understanding of the environmental risks than a less-detailed examination of the questions on a case-by-case basis. For this reason we have reached an understanding with the AEC that they will conduct such analyses with EPA participation concurrent with review of impact statements for individual facilities and will make the results available in the near future. We are taking this approach primarily because we believe that any changes in equipment or operating procedures for individual plants required as a result of the investigations could be included without appreciable change in the overall plant design. If major redesign of the plants to include engineering changes were expected or if an immediate public or environmental risk were being taken while these two issues were being resolved, we would, of course, make our concerns known.

The statement concludes "... that the environmental risks due to postulated radiological accidents ... are exceedingly small." This conclusion is based on the standard accident assumptions and guidance issued by the AEC for light-water-cooled reactors as a proposed amendment to Appendix D of 10 CFR Part 50 on December 1, 1971. EPA commented on this proposed amendment in a letter to the Commission on January 13, 1972. These comments essentially raised the necessity for a detailed discussion of the technical bases of the assumptions involved in determining the various classes of accidents and expected consequences. We believe that the general analysis mentioned above will be adequate to resolve these points and that the AEC will apply the results to all licensed facilities.

NON-RADIOLOGICAL ASPECTS

Biological Considerations

The FitzPatrick facility is located within an electrical power generating complex on the south shore of Lake Ontario in Oswego County, New York. The complex presently consists of an operating nuclear power plant and four operating fossil fuel generating plants. A fifth fossil fuel plant is under construction, and a construction permit has been requested for a third nuclear power generating plant that will be located in the same general area.

The intake structure for FitzPatrick is located 900 feet offshore with its top surface 10 feet below the minimum lake level. Entry velocity is 1.4 fps. The water then passes through a tunnel with a velocity of 4.7 fps and enters a forebay. Vertical traveling screens there strain the water before it enters the pumps. The applicant's intake structure, as designed, precludes the possibility of escape and survival for any aquatic organism once it becomes entrained in the intake tunnel.

The high cooling water ΔT of 31.5°F and total entrainment time of from 12.0 to 15.8 minutes will undoubtedly result in a high mortality of zooplankton, phytoplankton, small fish, fish eggs, and larvae. The question that must be answered with regard to these organisms is what effect their destruction will have on the overall health of the aquatic ecosystem in the vicinity of the plant's operation. No attempt was made in the statement to answer this question either for the operation of FitzPatrick alone, or in combination with the other plants in the area. Such losses may or may

not be detrimental to the overall fish population in the area, but only a well planned monitoring and sampling program can hope to arrive at the answer. Such a program, must of necessity, be carried out in conjunction with all the plants in the vicinity of the FitzPatrick site.

Our recommendations in this area are:

1. The continuation and expansion of comprehensive, long term ecological studies in the vicinity of the plant's operation. Particular emphasis should be placed on zooplankton, phytoplankton, and fish populations, with careful attention paid to seasonal trends. Such studies form the essential baseline from which long term trends can be deduced.

2. The effects of entrainment on zooplankton, phytoplankton, small fish, fish eggs, and larvae must be accurately assessed. The results of such studies should be correlated over the long term with the comprehensive ecological studies called for in 1 above.

We recognize that there will be practical problems associated with inlet and discharge sampling on submerged structures of this type, but in our opinion, it is feasible. Another procedure to obtain the required data would be the construction of a laboratory facility to simulate the operation of the plant. We recommend that a combination of these two methods be used.

3. The potential of the plant's cooling water intake design for large scale destruction of fish by impingement should be fully assessed. Monitoring of numbers and types of fish removed from

traveling screens is a necessary part of any ecological study. The results of this monitoring should be related over the long term to the data on fish populations acquired in the comprehensive ecological studies called for in 1 above.

4. To the greatest extent practicable, the above recommended studies should be performed for FitzPatrick in conjunction with Niagara Mohawk's Nine Mile Point plant. The proximity of these two facilities and their similarities in operation lead one to suppose that their impacts on the lake aquatic ecosystem will be similar and additive. Again, such a program must also consider the combined impact of all plants in the area on the aquatic biota.

5. The above studies being considerd, a timetable for their implementation and completion should be established and included in the final impact statement. This timetable should indicate when the AEC, based on study results, will be able to decide on the adequacy of the present cooling water intake design.

Thermal Considerations

New York State's thermal standards limit surface temperature rise to not more than 3°F outside a zone 300 feet in radius measured from the source. The applicant's model results, which predict that standards will be met, should be reconsidered in light of the AEC's statement that "it would not be unreasonable to expect the model results to be in error by a few degrees." Further doubt is cast on the validity of the applicant's predictions when one looks at the infrared studies done of the Nine Mile Point plant's thermal plume. These show a 3°F rise in ambient water temperature as far away as the intake structure for the FitzPatrick plant. However, the applicant contends in the assessment of thermal impact that during eastward current conditions, Nine Mile Point will contribute 0.5°F at the FitzPatrick diffuser site. This contradicts the results of the infrared study.

The applicant further contends that during westward current conditions there will be no interaction at all between plumes generated at Nine Mile Point and at FitzPatrick. The AEC concludes that more probable plume trajectories show FitzPatrick raising surface water temperatures in the Nine Mile Point discharge area by as much as 2°F, thus, contributing to the already poor thermal situation there.

In conclusion, it appears that the combined operation of Nine Mile Point, FitzPatrick, and the fossil fuel facilities is likely to cause a violation of New York State's thermal standards. If the infrared studies are correct and support this conclusion, and in light of the other units proposed for the area, then serious consideration

should be given to a closed cycle cooling system alternative for the FitzPatrick plant.

Waste Treatment.

Since the FitzPatrick facility is located within a generating complex, the interaction and cumulative effect of non-thermal discharge should be spelled out in sufficient detail to determine the overall environmental impact. The methods for disposal of biological and water treatment sludges should be specified. In our opinion, discharge of these wastes to the lake should be avoided.

The draft statement states that sanitary wastes will receive primary and secondary treatment, with 12 hours minimal detention in the septic tank. We believe that a septic tank system should not be considered as providing secondary waste treatment. Perhaps a package plant extended aeration treatment system should be consid red.

Air Quality Effects

The draft statement contains estimates from model projections for maximum ground level concentrations of sulfur dioxide and particulates. These estimates may be correct based on model predictions assuming that the subject plant facilities are the sole source of these pollutants. There is, however, no estimate of existing air quality in this area. Such an estimate should be included in the final statement with the results obtained from the model.

COST-BENEFIT

In the cost-benefit analysis of alternatives (page 9-3 to 9-10) the assumption is made that the power plant will have a baseload capacity of 80%. This assumption is vital to the economics of this plant as well as other light water reactor plants. The AEC has recently suggested that these plants may be derated by 20% from their designed limits. If this occurs with the FitzPatrick plant, the net output will decrease accordingly, even if an 80% average load factor is attained. Regarding this latter point, perhaps a more realistic load assumption might be a load factor gradually rising to 80% after a few years of commercial service and finally, during the latter years of the plant's life, declining again as newer and more efficient nuclear units come to life. Utilizing these assumptions may significantly change the economics of operations. The final statement should discuss the load factor assumption and present modifications to the cost-benefit analysis, if required. Also, the reason for using an 85% capacity factor (page 9-7) to assess environmental effects should be explained.

ADDITIONAL COMMENTS

During the review we noted in certain instances that the draft statement did 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 James A. FitzPatrick Nuclear Power Plant. The cumulative effects, however, could be significant. It would, therefore, be helpful in determining the impact of the plant if the following topics were addressed in the final statement:

1. The meteorological discussion should be expanded to include a presentation of a joint frequency distribution for wind speed, wind direction, and stability conditions for plant vent and stack releases. This would facilitate independent estimates of critical atmospheric dispersion parameters by those individuals without access to the data in the Final Safety Analysis Report.
2. A tabulation of the atmospheric dispersion factors used for dose calculations for elevated and ground level releases from the Nine Mile Point and FitzPatrick plants, including the critical point off-site, should be included.
3. The final statement should contain an evaluation of the potential thyroid dose from ingestion of radioiodine via the milk pathway from a cow potentially located at the nearest farm, 3,800 feet southeast of the plant.
4. The discussion of estimated doses should include an evaluation of the potential direct radiation dose from

radioactivity in the outside waste surge condensate storage tanks and the turbine building.

5. A discussion of expected off-site doses in relation to the criteria of the proposed Appendix I to 10 CFR Part 50.36a should be included. We note that these guidelines have been used as points of reference in past statements, in contrast to the lack of reference in this statement.

