NUREG-0884

Final Environmental Statement

related to the operation of Perry Nuclear Power Plant, Units 1 and 2

Docket Nos. 50-440 and 50-441

Cleveland Electric Illuminating Company

U.S. Nuclear Regulatory Commission

Office of Nuclear Reactor Regulation

August 1982

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ABSTRACT

The information in this Final Environmental Statement is the second assessment of the environmental impact associated with the construction and operation of the Perry Nuclear Power Plant, Units 1 and 2, located on Lake Erie in Lake County, about 11 km (7 mi) northeast of Painesville, Ohio. The first assessment was the Final Environmental Statement related to the construction of the plant issued in April 1974, prior to issuance of the construction permits (CPRR-148 and CPPR-149). Plant construction for Unit 1 is currently about 83% complete, and Unit 2 about 43% complete. Fuel loading for Units 1 and 2 currently estimated by the licensee (Cleveland Electric Illuminating Company) for November 1983, with Unit 2 fuel load scheduled for May 1987. The present assessment is the result of the NRC staff review of the activities associated with the proposed operation of the plant.

SUMMARY AND CONCLUSIONS

This Final Environmental Statement-Operating License Stage was prepared by the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation (the staff).

1. This action is administrative.

2. The proposed action is the issuance of operating licenses to the Cleveland Electric Illuminating Company (the applicant), also acting as agent for the Central Area Power Coordination (CAPCO) group (see Sections 1 and 2), for the startup and operation of the Perry Nuclear Power Plant, Units 1 and 2 (Docket Nos. 50-440 and 50-441) (PNPP, the Plant), located on Lake Erie in Lake County, about 11 km (7 miles) northeast of Painesville, Ohio.

   Units 1 and 2 will each employ a boiling water reactor (BWR) to produce up to 3579 megawatts thermal (MWt). For each unit, a steam turbine generator will use this heat to provide a gross electrical power output of up to 1250 megawatts electrical (MWe). The maximum design thermal power level of each unit is 3729 MWt, with a corresponding maximum design electrical power output of 1302 MWe. The exhaust steam will be condensed by a closed-loop cooling system including natural-draft towers. Makeup water for the cooling system will be obtained from Lake Erie through a submerged multi-port intake.

3. The evaluation in this statement represents the second assessment of the environmental impacts associated with the PNPP pursuant to the guidelines of the National Environmental Policy Act of 1969 (NEPA) and the Commission's Regulations set forth in 10 CFR 51. After receipt of an application in 1973 to construct this Plant, the staff carried out a review of impacts that would occur during the Plant's construction and operation. That evaluation was issued as a Final Environmental Statement--Construction Permit Stage (FES-CP) in April 1974. After that environmental review, a safety review, an evaluation by the Advisory Committee on Reactor Safeguards, and public hearings in the site area, the U.S. Nuclear Regulatory Commission (NRC) issued permits in May 1977 for the construction of Units 1 and 2 of the PNPP. As of June 1982, the construction of Unit 1 was 83% complete and Unit 2 was 43% complete. The applicant applied for licenses to operate Units 1 and 2 and submitted the required safety report (FSAR) in September 1980 and the required environmental report (ER-OL) in June 1980. The proposed fuel-loading date for Unit 1 is November 1983. The staff has reviewed the activities associated with the proposed operation of this Plant; the potential environmental impacts are summarized as follows:

   a. The additional generating capacity provided by the PNPP, Units 1 and 2, will permit CAPCO to achieve its minimum standards for generation reliability, result in significant cost savings for service area customers, and provide increased diversity of fuels within the system (Section 2).

b. A total land area of approximately 445 ha (1100 acres) will be used for the Plant site. Construction-related activities on the site have disturbed approximately 121 ha (300 acres). Operational land use impacts will be small (Sections 4.2.1 and 4.2.2).

c. Impacts from the construction of the two originally proposed transmission lines were evaluated in Sections 3.8 and 4.3.1.2 of the FES-CP. Construction of the Perry-Macedonia-Inland line is under way. The originally proposed Perry-Hanna line was recently refused certification by the Ohio Power Siting Board. A new routing for this line, which is to be used for transmitting power from Unit 2, will be proposed later by the applicant. The staff will then evaluate the impacts of this line (Section 5.5.1.4).

d. Plant makeup water for the natural-draft cooling towers is obtained from Lake Erie through a submerged intake structure. The average water loss for both units operating at a 100% load factor is about 1400 l/sec (22,187 gpm). This water loss will produce no significant impact on general water use from Lake Erie (Section 5.3.1.1).

e. Losses of fish due to entrainment and impingement will be minimal and will be orders of magnitude less than at other Lake Erie power plants using once-through cooling. Thermal discharges will not impact lake biota. The PNPP site vicinity is not a unique spawning or nursery area, but those fishes that do utilize the area will not be impacted. Neither lake fishing activity nor fishery harvests will be affected by Plant operation. The PNPP intake/discharge system is a state-of-the-art design and probably will result in PNPP having one of the lowest potentials for aquatic impact of the many power plants on Lake Erie (Sections 5.3.2, 5.5.2.1, and 5.5.2.2).

f. The operation of the Plant will have no impacts on endangered or threatened species (Section 5.6).

g. There is no serious potential for ground-level fogging and icing as a result of the operation of the cooling towers. The effects of drift on terrestrial ecosystems are considered to be insignificant. Although birds may collide with the cooling towers on occasion, relatively few deaths are expected each year. These potential collisions cannot be regarded as a threat to bird populations at large (Sections 5.4.1 and 5.5.1.3).

h. The risk associated with accidental radiation exposure is very low (Section 5.9.4).

i. No significant environmental impacts are anticipated from normal operational releases of radioactive materials. The estimated maximum individual dose for a member of the public subject to the maximum exposure will be very small compared to natural back-ground dose (~100 mrems/yr) or the dose limits specified in 10 CFR 20 (500 mrems/yr-whole body). As a result, the staff concludes that there should be no measurable radiological impact on members of the public from routine operation of the Plant (Section 5.9.3).

j. Operational noise levels are not expected to be objectionable to nearby residents and transients (Section 5.8.2).

k. By letter dated August 5, 1982, the applicant updated his application for operating licenses for Perry Units 1 and 2 of June 26, 1980, requesting the operating licenses have a duration of 40 years from date of issuance. In general, this Statement assesses various impacts associated with the operation of the facility in terms of annual impacts, and balances these impacts against the anticipated annual energy production benefits. Thus, the overall assessment and conclusion would not be dependent on specific operating life. There are, however, two areas in which a specific operating life was assumed: (1) radiological assessments that are based on a 15-year plant mid-life, and (2) the uranium fuel cycle impacts that are based on one initial core load and 29 annual refuelings. These areas were reassessed to determine whether the use of a 40-year operating period, rather than a 30-year operating period would significantly affect the staff's assessment as presented in this Statement. The staff's appraisal of the significance of the use of 40 years of operation for these areas are summarized as follows:

(1) Radiological Assessments--The staff calculates dose commitments to the human population residing around nuclear power reactors to assess the impact on people from radioactive material released from these reactors. The annual dose commitment is calculated to be the dose that would be received over a 50-year period following the intake of radioactivity for 1 year under the conditions that would exist 15 years after the plant began operation. The 15-year period is chosen as representing the midpoint of plant operation and is incorporated into the dose models by allowing for buildup of long-life radionuclides in the soil. It affects the estimated doses only for radionuclides ingested by humans that have half-lives greater than a few years. For a plant licensed for 40 years, increasing the buildup period from 15 to 20 years would increase the dose from long-life radionuclides via the ingestion pathways by 33% at most. It would have much less effect on dose from shorter life radionuclides. Tables D-7 and D-8, in Appendix D of the DES, indicate that the estimated doses via the ingestion pathways are well below the regulatory design objectives. For example, the ingestion dose to the thyroid is 10.0 mrems/yr for both units compared to the RM-50-2 design objective dose rate of 15 mrems/yr (see Table D-8 of Appendix D). Thus, an increase of even as much as 33% in these pathways would remain well below the RM-50-2 design objective and would not be significant.

(2) Uranium Fuel Cycle Impacts--The impacts of the uranium fuel cycle are based on 30 years of operation of a model light-water reactor (LWR). The fuel requirements for the model LWR were assumed to be one initial core load and 29 annual refuelings (approximately 1/3 core). The annual fuel requirement for the model LWR averaged out over a 40-year operating life (one initial core and 39

refuelings of approximately 1/3 core) would be reduced slightly when compared with the annual fuel requirement averaged for a 30-year operating life. The net result would be an approximate 1.5% reduction in fuel requirements for the model LWR. This small reduction in fuel requirements would not lead to significant changes in the impacts of the uranium fuel cycle. The staff does not believe that there would be any changes to Table 5.13 (S-3) of this Statement that would be necessary to consider 40 years of operation. If anything, the values in Table 5.13 become more conservative when a 40-year period of operation is considered.

4. The personnel that participated in the preparation of the Final Environmental Statement are listed in Section 7.

5. The OL-DES Statement was made available to the agencies and organizations specified in Section 8 and to the public.

6. On the basis of the analysis and evaluation set forth in the OL-DES, and the FES-CP after weighing the environmental, economic, technical, and other benefits against environmental and other costs and considering those alternatives appropriate at the operating license stage, it is concluded that the action called for under NEPA and the Commission's Regulations set forth in 10 CFR 51 is the issuance of operating licenses for Unit 1 and Unit 2 of the Perry Nuclear Power Plant, in accordance with the Environmental Protection Plan, and subject to the following conditions for the protection of the environment:

   a. Before engaging in additional construction or operational activities at PNPP that may result in a significant adverse environmental impact, which were not evaluated or which are significantly greater than those evaluated in the OL-DES, the applicant shall provide written notification to the Director, Office of Nuclear Reactor Regulation.

   b. The applicant shall carry out the environmental (meteorological, radiological, and ecological) monitoring programs outlined in this Statement as modified and approved by the staff and implemented in the Environmental Protection Plan and the Radiological Effluent Technical Specifications incorporated in the operating licenses for the PNPP. Monitoring of the aquatic environment shall be as specified in the NPDES Permit when it is issued.

   c. If evidence of irreversible damage or harmful effects is detected during the operating life of the Plant, the applicant shall promptly provide the staff with an analysis of the problem and a proposed course of action to alleviate the problem.

   d. The EPP will call for monitoring for Asiatic clams.

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FOREWORD

The Draft Environmental Statement--Operating License Stage was prepared by the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation (NRR, the staff) in accordance with the Commission's regulations set forth in Title 10 of the Code of Federal Regulations Part 51 (10 CFR 51), which implements the requirements of the National Environmental Policy Act of 1969 (NEPA).

The NEPA 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 aesthetically 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 that 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:

- The environmental impact of the proposed action
- Any adverse environmental effects which cannot be avoided should the proposal be implemented
- Alternatives to the proposed action
- The relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity
- Any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

An environmental report accompanies each application for a construction permit or for a full-power operating license. A public announcement of the availability of the report is made. Any comments by interested persons on the report are considered by the staff. In conducting the required NEPA review, the staff meets with the applicant to discuss items of information in the environmental report, to seek new information from the applicant that might be needed for an adequate assessment, and generally to ensure that the staff has a thorough understanding of the proposed project. In addition, the staff seeks information from other sources that will assist in the evaluation, and visits and inspects the project site and surrounding vicinity. Members of the staff may meet with state and local officials who are charged with protecting state and local interests. On the basis of all the foregoing and other such activities or inquiries as are deemed useful and appropriate, the staff makes an independent assessment of the considerations specified in Section 102(2)(C) of the NEPA and 10 CFR 51.

This evaluation leads to the publication of a Draft Environmental Statement (DES), which is then circulated to Federal, state, and local governmental agencies for comment. A summary notice of the availability of the applicant's environmental report and the DES is published in the Federal Register. Interested persons are also invited to comment on the proposed action and on the DES.

After receipt and consideration of comments on the operating license stage Draft Environmental Statement (DES-OL), the staff prepared this Final Environmental Statement (FES), which includes a discussion of questions and concerns raised by the comments and the disposition thereof; a final benefit-cost analysis, which considers and balances the environmental effects of the facility and the alternatives available for reducing or avoiding adverse environmental effects with the environmental, economic, technical, and other benefits of the facility; and a conclusion as to whether--after the environmental, economic, technical, and other benefits are weighed against environmental costs and after available alternatives have been considered--the action called for, with respect to environmental issues, is the issuance or denial of the proposed permit or license or its appropriate conditioning to protect environmental values. The same format used in the DES-OL was used in this FES to facilitate review.

This environmental review deals with the impact of operation of the Perry Nuclear Power Plant (PNPP), Units 1 and 2. Assessments that are found in this Statement supplement or modify those described in the Final Environmental Statement--Construction Permit (FES-CP) that was issued in April 1974 in support of issuance of construction permits for the units. Pursuant to recent amendments to 10 CFR 51 (46 FR 28630, May 28, 1981) and to the Commission's March 4, 1982 approval for publication of additional amendments to Part 51 (May 9, 1982 NRC Secretary's memorandum to the Executive Director for Operation and the Director of Congressional Affairs), the staff is not required to address, in environmental impact statements prepared in connection with operating licenses, the need for power from the facility, alternate sources for generating that power, nor alternatives to the plant site, unless otherwise required by the Commission. Although these matters were addressed as appropriate in the DES, the staff's treatment of them in this FES was affected by these amendments to the regulations.

The information to be found in the various sections of this Statement updates the FES-CP in four ways: (1) by evaluating changes to facility design and operation that will result in different environmental effects of operation (including those which would enhance as well as degrade the environment) than those projected during the preconstruction review; (2) by reporting the results of relevant new information that has become available subsequent to the issuance of the FES-CP; (3) by factoring into the Statement new environmental policies and statutes that have a bearing on the licensing action; and (4) by identifying unresolved environmental issues or surveillance needs which are to be resolved by means of license conditions. Otherwise the assessments contained in the FES-CP are not changed.

Copies of this Final Environmental Statement--Operating License Stage (FES-OL) are available for inspection at the Commission's Public Document Room, 1717 H Street, NW, Washington, DC 20555 and at the Perry Public Library, 3753 Main Street, Perry, Ohio 44081. Single copies of this Statement may be obtained by writing to the:

Division of Technical Information and Document Control
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Copies of the FES-CP also are available for inspection at the locations noted above and may be obtained by writing to the address above. John J. Stefano is the NRC Project Manager for the environmental review pertaining to the Perry Nuclear Power Plant, Units 1 and 2. He may be reached by writing to the Division of Licensing, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, Washington, DC 20555 or by calling (301) 492-9536.

Appendix A to the Draft statement was reserved for comments on the DES, now included in this Final Statement. Appendix B presents the NEPA Population Dose Assessments. The impacts of the uranium fuel cycle are presented in Appendix C, and examples of site-specific dose-assessment calculations are given in Appendix D. Appendix E discusses rebaselining the Reactor Safety Study Results for BWRs and Appendix F presents Consequence Modeling Considerations. Appendices G and H contain correspondence from the U.S. Department of the Interior, Fish and Wildlife Service, and from the Ohio State Historic Preservation Officer, respectively.

FINAL ENVIRONMENTAL STATEMENT RELATED TO THE OPERATION OF PERRY NUCLEAR POWER PLANT, UNITS 1 AND 2

1 INTRODUCTION

1.1 Résumé

The proposed action is the issuance of operating licenses to the Cleveland Electric Illuminating Company (the applicant) acting also as agent for the other co-owners (Duquesne Light Company, Ohio Edison Company, and the Toledo Edison Company) for the startup and operation of the Perry Nuclear Power Plant (the Plant, PNPP), Units 1 and 2 (Docket Nos. 50-440 and 50-441). Each unit will use a boiling-water reactor (BWR) and will have an initial gross electrical output of approximately 1250 MWe. Condenser cooling will be accomplished through a system of closed-loop, natural-draft, cooling towers. Makeup water for the cooling towers will be obtained from Lake Erie through two submerged intake structures connected to the Plant by 3-m-(10-ft-)diameter intake tunnels. The Plant is located on a 445-ha (1100-acre) site about 56 km (35 mi) northeast of Cleveland, Ohio and approximately 11 km (7 mi) northeast of Painesville, Ohio.

1.2 Administrative History

This operating license (OL) review is the second assessment of the environmental impacts associated with PNPP Units 1 and 2. After receiving an application in 1973 to construct the Plant, the staff reviewed impacts that could occur during the construction and operation of the Plant. This evaluation was issued as a Final Environmental Statement--Construction Permit Stage (FES-CP) in April 1974. As a result of that environmental review, a safety review, and an evaluation by the Advisory Committee on Reactor Safeguards (ACRS), and after public hearings before an Atomic Safety and Licensing Board between June 1974 and March 1977 in the site vicinity, the Nuclear Regulatory Commission (NRC) issued Construction Permits CPPR-148 and CPPR-149 on May 3, 1977.

On June 20, 1980, the applicant submitted the PNPP Environmental Report-Operating License Stage (ER-OL) and, on September 12, 1980, the Final Safety Analysis Report (FSAR)* as part of the application requesting operating licenses for Units 1 and 2. The FSAR was docketed on January 28, 1981, and the ER-OL on June 19, 1981. The operational safety and environmental reviews were initiated following the docketing of these documents.

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*See availability statement on the inside front cover of this report. Other documents referenced in this report also are available as noted on the inside front cover and are listed at the end of the section in which they are cited. Documents are arranged alphabetically in reference lists according to the name of author or publisher, as given in parentheses following the statement which cites the reference. However, NRC documents such as NUREG reports or IE Bulletins will be referred to by their alphanumeric designations but listed under the heading of U.S. Nuclear Regulatory Commission.

As of June 1982, construction of Unit 1 was 83% complete, with a proposed fuel-loading date of November 1983. Unit 2 was 43% complete, with a tentative fuel-loading date of May 1987.