FEDERAL POWER COMMISSION
WASHINGTON, D.C. 20426

50-333

February 21, 1973

IN REPLY REFER TO:

Mr. Daniel R. Muller
Assistant Director for
Environmental Projects
Directorate of Licensing
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Muller:

This is in response to your letter of November 14, 1972, requesting comments on the AEC Draft Environmental Statement related to the continuation of construction permit CPPR-71 and the proposed issuance of an operating license to the Power Authority of the State of New York (PASNY) for the James A. FitzPatrick Nuclear Power Plant (Docket No. 50-333).

Pursuant to the National Environmental Policy Act of 1969, and the April 23, 1971, Guidelines of the Council on Environmental Quality, these comments review the need for the facilities as concerns the adequacy and reliability of the affected bulk power systems and matters related thereto.

In preparing these comments, the Federal Power Commission's Bureau of Power staff has considered the AEC Draft Environmental Statement; the Applicant's Environmental Report and Amendments thereto; related reports made in response to the Commission's Statement of Policy on Reliability and Adequacy of Electric Service (Order No. 383-2); and the staff's analysis of these documents together with related information from other FPC reports. The staff of the Bureau of Power bases its evaluation of the need for a specific bulk power facility upon long term considerations as well as the load supply situation for the critical load period immediately following the availability of the facility.

Need for the Facility

The James A. FitzPatrick Nuclear Generating Plant, Unit No. 1, is an 821-megawatt boiling-water reactor generating unit. The plant is located in Scriba, New York approximately 3,000 feet to the east of the Niagara Mohawk Power Corporation's existing Nine Mile Point Nuclear Generating Station which has been in commercial operation since December 1969. The plant site was surveyed as part of the original site for the Nine Mile Point Nuclear Station.

Mr. Daniel R. Muller

The Power Authority of the State of New York is constructing the James A. FitzPatrick Plant and will have sole responsibility for marketing the power output of the plant. The plant's operation and maintenance personnel will be provided by the Niagara Mohawk Power Corporation on a cost basis pursuant to a contract between it and the Power Authority. Originally scheduled for commercial operation in June 1973, the plant has been delayed and is presently scheduled for commercial operation in October 1973. Due to the four-month delay, its 821 megawatts of baseload capacity will be unavailable for the 1973 summer peak load period. It is expected to be available in time to assist in meeting the 1974 summer peak loads.

The Power Authority is an agency of the State of New York. It is mandated by the New York State Legislature to build baseload nuclear units needed to supplement the state's baseload generation, to provide generation for growing municipal, cooperative and industrial loads in upstate New York and to provide generation to supplement the output of the Power Authority's hydroelectric plants during periods of low water flow.

The Power Authority and seven private utilities [1/] operating in New York State comprise the New York Power Pool. All of New York State's major systems are interconnected and are operated as one coordinated power system. The pool was established for the purpose of coordinating the operation and planning of power facilities throughout the State. A Power Pool control center near Albany coordinates the hour-to-hour operations of all available generation to meet the entire State demand reliably and economically. Power Pool standard operating procedures and New York Public Service Commission orders require that all areas of the State assist any area where there is a power shortage. In conformity with these practices,

---

1/ Central Hudson Gas and Electric Corporation
Consolidated Edison Company of New York, Inc.
Long Island Lighting Company
New York State Electric and Gas Corporation
Niagara Mohawk Power Corporation
Orange and Rockland Utilities, Inc.
Rochester Gas and Electric Corporation
*Jamestown Municipal Electric System
*Long Sault, Inc.
*Village of Freeport, Long Island, Municipal System

*New York State Systems that are not members of the New York Power Pool but report their load and capability as part of the New York State Interconnected systems.

Mr. Daniel R. Muller

all of the capacity in excess of that required to serve the Power Authority's direct load is committed by contract and actual operating practice to supply the load of other members of the Pool. Present estimates indicate approximately 75 megawatts of the capacity of the FitzPatrick Plant will be required by the Power Authority's municipal and industrial customers. The remaining capacity of the plant, approximately 746 megawatts, will be available to the New York Power Pool to supply statewide needs. Present plans are to allocate this capacity on a seasonal basis between upstate and downstate members of the Power Pool in the ratio of 5 to 2, with the preponderance of the delivery in each six-months' period directed toward the area having the greatest seasonal need. Thus, during the summer of 1974 upwards of 500 megawatts will be available to help relieve a possible shortage of power in the New York City area. The FitzPatrick Plant must be considered in relation to the overall supply and demand in the New York Power Pool which can be deemed the load area of the plant, rather than in relation to the specific demand of the Power Authority system.

The Pool has and will continue to take advantage of the diversity that exists between the upstate New York winter peaks and downstate New York summer peaks. The New York Power Pool is a summer-peaking system and the winter peaks are expected to be lower than the immediately preceding summer peaks. Due to the necessity for scheduling maintenance in the winter, the winter peak period is considered almost as critical as the summer peak period.

The current generation expansion program of large generating units for the New York Power Pool for completion during the period 1972 through June 1974 is tabulated below:

Mr. Daniel R. Muller

Generation Expansion Program - New York Power Pool

Estimated Commercial Service Date	Station	Type	Capability
June 1972 1/	Glenwood Gas Turbines	GT	105
July 1972 1/	Northport No. 3	F	386
May 1972 1/	Narrows No. 1	GT	174
June 1972 1/	Narrows No. 2	GT	174
October 1972 1/	Bowline Point No. 1	F	600
February 1973	Blenheim-Gilboa No. 1	PS	250
March 1973	Blenheim-Gilboa No. 2	PS	250
April 1973	Blenheim-Gilboa No. 3	PS	250
April 1973	Roseton No. 2	F	600
May 1973	Blenheim-Gilboa No. 4	PS	250
May 1973	Roseton No. 1	F	600
September 1973	Indian Point No. 2	N	873
October 1973	James A. FitzPatrick	N	821
May 1974	Glenwood Gas Turbine	GT	265
June 1974	Bowline Point No. 2	F	600

1/ In-Service.

The following tabulation shows the electric system loads to be served by the New York Power Pool, and the relationship of the electrical output of the James A. FitzPatrick Unit No. 1 to the available reserve capacities on the Pool's system at the time of the 1973-74 winter and 1974 summer peak load periods. These are the next seasonal peak load periods following the anticipated initial service date of the unit but the life of the unit is expected to be some 30 years or more, and it is expected to constitute a significant part of the Applicant's total generating capacity throughout that period. Therefore, the unit 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.

Mr. Daniel R. Muller

Forecast 1973-74 Winter Peak Load-Supply Situation

	New York State Interconnected System
Conditions With James A. FitzPatrick Unit No. 1 (821 Megawatts)	
Net Dependable Capacity - Megawatts	28,342 1/
Net Peak Load - Megawatts	19,816 2/
Reserve Margin - Megawatts	8,526
Reserve Margin - Percent of Peak Load	43.0
Conditions Without James A. FitzPatrick Unit No. 1	
Net Dependable Capacity - Megawatts	27,521
Net Peak Load - Megawatts	19,816 2/
Reserve Margin - Megawatts	7,705
Reserve Margin - Percent of Peak Load	38.9

Forecast 1974 Summer Peak Load-Supply Situation

	New York State Interconnected System
Conditions With James A. FitzPatrick Unit No. 1 (821 Megawatts)	
Net Dependable Capacity - Megawatts	28,172 4/
Net Peak Load - Megawatts	22,313 3/
Reserve Margin - Megawatts	5,859
Reserve Margin - Percent of Peak Load	26.3
Conditions Without James A. FitzPatrick Unit No. 1	
Net Dependable Capacity - Megawatts	27,351
Net Peak Load - Megawatts	22,313 3/
Reserve Margin - Megawatts	5,038
Reserve Margin - Percent of Peak Load	22.6

1/ Reduced 88 megawatts for delays in J. F. Kennedy Gas Turbines.
2/ Includes net firm sales of 26 megawatts.
3/ Includes net firm sales of 23 megawatts.
4/ Reduced 800 megawatts for delays in Astoria Unit No. 6.

Mr. Daniel R. Muller

The availability of James A. FitzPatrick Unit No. 1 for the 1973-74 winter peak period would provide the New York Power Pool with an expected system reserve margin of 8,526 megawatts or 43.0 percent of peak load. Any delay which results in the unavailability of James A. FitzPatrick Unit No. 1 for the 1973-74 winter peak load period would reduce system reserves to 7,705 megawatts or 38.9 percent of peak load. With the availability of the James A. FitzPatrick Unit for the summer of 1974, the New York Power Pool has an expected system reserve margin of 5,859 megawatts or 26.3 percent of peak load. Without the unit, system reserves would be reduced to 5,038 megawatts or 22.6 percent of peak load.

The reserve margins indicated in the foregoing tabulations and text are gross in that they include not only the capacity for meeting expected loads but that which may be out of service due to scheduled maintenance or forced outages and any that might be needed to meet unforeseen demands due to errors in load forecasting and exceptional weather.

While reserves may appear adequate, the Applicant states that generating capability available or in actual operation in New York State at the time of the State's weekly peak load as reported to the New York Public Service Commission is running between 13 percent and 30 percent less than the rated total capability stated in statistical reports to that Commission.

The New York Power Pool uses a reserve margin criterion based on coincidental statewide loads not exceeding available generation more frequently than one day in ten years. Although the Pool has attempted to achieve that degree of reliability, inability to meet in-service schedules, unexpectedly large equipment outage rates, forced deratings of unit capacity, and some underestimation of load growth about five years ago have resulted in performance well below the criterion during the past few years.

The Consolidated Edison Company of New York has experienced a concentration of the above factors. Indian Point Unit No. 3 has recently been delayed another 12 months and is not now expected for commercial operation till October 1975. Except for Indian Point Unit No. 2 now scheduled for commercial operation in September 1973, no new baseload capacity has been added to the system since 1969, while load has continued to grow. Some 1,900 megawatts of gas-turbine peaking capacity has been added; however, extended operation of such units has resulted in extensive maintenance problems and reduced availability. On the Consolidated Edison Company's system, thirty-six base-load generating units totaling 2,104 megawatts or approximately 25 percent of base-load capacity, are over thirty years old. Continued dependence

on over-aged generating equipment leads to increased maintenance, more forced outages and deratings resulting in decreased system reliability.

In 1970, the New York Power Pool experienced 17 days when voltage had to be reduced so that load would not exceed the available generating capacity. Despite such voltage reductions, there was one day in which 135 megawatts of residential and commercial load and 25 megawatts of industrial load had to be disconnected in order to preserve the system's operating integrity. In the summer of 1971, despite favorable weather with no prolonged hot spells, there were twenty days when voltage had to be reduced.

The adequacy and reliability of the New York Power Pool in meeting future loads is dependent upon the timely and commercial operation of all the units scheduled in its current construction program. Current information indicates that delays are being experienced in bringing most large new generating units into commercial operation and this trend may continue for some time in the future.

In view of possible construction and licensing delays, as well as the brief time for maturation of these units between their scheduled commercial service dates and the winter peak of 1973-74 and summer peak of 1974, the New York Power Pool resources appear none too large.

The Pennsylvania-New Jersey-Maryland Interconnection (PJM) and the New England Power Pool (NEPOOL) are experiencing capacity shortages similar to those of the New York Power Pool and the probability of any mutual capacity support is small. Ontario Hydro does have some spare capacity for sale during the summer months as their loads are predominantly winter-peaking. However, transmission capability, both within the New York Power Pool and in the interconnections from New York to Ontario is already used to capacity. New York, Ontario and Quebec power systems are presently investigating major transmission reinforcements for mutual support in the late 1970's and early 1980's.

Transmission Facilities

A 345-kilovolt transmission line approximately 70 miles long will integrate the output of the James A. FitzPatrick plant with the existing cross-state 345-kilovolt transmission system at the Edic Substation of the Niagara Mohawk Power Corporation. Backup transmission will be provided by an additional 345-kilovolt transmission line to the switchyard of the Niagara Mohawk Power Corporation's Nine Mile Point Nuclear Station. The Niagara Mohawk Power Corporation will, at the Power Authority's expense, reconstruct a section of its existing 115-kilovolt lines to provide a backup source of station service power between the two plants.

Mr. Daniel R. Muller

The Power Authority states the lines comply with the Guidelines for the Protection of Natural, Historic, Scenic and Recreation Values in the Design and Location of Rights-of-Way and Transmission Facilities published by the Federal Power Commission, the Environmental Criteria for Electric Transmission Systems published jointly by the Department of the Interior and the Department of Agriculture, and the New York State Public Service Commission and Department of Environmental Conservation rules and regulations affecting transmission lines.

Alternatives to the Proposed Facilities

The Power Authority is mandated by the New York State Legislature to build nuclear units to produce baseload electric generating capacity, and has no legal right to build any other type of baseload plant. The Power Authority's only alternatives are to disregard its legislative mandate and build no plant, or to construct the plant elsewhere.

The Power Authority conducted a detailed economic study of comparative costs for a fossil-fueled baseload plant to be constructed by another utility. The study clearly indicates the economic advantage of a nuclear-fueled plant at the FitzPatrick site over any other type of generation.

Conclusions

The staff of the Bureau of Power concludes that the electric power output represented by the James A. FitzPatrick Unit No. 1 is needed to implement the Applicant's and the New York Power Pool's generation expansion programs for meeting projected loads and to provide some reasonable measure of reserve margin capacity for the 1973-1974 winter and 1974 summer peak periods.

Very truly yours,

T. A. Phillips
Chief, Bureau of Power

APPENDIX L

COPY

POWER AUTHORITY OF THE STATE OF NEW YORK
10 COLUMBUS CIRCLE NEW YORK, N. Y. 10019
(212) 265-6310

March 1, 1973

Mr. A. Giambusso
Deputy Director for Reactor Projects
Directorate of Licensing
U. S. Atomic Energy Commission
Washington, D. C. 20545

Subject: James A. FitzPatrick Nuclear Power Plant
Draft Environmental Statement
AEC Docket No. 50-333

Dear Mr. Giambusso:

We have been requested orally by the AEC Staff to supply you with our comments on the comments filed by the various agencies and other organizations on the Draft Environmental Statement in this proceeding. We submit herewith ten (10) copies of the requested comments.

Very truly yours,

Asa George
General Manager

Att. 10

cc: See attached list

cc: w/att.

Bernard M. Bordenick, Esq.
Counsel for AEC Regulatory Staff
U. S. Atomic Energy Commission
Washington, D. C. 20545

J. Bruce MacDonald, Esq., Counsel
New York State Department of Commerce
99 Washington Avenue
Albany, New York 1210

Miss Suzanne Weber
78 West Seneca Street
Oswego, New York 13126

Ecology Action
c/o Richard Goldsmith
Syracuse University
College of Law
E. I. White Hall, Campus
Syracuse, New York 13210

Daniel M. Head, Esq., Chairman
Atomic Safety and Licensing Board Panel
U. S. Atomic Energy Commission
Washington, D. C. 20545

John H. Brebbia, Esq.
Alston, Miller & Gaines
1776 K Street, N. W.
Washington, D. C. 20006

Dr. Kenneth A. McCollum
Assistant Dean
College of Engineering
Oklahoma State University
Stillwater, Oklahoma 74074

Dr. Ernest O. Salo
Professor
Fisheries Research Institute - WH-10
College of Fisheries
University of Washington
Seattle, Washington 98195

Dr. Thomas H. Pigford
Professor of Nuclear Engineering
University of California
Berkeley, California 94720

March 1, 1973

JAMES A. FITZPATRICK NUCLEAR POWER PLANT

DRAFT ENVIRONMENTAL STATEMENT

DOCKET 50-333

APPLICANTS' COMMENTS ON COMMENTS

RECEIVED BY

AEC DIRECTORATE OF LICENSING

FROM

GOVERNMENTAL AGENCIES AND OTHER ORGANIZATIONS

A. U.S. Department of Commerce (December 27, 1972)

1. Earthquake intensities and tornado probabilities cannot be categorized as the results of the impact of the Plant on the environment but rather the impact of the environment on the Plant. Discussion of these two items in the Impact Statement is not appropriate. The impact on the Plant and its consequences are fully discussed in the FitzPatrick Plant FSAR.

2. The phenomenon of shifts in algae population is well documented, so that a general discussion could be developed in support of conclusion reached in the AEC Draft Environmental Statement. The Applicants are willing to assist the AEC Staff to prepare such a discussion if deemed necessary.

3. For the benthos and periphyton studies we do not see the relevance or the practicality of monitoring species diversity. There will be little, if any, thermal impact on the benthos. However, there is sufficient data on Lake Ontario to work up a general description of species diversity, seasonal abundance, nutrient requirements and trends of lake plankton and population. The Applicants are willing to assist the AEC Staff to prepare such a discussion if deemed necessary.

4. Necessary meteorological data are found on page 12 of the Applicants' Environmental Report and Section 2 of the FitzPatrick Plant FSAR.

B. Advisory Council on Historic Preservation (December 22, 1972)

Evidence of new contact with the State Liaison Officer for Historic Preservation will be submitted to the AEC shortly. Previous contact has been made and is documented by a letter from New York State Historic Trust dated March 27, 1969 (copy is attached). Recent contacts are demonstrated by letters from the New York State Department of Parks & Recreation dated February 7 and 12, 1973 (copies attached).