1.3 Permits and Licenses

The applicant has provided a status listing of environmentally related permits, approvals, and licenses required by Federal and state agencies in connection with the proposed PNPP project (ER-OL Section 12.0, and Supplement 1, page 2.2-4). The staff has reviewed the listing and is not aware of any potential non-NRC licensing difficulties that would significantly delay or preclude the proposed operation of PNPP. The issuance of a water quality certification pursuant to Section 401 of the Clean Water Act of 1977 by the State of Ohio Environmental Protection Agency is a necessary prerequisite for the issuance of an operating license by NRC. A water quality certification was issued by the State of Ohio on June 21, 1974 for operation of the closed-cycle cooling system. Application for a National Pollutant Discharge Elimination System (NPDES) Permit related to the operation of PNPP was received by the State of Ohio Environmental Protection Agency (Ohio-EPA) on June 21, 1982. Questions regarding the NPDES Permit should be addressed to the Ohio-EPA (see page A-37 in Appendix A of this Statement.

2 PURPOSE OF AND NEED FOR ACTION

The Commission has amended 10 CFR 51, "Licensing and Regulatory Policy and Procedures for Environmental Protection," effective April 26, 1982, to provide that need-for-power issues will not be considered in ongoing and future operating license proceedings for nuclear power plants unless a showing of "special circumstances" is made under 10 CFR 2.758 or the Commission otherwise so requires (47 FR 12940, March 26, 1982). Need-for-power issues need not be addressed by operating applicants in environmental reports to the NRC, nor by the staff in environmental impact statements prepared in connection with operating license applications. (See 10 CFR 51.21, 51.23(e), and 51.53(c).)

This policy has been determined by the Commission to be justified even in situations where, because of reduced capacity requirements on the applicant's system, the additional capacity to be provided by the nuclear facility is not needed to meet the applicant's load responsibility. The Commission has taken this action because the issue of need for power is correctly considered at the construction permit stage of the regulatory review where a finding of insufficient need could factor into denial of issuance of a license. At the operating license review stage, the proposed plant is substantially constructed and a finding of insufficient need would not, in itself, result in denial of the operating license.

Substantial information exists which supports the contention that nuclear plants cost less to operate than do conventional fossil plants. If conservation, or other factors, lowers anticipated demand, utilities remove generating facilities from service according to their costs of operation, and the most expensive facilities are removed first. Thus, a completed nuclear plant would serve to substitute for less economical generating capacity (see 46 FR 39440, August 3, 1981 and 47 FR 12940, March 26, 1982).

Accordingly, this environmental statement does not consider "need for power." Section 6 does, however, consider the savings associated with the operation of the nuclear plant.

3 ALTERNATIVES TO THE PROPOSED ACTION

The Commission has amended its regulations in 10 CFR 51 effective April 26, 1982 to provide that issues related to alternative energy sources will not be considered in ongoing and future operating license proceedings for nuclear power plants unless a showing of special circumstances is made under 10 CFR 2.758 or the Commission otherwise so requires (47 FR 12940, March 26, 1982). In addition, these issues need not be addressed by operating license applicants in environmental reports to the NRC, nor by the staff in environmental impact statements prepared in connection with operating license applications. (See 10 CFR 51.21, 51.23(e), and 51.53(c).)

The Commission has concluded that alternative energy source issues are resolved at the construction permit stage and the CP is granted only after a finding that, on balance, no superior alternative to the proposed nuclear facility exists. In addition, this conclusion is unlikely to change even if an alternative is shown to be marginally environmentally superior in comparison with operation of the nuclear facility because of the economic advantage that operation of the nuclear plant would have over available alternative sources (see 46 FR 39440, August 3, 1981 and 47 FR 12940, March 26, 1982). By earlier amendment (46 FR 28630, May 28, 1981), the Commission also stated that alternative sites will not be considered at the operating license stage, except under special circumstances per 10 CFR 2.758. Accordingly, this environmental statement does not consider alternative energy sources or alternative sites.

4 AFFECTED ENVIRONMENT

4.1 Résumé

The following sections provide a description of the Perry Nuclear Power Plant (the Plant or PNPP) facility and the related environment for only those areas where additional information has been provided or changes have occurred since the FES-CP review.

The major operational change is the substitution of a closed-cycle cooling system using natural-draft cooling towers for the originally proposed once-through system evaluated in the FES-CP. This substitution has resulted in changes in the plant layout (Section 4.2.1), water use (Section 4.3.5), non-radioactive waste management systems (Section 4.2.6), and water quality (Section 4.3.2), and the addition of a section (4.2.4.3) evaluating the effects of cooling-tower drift.

Other changes include the denial of certification for the originally proposed route for transmitting power from Unit 2 to Ohio Edison's Hanna Substation and the addition of two aquatic ecology analyses responsive to concerns of two Atomic Safety and Licensing Boards (Section 4.3.6.2).

Changes in the remaining sections involved only minor revisions and updating as required.

4.2 Facility Description

4.2.1 External Appearance, Plant Layout, and Land Use

The significant change in these areas from the analyses in Sections 2.1, 3.1, and 4.1 of the FES-CP results from the conversion from a once-through cooling system to closed-cycle cooling. This revised cooling system contains two 157-m (515-ft) natural-draft hyperbolic cooling towers. The towers are located in a line parallel to and on the eastern side of the reactor buildings. The total site is roughly 421.3 ha (1041 acres) of which less than 100 ha (250 acres) are actually developed and devoted to the main physical structure complex. Figure 4.1 contains details of the plant layout. The observation area, which had been planned, has been eliminated.

4.2.2 Site Land Use

Since the FES-CP was issued, there have been some changes in plant design that affect land use, and additional information characterizing the affected land has been obtained. This information, which supplements the information in the FES-CP (Section 2.2.2), is provided below.

Prior to construction, the principal land-use types for the 421.3-ha (1041-acre) site were agriculture and forests. The 93.9-ha (232-acre) area required for the plant and associated facilities consisted of 80% agricultural and 20% forests. Another 42.9 ha (106 acres) of the site have been temporarily disturbed as a

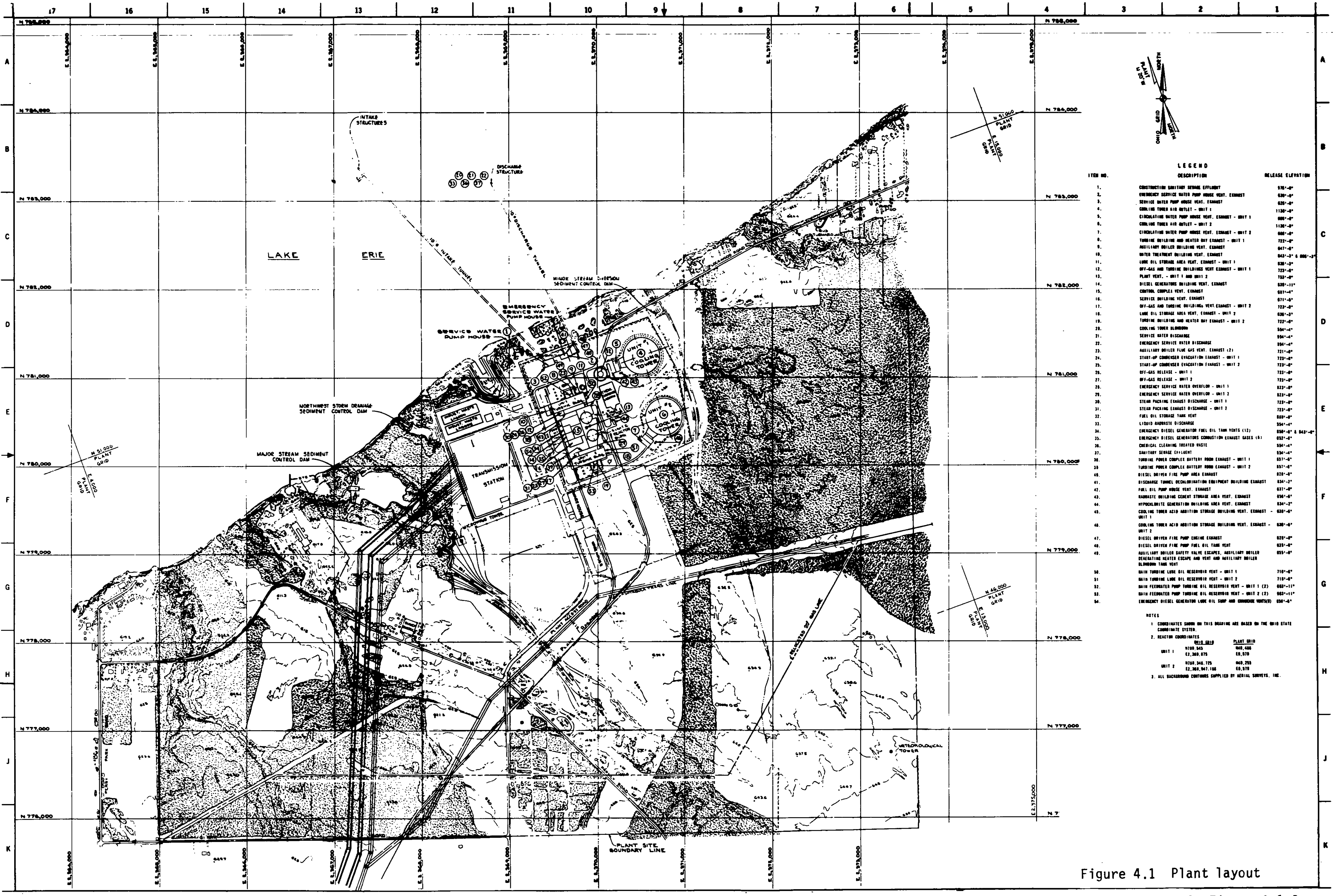


Figure 4.1 Plant layout

Source: ER-OL Figure 3.1-2

result of construction activities. Soil types were discussed in Appendix C of the FES-CP. It is the staff's assessment that practically all of the 101 ha required for the plant site itself may be classified as prime farmlands.

Approximately half of the land owned by the applicant and not needed for plant operation has remained undisturbed by construction activities. Areas disturbed by the plant site will be revegetated. The applicant has indicated that use of onsite areas will be limited to the generation of electric power (ER-OL Section 2.1.3.1).

Changes in land use as a result of transmission line construction are primarily caused by the clearing of land along the right-of-way. The most common types of land crossed by the originally proposed transmission lines (Section 4.2.7) are farmlands and woodlands.

4.2.3 Water Use

After the publication of the FES-CP the applicant redesigned the cooling-water heat-dissipation system to use closed-cycle evaporative cooling. This reduced the major water use rate substantially. Under the current operating plan, during full-load operation, the station will withdraw water from the lake at a rate of 4400 l/s (69,400 gpm). This is contrasted with a rate of about 72,500 l/s (1,150,000 gpm) with the once-through cooling system evaluated at the time of the CP review. The average discharge rate is reduced to about 2800 l/s (44,010 gpm).

The closed-cycle cooling system will evaporate water at an average annual rate of about 1400 l/s (22,200 gpm). The FES-CP anticipated that the discharge of waste heat into the lake would result in an additional evaporative loss of water from the lake surface of about 1130 l/s (18,000 gpm).

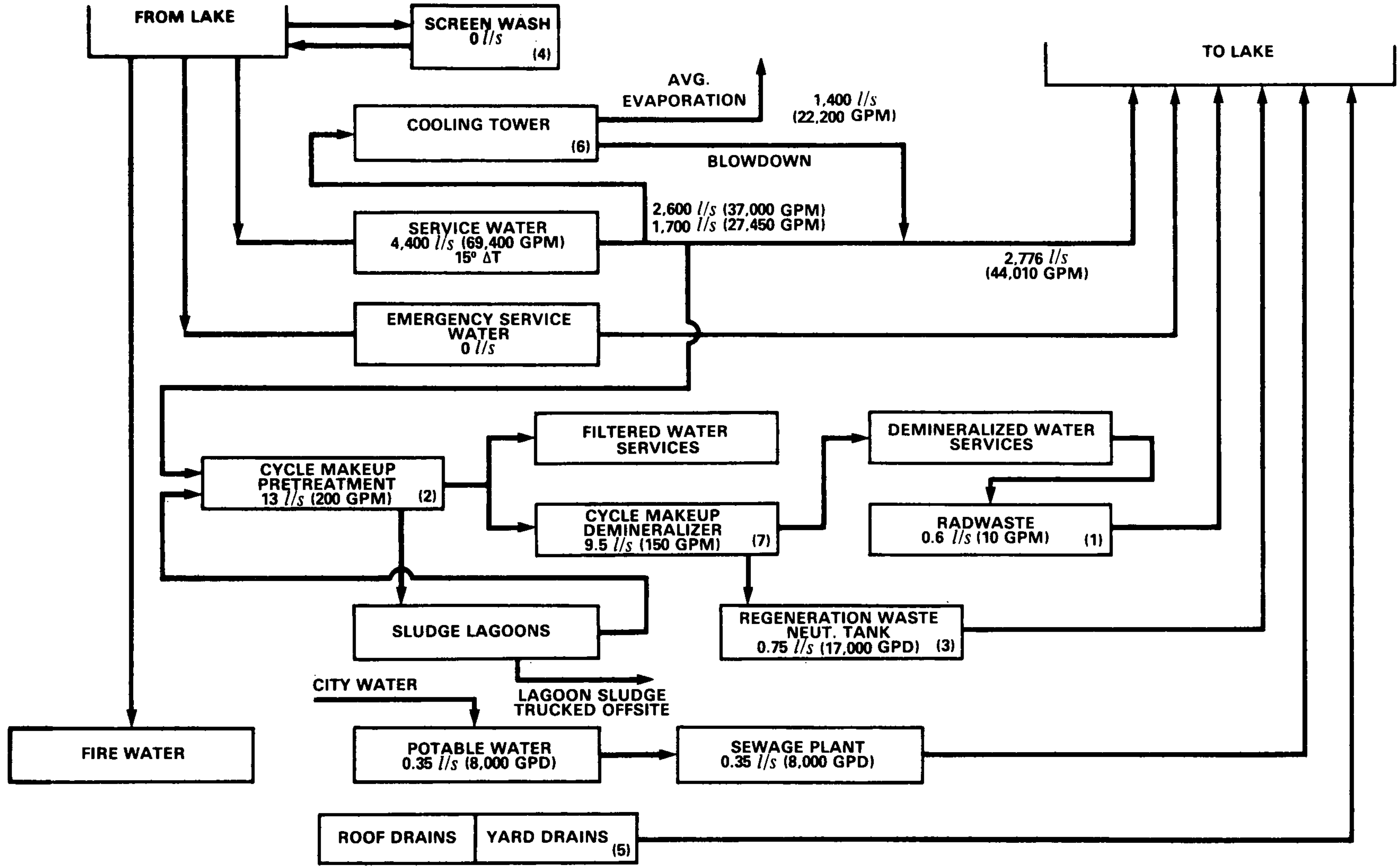
Figure 4.2 is a schematic water-use diagram illustrating water use within the plant.

4.2.4 Cooling System

The heat-dissipation system proposed and reviewed in the FES-CP was a once-through system utilizing a series of 12 independent intake structures and 6 discharge ports, all submerged offshore in Lake Erie (FES-CP Sections 3.4 and 11.1 and Comments 5 and 6, pages A-63 through A-65). The system now being constructed is a closed-cycle design using natural-draft cooling towers.

On May 11, 1973, the applicant applied to the State of Ohio Environmental Protection Agency (OEPA) for certification of the once-through cooling system pursuant to Section 401 of the Federal Water Pollution Control Act, stating that discharges from PNPP would comply with applicable sections of the Act. Subsequent to issuance of FES-CP, OEPA denied the application for certification of the once-through cooling system*, thus requiring closed-cycle cooling.

*This decision was noted in a letter dated May 8, 1974, to Harold L. Williams, Vice President-Engineering, The Cleveland Electric Illuminating Company, from: Ira L. Whitman, Director, OEPA, with Findings of Fact, Conclusion of Law, and Order.



(1) MAXIMUM DISCHARGE RATE - 13 l/s (200 GPM)
MINIMUM DISCHARGE RATE - 0.06 l/s (0.1 GPM)

(2) MAXIMUM INTAKE - 38 l/s (600 GPM)
AVERAGE INTAKE - 13 l/s (200 GPM)

([illegible]) MAXIMUM FLOW - 1.5 l/s (34,000 GPD)
AVERAGE FLOW - 0.75 l/s (17,000 GPD)

([illegible]) [illegible] l/s (3,[illegible] GPM) WHEN USED

(5) 3,154 l/s (50,000 GPM) MAXIMUM AT 10 cm (4 in) RAIN PER HOUR

(6) AVERAGE MAKEUP RATE - 2,633 l/s (37,000 GPM)
AVERAGE BLOWDOWN RATE - 1,045 l/s (14,800 GPM)

(7) MAXIMUM FLOW RATE - 19 l/s (300 GPM)
AVERAGE FLOW RATE - 9.5 l/s (150 GPM)

(Source: ER-OL Figure 3.3-1)

Figure 4.2 Schematic water-use diagram

During May, June, and July of 1974, the Atomic Energy Commission (now the NRC) held evidentiary hearings on environmental and site suitability issues. A change in the operational plan from once-through cooling to a closed-cycle system was examined during the hearing process. On September 18, 1974, the AEC Atomic Safety and Licensing Board issued its Partial Initial Decision (LBP-74-69, 8 AEC 538) that reviewed the closed-cycle proposal and found that it is "an acceptable alternative and is clearly preferable to the once-through system."

The closed-cycle cooling system is described in the following sections (taken from ER-OL Section 3.4).

4.2.4.1 Intake System

Makeup water for the closed-cycle cooling system will be withdrawn from Lake Erie through two submerged circular intake structures located on the lake bottom in 6.4 m (21 ft) of water, approximately 777 m (2550 ft) from shore (ER-OL Fig. 2.1-3). Inflow will be through eight ports around the perimeter of each structure. The ports are 1.1 m (3.62 ft) high and 3.7 m (12 ft) wide, and are 0.9 m (3 ft) above the lake bottom (ER-OL Fig. 3.4-10). The structures are 11 m (36 ft) in diameter and are fitted with velocity caps so that the inflow predominantly will be horizontal, with an approach velocity of less than 15 cm/s (0.5 fps). Trash racks or bar screens are not planned for the intake, but insert channels have been constructed around each port to accommodate trash racks, should they be necessary in the future. Blockage of an intake with debris will be detected by level alarms in the onshore service-water pumphouse. At a predetermined level, the power plant could be shut down. Divers and barge-mounted equipment would be used to clear the intake.