C. U.S. Department of Transportation (January 8, 1973)

The F.A.A. has been contacted concerning possible conflicts between airspace and the FitzPatrick-Edic Transmission Line. At a meeting on October 29, 1970, at the F.A.A. office in Burlington, Mass., the routing of the F.E. line was reviewed and F.A.A. requested that Form 7460 be prepared for the Riverside Airport, this airport is located some 2.5 miles northwest of Utica, N.Y. This form was prepared and sent to the F.A.A. A copy of executed Form 7460-1 is attached. F.A.A. indicated no conflict with any other airspace along the F.E. Transmission Line routing.

Rome Air Development Center was also contacted regarding any possible conflict with Griffiss Air Force Base. A letter from Colonel W.E. Britting, USAF, dated April 28, 1970 indicated there would be no conflict between the F.E. Line and the current or projected operations at Griffiss A.F.B. (A copy of the letter is attached).

D. U.S. Department of Agriculture (January 11, 1973)

1. Forest Service

Public off-road vehicle use for hunting and recreational use will be dictated by the ownership of the right-of-way. PASNY easement allows present owners to retain fee title and they continue to use the R.O.W. for any purpose that does not interfere with the operation and maintenance of the line.

2. Soil Conservation Service

All comments refer to restoration procedures for access roads, tower sites and R.O.W. in general. We agree with comment as made. Restoration procedures are included under clearing contract. In addition, it has been agreed to extend the contract requirements to include seeding at tower sites, clean-up in swamp areas and requirements for additional topsoil and fertilizer.

E. Ecology Action (January 3, 1973)

The comments of Ecology Action, dated January 3, 1973, on the Commission's Draft Environmental Statement correspond closely to contentions which it has raised in this proceeding as a petitioner to intervene. These contentions are under the purview of the Atomic Safety and Licensing Board and are being addressed by the Applicants and other parties in appropriate detail. Therefore Applicants' position will be presented here in summary form.

A. The position of the Applicants is that the information available and the experience with operating plants to date are adequate to justify the selection of the once-through cooling system for the FitzPatrick Plant.

The adequacy of the preoperational ecological studies and monitoring program is addressed in the Applicants' comments of December 29, 1972 to Mr. A. Giambusso (page 9). We believe that little would be gained by expanding the monitoring program in the manner suggested by Ecology Action.

The Applicants intend to use outside organizations for carrying out the monitoring programs.

B. "Class 9" accidents need not be considered in the Staff Environmental Statement. See 10CFR50 Appendix D Annex (proposed), which, according to the accompanying statement of consideration, is to be used as interim guidance.

The Applicants believe that the transportation accidents are adequately covered in the Staff Environmental Statement. Additional information on the nature of transportation accidents and other matters is found in the Supplement to the Applicants' Environmental Report of November 1971. (Page 12)

C. The Draft Environmental Statement does show that the Staff has performed an independent review of the need for power from the FitzPatrick Plant. In performing such an independent review the Staff has properly evaluated and made use of data developed by the Applicants and other agencies such as the Federal Power Commission, New York State Public Service Commission, and the Northeast Power Coordinating Council, which have considerable expertise in this area.

An analysis of PASNY's "load factor" is not necessary for a meaningful analysis of the need for power since by the nature of its customers PASNY is essentially a "base load" system.

Finally, the Power Authority is authorized by statute to supply surplus power to the New York Power Pool. The associated benefit is properly discussed and included in the benefit-cost analysis.

D. There is no requirement that the environmental effects of the various elements of the nuclear fuel cycle be considered in the Environmental Statement for the FitzPatrick Plant. Vermont Yankee Nuclear Power Corporation, ALAB-73, October 11, 1972; Vermont Yankee Nuclear Power Corporation, ALAB-56, June 6, 1972.

The environmental impact of the FitzPatrick Plant has been evaluated taking into account the aggregate effects of existing plants such as Nine Mile Point Unit No. 1. The effects of future plants such as Nine Mile Point Unit No. 2 are a proper subject of environmental reviews in other proceedings. The environmental review of such a future plant will take into account previous plants, including the FitzPatrick Plant, as appropriate.

E. The suggestions of Ecology Action concerning load shedding and various ways of reducing demand for electric power are not reasonable alternatives to the construction and operation of the FitzPatrick Plant. Furthermore, such steps would involve policy decisions within the purview of other governmental bodies and beyond the scope of this proceeding.

F. Ecology Action's assertions concerning alleged deficiencies in the benefit-cost analysis are without merit. In particular, there is no indication that fines will be imposed by New York State for fish killed at the FitzPatrick Plant. Finally, Ecology Action's comment fails to recognize that quantification of environmental costs is required only to the extent that it can be done in a meaningful way. We feel that this has been done.

F. State of New York Department of Environmental Conservation (January 15, 1973)

The comments below follow the same numbering as those given in the State of New York Department of Environmental Conservation letter of January 15, 1973.

2. A land use map is included on page 15 of the Applicants' Environmental Report.

   Information with regard to the use of portion of the site as part of a Wildlife Management Program was discussed on page 3 of Supplement No. 3 to the Applicants' Environmental Report.

3. The boundary between the Niagara Mohawk and PASNY property is shown on page 5 of the Applicants' Environmental Report.

4. The question of seismic design is addressed in the Applicants' comment No. 1 on the comments of the U. S. Department of Commerce.

5. Data on impingement experience to date at Nine Mile Point Unit 1 have been submitted to the AEC in Supplement No. 3 of the Nine Mile Point No. 2 Environmental Report - (AEC Docket No. 50-410). It is the Applicants' opinion that this data will confirm that the impact on the Lake Ontario ecosystem of impingement at Nine Mile Point will be insignificant.

7. The purpose of the preoperational monitoring is given in the FitzPatrick Final Safety Analysis Report as follows (p. 2.7-3):

   (a) Determine the suitability of specific locations
   (b) Delineate radiological anomalies
   (c) Check out equipment

   The preoperational program thus establishes the interrelationship between the various monitoring locations in the system. A statistically significant change in this interrelationship is evidence of some plant effect on the environment rather than a change in the absolute values at any one location.

9. We concur with this comment which is in accord with the Applicants' comment on this subject in the letter to Mr. Giambusso of December 29, 1972.

11. The table of isotopes given for liquid releases lists those which are, by far, the most controlling. Disolved noble gases would add only insignificantly to these amounts.

13. We concur with this statement.

14. The expected releases from the radwaste building have been listed in Table 11.4-1 of the FSAR for the FitzPatrick Plant. The redundancy of the recombiner system is discussed in the Applicants' response on EPA comments.

15. A. The potential presence of the Bog Turtle in the transmission right of way is recognized. However, this species is not on the endangered species list of the U.S. Department of Interior although it is rare.

    B. Restoration of the transmission line right-of-way will cover the points raised by N.Y. Department of Environmental Conservation. This subject was also discussed on page 5 of the Applicants' letter of December 29, 1972 commenting on the Draft Environmental Statement.

    C. The Authority will cooperate with state, regional, county and local agencies in establishing any beneficial secondary use programs by acquiring specific portions of the right-of-way in fee, providing such agencies assume responsibility for establishing, operating and maintaining any programs that result from such cooperative efforts.

16. See item 5 above.

17. The bioaccumulation factors used are intended to be an average value.

21. The R. E. Ginna plant has no influence on radiation levels in the vicinity of Nine Mile Point. The aggregate effect of Nine Mile Point Unit 2 with Unit 1 and FitzPatrick is a proper subject for the Nine Mile Point Unit 2 environmental reviews and should not be discussed here.

23. The Applicants' position on this matter was given in the letter dated December 29, 1972 (Pages 9 & 10) commenting on the Staff's Draft Environmental Statement.

24. The Applicants' position on this matter was given in the letter dated December 29, 1972 (Page 9) commenting on the Staff's Draft Environmental Statement.

26. The accident analysis in the FSAR is based on design conditions. The analysis in the Draft Environmental Statement, on the other hand, used "expected" or realistic conditions. Thus, the assumptions used in the respective calculations are different and the results express upper limit vs. expected effects of such accidents.

28. These points on protective actions in the event of an accident are addressed in the emergency plan for FitzPatrick Plant; the emergency plan is a part of the Final Safety Analysis Report and is an appropriate subject for the Staff Safety Evaluation rather than the Draft Environmental Statement.

29. This information is contained in pages 12-16 of Supplement No. 1 to the Applicants' Environmental Report.

32. Discussion of the environmental effects of the entire fuel cycle associated with the FitzPatrick Plant or with any alternatives is not appropriate. See item D of Applicants' response to the comments of Ecology Action on the Draft Environmental Statement.

34. This potential effect was discussed on page 16 of Supplement No. 2 to the Applicants' Environmental Report.

35. Information on the anticipated noise level contours of the FitzPatrick Plant as proposed is included on pages 10 and 11 of Supplement No. 2 to the Applicants' Environmental Report.

G. U. S. Department of Health, Education and Welfare (January 18, 1973)

We concur with the comment contained in the letter from the U. S. Department of Health, Education and Welfare dated January 18, 1973.

H. U. S. Department of The Interior (February 5, 1973)

1. Historical and National Landmarks

See Applicants' response to the comments of the Advisory Council on Historic Preservation.

2. Topography and Geology

For reasons given in Applicants' comment No. 1 on the comments of the U. S. Department of Commerce, the geologic and seismologic characteristics of the site as they bear upon the design of the Plant are fully described in the Final Safety Analysis Report and are a proper subject for the AEC radiological safety review rather than the Draft Environmental Statement.

3. Heat Dissipation System

See pages 1-4 of the Applicants' comments dated December 29, 1972 on the Draft Environmental Statement.

4. Effect on Land Use

See comments #2 and 15 C above under "F" State of New York Department of Environmental Conservation.

5. Plant Accidents

Accidental liquid radioactive releases are considered in the Draft Environmental Statement. The rupture of a condensate storage tank is the worst accident involving liquid discharges, and is properly considered as a "Class 3" accident.

"Class 9" accidents need not be discussed in the Draft Environmental Statement. See item B of Applicants' response to Ecology Action's comments on the Draft Environmental Statement.

I. U. S. Environmental Protection Agency (February 7, 1973) Radiological Aspects

Radioactive Waste Management

1. The Power Authority considers that the present design of the Plant and the presently proposed operating techniques will result in maintaining radioactive effluents from the FitzPatrick Plant at levels which are as low as practicable. It must be borne in mind that the levels of releases considered "as low as practicable" are different in different situations. What is practicable for a plant in the early design stage may not be practicable for a plant in a late stage of construction. This principle is recognized in the AEC's regulations and in proposed Appendix I to 10 CFR Part 50. The construction permit for the FitzPatrick Plant, which approved the preliminary design including the radwaste system, was issued in the Spring of 1970. The regulation which required releases to be kept "as low as practicable" became effective on December 28, 1970, well after construction was under way. Appendix I to 10 CFR Part 50 was not proposed until June 1971. In response to these new regulations, the Power Authority has proposed a number of design changes for the purpose of reducing radioactive effluents and has established procedures for the same purpose. Appendix I is only proposed, and if it becomes effective in its present form it will allow 36 months for plants such as FitzPatrick Plant to come into compliance with the numerical guides. Nevertheless, Applicants have shown that proposed Appendix I guides will be complied with at initial operation.

It is the opinion of the Applicants that the design of the charcoal absorber system will provide holdup times more like 18 hours for krypton and 245 hours (10 days) for xenon. The Applicants are unclear as to what basis exists for the lower holdup times given in the AEC Draft Environmental Statement and subsequently in the Environmental Protection Agency (EPA) comments. These longer times which are the design objectives of the FitzPatrick Plant holdup system are approximately three times greater than those used in the Draft Environmental Statement. It is the opinion of the Applicants, and apparently the EPA as well, that these longer times are "as low as practicable".

2. It is also unclear to the Applicants what basis exists for the AEC assumed ten days of recombiner downtime. It is our opinion that the downtime will not be so large as this and will be, in fact, small enough that the bypassing of the charcoal bed system will not significantly affect the average annual effluent release quantities.

3. The automatic purge system is initiated whenever the turbine is shutdown. Valves AOV114 A & B (figure 10.4-1 of the FSAR) open for 30 minutes after turbine shutdown. This allows approximately 200 scfm of air to be drawn in by the steam jet air ejectors and purge the lines between the condenser and the stack of hydrogen. This air passes through the recombiner system until the recombiner effluent temperature switch indicates that no more hydrogen is being recombined. At this time the recombiner system is automatically isolated and the air passes through the 30 minute hold up pipe. This purge air will enter the charcoal beds in the stack unless the air moisture content monitors indicate that air with a moisture content greater than 1 ppm water is entering the charcoal. If this occurs the charcoal beds are isolated and the purge air enters the stack directly from the holdup pipe.

The dose at the site boundary resulting from this purging operation is expected to be insignificant following the 2 to 3 turbine trips per year. The Applicants have calculated the resultant dose at the site boundary assuming a conservative ten (10) turbine trips per year and the results of the calculation are as follows:

Dose (Gamma)	5.9×10^{-3} mrem/year
Dose (Beta)	2.3×10^{-3} mrem/year

4. There will be no laundry wastes connected with the operation of the FitzPatrick Plant. Laundry operations will be carried out at the Nine Mile Point Unit No. 1 facility. The criteria used for release of laundry wastes from that facility are a part of their technical specifications which have already been approved by the AEC.

Dose Assessment

The potential doses for organ and whole body from the consumption of apples irrigated with water withdrawn from Lake Ontario at a location five miles from the FitzPatrick Plant have been estimated to be less than 0.01 mrem per year to a hypothetical individual consuming one pound of these apples per day.

The major transfer of radionuclides from irrigation water to the edible parts of apples is through the following mechanisms: (a) accumulation of radionuclides in the soil, (b) transfer of radioactive ions from soil to apple by natural processes involving incorporation of the ion into the plant structure, and (c) direct contamination of blossoms and apples from water spray with varying rates of incorporation of the ion into the plant structures.[1]

Environmental conditions (e.g. soil characteristics) can have significant effects on transfer coefficients and since detailed information was not available for this specific species and environment, dose estimates by Denham et al[2] (for fruits and vegetables irrigated with diluted effluents from a hypothetical BWR station) were utilized in this evaluation. The assumed characteristics of the FitzPatrick Plant releases with dilution to the point of irrigation intake were then compared with these assumptions of Denham et al in the AEC guide. The AEC values concerning irrigation rates, biological half-times, transfer coefficients were presumed to apply for the apple orchard. Although the AEC assumed that 3 pounds of irrigated fruit and vegetables were consumed for 1/3 of a year, it was conservatively assumed in this evaluation that one pound of irrigated apples was consumed every day by a hypothetical individual.

The internal radiation doses to individuals from the consumption of deposited radionuclides on vegetables were calculated for estimated atmospheric radionuclide discharges from the FitzPatrick Plant. The organ and whole body doses to an individual consuming 150 grams per day of leafy vegetables,[3] grown at the site boundary location with the lowest average ground level dilution factors, were all less than 0.001 mrems per year.

The dose calculations were based on representative radionuclide release estimates for the FitzPatrick Plant annual average dilution factors at 975 meters due east (χ/Q's of 4.1×10^{-6} sec/m^3 for ground level releases and 1.2×10^{-7} sec/m^3 for elevated releases), deposition velocities of 0.3 cm/sec for particulates and 1.0 cm/sec for iodine, and edible leafy vegetation of 2.7 kg/m^2 of land area.[3] No credit was taken for radionuclide losses occurring in food preparation (e.g. washing).

References

1. Disposal of Radioactive Wastes into Rivers, Lakes and Estuaries, Safety Series 36, International Atomic Energy Agency, Vienna, 1971.

2. Denham, D. H., J. K. Soldat, E. C. Watson, and J. R. Young,

"Correlation of Radioactive Waste Treatment Systems Costs with General Population and Biota Radiation Doses for Light Water Nuclear Power Plants," Appendix C Draft Environmental Statement Concerning Proposed Rule Making Actions: Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As Low as Practicable" for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents, U. S. Atomic Energy Commission, January 1973.

3. Blanchard, R. L. and B. Kahn, "Pathways for the Transfer of Radionuclides from Nuclear Power Reactors through the Environment to Man," Proceedings of the International Symposium on Radioecology Applied to the Protection of Man and His Environment, Rome, September 1971.

Non-Radiological Aspects Biological Considerations

1. The Applicants do not agree that the fossil fuel units at Oswego Steam Station and the FitePatrick Plant could be characterized as being located at a single generating complex, since they are about 7 miles apart.

2. The question of adequacy of intake structure design was addressed in the Applicants' comments on the Draft Environmental Statement, pages 5 through 8 of the letter to Mr. Giambusso dated December 29, 1972.

3. The question of the adequacy of the aquatic studies carried out to date was addressed in the Applicants' comments on the Draft Environmental Statement, page 9 of the letter to Mr. Giambusso dated December 29, 1972 and in the above responses to the comments of the State of New York Department of Environmental Conservation and the U. S. Departments of Commerce and Interior.