A single 3.0-m- (10-ft-) diameter intake tunnel (excavated beneath the lake bottom) connects the two offshore intake structures with the onshore service-water pumphouse. In the pumphouse, four 1.5 m^3/s (52.5 cfs) pumps (three in use, one on standby) will move the water through two traveling screens of 9.5-mm (3/8-in.) mesh and then to the condenser cooling system. Approximately 4.4 m^3/s (156 cfs) will be withdrawn from the lake during two-unit operation. This represents a 95% reduction in water to be withdrawn from the lake compared with 72.5 m^3/s (2560 cfs) required for the once-through cooling system proposed in the FES-CP (Sections 3.3, 3.4, 11.1).

An onshore safety-class emergency service-water pumphouse will contain three 0.7-m^3/s (27.5-cfs) pumps per unit that draw water from Lake Erie through the submerged offshore discharge nozzle and discharge tunnel. Two 9.5-mm mesh traveling screens are provided in the emergency pumphouse.

4.2.4.2 Discharge System

Cooling system blowdown will be returned to Lake Erie through a single 3-m- (10-ft-) diameter discharge tunnel (excavated beneath the lake bottom) to a discharge structure 503 m (1650 ft) from shore to the lake bottom in 5.8 m (19 ft) of water (ER-OL Fig. 2.1-3). Approximately 65% of the water withdrawn from the lake will be returned as blowdown, with discharge flows ranging from 2.7-3.2m^3/s (96.0-112.5 cfs). Effluent will exit a single diffuser nozzle (0.4 m above the bottom) at a maximum velocity of 10.7 m/s (35 fps), thus providing for rapid mixing. The temperature rise (ΔT) of the thermal effluent above lake ambient temperature is estimated to range between 7.7° and 12.0°C

(13.8° and 21.6°F) (ER-OL Table 3.4-1). This represents a decrease from the 16.1°C (29°F) ΔT for the once-through cooling system proposed in the FES-CP (Section 11.1). The once-through cooling thermal plume model reviewed in the FES-CP (Section 11.1.3.1) predicted lake surface plumes within the 1.7°C (3°F) ΔT isotherm to range between 1.2 and 6.5 ha (3-16 acres) in size. The thermal plume analysis for the present closed-cycle cooling system predicts no surface plume with a ΔT in excess of 1.1°C (2°F), and in most cases only a small surface plume within the 0.6°C (1°F) ΔT isotherm (ER-OL Section 5.1.2.2).

4.2.4.3 Cooling-Tower Drift

Most of the dissolved solids present in the intake water and added for makeup water treatment will be discharged with the cooling-tower blowdown into the lake; however, a small amount will be discharged into the atmosphere as cooling-tower drift. This drift will consist of small droplets of water and dissolved solids picked up by the air flowing through the cooling tower.

Because the design of the heat-dissipation system has been changed from a once-through system to a closed-cycle system (Section 4.2.4.2), the applicant has provided estimates of cooling-tower drift (ER-OL Sections 5.1.4.3.1 and 5.1.4.3.2). Table 4.1 provides the design parameters for one PNPP natural-draft cooling tower. The chemical composition of the drift is essentially the same as the chemical composition of the circulating water, and the relative amounts of varous chemicals are provided in the ER-OL (Q290.04).

4.2.5 Radioactive-Waste-Management System

Under requirements set by 10 CFR 50.34a, an application for a permit to construct a nuclear power reactor must include a preliminary design for equipment to keep levels of radioactive materials in effluents to unrestricted areas as low as is reasonably achievable (ALARA). The term ALARA takes into account the state of technology and the economics of improvements in relation to benefits to the public health and safety and other societal and socioeconomic considerations and in relation to the utilization of atomic energy in the public interest. Appendix I to 10 CFR 50 provides numerical guidance on radiation dose design objectives for light-water-cooled nuclear power reactors to meet the requirement that radioactive materials in effluents released to unrestricted areas be kept ALARA.

To comply with the requirements of 10 CFR 50.34a, the applicant provided final designs of radwaste systems and effluent control measures for keeping levels of radioactive materials in effluents ALARA within the requirements of Appendix I to 10 CFR 50. In addition, the applicant provided an estimate of the quantity of each principal radionuclide expected to be released annually to unrestricted areas in liquid and gaseous effluents produced during normal reactor operations, including anticipated operational occurrences.

The NRC staff's detailed evaluation of the radwaste systems and the capability of these systems to meet the requirements of Appendix I (10 CFR 50) are presented in Chapter 11 of the staff's Safety Evaluation Report, which was issued in May 1982 (NUREG-0887). The quantities of radioactive material that the NRC staff calculates will be released from the plant during normal operations, including anticipated operational occurrence, are presented in Appendix D of

Table 4.1 Design parameters for the PNPP natural-draft cooling-towers analyses

Parameter	Value*	
	Metric	English
Generating capacity	1205 MWe	1205 MWe
Heat-rejection rate	8.81×10^{9} Kj/hr	8.35×10^{9} Btu/hr
Circulating-water flow rate	34,390 l/sec	545,400 gpm
Air flow rate	6.88×10^{7} kg/hr	1.5175×10^{8} lb/hr
Exit air temperature	46°C	114°F
Ambient wet-bulb temperature	24°C	76°F
Relative humidity	50%	50%
Approach	10°C	18°F
Hot-water temperature	51°C	124.6°F
Cold-water temperature	34.4°C	94.0°F
Cooling range	17°C	30.62°F
Cycles of concentration of circulating water	2.5	2.5
Total dissolved solids	535 ppm	535 ppm
Makeup water rate	1525 l/sec	24,167 gpm
Evaporation rate	915 l/sec	14,500 gpm
Blowdown rate	607 l/sec	9612 gpm
Drift rate	3.5 l/sec	55 gpm
Maximum drift loss, percent of circulating-water flow	0.01%	0.01%
Base diameter of towers	120 m	395 ft
Tower discharge height	146.5 m	480.5 ft
Tower exit diameter	78.3 m	256.7 ft

Source: ER-OL Table 5.1-1

*Values are given for one unit (and one tower) only.

this Statement, along with examples of the calculated doses to individual members of the public and to the general population, resulting from these effluent quantities.

The staff's detailed evaluation of the solid radwaste system and its capability to accommodate the solid wastes expected during normal operations, including anticipated operational occurrences, is presented in Chapter 11 of the SER.

As part of the operating license for PNPP, the NRC will require Technical Specifications limiting release rates for radioactive material in liquid and gaseous effluents and requiring routine monitoring and measurement of all principal release points to ensure that the plant operates in conformance with the radiation-dose-design objectives of Appendix I (10 CFR 50).

The staff's detailed evaluation of the solid radwaste system and its capability to accommodate the solid wastes expected during normal operations, including anticipated operational occurrences, is presented in Chapter 11 of the SER. On the basis of its evaluation and on recent data from operating BWRs, the staff estimates that approximately 545 m^3 (19,300 ft^3) of "wet" solid wastes containing approximately 2300 Ci of radioactivity (mainly the long-lived fission and corrosion products, Cs-134, Cs-137, Co-58, Co-60, and Fe-55) and approximately 450 m^3 (16,000 ft^3) of "dry" solid wastes containing less than 50 Ci of radioactivity will be shipped off site annually from each PNPP unit to a licensed burial site. The packaging and shipping of all these wastes will be in conformance with the applicable requirements of 10 CFR 20 and 71 and 49 CFR 170-178.

4.2.6 Nonradioactive-Waste-Management System

Design revisions--principally those associated with the cooling system--have changed estimates of the composition of plant effluent. Closed-cycle cooling in lieu of once-through cooling results in an increase in concentration of ambient constituents of water because of losses due to evaporation and introduces changes in the use of chemicals in the condenser cooling system.

Before station startup, the reactor flow passages and piping and equipment that convey water or steam to or from the reactor will be thoroughly cleaned, first with a flushing with demineralized water, then with an alkaline phosphate detergent solution (900 kg (2000 lb) of trisodium phosphate, 45 kg (100 lb) of disodium phosphate, and 230 l (60 gal) of a biodegradable detergent in 4.5×10^5 l (120,000 gal) of demineralized water), followed by additional rinses with an additional 3.8×10^6 (1,000,000 gal) of demineralized water. Phosphate will be precipitated with lime (about 1600 kg (3500 lb)). The remaining clear solution will be neutralized and discharged at a low rate with the Plant discharge. During the 17-hour pumpout period, total dissolved solids in the effluent stream will be increased by about 30% and the phosphate content of the effluent stream will be approximately 50% above the lake ambient concentration (ER-OL).

The cooling system will be managed by altering makeup and blowdown as necessary to produce about a 2.5-fold increase in concentration of substances in the makeup water. The applicant's planned operation of the closed-cycle cooling system includes the addition of about 8300 kg (18,200 lb) per day of 93% sulfuric acid to prevent formation of scale on the condenser tubes. Concentration of sulfate ion in the Plant discharge will be at about five times the nominal lake water ambient value; bicarbonate ion will be reduced in concentration by about 50%. The concentration of dissolved solids in the effluent stream will be about 40% greater than the ambient value. The increase in dissolved solids reflects a combination of the effects of evaporative loss of water and the addition of acid.

At the time of the CP review, the applicant did not intend to use a biocide in the main condenser cooling water system. With the adoption of closed-cycle

evaporative cooling, a biocide will now be necessary. The applicant proposes intermittent injection of an 0.8% sodium hypchlorite solution as the biocide for all cooling systems. Sodium sulfite will be injected into the cooling-tower blowdown and service water discharge line to remove residual chlorine, making the discharge concentration nontoxic. The daily usage of these chemicals will be about 360 kg (800 lb) of sodium hypochlorite and about 11 kg (25 lb) of sodium sulfite.

Table 4.2 shows the chemical composition of effluent and, nominally, of lake water.

It should be noted that the discharges described and evaluated here are those proposed by the applicant. The actual releases will be constrained by limits set forth in the National Pollution Discharge Elimination System (NPDES) Permit to be issued by the State of Ohio. Establishment of limits in the Permit will consider both technology-based limitations from Environmental Protection Agency (EPA) regulations (49 CFR 423) and limitations necessary to ensure compliance with state water quality standards. The applicant applied to the State of Ohio for the NPDES Permit in June 1982 (see page A-37 in Appendix A of this Statement.

Table 4.2 Chemical composition of station effluent with comparison to Lake Erie water quality

Acidity level and constituent	Nominal lake-water composition	Lake-water composition range	Cooling-water* discharge to lake	Cooling water when also containing regeneration waste
pH	7.9	7.7-8.5	6-9	6-9
Na, ppm	16	13-26	25.6	45.9
Ca, ppm	40	33-45	69.2	69.2
Mg, ppm	8	7-8.9	14.6	14.6
HCO_3, ppm	106	80-124	62.6	62.6
Cl, ppm	38	30-57	63.8	63.9
SO_4, ppm	24	14-60	106.4	144.8
Suspended solids, ppm	12	1-200	19.2	19.2
Dissolved solids, ppm	244	130-325	341.8	401

Source: ER-OL, Tables 3.6-2 and 3.6-5.

*Cooling water is composite cooling water discharge to Lake Erie with cooling towers operating at 2.5 concentrations and maximum cooling tower evaporation. Emergency service water flow is assumed to be zero.

4.2.7 Power Transmission System

Two 345-kV transmission lines are to originate at PNPP. One, the Perry-Macedonia-Inland line, is a double-circuit line under construction through Lake, Geauga, Cuyahoga, and Summit Counties to the Inland Substation. The second line, Perry-Hanna, was proposed to carry power from Unit 2 through Lake, Geauga, and Portage counties to the Ohio Edison Hanna Substation near Ravenna. Figure 4.3 shows the proposed location of these two lines. Since issuance of the FES-CP, there has been one routing change in the Perry-Macedonia-Inland line (Figure 4.4): the Grand River crossing was moved to avoid crossing that segment of the river designated as a wild river (ER-OL Section 3.9). On January 11, 1982, the originally proposed Perry-Hanna line was denied approval and certification by the Ohio Power Siting Board. To date, the staff has not been advised by the applicant of any proposed changes to the Perry-Hanna line as a result of denied State approval. When final alignments of the Perry-Hanna transmission line are certified by the State of Ohio, the applicant will be required to provide a description and analyses of any changes pursuant to condition 7.2. of the construction permit (CP-FES, page iv).

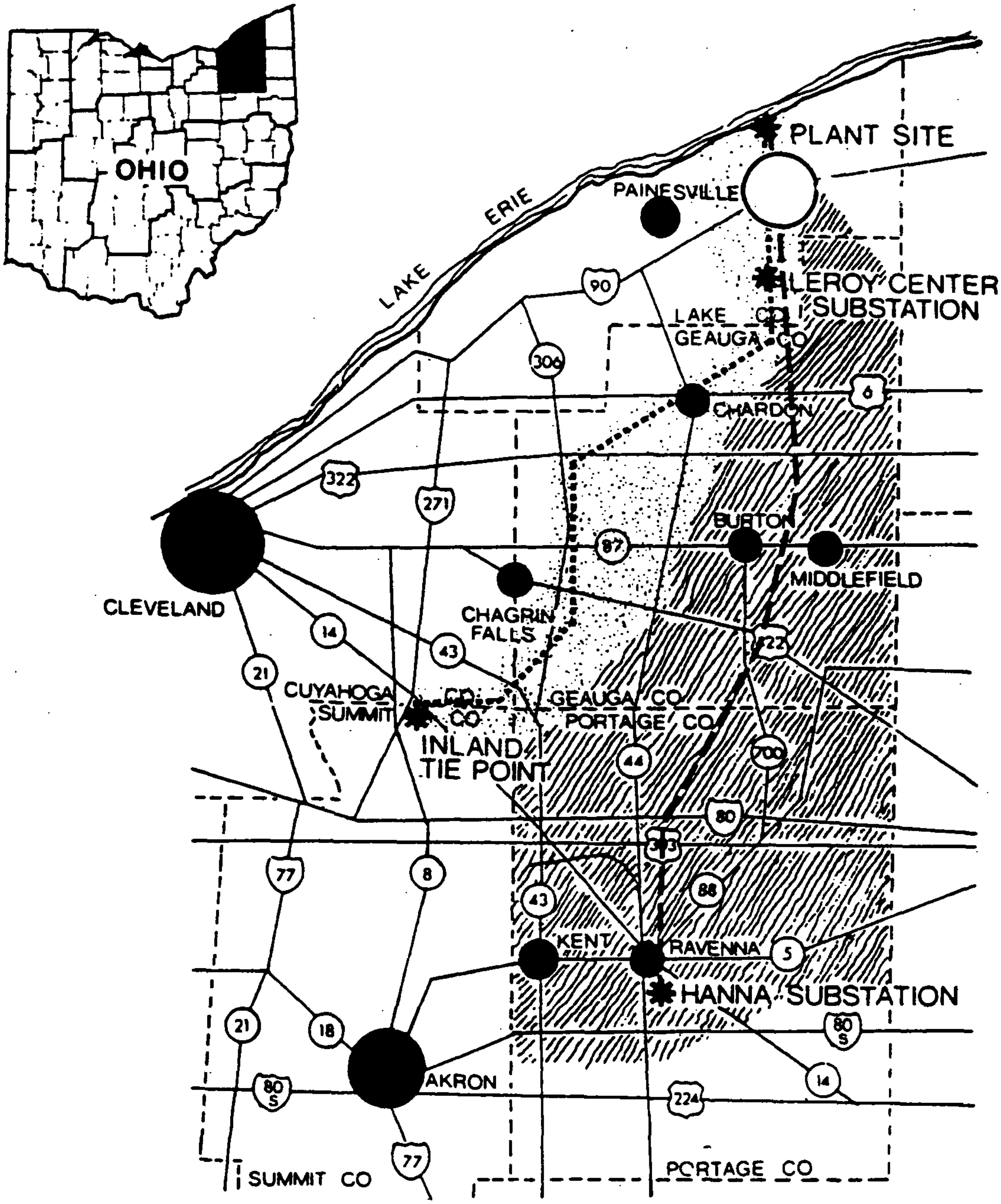
4.3 Project-Related Environmental Descriptions

4.3.1 Community Characteristics

Sections 2.2 and 11.3 of the FES-CP describe the socioeconomic characteristics of the area, including demography and land use. Lake County remains predominantly nonrural, with slow population growth. The area around the plant, however, is rural. The population forecasts contained and referred to in the FES-CP were, in general, higher than the more recent ER-OL estimates. For example, the population estimate within 16 km (10 mi) of the site for the year 2020 is 86,443, which is less than half of the FES-CP projection. The 2020 estimated 80-km (50-mi) population projection is 2,413,453, which is about 60% of the earlier estimate. The ER-OL 1980 population projections have been compared with 1980 Census results and were within 10% of the Census data. However, the ER-OL projections for 1980 were low for Geauga County by 8.6%, for Lake by 5.6%, and for Medina by 5.7%. The 1970 population within 16 km (10 mi) of the plant was 67,900. In 1980, it was 73,265, which represents a growth of less than 8% over the decade. The 80-km (50-mi) population in 1980 was 2,451,640, a decrease of over 2% during the 1970s. With regard to transient population, a significant change occurred when the IRC Fibers Company ceased operations on August 31, 1980. The facility is 5.6 km (3.5 mi) west-southwest of the Plant, and had employed about 600 workers (ER-OL Section 2.1.2.3). There are no other significant changes from the description in the FES-CP.

4.3.2 Water Quality

Since the CP review, water quality data have been collected in the PNPP site vicinity as part of the applicant's construction monitoring program. In general, the staff's understanding of water quality remains as described in the FES-CP. Values slightly above the previously reported range for biochemical oxygen demand, suspended solids, phosphorus, and bacteria were attributed to the stirring of sediments during dredging of the barge slip.



PROJECT I STUDY AREA

PROJECT 2 STUDY AREA

Figure 4.3 Proposed PNPP transmission system (Source: ER-OL Figure 3.9.1)

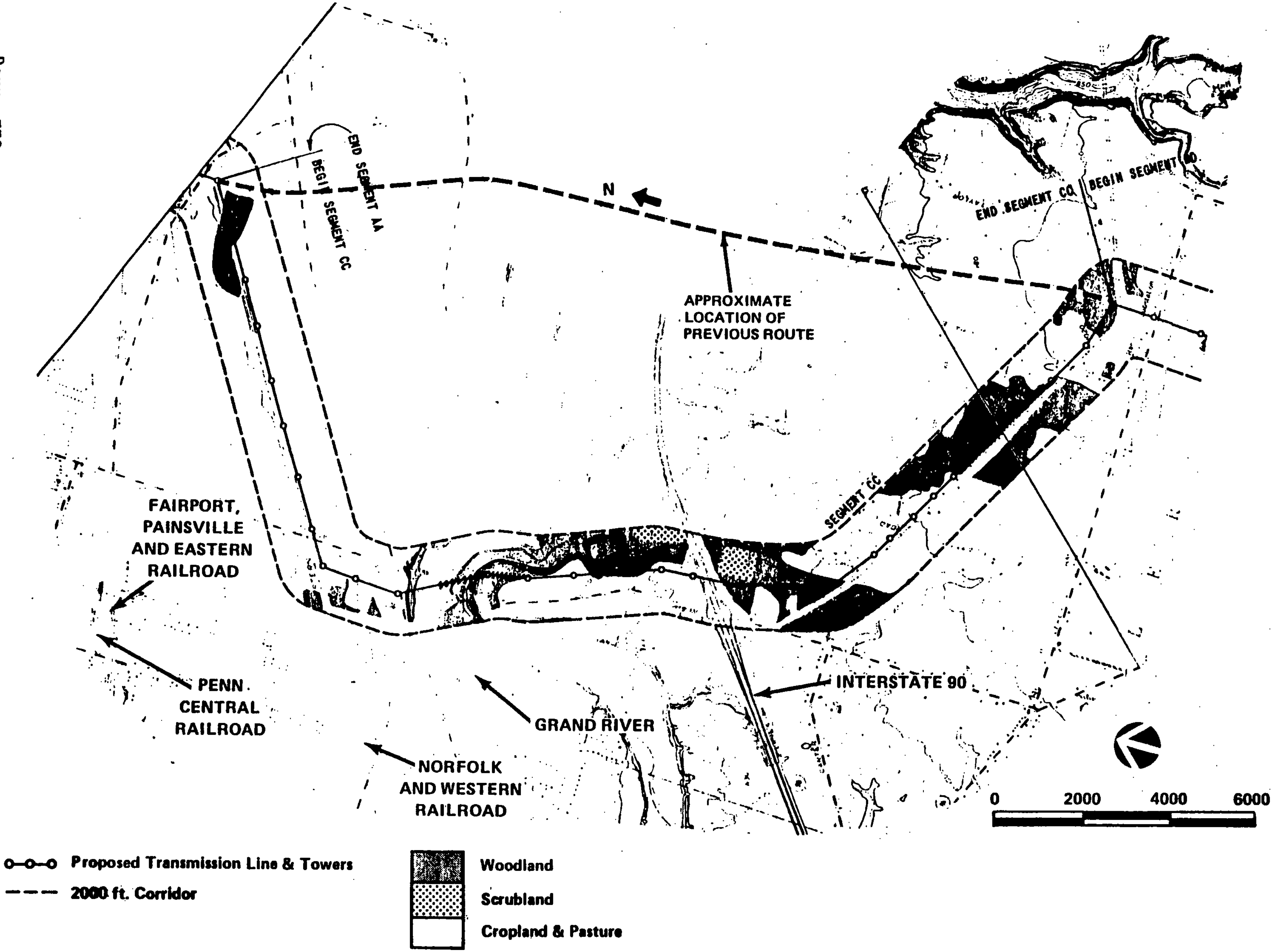


Figure 4.4 Modification of the Perry-Macedonia-Inland line (Source: ER-OL Figure 3.9.2)

With the adoption of the closed-cycle cooling system and the planned addition of sulfuric acid for scale control, data on dissolved solids and on sulfate concentration take on new relevance. The nominal lake concentration of dissolved solids was reported in the FES-CP as 244 mg/l. The nominal concentration of sulfate ion is 24 mg/l, with a range of values reported from 14 to 60 mg/l.

The International Joint Commission (IJC) on the Great Lakes has proposed as an objective for Lake Erie that the level of total dissolved solids should not exceed 200 mg/l. A specific objective has not yet been recommended for sulfate, although the need to develop such an objective has been recognized (IJC).

4.3.3 Surface-Water Hydrology

The surface-water hydrology description in FES-CP Sections 2.2.3 and 2.5 is still generally applicable. Some additional onsite data were obtained by the applicant and are discussed below.

In the vicinity of the proposed intake (1070 m (3500 ft) offshore) and of the proposed discharge (760 m (2500 ft) offshore), underwater instrument towers were installed in July 1972. Data were collected from July 20, 1972 through December 1973. At the intake, two current-direction meters were installed 2.4 m (8 ft) and 3.7 m (12 ft) above the bottom of the lake. In addition, three temperature sensors were mounted on the tower 0.3 m (1 ft), 2.4 m (8 ft), and 4 m (13 ft) above the bottom. At this location, the water depth at mean low water is about 7.9 m (26 ft). At the discharge, one current-direction sensor was located 2.1 m (7 ft) above the lake bottom, and three water temperature sensors were located 0.3 m (1 ft), 1.5 m (5 ft), and 2.4 m (8 ft) above the bottom. The water depth at mean low water at this location is about 6.7 m (22 ft). The monthly average temperature data for all six temperature sensors and for the entire data collection period are in Table 4.3. The applicant has provided the current direction roses for each temperature sensor in ER-OL Table 2.4-2. It should be noted that the intake and discharge structures have actually been built at closer-in locations than the proposed sites (see Section 4.2.4 of this report).

Table 4.3 Monthly average water temperatures in the vicinity of intake and discharge

Month	Temperature °C	Temperature °F	Month	Temperature °C	Temperature °F
January	1.7	35	July	21.7	71
February	1.1	34	August	23.3	74
March	2.8	37	September	21.1	70
April	6.7	44	October	16.1	61
May	10.6	51	November	8.3	47
June	19.4	67	December	3.3	38

Source: ER-OL Table 2.4-1

The coastal watershed in the vicinity of the site extends about 7.2 km (4.5 mi) from Lake Erie and is drained by several small streams that have cut deep channels as they approach the lake. The nearest stream, which has a drainage area of 2.0 km^2 (0.76 mi^2), borders the plant area to the east and north. A larger stream with a drainage area of 18.5 km^2 (7.16 mi^2) flows within 305 m (1000 ft) of the southwest corner of the Plant.

Lake Erie, which has a surface area of about 25,800 km^2 (9970 mi^2) and a drainage basin of 76,800 km^2 (29,650 mi^2), is adjacent and to the north of the plant. The lake surface partially freezes in the winter but is rarely completely covered with ice. The minimum lake surface temperatures occur in January; the maximum surface temperatures occur in August. The lake thermally stratifies during the summer. As winter approaches, surface cooling results in denser surface water that sinks and causes complete mixing.

The surface flow in Lake Erie is eastward at the PNPP site. This wind-induced surface flow is balanced by a reverse flow at intermediate depths. An extensive discussion of water chemistry in Lake Erie is in Section 2.5.3.3 of the ER-CP. Additional descriptions of the physical characteristics of Lake Erie are in Appendix B of the FES-CP.

4.3.4 Groundwater Hydrology

At the PNPP site, the formation that contains groundwater--the lacustrine soil deposits--consists of low-permeability fine sands, silty sands, and silty clay. The average thickness is 7.3 m (24 ft), and the underlying glacial till is essentially impervious. Groundwater in the site vicinity is found in semi-perched as well as in regional groundwater flow conditions. The principal direction of groundwater movement is toward Lake Erie; however, groundwater also flows toward the natural stream channels when the aquifer fills to capacity.

4.3.5 Water Use

Residential water users obtain their water supplies from shallow wells in the PNPP site vicinity. These wells generally bottom on the till and yield less than 19 l/min (5 gpm). The primary source of potable water for communities in the area is Lake Erie. The nearest municipal water intake presently in operation is the Green Street intake located in Madison Township, which is 6.8 km (4.2 mi) northeast of the Perry site. A new municipal water intake is being built at the former location of the Industrial Rayon Corporation intake, which is about 2.5 km (1.5 mi) southwest of the Perry site. This intake is expected to be in service by November 1982. Lake Erie supplies public water for communities in both the United States and Canada. Furthermore, large quantities of industrial cooling water are used by both countries. Canada uses about 500 l/s (11.4 mgd) for crop irrigation, but the United States makes very little use of Lake Erie for irrigation. Important nonconsumptive uses of Lake Erie water include fishing (both sport and commercial), recreation, and shipping.

Plant water use has changed from that described in the ER-CP because of the change in the cooling system from once-through cooling to closed-cycle cooling towers. All the water required for normal plant operation (about 440 l/s (69,400 gpm)) will be drawn from Lake Erie. The blowdown from the cooling towers, diluted by the service water discharge (about 65% of the total water

withdrawn), will be returned to the lake. Potable water for plant use is obtained from the Ohio Water Service Company.

4.3.6 Ecology

4.3.6.1 Terrestrial

The terrestrial ecology of the area is essentialy unchanged from the description prepared prior to construction (FES-CP Section 2.7.1). Data obtained during baseline studies have been supplemented by a construction monitoring program (ER-OL Section 6.1.4.3). Analysis of data obtained from construction monitoring did not yield results that would significantly change the description in the FES-CP.

4.3.6.2 Aquatic

The aquatic ecology of Lake Erie in the vicinity of the Perry site was described in the FES-CP (Section 2.7.2). Several surveys of aquatic biota have been conducted since the FES-CP review. This discussion will summarize the new information and provide a more extended discussion of three areas of concern and possible impact from operation of PNPP: Lake Erie fishes and fisheries (described in this section and Section 4.3.6.3); the CP stage Atomic Safety and Licensing Board's concern with fish spawning and nursery grounds near PNPP (LBP-74-69 of September 18, 1974); and the presence of Asiatic clams (Corbicula sp.) in Lake Erie, as per Issue No. 7 in the July 28, 1981 Special Prehearing Conference Memorandum and Order of the Operating License Stage, Atomic Safety and Licensing Board.

Aquatic ecological surveys of Lake Erie biota near the PNPP site were conducted by the applicant during 1971-1976. Data used in preparing the FES-CP included those from 1971-1973 (FES-CP Section 6.1.3.2). Since the publication of the FES-CP, additional surveys were conducted between 1974 and 1980, some of which were continuations of those done earlier. The 1974 studies included phytoplankton, zooplankton, benthic invertebrates, fishes, and ichthyoplankton (NUS 1975, 1975a, 1981). The ichthyoplankton survey studied species composition and distribution and evaluated the Perry site as a fish spawning and nursery ground (NUS 1975a). Studies conducted during 1975 and 1976 surveyed benthic invertebrates (NUS 1981).

Fishes

During 1974, fishes were sampled using gill nets, bottom trawls, and shore seines (NUS 1975). The species composition and dominance of yellow perch and freshwater drum captured by gill net were similar to the results of previous studies (as summarized in FES-CP Section 2.7.2.4). Shore seining in 1974 indicated that emerald shiners and young alewives were the dominant species of the shore zone near PNPP. Trawl and gill-net collections were made in the offshore areas near the locations of the intake and discharge structures. Those collections indicated that the species with the most potential for interaction with the structures are freshwater drum, yellow perch, emerald shiner, spottail shiner, rainbow smelt, white sucker, carp, and gizzard shad. Fish impingement studies at the Ashtabula C fossil-fueled power plant (that withdraws Lake Erie cooling water through an offshore intake system) during 1977-1978 showed that 95% of the fishes impinged were those species (App. Biol. 1979a). Commercial

and recreational species (see Section 4.3.6.3) comprised about 5% (or about 11,000 fish) of the total annual impingement. Trout and salmon species that are stocked into streams near Ashtabula and Perry were not impinged at the Ashtabula C plant (see Figure 4.5 for location relative to PNPP).

Annual trawl surveys of the major fish species of Lake Erie are conducted by the Ohio Department of Natural Resources (ODNR). The results for 1980 (ODNR 1981) indicate that the stocks of walleye, yellow perch, white bass, smallmouth bass, and freshwater drum all were stable. The abundance of the principal forage species (gizzard shad) has been good during recent years (1977-1980) (ODNR 1979, 1981; Davies et al. 1980). Shiners have been moderate in abundance in the central basin. Trawl sampling during October of 1979 in Sandusky Bay and in Lake Erie Districts 1 (western basin, Toledo to Huron), 2 (central basin, Huron to Fairport), and 3 (central basin, Fairport to Conneaut) (Figure 4.5) showed that: alewives were considerably more abundant in District 1 than elsewhere, freshwater drum were most abundant in Sandusky Bay, yellow perch were considerably more abundant in District 1, gizzard shad were most abundant in Sandusky Bay and District 2, and emerald and spottail shiners were considerably more abundant in District 3 than elsewhere.

Young-of-the-year and juvenile fishes were collected during the lake studies near PNPP in 1974 (NUS 1975). The most numerous young were alewives, gizzard shad, and shiners taken by shore seine. In much lower abundance were young of yellow perch, white bass, freshwater drum, channel catfish, and suckers. Sampling in the central basin and District 3 by ODNR also confirms the presence of young fishes of several species in those areas (ODNR 1981, Davies et al. 1980).

Ichthyoplankton

The Central Basin of Lake Erie near the PNPP site does function as a nursery area for several species of fishes, as indicated by the presence of young and juveniles (discussed above). Spawning also occurs in the site vicinity, as indicated by the applicant's ichthyoplankton survey during 1974 (NUS 1975a).

At least 17 species of fish spawned during April through August, based on the presence of fish eggs and larvae in the lake. Freshwater drum comprised 24% of the eggs collected, followed by yellow perch (9%), trout-perch (9%), rainbow smelt (3%), cyprinids (2%), and other unidentified species. Larvae were dominated by cyprinids (principally shiners, 76%), smelt (8%), drum (1%), alewife and gizzard shad (0.7%), yellow perch (0.3%), and others. The abundance of young alewife and gizzard shad near shore (in seine collections) and their relative scarcity as plankters suggest that the young moved into the Perry area from elsewhere. The abundance of cyprinids (principally emerald and spottail shiners) as plankters and young indicates that the PNPP area was utilized for spawning. Although ripe or nearly ripe yellow perch were taken near PNPP during the spring, eggs and larvae were not abundant, suggesting limited spawning there. Spawning of other important fishes near PNPP during 1974 appears to have been limited.

Ichthyoplankton studies during 1974 in other Lake Erie areas to the west of PNPP showed species composition to be similar to those near Perry (NRC Erie

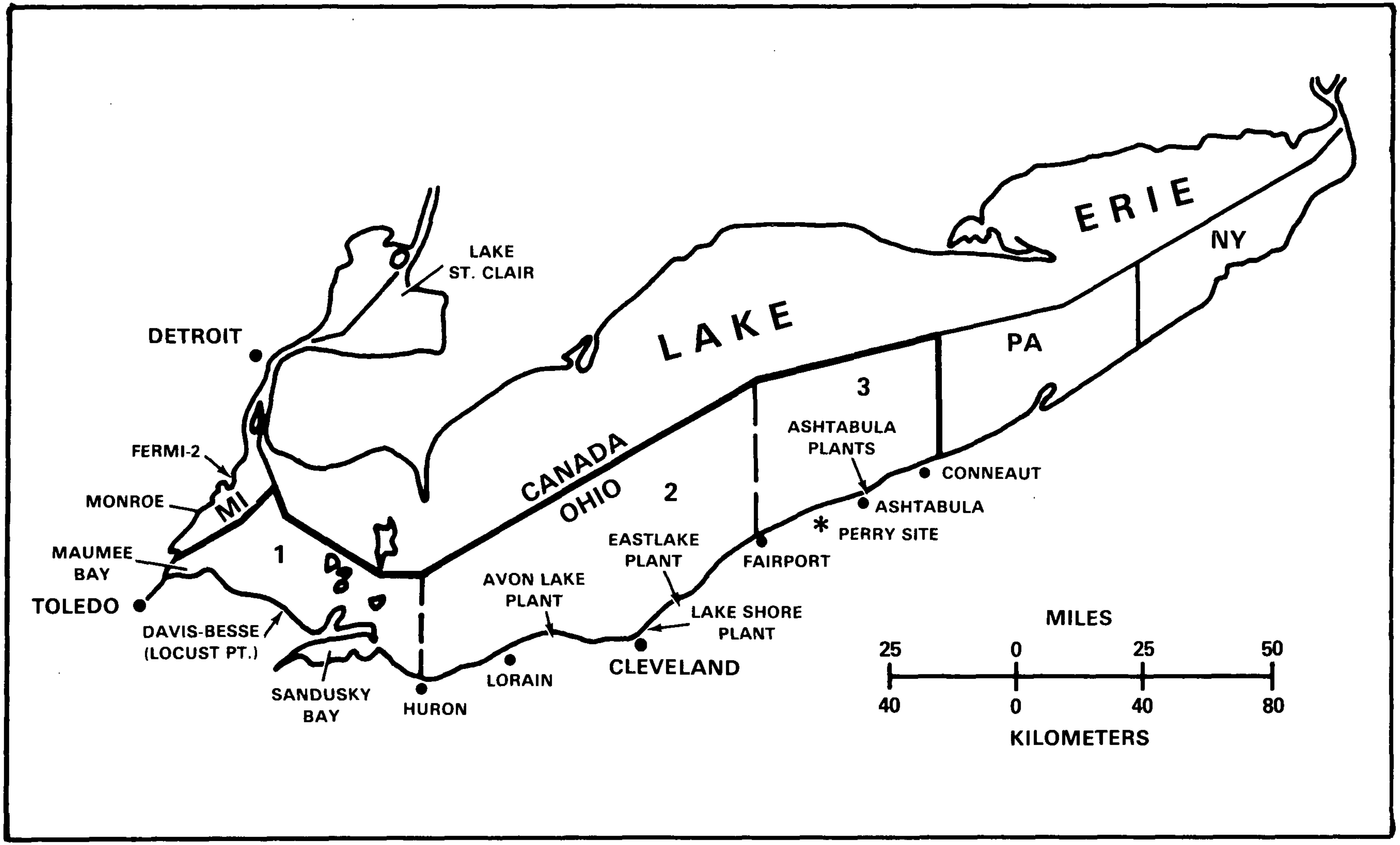


Figure 4.5 Map of Lake Erie showing locations of Ohio waters and Fishery Statistical Districts 1, 2, and 3, and ports, bays and power plants mentioned in the text on aquatic ecology and fisheries in relation to the Perry site

DES-CP, Davies et al. 1975, Nelson 1975). Going westward, yellow perch progressively comprised increasing proportions of the catch of larvae: 0.3% at PNPP (NUS 1975a); 1.3% near Huron (NRC Erie DES-CP); 4.8% at Locust Point (Davies et al., 1975); and 19.5% at Monroe, Michigan (Nelson).