Thermal Considerations

In general, the subject of the adequacy of hydrothermal analysis was addressed in the Applicants' comments on the Draft Environmental Statement, pages 1 through 4 and pages 1 through 8 of the "Answers to Questions Regarding Engineering and Ecological Studies Report" which are contained in a letter to Mr. Giambusso dated December 29, 1972. Further, the subject was extensively addressed in the comments of the New York State Department of Environmental Conservation as well.

One specific point in the EPA comments that needs to be mentioned is the reference to the infrared study. The 3 F rise shown by this study was a surface temperature and does not represent the temperature at submerged intake. This temperature at the intake is expected to be 0.5 F above ambient. This fact does not contradict the results of the infrared study.

Waste Treatment

The secondary waste treatment system consists of extended aeration and filtration of the septic tank effluent in two 2600 square feet sand filtration beds. The distribution pipe grids are vented to support the growth and action of aerobic bacteria. With a normal operating population of only 60 and an inflow of 2100 gallons per day, adequate aeration is assured in a filtration system which has been designed for a maximum population of 160 people (during refueling). There are no significant advantages to be found in the package plant suggested.

Additional Comments

1. A joint frequency distribution for wind speed, wind direction and stability conditions for plant vent and stack releases is provided on page 12 of the Applicants' Environmental Report and Section 2 of the FitzPatrick Plant FSAR.

2. A tabulation of dispersion factors for elevated releases is given in Supplement 5 to the FitzPatrick Plant FSAR. The tabulation of dispersion factors for ground level releases is given on page 14.8 of Section 14 of the FSAR.

3. The Applicants reported in the Environmental Report a dose of 1.8 mr/yr at the 1.6 mi. SE dairy farm with a ψ/Q of 2.6×10^{-7}. This data would result in an estimated dose of about 7 mr/yr at the 3,800 ft. SE location.

All of the dose calculations for the cow-milk pathway are extremely conservative and the environmental sampling program is not expected to produce any concentrations of radioiodine, which would confirm such conservatively calculated levels. A major area of conservatism is the inherent assumption that all the iodine is released in the elemental form. As discussed in the Draft Environmental Statement concerning the Proposed Rule Making Action for Appendix I, the experimental evidence from operating plants would indicate that very little of the radioiodine released is in the elemental form and thus available to go through the cow-milk pathway to an infant's thyroid.

4. Shielding is being added to the walls of the turbine building such that the dose rate received by an individual spending up to 500 hours per year in recreational use of the lake near the Plant for boating, fishing, swimming and water skiing will not be greater than 5 millirem per year. Similarly, occupancy up to one-half of a year would not result in a dose greater than 5 millirem at the eastern site boundary. The annual dose rate at the nearest private residence, approximately 3,700 ft. SE, would be less than 5 millirem per year with full time occupancy and no credit for shielding provided by the house.

   The direct radiation from the waste surge condensate storage tanks has been estimated to be very insignificant based on full-time occupancy at the nearest site boundary. In no case does the total dose from direct radiation at the eastern site boundary from all sources exceed 5 mrem/year.

J. Federal Power Commission (February 21, 1973)

The Applicants concur with the Federal Power Commission conclusions as stated on page 8 of their letter dated February 21, 1973. Our specific comments are listed below:

1. The second paragraph on page 2 of the FPC letter should read as follows:

   "The Power Authority is an agency of the State of New York. It is mandated by the New York State Legislature to construct (i) such hydroelectric pumped storage projects as it deems necessary or desirable to supplement the supply of electric power and energy, (ii) such baseload nuclear generating facilities as in its judgment are necessary to supply sufficient supplemental energy to make possible optimum use of generating capacity of its St. Lawrence and Niagara hydroelectric projects, to supply low cost power and energy to high load factor manufacturers and to supply future needs of Authority's municipal electric and rural electric cooperative customers and (iii) such baseload generating facilities as it deems necessary or desirable to assist in maintaining an adequate and dependable supply of electricity by supplying power and energy for the Metropolitan Transportation Authority, its subsidiary corporations and the New York City Transit Authority."

2. The new estimated commercial service dates (page 4 of the FPC letter) for the Blenheim-Gilboa units are:

Units 1 & 2	-	April 1973
Units 3 & 4	-	June 1973

3. The new estimated commercial service dates (page 4 of the FPC letter) for Roseton Units 1 and 2 are as follows:

Roseton Unit #1	-	June 1973
Roseton Unit #2	-	September 1973

4. The statement in last paragraph on page 6 of the FPC letter regarding the addition of units since 1969 does not agree with the list on page 4 of the same letter.

5. Referring to the statement under "Alternatives to the Proposed Facilities" on page 8 of the FPC letter, it should be pointed out that at the time the Power Authority made its application to the Atomic Energy Commission to build the James A. FitzPatrick Nuclear Power Plant its mandate from the New York State Legislature was limited to the building of nuclear units to produce baseload generating capacity and it then had no legal right to build any other type of baseload plant. It now has a further mandate from the Legislature to build such baseload generating facilities including nuclear and fossil fuel as it deems necessary or desirable to assist in maintaining an adequate supply of electricity by supplying power and energy for the Metropolitan Transportation Authority, its subsidiary corporations and the New York City Transit Authority.

L-17

STATE OF NEW YORK

NEW YORK STATE HISTORIC TRUST

DIVISION OF PARKS
CONSERVATION DEPARTMENT, ALBANY, N. Y. 12226

March 27, 1969

Mr. Scott B. Lilly
Power Authority of the
State of New York
10 Columbus Circle
New York, New York 10019

Dear Mr. Lilly:

Thank you very much for your thoughtful letter informing me of the Power Authority Plans to construct a nuclear power plant in the Town of Scriba, Oswego County; a pumped storage project on Schoharie Creek, on the Blenheim-Gilboa town line and also the possible plans to construct transmission lines from those plants to sub-stations.

One of the consultants who worked for the New York State Historic Trust in preparing the survey of historic sites and buildings has located, on the accompanying maps, sites that have been surveyed. It is planned to nominate for the National Register some of the outstanding places in the very near future. Other sites that have been surveyed, will be nominated eventually.

We believe it is also important to consider the proposed historic districts of Rensselaerville, in Albany County, and Oak Hill, in Greene County.

I hope this information will be useful to you. If you have any questions, please be sure to let me know.

Thank you, again, for your interest.

Sincerely yours,

W. E. Wright

WILBUR E. WRIGHT
Executive Secretary

Enclosures


L-18
FITZPATRICK NUCLEAR POWER PLANT
OSWEGO CITY
SCRIBA
NEW HAVEN
POSSIBLE
TRANSMISSION LINE ROUTES
YET TO BE SELECTED
3/20/69
VOLNEY
PALERMO
FULTON CITY
(GRELL'S HOTEL)
SCHROEPPEL
CAUGHDENOY LOCKS (1841)
ONEIDA LAKE
CLAY
CICERO
NATIONAL REGISTER NOMINATION 1969
SALINA
SYRACUSE CITY
DE WITT SUB-STATION
DE WITT
OSWEGO & ONONDAGA COUNTY

L-19

NEW YORK STATE PARKS & RECREATION • South Swan Street Building, South Mall, Albany, N.Y. 12223

Alexander Aldrich
Commissioner

February 7, 1973

Asa George
General Manager
New York State Power Authority
10 Columbus Circle
New York, New York 10019

Dear Mr. George:

The New York State Office of Historic Preservation is pleased to have had an opportunity to examine the route of the transmission line from the Fitzpatrick Power Plant, on Lake Ontario, to Edic, in the Town of Marcey, Oneida County, New York. I am pleased to report the following on behalf of the State Liaison Officer for Historic Preservation in New York State, the Honorable Alexander Aldrich.

On the basis of information available at the present time, the route of this transmission line as shown on an undated map titled "Fitzpatrick-Edic/345 KV Transmission Line," will not have a harmful effect on any sites of historic or architectural importance.

Sincerely,

F. L. Rath, Jr.
Deputy Commissioner
for Historic Preservation

FLR/11

NEW YORK STATE PARKS & RECREATION • South Swan Street Building, South Mall, Albany, N.Y. 12223

Alexander Aldrich
Commissioner

February 12, 1973

Mr. Asa George
Power Authority of the
State of New York
10 Columbus Circle
New York, New York 10019

Dear Mr. George:

The Division of Historic Preservation, some time ago, carefully considered the impact that the proposed location of the Fitzpatrick Power Plant, on Lake Ontario, in the Town of Scriba, Oswego County, New York, might have on historic resources of the area.

Based on the evaluation, it was concluded that the facility would not have a damaging effect on any places of historical or architectural significance.

I hope this information will be useful.

Very truly yours,

F. L. Rath, Jr.
Deputy Commissioner
for Historic Preservation

FLR/11

L-21

Form Approved. Budget Bureau No. 04-R0001.