Ichthyoplankton entrainment sampling in the pumphouse at the Ashtabula C power plant (with an offshore intake of lake water) during 1977 captured few plankters, but those captured were rainbow smelt (50%), carp (15%), freshwater drum (15%), shiners (5%), and others. No yellow perch were recorded in entrainment samples even though they occurred in samples taken in Lake Erie (App. Biol. 1979a). Entrainment sampling during 1977 at power plants with shoreline intakes to the east (Ashtabula A and B plants) (App. Biol. 1979) and west (Eastlake Plant) (App. Biol. 1979b) of PNPP recorded the capture of many species of fish eggs and larvae, including carp and shiners, rainbow smelt, yellow perch, gizzard shad, trout perch, log perch, mottled sculpin, and others.

In summary, Lake Erie in the vicinity of the PNPP site is used as a fish spawning and nursey area, but does not appear to be unique with respect to the occurrence or abundance of planktonic or juvenile fishes. The most abundant species spawned and those using the lake near PNPP for nursery purposes appear to be the forage species, principally shiners, alewife, and gizzard shad. Studies at power plants near PNPP indicate that the forage species (as opposed to the commercial and recreational fisheries species) are those with the most potential for interaction during intake and discharge operations from PNPP.

Asiatic Clams

The Asiatic clam, Corbicula fluminea, is present in the western basin of Lake Erie and was first collected in December 1980 (Clark). It was recorded from the lake proper in shallow water (depth of $\sim$ 1 m or 3 ft) near shore on a sand bottom. Corbicula also have been found in or near the effluent discharge canals (primarily shoreline types) of several once-through cooling power plants in the western basin and Maumee Bay, including Michigan and Ohio waters (NUREG-0769, IEB 81-03).

On April 10, 1981, the staff issued Inspection and Enforcement Bulletin 81-03 to holders of operating licenses and construction permits requiring them to submit the following information: the known occurrence of Corbicula in the vicinity of their plants; an inspection of plant equipment for fouling by Corbicula; and a description of methods (in use or planned) for preventing and detecting fouling by Corbicula. The applicant responded on June 18, 1981 and stated that as of May 28, 1981, no Asiatic clams have been found in the lake at PNPP (Davidson). Further, the applicant stated that methods for preventing and detecting future flow blockage or degradation from Asiatic clams are not planned at this time; however, should future results of the environmental monitoring program indicate the presence of the clams near PNPP, appropriate preventive and corrective actions would be implemented and evaluated. This monitoring program will be included in the Environmental Protection Plan (Appendix B to the operating license to be issued). Asiatic clams are also evaluated in the staff's Safety Evaluation Report (NUREG-0887) under Section 9.2.1, "Emergency Service Water System."

The presence of the clams in the western basin of Lake Erie renders their eventual presence near PNPP likely. Shoreline thermal discharges appear to be conducive to the clam's presence and survival in the lake (NUREG-0769). The net

flow of water in Lake Erie is from the west to the east, thus the meroplanktonic clam larvae eventually could establish the species in the central and eastern basins. Shoreline thermal discharges from power plants along the south shore of the lake might provide refuge for the clams.

The PNPP discharge structure is an offshore, submerged, high-velocity diffuser that should provide no thermal habitat or refuge for the clams. In addition, the presence of Corbicula in the vicinity of other power plants sited along Lake Erie does not yet appear to have resulted in fouling problems. Should the presence of Corbicula in the vicinity of PNPP threaten the operation of a safety system, measures to control Corbicula would be undertaken. Which method or combination of methods would be required at PNPP will depend on the nature of the problem, if any, that might arise. Any effluent to Lake Erie resulting from biofouling control will be required to meet effluent limitations set by the State of Ohio for environmental protection.

4.3.6.3 Commercial Fishery

Commercial fishing occurs throughout Lake Erie, with landings reported for all four of the bordering states (Michigan, Ohio, Pennsylvania, New York) and the Canadian Province of Ontario (Baldwin et al.). Total commercial landings for the lake (U.S. and Canada) have ranged between about 17 million to 22 million kg (38 million to 49 million lb) annually since 1970. Landings from Ohio waters in recent years have been between 7.4 to 10.5 million lb, worth $2.2 to $3.0 million (Table 4.4).

Table 4.4 Annual commercial harvest and dollar value of fish from Ohio waters of Lake Erie during 1976-1980

Year	Kilograms	Pounds	Dollar value
1976	3,530,309	7,783,000[a]	2,238,655[b]
1977	3,870,504	8,533,000[a]	-
1978	4,224,306	9,313,000[a]	2,559,330[c]
1979	4,754,102	10,481,000[d]	3,045,977[e]
1980	3,366,563	7,422,000[d]	-

(a) Ohio Department of Natural Resources, "Status of Ohio's Lake Erie Fisheries," Sandusky, January 1980.
(b) U.S. Department of Commerce, "Great Lakes Fisheries, Annual Summary 1976," Current Fisheries Statistics No. 7705, September 1979.
(c) Ohio Department of Natural Resources, "Commercial Fish Landings, Lake Erie - 1978," Sandusky, 1979.
(d) Ohio Department of Natural Resources, "Status of Ohio's Lake Erie Fisheries," Sandusky, January 1981.
(e) Ohio Department of Natural Resources, "Commercial Fish Landings, Lake Erie - 1979," Sandusky, 1980.

The State of Ohio Fishery Statistical District 3 encompasses the Ohio waters of Lake Erie from Fairport through Conneaut to the Ohio/Pennsylvania border; it includes the PNPP site (Figure 4.5). Commercial harvests within District 3 were 412,443 kg (909,282 lb) in 1978 and 258,820 kg (570,600 lb) in 1979, which represented 9.8% and 5.4%, respectively, of the total harvest from Lake Erie, Ohio (Tables 4.5 and 4.6). Fishing was by gill net only and primarily for yellow perch and freshwater drum.

Commercial fisheries of Lake Erie within an 80-km (50-mi) radius of PNPP includes most of the Ohio waters of the central basin and portions of Pennsylvania and Canadian waters (Figure 4.5). The primary species harvested in U.S. waters are yellow perch, white bass, and fresh water drum, with lesser catches of buffalo, carp, catfishes, gizzard shad, quillback, and suckers (ODNR 1979, Davies et al. 1980). Walleye is harvested commercially in Pennsylvania and Canadian waters, but not in Ohio waters (Baldwin et al). Total commercial landings in these various lake segments within 80 km of PNPP probably are between about 1 to 3 million lb annually. Principal ports for the U.S. lakeshore in that area are at Cleveland, Fairport Harbor, Ashtabula, and Conneaut, all in Ohio. It is estimated that 90-95% of the commercial landings at those ports are shipped out of the port city and that generally 40% of all Ohio-produced fish are sold out of state (ER-OL Section 2.1.3.5). Walleye sold in restaurants and markets in Ohio near PNPP is from Canadian waters of Lake Erie.

4.3.6.4 Recreational Fishery

Recreational fishing occurs throughout most of the Ohio waters of Lake Erie and in rivers and streams that are lake tributaries. Total annual harvests for Ohio waters have ranged between about 1.8-3.6 million kg (4-8 million lb) since 1975 (Tables 4.7 and 4.8). Harvests within Ohio Fishery Statistical District 3 during 1975 were 7.4% by number and 10.5% by weight of the Ohio Lake Erie total. Within District 3, the harvests predominantly were centered near Fairport, Ashtabula, and Conneaut. Virtually no harvest occurred in the lake in the immediate vicinity of the PNPP site (Baker et al. 1976). Recreational harvests within an 80-km (50-mi) radius of PNPP probably are roughly comparable to the commercial landings of about 1-3 million lb annually.

An estimated 256,000 and 300,000 licensed anglers fished in Lake Erie, Ohio, during 1975 and 1978, respectively, and spent $45-$60 million in pursuit of Lake Erie fish, during an estimated 7 million man-days of effort (1975) (ODNR 1976, 1979). The hours of fishing effort expended by anglers in the central basin during 1975-77 are shown in Table 4.9 (Baker et al. 1979).

Recreational fishing in Lake Erie is done by shore angling, from private boats, and from charter boats. During 1975-1977, the charter fleet operated only in western Lake Erie and sought walleye and yellow perch primarily (Baker et al. 1979). In the central basin waters of Lake Erie, Ohio, private boat angling is concentrated near shore in the vicinity of harbor and departure sites (Baker, et al. 1979). Within the 80-km (50-mi) radius of PNPP, those sites would be near Cleveland, Fairport, Ashtabula, and Conneaut. Central basin boat anglers sought yellow perch and white bass primarily, but also caught freshwater drum, channel catfish, smallmouth bass, and other species.

The shore fishery extends from May through October. During 1975, 55% of all Lake Erie, Ohio, recreational fishermen were shore anglers, with 40% of the

Table 4.5 1978 commercial harvest (in pounds) of fish by species in Ohio Fishery Statistical District 3 in relation to the total Ohio landings of those species (to convert pounds to kilograms, multiply by 0.454)

Species	Total landings, Ohio waters	Total landings, District 3*	District 3 as % of total
Catfish	204,844	57	< 0.1
Freshwater drum	1,189,315	187,642	15.8
White bass	1,687,345	5,188	0.3
Yellow perch	2,110,859	717,490	33.7
Total (all species)	9,312,528	909,282	9.8

Source: Ohio Department of Natural Resources, "Commercial Fish Landings Lake Erie - 1978," Sandusky, 1979.

*State of Ohio Fishery Statistical District 3 encompasses the Ohio waters of Lake Erie from Fairport through Conneaut to the Ohio/ Pennsylvania border, and includes the PNPP site (see Figure 4.5).

Table 4.6 1979 commercial harvest (in pounds) of fish by species in Ohio Fishery Statistical District 3 in relation to the total Ohio landings of those species (to convert pounds to kilograms, multiply by 0.454.)

Species	Total landings, Ohio waters	Total landings, District 3*	District 3 as % of total
Catfish	240,430	11	< 0.1
Freshwater drum	1,271,378	10,480	0.8
White bass	1,942,310	1,239	0.6
Yellow perch	2,678,483	558,731	20.9
Total (all species)	10,480,922	570,600	5.4

Source: Ohio Department of Natural Resources, "Lake Erie Fisheries Research," Performance Report for the Period July 1, 1979 to June 30, 1980, Sandusky, Ohio.

*State of Ohio Fishery Statistical District 3 encompasses the Ohio waters of Lake Erie from Fairport through Conneaut to the Ohio/ Pennsylvania border, and includes the PNPP site (see Figure 4.5).

Table 4.7 Recreational harvest (in pounds) of fish from Ohio waters (total) of Lake Erie and from the central basin, 1975-1977 (to convert to kilograms, multiply by 0.454)

Year	Total	Central basin
1975	4,600,818	2,557,305
1976	3,935,280	979,578
1977	8,227,028	999,874

Source: Ohio Department of Natural Resources, "Ohio's Lake Erie Creel Census," Final Report, Sandusky, June 1979.

Table 4.8 1980 recreational harvest of fishes from Ohio waters of Lake Erie (to convert to kilograms, multiply by 0.454)

Species	Number	Pounds
Yellow perch	11,806,000	3,019,000
Walleye	2,228,000	4,010,000
White bass	729,000	355,000
Smallmouth bass	42,000	27,000
Freshwater drum	393,000	432,000
Channel catfish	408,000	215,000
Total	15,606,000	8,058,000

Source: Ohio Department of Natural Resources, "Status of Ohio's Lake Erie Fisheries," Sandusky, January 1981.

Table 4.9 Hours of fishing effort expended by shore anglers and boat anglers in the central basin of Lake Erie, Ohio, during 1975-1977

Year	Shore anglers	Boat anglers	Total
1975	910,200	2,278,850	3,189,050
1976	709,875	1,272,425	1,982,300
1977	632,000	1,432,200	2,064,200

Source: Baker et al. 1979.

shore angling occurring between Lorain and Cleveland (ODNR 1976). Species caught by shore anglers include yellow perch, white bass, freshwater drum, channel catfish, and others (smallmouth bass, walleye). Within the 80-km (50-mi) radius of PNPP, yellow perch catches were concentrated at Cleveland and Fairport where anglers have access to the lake shore and to piers, breakwaters, and jetties (Baker et al. 1979). White bass angling is concentrated where shore anglers have access to industrial thermal discharges that attract the fish and make them available near shore during the summer months. During 1975-1977, 80% of the Lake Erie, Ohio, white bass harvested by shore anglers occurred at thermal discharges between Lorain and Fairport. Heavy fishing pressure and large catches of white bass in thermal plumes also occur in Michigan waters of Lake Erie (NUREG-0769). Freshwater drum harvests were greatest in the Cleveland area, with good catches also at Fairport, Ashtabula, and Conneaut. Channel catfish were caught at Fairport and Cleveland. The greatest Lake Erie, Ohio, shore harvest of smallmouth bass occurred at Conneaut.

Several species of recreational fishes are stocked by the ODNR into tributary streams in the vicinity of the PNPP site. The 1977 and 1979 species and streams stocked are shown in Tables 4.10 and 4.11.

4.3.7 Endangered and Threatened Species

4.3.7.1 Aquatic

The group of aquatic animals most susceptible to impact from PNPP operation are the fish (see Section 4.3.6.2). Two species known to occur in Lake Erie or tributary streams are listed as endangered by the U.S. Fish and Wildlife Service: longjaw cisco (Coregonus alpenae), and blue pike (Stizostedion vitreum glaucum) (ER-OL Supplement 1). The blue pike is extinct for all practical purposes (personal communication, Carl Baker, ODNR, March 26, 1981). Neither species has been captured during studies near PNPP by the applicant nor by ODNR (see Section 4.3.4.2 above).

During April 1981, the staff initiated a formal request for information on the occurrence of endangered species near PNPP from the U.S. Fish and Wildlife Service (FWS) under Section 7(c) of the Endangered Species Act Amendments of 1978 (PL 95-632) (Schwencer). The FWS replied that it found no aquatic species in the PNPP area that are endangered, threatened, or proposed as endangered or threatened (Popowski).

The ODNR, which maintains its own list of rare and endangered species, recognizes as endangered 23 additional fishes that have been reported to occur in Lake Erie and its tributary streams. None of those species has been captured during the studies at PNPP by the applicant. One state endangered species, the burbot (Lota lota), has been captured occasionally near Fairport by the ODNR (personal communication, Carl Baker, March 1981), but none have been recorded during recent studies.

4.3.7.2 Terrestrial

The Fish and Wildlife Service has noted (see Appendix G) that the Indiana bat (Myotis sodalis) may be found in the PNPP area. As suggested by the FWS, the staff asked knowledgeable experts in the ODNR to visit the PNPP site to determine if the Indiana bat or its habitat were likely to be affected by the

Table 4.10 Number of fish (by species) stocked into Lake Erie tributary streams near the PNPP site during 1977

Species	Streams		
	Chagrin River	Conneaut Creek	Arcola Creek
Coho salmon	143,717	--	--
Chinook salmon	201,705	--	--
Steelhead trout	--	29,151	--
Rainbow trout	102,306	--	3,000
Brown trout	--	902	--

Source: Great Lakes Fishery Commission, "Annual Report for the Year 1977," Ann Arbor, Michigan, 1980.

Table 4.11 Number of fish (by species) stocked into Lake Erie tributary streams near the PNPP site during 1979

Species	Streams			
	Chagrin River	Conneaut Creek	Grand River	Arcola Creek
Coho salmon	30,000	--	--	--
Steelhead trout	--	5,500	--	--
Rainbow trout	131,700	55,000	41,200	8,000
Sauger	--	--	10,000	--
Chinook salmon	90,000	--	--	--

Source: Ohio Department of Natural Resources, "Status of Ohio's Lake Erie Fisheries," Sandusky, January 1980.

operation of PNPP. In letters following the site visit (Case 1981, 1981a), the staff of ODNR indicated that although individuals or populations of Indiana bat were not observed, the PNPP site contains potentially suitable habitat for the Indiana bat. However, ODNR also indicated that those areas of potentially suitable habitat have not been affected by construction activities and normal plant operation will not impact on these areas. It is also the staff's understanding that these areas will not be impacted by either construction and/or operational activities.

The spotted turtle (Clemmys guttata) and the sharp-skinned hawk (Accipiter striatus velox), which are on the state-listed species, have been observed on site (ODNR). The applicant maintained a raptor monitoring program from 1976 to

1980. Although the sharp-skinned hawk was observed in 1980 on the site, no breeding populations have been established (Thomas). The spotted turtle has been observed on site (ER-OL Section 2.2.3 and Q 290.08). It is the staff's understanding that the applicant is currently discussing with ODNR (Division of Wildlife) habitat requirements and possible methods of protection of the spotted turtle. To date, spotted turtle habitat has not been affected by activities at PNPP.