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

NOTICE OF PROPOSED CONSTRUCTION OR ALTERATION

TO BE COMPLETED BY FAA

AERONAUTICAL STUDY NO. 71-EA-183-OE

FAA WILL COMPLETE AND RETURN THIS FORM IF ONE OR MORE OF THE FOLLOWING IS APPLICABLE. OTHERWISE SEPARATE ACKNOWLEDGEMENT WILL BE ISSUED.

A. A STUDY OF THIS PROPOSAL HAS DISCLOSED THAT THE PROPOSED STRUCTURE:

- [x] DOES NOT REQUIRE A NOTICE TO FAA.
- [ ] WOULD NOT EXCEED ANY STANDARD OF PART 77 AND WOULD NOT BE A HAZARD TO AIR NAVIGATION.
- [ ] SHOULD BE MARKED AND LIGHTED PER FAA "OBSTRUCTION MARKING AND LIGHTING" ADVISORY CIRCULAR 70/7460-1
- [ ] REQUIRES SUPPLEMENTAL NOTICE. NOTICE FORM (FAA FORM 117-1) ENCLOSED.

B. COPY SENT TO FCC? ☐ YES ☒ NO

REVIEWING OFFICER: CC Clifford (signature) DATE: 4-20-71

1. NATURE OF STRUCTURE *(Complete both A and B below)*

A. *(Check one)* ☒ NEW CONSTRUCTION ☐ ALTERATION

B. *(Check one)* ☒ PERMANENT ☐ TEMPORARY *(State length of time)* ______ Mos.

2. NAME AND ADDRESS OF INDIVIDUAL, COMPANY, CORPORATION, ETC. PROPOSING THE CONSTRUCTION OR ALTERATION *(Number, Street, City, State and Zip Code)*

TO
Power Authority of the State of New York
The Coliseum Tower
10 Columbus Circle
New York, New York 10019

3. TYPE AND COMPLETE DESCRIPTION OF STRUCTURE

Steel structure supporting a single circuit 345 kV transmission line with overhead ground wires. Attached maps and drawings show relation of airport to routing of transmission line and heights of structures.

4. LOCATION OF STRUCTURE

A. COORDINATES *(To nearest second)*

LATITUDE °	'	"	LONGITUDE °	'	"
43	09	40	75	14	20

B. NEAREST CITY OR TOWN, AND STATE: Utica, New York

(1) DISTANCE FROM 4B: 2.5 MILES

(2) DIRECTION FROM 4B: Northwesterly

C. NAME OF NEAREST AIRPORT, HELIPORT, OR SEAPLANE BASE: Riverside Airport

(1) DISTANCE FROM NEAREST POINT OF 4C: 2.5 miles

(2) DIRECTION FROM AIRPORT: Northeast

D. *DESCRIPTION OF LOCATION OF SITE WITH RESPECT TO HIGHWAYS, STREETS, AIRPORTS, PROMINENT TERRAIN FEATURES, EXISTING STRUCTURES, ETC. (Attach a highway, street, or any other appropriate map or scaled drawing showing the relationship of construction site to nearest airport(s). If more space is required, continue on a separate sheet of paper and attach to this notice.)*

See attached copies USGS "Oriskany, New York" & South Trenton, N.Y." for line routing in vicinity of Riverside Airport; see attached copies of dwgs. FE-7T669, FE-7T670 & FE-7T671 for ground & tower heights along transmission line.

5. HEIGHT AND ELEVATION *(Complete A, B and C to the nearest foot)*

A. ELEVATION OF SITE ABOVE MEAN SEA LEVEL	See attached.
B. HEIGHT OF STRUCTURE INCLUDING APPURTENANCES AND LIGHTING (if any) ABOVE GROUND, OR WATER IF SO SITUATED	See attached.
C. OVERALL HEIGHT ABOVE MEAN SEA LEVEL (A + B)	See attached.

6. WORK SCHEDULE DATES

A. WILL START: August, 1971

B. WILL COMPLETE: December, 1972

7. OBSTRUCTION MARKINGS — The completed structure will be:

	YES	NO
A. MARKED AS SPECIFIED IN THE FAA ADVISORY CIRCULAR 70/7460-1, OBSTRUCTION MARKING AND LIGHTING		X
B. LIGHTED AS SPECIFIED IN THE FAA ADVISORY CIRCULAR 70/7460-1, OBSTRUCTION MARKING AND LIGHTING		X

I HEREBY CERTIFY that all of the above statements made by me are true, complete, and correct to the best of my knowledge.

8. NAME AND TITLE OF PERSON FILING THIS NOTICE *(Type or Print)*: Asa George, Chief Engineer

9. SIGNATURE *(In ink)*: Asa George (signature)

10. DATE OF SIGNATURE: 4-13-71

11. TELEPHONE NO. *(Precede with area code)*: 212-265-6510

Persons who knowingly and willfully fail to comply with the provisions of the Federal Aviation Regulations Part 77 are liable to a fine of $500 for the first offense, with increased Penalties thereafter as provided by Section 902(a) of the Federal Aviation Act of 1958 as amended.

FAA Form 7460-1 (11-68) SUPERSEDES FAA Form 117.

L-22

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 2856TH AIR BASE GROUP (AFLC)
GRIFFISS AIR FORCE BASE, NEW YORK 13440

REPLY TO ATTN OF: ROB

28 APR 1970

Mr. J. M. Collyer
74 Main Street
Stamford, N. Y. 12167

Dear Sir

This letter is in response to your contact with the Rome Air Development Center regarding the proposed installation of a new 345KV high power line through Oneida County.

After reviewing the proposed routing it has been determined that there will be no conflict with current or projected operations at Griffiss Air Force Base.

Sincerely

WESLEY E. BRITTING, Colonel, USAF
Commander

RECEIVED
MAY - 1 1970
POWER AUTHORITY
STAMFORD, N. Y.

APPENDIX M

WATER QUALITY STANDARDS

With the possible exception of the limits on total dissolved solids and the phosphate concentration in the discharged sewage, the effluents of the FitzPatrick Plant will conform to all criteria and standards of the State of New York, minimum Federal Water Quality Criteria (MFWQC) provided by the Environmental Protection Agency, and the International Agreement on Great Lakes Water Quality between the United States and Canada (1972). Details are as follows, in order of the New York State Standard 701.3, Classes and Standards for Fresh Surface Waters, Class AA.

1. Floating solids; settleable solids; oil; sludge deposits; taste or odor producing substances (see also MFWQC 1.1, 1.2 and 1.3). There will be no discharge from the FitzPatrick Plant of materials that will form objectionable deposits, that will provide floating debris, oils, scum and other matter, or substances producing objectionable color, odor, taste or turbidity in Lake Ontario.

2. Sewage or waste effluents: Disinfection is required; the geometric mean of fecal coliform counts in the lake is limited to 200 per 100 ml (MFWQC 2.2.1). All plant sanitary wastes will have extended aeration secondary treatment, and chlorine disinfection before discharge in the lake, using a system designed in accord with the Water Pollution Control Federation Sewage Treatment Plant Design Manual of Practice No. 8 (1972). According to that manual, the effluent is expected to contain 1000 fecal coliform bacteria per 100 ml or less. Because of natural variability and variability in aeration, it is not possible to estimate whether the geometric mean count would be as low as 200 per 100 ml. Since the rate of flow of the sewage into the lake is small (2100 gpd or 3 oz/sec.) the size of the area in the lake (if any) that would not meet the specification would be very small, and should be acceptable.

3. pH: The combination of the International Agreement and MFWQC apparently would require that effluent pH be maintained in the range of 6.7 to 8.3 "except when due to natural causes and in no case shall be less than 5.0 nor more than 9.0. When the pH is less than 6.5 or more than 8.3, discharge of substances which would increase the buffering capacity of the water should be limited."* The Plant circulating water is returned to the lake at the same pH at which it was removed from the lake. Since the natural pH of Lake Ontario in the vicinity of FitzPatrick ranges from 7.2 to 9.0 (Table 2.2) and since the pH is not measurably changed by passage through the Plant, and since no significant buffering capacity is added to the circulating water, the Staff concludes that the regulation will be complied with.

* This quotation is from the Report of the Committee on Water Quality Criteria to the Federal Water Pollution Control Administration, U. S. Department of the Interior ("The Green Book"). The MFWQC were formulated by using this report as a guide.