4.3.8 Historic and Archeologic Sites and Natural Landmarks

The FES-CP (Sections 2.3 and 11.3.15) describes these topic areas. At the time of issuance there were two listings in the National Register of Historic Places that were within 16 km (10 mi) of the site. Table 4.12 lists all of the sites within 16 km (10 mi) that are presently on the Register. There are also two listings in the National Registry of Natural Landmarks in Lake County: Mentor Marsh, near Painesville, and the Holden Natural Areas, 48 km (30 mi) east of Cleveland.

There is also a listing in the National Register within 2 km (1.2 mi) of the certified transmission corridor, the Perry-Macedonia-Inland-Line. This is the Alonzo Drake House in Oakwood, Cuyahoga County. The Holden Natural Areas are also within 2 km (1.2 mi) of the line.

An archeological survey of the site reported in the FES-CP (Section 11.3.15) concluded: "The PNPP area was occupied by only a small hunting camp some time during the Archaic Period." Archeologic surveys concerning the Perry-Macedonia-Inland transmission corridor have been conducted and encountered no significant archeologic resources.

4.3.9 Noise

Ambient noise level data for locations in the vicinity of PNPP were not presented in the FES-CP because of the type of plant cooling system anticipated for use at that time. However, since that time, in anticipation of the use of natural-draft cooling towers at the site, the applicant has collected ambient noise level data at 10 locations in the site vicinity. The sampling locations included the site and offsite areas in North Perry, Ohio; the Neff-Perkins plant northwest of the site; and residential areas south of the site and northeast of the site along the lake front and along Antioch Road.

The design and conduct of the ambient noise level surveys followed American National Standards Institute standards (ER-OL Section 6.1.3.3, NUS 1974). The surveys included representative summer and winter conditions and daytime and nighttime periods. The results of the surveys are presented in ER-OL Section 2.7 in the form of background noise level contours for the site vicinity and as a listing of L_{50} values* for the sampling locations. These values ranged between 39 dBA to 62 dBA for daytime periods and 37 dBA to 56 dBA for nighttime periods. The identified dominant noise sources were vehicular and train traffic, industrial plant operations, and wind and water noise associated with the Lake Erie shoreline.

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*L_{50} values represent the noise level that is exceeded 50% of the time.

Table 4.12 Listings on the National Register of Historic Places within 16 km (10 mi) of PNPP

Location	Listing
Fairport Harbor	Fairport Marine Museum
Madison and vicinity	David R. Paige House Judge David Paige House Ladd's Tavern Madison Fort Madison Multiple Resource Area-29 Listings Madison Seminary and Home
Painesville and vicinity	Administration Building Lake Erie College (College Hall) Casement House Lutz's Tavern Mathews House Mentor Avenue District Morley Lewis House Painesville City Hall (Old Lake County Court House) Uri Seeley House Sessions House (Tuscan House) Smead House St. James Episcopal Church South Leroy Meeting House Indian Point Fort
Perry	Lucius Green House
Unionville	Connecticut Land Company Office Judge Abraham Tappan House Unionville District School Unionville Tavern

The staff calculated the day-night equivalent noise levels* for the applicant's survey locations to be primarily between 52 dBA and 63 dBA, based on available weekday data from the summer ambient survey.

These values are representative of an acoustic environment typically described as "normal suburban residential" in the literature.

*The equivalent steady A-weighted noise level during a 24-hour time period that would contain the same noise energy as the time varying noise during this same period but with a 10 decibel weighting applied to the equivalent sound level during the nighttime hours of 10 p.m. to 7 a.m. to account for the greater potential for annoyance and activity interference of noise during this time period.

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5 ENVIRONMENTAL CONSEQUENCES AND MITIGATING ACTIONS

5.1 Résumé

This résumé highlights changes in the staff's evaluation of environmental effects of operating Perry Nuclear Power Plant Units 1 and 2 (PNPP or the Plant) in the light of information gained since the FES-CP was issued in April 1974. Many sections only required minor updating and no discussion is provided for those impacts for which there has been no new information or change since the construction review.

The major change, as was also noted in Section 4.1, is the use of a closed-cycle cooling system, which utilizes natural-draft cooling towers to dissipate the heat from condenser cooling, instead of the once-through system analyzed in the FES-CP. This change required an analysis of surface water usage, fogging and icing, the effect of cooling tower drift on air quality and terrestrial biota, and bird impaction. No significant impacts are anticipated as a result of using a recirculatory cooling system as opposed to a once-through system. In addition, because the intake of water from Lake Erie is much lower with the closed-cycle system, impingement and entrainment impacts will be less.

Floodplain effects also were analyzed because the FES-CP was issued before Executive Order 11988, Floodplain Management, was signed in May 1977. From this analysis, the staff has concluded that construction of the plant is consistent with the guidance of Executive Order 11988.

The material on plant accidents now contains information that has been revised and updated to include Class 9 accidents, a liquid pathway assessment, and the lessons learned from the accident at Three Mile Island, Unit 2.

Operational monitoring programs are to be conducted in accordance with the Environmental Protection Plan (EPP) to be issued by NRC as part of the operating license. The EPP will require the applicant, as licensee, to (1) notify NRC if changes in plant design or operation occur, or if tests or experiments affecting the environment are performed, provided that such changes, tests, or experiments involve an unreviewed environmental question; (2) maintain specific environmentally related records; and (3) report unusual or important environmental events.

5.2 Site Land Use

Much of the discussion in the FES-CP of operational impacts on land use (FES-CP p. 5-1) remains valid. Changes in plant design, namely the cooling towers, discussed in Section 4.2.1, will have a negligible effect on land use. The staff concludes that the land-use impacts as a result of the operation of PNPP will not exceed estimates given in the FES-CP.

5.3 Water-Use and Hydrological Impacts

5.3.1 Water-Use Impacts

5.3.1.1 Surface Water

The primary suface-water-use impact from plant operation will be consumptive water loss through evaporation from the cooling towers. There will also be a slight additional water loss because of the entrainment of water droplets as consumptive water losses based on a 100% load factor and site meteorological data. These water losses are summarized in Table 5.1.

Table 5.1 Monthly average water loss, blowdown, and makeup for each of the two PNPP natural-draft cooling towers* in gpm (to convert to l/sec multiply by 0.0631)

Month	Evaporation and drift,** gpm	Blowdown, gpm	Makeup,** gpm
Jan	9,686	6403	16,144
Feb	9,062	5987	15,104
Mar	10,151	6713	16,919
Apr	11,167	7390	18,612
May	11,734	7768	19,557
June	12,270	8125	20,450
July	12,513	8288	20,856
Aug	12,406	8216	20,677
Sept	12,181	8066	20,302
Oct	11,511	7619	19,185
Nov	10,695	7075	17,825
Dec	9,848	6511	16,414

Source: ER-OL Table 5.1-4

*Values are based on a 100% load factor and were calculed from monthly averages of hourly meteorological data collected at the site during 3 years: May 1, 1972 through April 10, 1973; May 1, 1973 through April 30, 1974; and September 1, 1977 through August 31, 1978.

**Includes a loss of 55 gpm through the entrainment of droplets as drift.

Based on the data in Table 5.1, the average water loss for both units operating at a 100% load factor is about 1400 l/sec (22,200 gpm). This is about 280 l/sec (4437 gpm) more than was estimated in the FES-CP for once-through cooling. This water loss will produce no significant impact on general water usage from Lake Erie.

5.3.1.2 Groundwater

Only minor amounts of groundwater will be withdrawn as a result of the use of the PNPP underdrain system, and no effluents will be discharged to the groundwater during plant operation. Therefore, there will be a negligible impact on groundwater as a result of plant operation. Furthermore, there will be no impact on the plant as a result of nearby groundwater usage because of low-water-yielding materials.

5.3.2 Water Quality

Impacts to aquatic biota and to other water users as a result of water quality changes will be so small as to be negligible. The proposed dechlorination system eliminates any concern over the toxic effects of residual chlorine.

The addition of sulfuric acid to the cooling system for scale control will result in a concentration change in the lake that will be measurable only in the vicinity of the discharge plume. The incremental effect on the nominal lake concentration would be a fraction of a mg/l at equilibrium, but because of the large volume of the lake, a number of years would be required to build toward that increment. Thus, the addition of sulfuric acid, in apparent conflict with ongoing efforts of environmental agencies to reduce concentrations of certain water quality constituents, seems to be a question of policy rather than a significant impact.

Any limitation on acid addition would be developed through the NPDES Permit process rather than through the NRC licensing process. Should the state further limit the use of acid addition through the NPDES Permit process, it is likely that PNPP could be operated with no significant additional impact by increasing the makeup and blowdown flow rates to reduce the concentration factor and, thus, the potential for scale formation within the cooling system.

5.3.3 Floodplain Effects

Construction of PNPP had already begun at the time Executive Order 11988 was signed in May 1977. Furthermore, plant construction resulted in minimal effects to floodplains in the site vicinity. Therefore, it is the staff's conclusion that consideration of alternatives to the modification of the PNPP site is neither required nor practical. The following discussion addresses floodplain-related effects at the Plant site.

The floodplain at the site is defined by the preconstruction areas of the lake shore and of two unnamed streams inundated by the flood which has a probability of occurrence of 1% per year (100-year floodplain). Construction activities that have occurred in the floodplain are related to major rerouting and channelization of the two unnamed streams and the construction of the sediment control dams, the barge slip, the submerged intake and discharge tunnels, and the intake and discharge structures. Because the bluffs of the lake are continually eroding, contingency plans call for the placement of protective revetments if the shoreline recedes to within 76 m (250 ft) of the emergency pumphouse. These revetments would be in the 100-year floodplain of the lake. Their construction would involve clearing and grading of the banks and would cover approximately 610 m (2000 ft) of shoreline. The lower part of the bank

would probably be covered with a rubble mound and the upper part vegetated. Final design would be made when and if slope protection becomes necessary. Permits from the Department of the Army and the Ohio Department of Natural Resources would be required before construction of the revetment could proceed. Plant features actually in the floodplain include small bridges and culverts in the unnamed streams, the sediment control dams on the streams, the barge slip and its protective revetment, the riprap-protected outfall of the rerouted minor stream, and the submerged discharge and intake structures. The Plant itself will not be subject to flooding because it is high above the probable maximum flood level on Lake Erie or either of the two unnamed streams.

None of the plant features constructed in the floodplain will have a measurable adverse effect on flooding in Lake Erie or on upstream areas of the two unnamed streams passing through the site. Furthermore, there do not appear to be any obviously superior alternative construction practices or designs at the site for structures that must be located in the floodplain. Therefore, the staff concludes that construction of the Plant is consistent with the guidance of Executive Order 11988.

5.4 Air Quality

5.4.1 Fog and Ice

The only significant source of fog and ice from plant operations will be from the natural-draft cooling towers. The generation of visible plumes, which sometimes remain aloft for extended distances, is the most apparent atmospheric effect of natural-draft cooling-tower operation. Using upper air soundings from Buffalo, New York, the applicant has analyzed (ER-OL Section 5.1.4.1) the extent of visible plumes and determined that the maximum annual frequency of elevated visible plumes expected to occur in the vicinity of the cooling towers is approximately 220 hours per year. The maximum annual frequency of elevated visible plumes at nearby airports is expected to be 24 hours per year.

The visible plumes from a natural-draft cooling tower will reduce the amount of sunshine reaching the ground below. Studies have indicated that reductions in sunshine of up to 20 minutes a day can occur in the immediate vicinity of such towers. At distances of about 10 km (6 mi) such reductions drop to about 1 minute a day. It is reasonable to expect plume-shadowing effects of a similar magnitude in the vicinity of the PNPP site.

Ground-level fogging (and icing when the temperature is below freezing) can result when the cooling-tower plume descends to or meets the surface. Using onsite meteorological data, the applicant (ER-OL Section 5.1.4.1) has determined that ground-level fogging induced by the natural-draft cooling towers would not reduce visibility to 1000 m (3280 ft) or less. Horizontal icing more than 1 mm (0.04 in.) should not occur, and the maximum vertical icing (7 mm (0.28 in.)) at a typical height of 18 m (60 ft) would occur at a frequency of 26 hours during the average winter season and at a distance of approximately 5 km (3 mi) east-northeast from the towers. There should be no impaired driving conditions on the roads in the vicinity of PNPP, and none of the airports, shipping ports, or waterways in the vicinity are expected to be adversely affected by tower-induced fogging and icing.

Plumes from natural-draft cooling towers have been observed to create cumulus clouds and produce precipitation (primarily snow in winter), although these ocurrences are relatively infrequent. The small and infrequent increases in the creation of cumulus clouds or precipitation that have been observed downwind of natural-draft cooling towers are considered to be generally neutral or benign impacts.

After examination of the available information, the staff agrees that the applicant's assessment of cooling-tower impacts on the atmosphere is reasonable. The staff concludes that these impacts will not be significant at and near the PNPP site.

5.4.2 Emissions and Dust

5.4.2.1 Cooling-Tower Drift

Estimates of the total rate of emission of solids in the cooling-tower drift from both towers and of the composition of these solids (mostly calcium, sodium and magnesium sulfates, carbonates, chlorides, and silicates) were reviewed by the staff (Section 4.2.4.3) on the basis of new data provided by the applicant. The maximum calculated value for drift is 89.6 g/ha/year (0.08 lb/acre/year) at a distance of 3.6 km (2.25 mi) to the east-northeast of the cooling towers (Figure 5.1). These estimates are within the range of values predicted for fresh-water, natural-draft cooling towers. The observed drift effects from fresh-water towers are small and limited to the immediate vicinity of the cooling towers (Carson).

Therefore, the staff concludes that the use of cooling towers at PNPP will not result in adverse air-quality impacts. Terrestrial impacts from drift fallout are considered in Section 5.5.1.2.

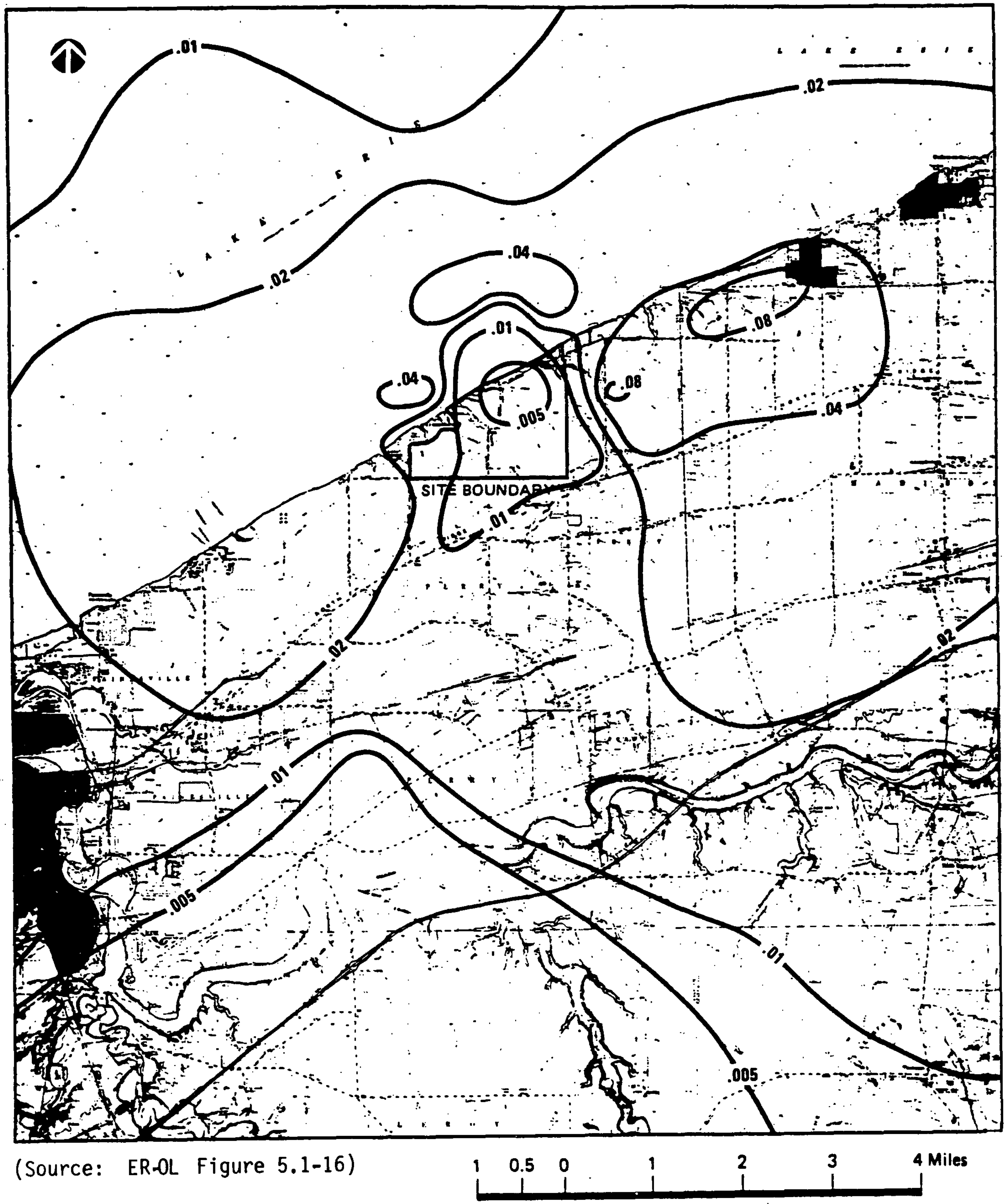
5.4.2.2 Other Emissions and Dust

Based on an analysis of the emission rates reported by the applicant (ER-OL Section 3.7.2) for nonradioactive pollutants (SO_2, nitrogen oxides, CO) and particulates from diesels and auxiliary boilers and the short annual-usage periods for this equipment, the staff has determined that operation of this equipment will not have a significant impact on the air quality in the vicinity of the plant.

5.5 Ecology

5.5.1 Terrestrial

The terrestrial-ecology impacts that were expected to be caused by operation of the plant were discussed in the FES-CP Sections 5.5.1 and 9.2.1.1. Additional impacts that were expected to occur during operation but were not considered previously and impacts that were reevaluated in light of changes in plant design are considered below. The permanent loss of terrestrial habitat from the presence and operation of the PNPP is about 93.9 ha (232 acres) (see Section 4.2.2).



(Source: ER-OL Figure 5.1-16)

Figure 5.1 Predicted drift deposition

5.5.1.1 Cooling-Tower Emissions

Terrestrial impacts resulting from the form of condenser cooling were reexamined by the staff in the light of the changes in cooling system design made by the applicant from once-through to closed-cycle natural-draft cooling towers. New information concerning the effects of operation of the PNPP natural-draft cooling towers is discussed below.

5.5.1.2 Drift Fallout

The applicant has provided calculations of the predicted distribution of drift for two units using onsite meteorological data (ER-OL Section 5.1.4). The staff has reviewed the applicant's calculations and concludes that they are within a range of model-predicted valves for fresh-water natural-draft cooling towers. The estimated maximum offsite drift deposition rate of 89.6 g/ha/yr (0.08 lb/acre/yr) is expected at approximate distances of 1.6 and 3.6 km (1.0 and 2.25 mi) to the east-northeast of the towers. The composition of the drift will be as described in Section 4.2.6.3. Natural rainfall will prevent a build-up of chemical-drift deposits in the soil. A review of experience with fresh-water cooling towers, both in this country and abroad, has failed to provide any findings of an environmental effect beyond the immediate vicinity of the cooling towers (Carson). Therefore, the staff concludes that terrestrial impacts resulting from cooling-tower drift from the operation of PNPP will be small.

5.5.1.3 Bird Impaction

Bird kills by collision with cooling towers and other manmade structures have been studied and reviewed (Avery et al.). Based upon the results of monitoring programs at other facilities with similar types of cooling towers (Jackson and Temme), the staff expects that the number of birds killed will be small relative to their populations.

5.5.1.4 Transmission Lines

Construction of the Perry-Macedonia-Inland transmission line is nearing completion. The originally proposed Perry-Hanna line was recently refused certification by the Ohio Power Siting Commission, and an alternate line or an alternate segment to the proposed line has not been chosen by the applicant.

The staff has reviewed the environmental impacts which could be associated with the operation of the PNPP transmission system. The potential sources of impacts are (1) ozone production, (2) induced electrical currents, (3) electric fields, and (4) corridor maintenance.

Impacts associated with ozone are not expected to change significantly from those discussed at the CP stage of review (FES-CP Section 5.5.1.2).

Potential biological effects from electrical fields associated with transmission lines have been reviewed by the U.S. Department of Energy (DOE). While experimental work is still under way on the biological effects of electric fields along transmission lines, the staff has found no evidence at this time that the operation of 345-kV lines similar to the PNPP system will have a significant effect on the health of humans or that it will affect plant or animal life.

The applicant has designed the transmission system in accordance with clearance requirements of the National Electric Safety Code to ensure the safeguard of persons from shock hazards arising from induced electrical currents emanating from transmission lines. In addition, the applicant undertakes an extensive grounding program within the right-of-way to further reduce shock potentials. Complaints regarding annoyances from induced voltages outside the right-of-way are responded to by the applicant by additional grounding procedures (ER-OL Q&R, 5.5.1).

Maintenance procedures for vegetative control along the PNPP transmission lines will consist of periodical mechanical cutting employing a bush hog. The applicant indicates that it is not his policy to use herbicides for vegetation control along the PNPP transmission lines. Thus, it is the staff's evaluation that adverse impacts from maintenance activities will be minimal.

5.5.1.5 Monitoring

The staff has concluded (Section 5.5.1.2) that the potential for damage to the surrounding ecosystem caused by the water and chemicals in drift from the PNPP cooling towers will be small. Nevertheless, the staff believes it is prudent to undertake a limited-term inspection program because a margin of uncertainty still exists in the foregoing conclusion. An acceptable monitoring program could rely on infrared aerial photography with accompanying ground verification. A program to accomplish this will be specified in an environmental protection plan that will be included as Appendix B of the operating license. This plan also will include requirements for prompt reporting by the licensee of any occurrence of important events that potentially could result in significant environmental impact causally related to plant operation. Examples of such events are excessive bird destruction due to collision with plant facilities, onsite plant or animal disease outbreaks, and mortality of any species protected by the Endangered Species Act of 1973 as amended.

5.5.2 Aquatic

The impacts of PNPP operation on aquatic biota of Lake Erie were considered in the FES-CP (Sections 5.5.2, 11.1.1, and 11.1.2) for the once-through cooling design proposed at that time. The denial of certification of that system by the State of Ohio in 1974 (see Section 4.2.4 above) required the installation of the closed-cycle cooling system now proposed and under construction. The Partial Initial Decision (LBP-74-69, 8 AEC 538) of the AEC Atomic Safety and Licensing Board (ASLB) on September 18, 1974 reviewed the applicant's closed-cycle design and found the impact potential to be greatly reduced in comparison with the previous once-through proposal.

This analysis does not reiterate the detailed findings of the AEC ASLB, but it focuses rather on identification of any new concerns and a general confirmation of previous findings based on information available since 1974 including: studies at the Perry site (see Section 4.3.4); data collected at other operating power plants on Lake Erie in the Perry vicinity; NRC confirmatory assessment of the impacts of operation of closed-cycle cooling at the Davis-Besse Nuclear Plant. The potential impact of PNPP on fish spawning and nursery activities is addressed.

5.5.2.1 Intake Impacts

Fish Impingement

Impingement of fish on the intake screens of power plants is an unavoidable consequence of water withdrawal from water bodies containing fish (Sharma and Freeman). The magnitude of impingement losses will be determined by the cooling system design, capacity, and location, and by the composition and abundance of fishes susceptible to entrapment and subsequent impingement. The redesign of the PNPP system to closed cycle substantially reduces the potential for interaction between the intake structures and Lake Erie fishes, compared with the potential for the previous once-through design (see Section 4.2.4 for comparative descriptions). At the Palisades Nuclear Power Plant on Lake Michigan, a conversion of the cooling system from once through to closed cycle reduced the number of fish potentially impinged by 95% (Benda et al.). The location of the two Perry intakes offshore and submerged in the lake removes them from the area of maximum abundance of young-of-the-year and yearling fishes in the near-shore area (see Section 4.3.4). The horizontal direction of water flow into the intakes (by using velocity-capped structures) and a low intake velocity (< 0.5 fps) will reduce further the potential for entrapment of fishes. The cooling water withdrawal system at PNPP utilizes state-of-the-art design for minimizing impingement (and entrainment) of fishes: low water volume requirements; low intake flow velocity; horizontal inflow of water; and intakes located offshore and submerged in an area removed from concentrations of fish.

The potential for impingement at PNPP can be more fully understood by examining the results of impingement studies at other nearby power plants.

During a 1-year period (1977-1978), fish impingement studies were conducted at five fossil-fueled power plants within an 80-km (50-mi) radius of PNPP in the central basin of Lake Erie (Appl. Biol. 1979a, b, c, d, e) (Figure 4.1 and Table 5.2). Fish impingement loss estimates at four of the plants (Avon Lake, Lake Shore, Eastlake, and Ashtabula A and B) were 10 to 53 times greater than at the Ashtabula C plant even though the water usage at the four plants was only 1.3 to 3.7 times greater than at Ashtabula C. A submerged offshore intake design at Ashtabula C compared with shoreline intakes at the other four plants appears to be largely responsible for the differences. Important commercial and recreational species (Section 4.3.7) comprised about 5% of the annual estimate of impingement losses at Ashtabula C; the remaining 95% were rough and forage species (principally smelt, gizzard shad, and shiners) (Appl. Biol. 1979e).

Studies in the vicinity of PNPP suggest that the species composition of impinged fishes expected to occur at Perry will be similar to that actually observed at the Ashtabula C plant. The numbers of impinged fishes at Perry probably will be lower, however, as a result of the lower water withdrawal volume and velocity-capped intakes.

Presently, there are 18 power plants existing or proposed on Lake Erie, plus an additional 20 on the Detroit River-Lake St. Clair system flowing into Lake Erie (Kelso and Milburn). Annual impingement losses at only nine plants within Ohio waters of the lake and its tributaries have totaled as high as 115,000,000 fish (personal communication with Joseph Reidy, Ohio Environmental Protection Agency,

Table 5.2 Annual fish impingement and entrainment estimates (April 1977 - April 1978) for power plants on Lake Erie within an 80-km (50-mi) radius of PNPP, and for the Davis-Besse Nuclear Power Plant on the western basin of Lake Erie (during 1978 and 1979)

Power plant and intake vol, cfs*	Impingement	Entrainment	
	No. of fish	No. of eggs	No. of larvae
Avon Lake, 1290	5.07×10^6	3.70×10^7	3.16×10^8
Lake Shore, 629	3.64×10^6	3.60×10^7	7.00×10^6
Eastlake, 1169	1.17×10^7	8.47×10^7	9.83×10^7
Ashtabula A&B, 443	2.27×10^6	1.42×10^7	3.75×10^7
Ashtabula C, 346	2.22×10^5	1.40×10^6	5.90×10^6
Davis-Besse, 62	6.61×10^3 (1978) 4.39×10^3 (1979)	4.43×10^4 1.01×10^5	6.31×10^6 2.06×10^7

Sources: Appl. Biol. 1979a, b, c, d, e; NUREG-0720; Reutter and Herdendorff.

*Average intake flow per day during the study period.

March 1981). Sustained annual impingement losses at PNPP on the order of those observed at Ashtabula C (and probably less) should not add measurably or incrementally to the total impingement impact to fishes from the many power plants operating on Lake Erie.

A measure of confidence in the projection of minimal impact at PNPP is provided by the NRC staff assessment of impingement impact at Davis-Besse Nuclear Power Station (NUREG-0720), which is located on the western basin of Lake Erie, Ohio. That study assessed impingement losses actually observed during station operation and compared the observed impacts with those in the preoperational FES-CP and the FES-OL. The projections of minimal impact in the preoperational statements were found to be reasonable and adequate for Davis-Besse. In fact, the annual losses incurred (6,607 fish in 1978 (NUREG-0720) and 4,385 fish in 1979 (Reutter and Herdendorff)) probably are the lowest impingement losses for any base-load power plant on Lake Erie. The cooling system design at Davis-Besse is similar to that being constructed at Perry: closed-cycle with natural-draft cooling tower; low water volume requirement (94 cfs); low intake flow velocity (0.25 fps); and submerged offshore intake structure.

The impacts of operation at PNPP are expected to be similar to those projected and confirmed at Davis-Besse. Impingement losses at PNPP should be low, and 1 to 2 orders of magnitude less than at Lake Erie plants utilizing once-through cooling. The species affected will be those rough and forage fishes that are numerous in the central basin. The PNPP site vicinity is not a unique spawning or nursery area for fishes, but those species that do utilize the area will not

be impacted by losses due to impingement. Recreational and commercial fisheries will not be disrupted either by impingement of fishes or displacement of fishing operations that occur primarily in the vicinity of harbor facilities in the central basin.

Ichthyoplankton Entrainment

Entrainment of fish eggs and larvae in the intake cooling water of power plants is an unavoidable consequence of water withdrawal from water bodies containing them. The magnitude of entrainment losses will be determined largely by the volume of cooling water required, by cooling system design and location, and by the composition and abundance of eggs and larvae in the vicinity of the intake. The redesign of the PNPP system to closed cycle substantially reduces the potential for interaction between the intake structures and Lake Erie ichthyoplankton, compared with the potential for the previous once-through design. The location of the intakes offshore removes them from the spawning activities near the shoreline. The intake ports are about 1 m high and 1 m off the lake bottom, and they withdraw water from the lower one-third of the water column (the lake depth is about 6.4 m; see Section 4.2.4). Only freshwater drum have truly pelagic floating eggs, found in the upper water column. The other lake species predominantly deposit their eggs demersally on the bottom. Therefore, water withdrawn at PNPP probably will not contain large numbers of eggs, because the eggs will be mostly on the bottom, with only some eggs floating on the surface. Even though the Ashtabula C plant was estimated to have entrained 1.4 million fish eggs (Table 5.2), only 5 eggs were captured during the ten 24-hour sampling days that were used to produce the loss estimates (Appl. Biol. 1979e). Similarly, the 5.9 million fish larvae loss estimate was based on the capture of just 20 larvae in the onshore intake well. No yellow perch were found during the entrainment sampling. Based on the findings at Ashtabula C, the similarities in intake locations between that plant and PNPP, and the lower water withdrawal requirements at PNPP, the impact of entrainment of fish eggs and larvae because of the PNPP plant should be insignificant. The losses due to entrainment should not add measurably or incrementally to the total entrainment losses at the many power plants operating on Lake Erie.

The staff assessment of operational entrainment impact at Davis-Besse found the loss estimates to be 1 to 2 orders of magnitude lower for larvae and 3 to 4 orders lower for eggs compared with other power plants on the western basin (NUREG-0720). The projections of minimal impact in the preoperational impact statements were found to be reasonable and adequate when evaluated against observed effects during power plant operations. Similarly, the impacts of entrainment at PNPP should be insignificant, with losses of eggs and larvae orders of magnitude lower than at Lake Erie power plants utilizing once-through cooling. Those fish that use the PNPP site for spawning and nursery activities should not be impacted by losses due to entrainment.

Summary and Conclusions - Intake Effects

Losses of fish due to entrainment and impingement at PNPP will be minimal and will be orders of magnitude less than at other Lake Erie power plants. Those species that will be affected will be the rough and forage fish that are numerous in the central basin of the lake. The PNPP site vicinity is not a unique spawning or nursery area, but those fish that do utilize the area will not be

impacted by water withdrawal. Neither lake fishing activity nor fishery harvests will be affected by plant operation. Fishery stocking programs and harvests in nearby streams will not be affected. The intake system at PNPP is a state-of-the-art design and probably will result in PNPP having one of the lowest potentials for aquatic impact of the many power plants on Lake Erie. Based on the paucity of information that existed during the writing of the FES-CP in 1974 and the concern with potential impacts to yellow perch (as per LBP-74-69), the CP-stage Licensing Board's concerns were valid. Based on the information generated since then (studies at Perry, and at nearby Davis-Besse), a conclusion of minimal and insignificant impact now is appropriate. The Licensing Board's finding of greatly reduced impact potential with closed-cycle cooling is substantiated and remains valid.

5.5.2.2 Discharge Impacts

The redesign of the PNPP discharge system to closed cycle substantially reduces the potential for interaction between the effluent plume and Lake Erie fishes, compared with the potential for the previous once-through cooling design (see Section 4.2.4 for comparative description). The discharge point located offshore and submerged in the lake removes it from the area of maximum abundance of young-of-the-year and yearling fishes in the near-shore area (see Section 4.3.4). The very high exit velocity of >10 m/s will preclude fishes from entering or residing in the warmer parts of the effluent. Therefore, fish will not become acclimated to increased temperatures and will not be affected by cold shock during reactor shutdown. During two-unit operation, a shutdown of one unit will not result in a total change or decrease in effluent temperature because the second unit will be operating.

A decrease in the effluent volume by about 96% (closed-cycle versus previous once-through design) has decreased the size of the plume substantially. The staff's concern with thermal effluent for the once-through design concerned effects felt in the far-field regions (away from the diffuser) receiving small temperature increases (FES-CP Sections 5.5.2.1 and 5.5.2.2). The substantially smaller plume now predicted reduces the potential and likelihood of interaction between plume and biota. Although some fishes might be attracted to the warm fringes of the plume, the numbers should be few. The thermal plume should create no levels of fish attraction that would result in creation of a local recreational fishery, as has occurred at other power plants that use shoreline thermal discharge designs (see Section 4.3.7.4).

The CP-stage Licensing Board concluded that because of the smaller increment in temperature of the discharged water (for the closed-cycle design versus once through) and the high discharge velocities, the thermal discharge of the PNPP plant will not have a significant impact on the biota at any time of the year. That conclusion remains valid.

5.5.2.3 Monitoring

The certifications and permits required under the Clean Water Act provide the mechanisms for protection of water quality and aquatic biota. Operational monitoring of effluents will be required by the NPDES Permit issued by the State of Ohio Environmental Protection Agency. NRC will rely on the decisions made by the State of Ohio, under the authority of the Clean Water Act, for any requirements for monitoring of intake losses of aquatic biota and for any

requirements for intake-design changes, should they be necessary. As of the date of this statement, the applicant has not received a final NPDES Permit from the State of Ohio. Application for the Permit was received by the Ohio Environmental Protection Agency on June 21, 1982.

An Environmental Protection Plan will be included as Appendix B of the PNPP operating license. This plan will include requirements for prompt reporting by the licensee of any occurrence of important events that potentially could result in significant environmental impact causally related to plant operation, for example: fish kills; mortality of any species protected by the Endangered Species Act of 1973 as amended; increase in or presence of nuisance organisms (including Asiatic clams) or conditions; and unanticipated or emergency discharge of waste water or chemical substances. (See Section 4.3.6.2 where Asiatic clams are discussed.)

5.6 Endangered and Threatened Species

5.6.1 Aquatic

Fishes considered to be endangered or threatened either are absent or extremely rare in the PNPP site vicinity (see Section 4.3.5). None were found during impingement or entrainment sampling at five other power plants on Lake Erie within an 80-km radius of PNPP (see Section 5.5.2). It is concluded, therefore, that the operation of PNPP will have no impacts on endangered or threatened fishes of Lake Erie.

5.6.2 Terrestrial

As indicated in Section 4.3.5, the only federally listed endangered terrestrial species that could potentially occur on the PNPP site is the Indiana bat. As indicated in Section 4.3.5, the construction and operation effects will not disturb any known or potential nesting or feeding areas of the Indiana bat; hence, the operation of PNPP will have no impact on this species.