4. Dissolved oxygen: The most restrictive applicable standard is item 2.1.1.1 (b) of the MFWQC, which requires that the dissolved oxygen be not less than 6.0 mg/l (except that the dissolved oxygen may be between 5.0 and 6.0 for not more than 4 hours within any 24 hour period, provided the water quality is favorable in all other respects and normal daily and seasonal fluctuations occur). The dissolved oxygen in Lake Ontario in the vicinity of the FitzPatrick Plant (measured near Nine Mile Point) is near or above saturation (See Section 5.4.4). This is in conformity with widespread observations of oxygen content of the water of Lake Ontario; in one study[1], summertime saturations ranged from about 95% to 130%, corresponding to oxygen concentrations from 9.5 to 13 mg/l. The oxygen content in the cooling water is not expected to be diminished by passage through the condenser even though the temperature is increased. The Staff concludes that the standard will be complied with.

5. Toxic wastes, deleterious or colored substances: For the protection of people who might use the lake water as a supply of drinking water, the Standards of the U. S. Health Service apply. Limits are provided for some 21 chemical species or groups. Of these species, only iron (limit 0.3 mg/l) and sulphate (limit 250 mg/l) are added to the circulating water. The iron content of the lake is of the order of 0.005 mg/l.[2] Unless there is a rare or unexpected event, it is therefore anticipated that the concentration of iron in the discharge will not exceed about 0.015 (0.01 above background, Table 3.6), during periods in which iron is discharged in the circulating water stream. No violation of Standard is expected.

   The sulfate in nearby Lake Ontario ranges from about 13 to 50 mg/l (Table 2.2), and the incremental concentration during periods of discharge of regeneration wastes from the makeup water demineralizers is about 0.6 mg/l (Table 3.6). The maximum total is expected to be about 50.6 mg/l, which is below the specified Standard of 250 mg/l. No violation of this criteria is expected.

   For all other chemicals in the water except sodium, the concentration in the circulating water discharge is expected to be the same as in the lake water except during periods of discharge of makeup water ion exchanger regeneration wastes. At that time there will be less than a 0.1% increase in the concentrations of nearly all chemical species. The ions present in the water which have concentrations below the limits allowed in the Standards will be returned to the water in the same state. Thus, if the concentrations naturally present in the lake are below the Standards, there will be no violations. All ions for which the natural levels in the lake are known (see Table A), have the concentrations substantially below the maximum permitted levels, and therefore, for those ions no violations are expected. For the remaining substances for which naturally occurring concentrations are unknown (see Table A), no statement can be made with certainty. The Staff, however, knows of no reason to expect violations.

Table A. Drinking Water Standards for Lake Ontario

Substances	Limit[a] mg/l	Concentration in lake mg/l
Arsenic	0.05	Unknown (0.06)[b]
Barium	1.0	Unknown (0.04)[c]
Cadmium	0.01	0.00009[d]
Chromium	0.05	0.0007[d]
Lead	0.05	0.0008[d]
Chloride	250	30 (Table 2.2)
Copper	1.0	0.006[d]
Manganese	0.05	0.0005
Nitrate	45	0.14 (Table 2.2)
Sulfate	250	30 (Table 2.2)
Total dissolved solids	500	233 (Table 2.2)
Zinc	5	0.007[d]
Cyanide	0.2	Unknown
Fluoride	∿1	Unknown
Selenium	0.01	Unknown
Silver	0.05	Unknown
Alkyl benzene sulfate	0.5	Unknown
Carbon chloroform extract	0.2	Unknown
Phenols	0.001	Unknown

[a]U. S. Public Health Service Drinking Water Standards, 1962.

[b]Average concentration in 5.5% of samples in the United States.[3] The arsenic was undetectable in the remaining samples.

[c]Average concentration in 99% of samples in the United States.[3]

[d]Reference 2.

With reference to toxic substances affecting fish life, six are identified in the New York State Standard for natural waters whose alkalinity is 80 ppm or above (which is the case for Lake Ontario). None of these will be added to discharge streams. Ammonia or ammonium compounds levels in the nearby lake (limit 2.0 mg/l at pH of 8.0 or above) have ranged from 0.0 mg/l through 1.59 mg/l, averaging 0.57 mg/l (Table 2.2). The level of ferro-or ferricyanide (limit of 0.4 ppm) in the lake is unknown, but small; the concentrations of copper, zinc, and cadmium, are as given in Table A. For substances present in the natural water, the levels are below those permitted in the Standard, and the Staff does not expect the violation to occur. No reason is known to expect violations to occur for the remaining ions.

6. Additional items: Federal Water Quality Criterion 2.1.1.2, covering thermal criteria is discussed in detail in Sections 3 and 12 of this statement. On March 9, 1973 the Applicant filed an application for certification under Section 401 of the Federal Water Pollution Act, as amended.

   The objective for total dissolved solids in the Great Lakes Water Quality Agreement between the U. S. and Canada (Ottawa, April 15, 1972) is more restrictive than has been covered above. In the International Agreement, the level of dissolved solids in Lake Ontario "should not exceed" 200 mg/l. The average level of dissolved solids in nearby Lake Ontario is about 233 mg/l (range of 127 mg/l to 489 mg/l, Table 2.2). In view of the fact that the increase in dissolved solids caused by operation of the Plant is very small (See reply to EPA comments in Section 12, also Table 3.6), the Staff believes that the intent of the Standard in preventing increases in the level of total dissolved solids is being met.

   The MFWQC also restrict phosphorus. The total phosphorus is not to exceed 50 μg/l in any lake or at any point where it enters the lake (Section 2.1.1.5). The phosphorus added to the circulating water discharge from blowdown of the auxiliary boilers (8×10^{-4} μg/l) will be a small fraction of the permitted maximum (Section 3.5). The phosphorus content of the sewage is expected to be equal to or less than the 4 mg/l in the Nine Mile Point, Unit 1 sewage. Thus, for times when there is no storm water flowing in the storm sewer from which sewage is discharged to the lake, the Federal Water Quality criterion for phosphorus will be exceeded. Because of the low flow rate (average flow of 3 oz/sec) the quantity of phosphorus will be small, and the size of the zone in which the concentration will exceed the criterion would be small. When storm water in that sewer is flowing at a rate greater than 40 times the flow rate of sewage (i.e., greater than 58 gpm) the 50 μg/l concentration will not be exceeded because of the resultant dilution of the sewage before discharge to the lake.

The Federal Water Quality Criteria limit radioactivity in the lake to the levels in the U.S. Public Health Standards for drinking water. These allow 1000 picocuries per liter of gross beta activity in the absence of strontium and alpha emitters, 3 pCi of radium-226 and 10 pCi/l of strontium-90. Applying these standards to the circulating water discharge, the data in Table 3.3 indicate that the total release of gross β-emitting radioactive substances is 6 pCi/l for the FitzPatrick Plant. The Nine Mile Point Nuclear Station, Unit 1 discharge contains an estimated 60 pCi/l of gross β-emitters (Table 5.2); if one-third of this concentration reaches the point of discharge of the FitzPatrick Plant, a maximum of 26 pCi/l will be found in the lake near the FitzPatrick discharge. This is substantially below the 1,000 pCi/l permitted. Table 3.3 also indicates a discharge of strontium-90 of about 1.8×10^{-3} pCi/l in the circulating water. The equivalent number for Nine Mile Point, Unit 1 is 0.021 pCi/l; if one-third of this concentration reaches the point of discharge of the FitzPatrick Plant, 0.009 pCi/l will be found in the lake near the FitzPatrick discharge. This is substantially below the level permitted by the Standard. It is anticipated that no radium-226 will be emitted, and therefore, the Standard for that radionuclide will not be exceeded.

Section 2.2.4 of the MFWQS limits the color and turbidity of the water. The FitzPatrick Plant will not discharge water that is more turbid than the water drawn. Because of the highly variable turbidity of the inshore water of the lake, and because the range of turbidity is not accurately known, no quantitative statement can be made about the turbidity of the circulating water discharge. On the basis of the expectation that the discharged water will not be more turbid than the nearby lake water, it is believed that the intent of the criterion is met.

Sections 3 and 4 of the MFWQC, requiring that mixing zones of discharges be small compared to the size of the lake and that there be ample undisturbed portions of the lake, will readily be met by the discharges from the FitzPatrick Plant.

References

1. Hugh H. Dobson, "Principal Ions and Dissolved Oxygen in Lake Ontario," Proceedings 10th Conference on Great Lakes Research, Toronto, Ontario, April 10, 1967, Pp 337-356.

2. Y. K. Chau, K. Chawla, H. F. Nicholson, and R. A. Vollenweider, "Distribution of Trace Elements and Chlorophyll in Lake Ontario." New York, April 1-3, 1970, Part 2, Pp 659-672.

3. John H. Kopp and R. C. Kroner, "Trace Metals in Waters of the United States: A 5 Year Summary of Trace Metals in Rivers and Lakes of the United States" (Oct. 1, 1962 - Sept. 30, 1967). Published by U. S. Dept. of the Interior, Federal Water Pollution Control Administration.