The staff has also considered the impacts of PNPP operation on rare and endangered species from the State list (Section 4.3.5). The spotted turtle has been observed on site. To date, spotted-turtle habitat has not been affected by activities at PNPP. It is the staff's understanding that the applicant is currently discussing with the State of Ohio the status of the spotted turtle and possible effects of construction and operating activities at PNPP on this species.

5.7 Historic and Archeologic Site and Natural Landmark Impacts

The staff concludes that there will be no significant impacts on the historic sites and natural landmarks as a result of PNPP operation. The cooling towers are visible from the Lucius Green House in Perry, 5 km (3 mi) from the plant. The staff concludes that the visual impacts at the historic sites will be minor because of distance and intervening trees.

The archeologic surveys conducted on the PPNP site and on the Perry-Macedonia-Inland transmission corridor discovered no significant sites which were recommended as being eligible for inclusion in the National Register of Historic Places. Because of these findings the staff believes that the operation of the PNPP will have no significant impact on archeologic sites. The State

Historic Preservation Officer has also determined that the operation of the station will have no significant impact on any sites listed or eligible for listing in the National Register (see Appendix H).

It should also be noted that the Perry-Hanna transmission line was not granted a certificate of environmental compatibility and public need by the Ohio Power Siting Board. That line is required for the operation of Unit 2 and its status has not yet been determined.

5.8 Socioeconomics

5.8.1 Socioeconomic Impacts

The socioeconomic impacts of station operation are analyzed in Sections 5.6 and 11.3 of the FES-CP. Changes that have occurred since then include an estimated operating work force of about 399 workers (ER-OL, RQ 310.03), which would result in no overtaxing of community services. This work force should have a total annual salary of over $10 million in 1980 dollars.

The plant should have a significant impact on the local jurisdictions in which it is located with regard to real and personal property taxes. The applicant estimated that the annual total of PNPP's contribution to these local tax revenues is $22.9 million, of which about 25% would go to Lake County, 63% to the Perry School District, and 12% to the village of North Perry. The staff believes that the dollar estimates may be high because millage may drop when the Plant is operational and contributing to the property taxes. For example, the property taxes collected by the village in 1981 were about $400,000. During operation, the applicant's estimated annual contribution would be over $2.7 million. The Lake County Coastal Energy Impact Program Tax Analysis estimates a potential tax receipt in 1984 based on 1978 effective tax rate, from Perry for the county, schools, villages, and township, of $15.9 million. The analysis also reports that a large majority of these tax receipts would be uncollectible as the total estimated distributions for 1984 would only be about $1 million, and Ohio State law stipulates that tax collections cannot exceed distributions. The total jurisdictions may then lower the tax rates or assessments and/or increase expenditures or capital improvements as ways of dealing with the noncollectible excess funds. Whichever course the local governments choose, the effect of Perry plant operations on the tax situation for local jurisdictions should be significant. The staff anticipates no other significant socioeconomic impacts.

5.8.2 Noise

Offsite noise during the operation of the PNPP will result from the continuous operation of the natural-draft cooling towers, the turbines, plant ventilation fans, transformers and their cooling fans, and the station water pumps. Offsite noise character and level are expected to be dominated by the plant cooling towers. However, the switchyard/transformer area and the plant water pumps and associated equipment could be expected to be predominant for offsite locations near this equipment.

The applicant based the estimates of operational phase noise levels in the site vicinity on the cumulative contribution of the sound power level of each source of plant noise. All major noise sources for this type of plant were considered in the analysis, using manufacturers' data or published estimation techniques

for source levels. The staff has reviewed the scope of the applicant's analysis and prediction techniques used and finds them acceptable.

The results of the applicant's analysis are presented in ER-OL Section 5.6.2. These results indicate that the maximum predicted landward site boundary day-night equivalent (L_{dn}) noise levels are about 58 dBA and 56 dBA in the vicinity of sampling locations 3 (Neff Perkins plant) and 1 (residential area northeast of the site), respectively (see ER-OL Figure 2.7-1 for sampling locations). At the nearest residence, the applicant estimates an operational phase L_{dn} value of about 55 dBA. These estimates are conservative in that they are based on hemispherical radiation of sound and do not account for attenuation of noise by vegetation, ground effects, or atmospheric effects. Ambient L_{dn} values for locations 3 and 1 were about 54 dBA.

The staff checked the offsite noise level estimates of the applicant for locations expected to be dominated by cooling tower noise by comparing them to values obtained from a field verified noise estimation technique by Capano and Bradley. From this comparison, the staff concludes that the applicant's estimates for these locations are reasonable. For all offsite sampling locations, the increase in noise level over the ambient level is expected to be less than 5 dB due to cooling tower operation.

For all offsite locations, with the exception of location 3 (Neff-Perkins plant), noise levels are not expected to increase above an L_{dn} of 55 dBa due to PNPP plant operation. This level has been identified by the Environmental Protection Agency as the maximum for residential areas with outdoor space consistent with protecting public health and welfare with an adequate margin of safety. For all offsite locations, operational phase noise levels are not expected to increase more than 5dB due to plant operation. Studies by Stevens and others indicate that changes in community noise levels below this amount would not be expected to cause a change in the general reaction pattern to such noise and that significant increased annoyance and activity interference would not be expected.

Based on the predicted noise levels in the site vicinity during operation of PNPP and considering the attenuation that will likely occur to noise transmission offsite from vegetation and ground cover and atmospheric effects, the staff concludes that significant increases in offsite noise levels and increases in activity interference at nearby noise-sensitive land uses are not expected during operation of PNPP.

5.9 Radiological Impacts

5.9.1 Regulatory Requirements

Nuclear power reactors in the United States must comply with certain regulatory requirements in order to operate. The permissible levels of radiation in unrestricted areas and of radioactivity in effluents to unrestricted areas are recorded in 10 CFR 20, "Standards for Protection Against Radiation." These regulations specify limits on levels of radiation and limits on concentrations of radionuclides in the facility's effluent releases to the air and water (above natural background) under which the reactor must operate. These regulations state that no member of the general public in unrestricted areas shall receive a radiation dose, as a result of facility operation, of more than 0.5 rem in one

calendar year, or if an individual were continuously present in an area, 2 mrems in any 1 hour or 100 mrems in any 7 consecutive days to the total body. These radiation-dose limits are established to be consistent with consideration of the health and safety of the public.

In addition to the radiation protection standards of 10 CFR 20, there are recorded in 10 CFR 50.36a license requirements that are to be imposed on licensees in the form of Technical Specifications on effluents from nuclear power reactors to keep releases of radioactive materials to unrestricted areas during normal operations, including expected operational occurrences, as low as is reasonably achievable (ALARA). Appendix I of 10 CFR 50 provides numerical guidance on dose-design objectives for LWRs to meet this ALARA requirement. Applicants for permits to construct and for licenses to operate an LWR shall provide reasonable assurance that the following calculated dose-design objectives will be met for all unrestricted areas: 3 mrems/yr to the total body or 10 mrems/yr to any organ from all pathways of exposure from liquid effluents; 10 mrads/yr gamma radiation or 20 mrads/yr beta radiation air dose from gaseous effluents near ground level--and/or 5 mrems/yr to the total body or 15 mrems/yr to the skin from gaseous effluents; and 15 mrems/yr to any organ from all pathways of exposure from airborne effluents that include the radioiodines, carbon-14, tritium, and the particulates.

Experience with the design, construction, and operation of nuclear power reactors indicates that compliance with these design objectives will keep average annual releases of radioactive material in effluents at small percentages of the limits specified in 10 CFR 20 and, in fact, will result in doses generally below the dose-design objective values of Appendix I. At the same time, the licensee is permitted the flexibility of operation, compatible with considerations of health and safety, to ensure that the public is provided a dependable source of power, even under unusual operating conditions which may temporarily result in releases higher than such small percentages but still well within the limits specified in 10 CFR 20.

In addition to the impact created by facility radioactive effluents as discussed above, within the NRC policy and procedures for environmental protection described in 10 CFR 51 there are generic treatments of environmental effects of all aspects of the uranium fuel cycle. These environmental data have been summarized in Table S-3 (of 10 CFR 51.20) and are discussed later in this report in Section 5.10. In the same manner the environmental impact of transportation of fuel and waste to and from an LWR is summarized in Table S-4 (of 10 CFR 51.20) and presented in Section 5.9.3 of this report.

Recently an additional operational requirement for uranium-fuel-cycle facilities including nuclear power plants was established by the Environmental Protection Agency in 40 CFR 190. This regulation limits annual doses (excluding radon and daughters) for members of the public to 25 mrems total body, 75 mrems thyroid, and 25 mrems other organs from <u>all</u> fuel-cycle facility contributions that may impact a specific individual in the public.

5.9.2 Operational Overview

During normal operations of PNPP, small quantities of radioactivity (fission and activation products) will be released to the environment. The staff has determined the dose estimated to members of the public outside of the plant boundaries as a result of the radiation from these radioisotope releases and relative to natural-background-radiation dose levels.

These Plant-generated environmental dose levels are estimated to be very small because of both the Plant design and the development of a program that will be implemented at the facility to contain and control all radioactive emissions and effluents. As mentioned in Section 4.2.5, highly efficient radioactive-waste management systems are incorporated into the plant design. These systems are designed to remove most of the fission-product radioactivity that is assumed to leak, in small amounts, from the fuel, as well as most of the activation-product radioactivity produced by neutrons in the reactor-core vicinity. The effectiveness of these systems will be measured by process and effluent radiological monitoring systems that permanently record the amounts of radioactive constituents remaining in the various airborne and waterborne process and effluent streams. The amounts of radioactivity released through vents and discharge points to be further dispersed and diluted to points outside the plant boundaries are to be recorded and published semiannually in the Radioactive-Effluent-Release Reports for the facility.

The small amounts of airborne effluents that are released will diffuse in the atmosphere in a fashion determined by the meteorological conditions existing at the time of release and are generally much dispersed and diluted by the time they reach unrestricted areas that are open to the public. Similarly, the small amounts of waterborne effluents released will be diluted with Plant waste water and then further diluted as they mix with Lake Erie water.

Radioisotopes in the facility's effluents that enter unrestricted areas will produce doses through their radiations to members of the general public in a manner similar to the way doses are produced from background radiations (that is, cosmic, terrestrial, and internal radiations), which also include radiation from nuclear-weapons fallout. These radiation doses can be calculated for the many potential radiological-exposure pathways specific to the environment around the facility, such as direct-radiation doses from the gaseous plume or liquid effluent stream outside of the plant boundaries, or internal-radiation-dose commitments from radioactive contaminants that might have been deposited on vegetation, or in meat and fish products eaten by people, or that might be present in drinking water outside the plant or incorporated into milk from cows at nearby farms.

These doses, calculated for the "maximally exposed" individual (that is, the hypothetical individual potentially subject to maximum exposure), form the basis of the NRC staff's evaluation of impacts. Actually, these estimates are for a fictitious person because assumptions are made that tend to overestimate the dose that would accrue to members of the public outside the plant boundaries. For example, for this maximally exposed individual to receive the total body dose calculated at the plant boundary as a result of external exposure to the gaseous plume, he/she is assumed to be physically exposed to gamma radiation at that boundary for 70% of the year, an unlikely occurrence.

Site-specific values for various parameters involved in each dose pathway are used in the calculations. These include calculated or observed values for the amounts of radioisotopes released in the gaseous and liquid effluents, meteorological information (for example, wind speed and direction) specific to the site topography and effluent release points, and hydrological information pertaining to dilution of the liquid effluents as they are discharged.

An annual land census will identify changes in the use of unrestricted areas to permit modifications in the programs for evaluating doses to individuals from principal pathways of exposure. This census specification will be incorporated into the Radiological Technical Specifications and satisfies the requirements of Section IV.B.3 of Appendix I to 10 CFR 50. As use of the land surrounding the site boundary changes, revised calculations will be made to ensure that the dose estimate for gaseous effluents always represents the highest dose that might possibly occur for any individual member of the public for each applicable foodchain pathway. The estimate considers, for example, where people live, where vegetable gardens are located, and where cows are pastured.

An extensive radiological environmental monitoring program, designed specifically for the environs of PNPP, provides measurements of radiation and radioactive contamination levels that exist outside of the facility boundaries both before and after operations begin. In this program, offsite radiation levels are continuously monitored with thermoluminescent detectors (TLDs). In addition, measurements are made on a number of types of samples from the surrounding area to determine the possible presence of radioactive contaminants which, for example, might be deposited on vegetation, be present in drinking water outside the plant, or be incorporated into cow's milk from nearby farms. The results for all radiological environmental samples measured during a calendar year of operation are recorded and published in the Annual Radiological Environmental Operating Report for the facility. The specifics of the final operational-monitoring program and the requirement for annual publication of the monitoring results will be incorporated into the operating license Radiological Technical Specifications for the PNPP facility.

5.9.3 Radiological Impacts from Routine Operations

5.9.3.1 Radiation Exposure Pathways: Dose Commitments

The potential environmental pathways through which persons may be exposed to radiation originating in a nuclear power reactor are shown schematically in Figure 5.2. When an individual is exposed through one of these pathways, the dose is determined in part by the amount of time he/she is in the vicinity of the source, or the amount of time the radioactivity inhaled or ingested is retained in his/her body. The actual effect of the radiation or radioactivity is determined by calculating the dose commitment. The annual dose commitment is calculated to be the total dose that would be received over a 50-year period, following the intake of radioactivity for 1 year under the conditions existing 15 years after the station begins operation. (Calculation for the 15th year, or midpoint of station operation, represents an average exposure over the life of the plant.) However, with few exceptions, most of the internal dose commitment for each nuclide is given during the first few years after exposure because of the turnover of the nuclide by physiological processes and radioactive decay.

There are a number of possible exposure pathways to humans that are appropriate to be studied to determine the impact of routine releases from the PNPP facility site on members of the general public living and working outside of the site boundaries, and whether the releases projected at this point in the licensing process will in fact meet regulatory requirements. A detailed listing of these exposure pathways would include external radiation exposure from the gaseous effluents, inhalation of iodines and particulate contaminants in

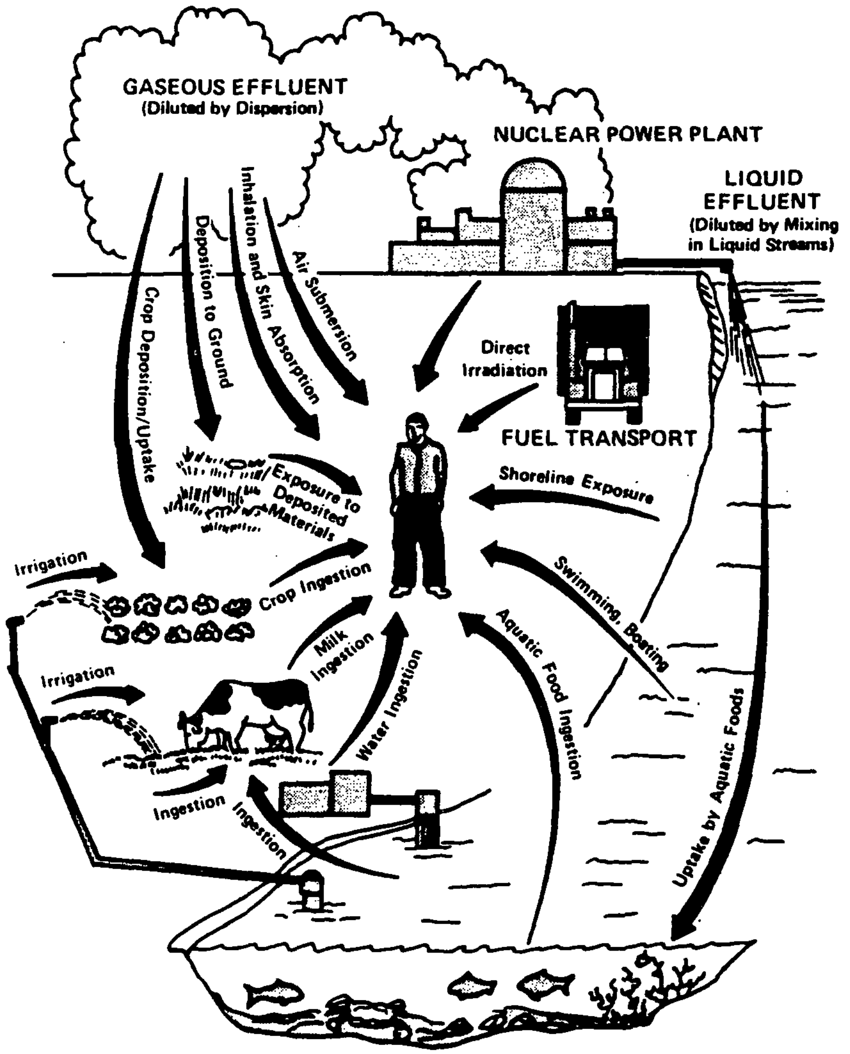


Figure 5.2 Potentially meaningful exposure pathways to individuals

the air, drinking milk from a cow or eating meat from an animal that feeds on open pasture near the site on which iodines or particulates may have deposited, eating vegetables from a garden near the site that may be contaminated by similar deposits, and drinking water or eating fish caught near the point of discharge of liquid effluents.

Other less important pathways include: external irradiation from radionuclides deposited on the ground surface, eating animals and food crops raised near the site using irrigation water that may contain liquid effluents, shoreline, boating and swimming activities near lakes or streams that may be contaminated by effluents, drinking potentially contaminated water, and direct radiation from within the plant itself.

Calculations of the effects for most pathways are limited to a radius of 80 km (50 mi). This limitation is based on several facts. Experience, as demonstrated by calculations, has shown that all individual dose commitments (>0.1 mrem/yr) for radioactive effluents are accounted for within a radius of 80 km from the plant. Beyond 80 km the doses to individuals are smaller than 0.1 mrem/yr, which is far below natural-background doses, and the doses are subject to substantial uncertainty because of limitations of predictive mathematical models.

The NRC staff has made a detailed study of all of the above important pathways and has evaluated the radiation-dose commitments both to the plant workers and the general public for these pathways resulting from routine operation of the facility. A discussion of these evaluations follows.

5.9.3.1.1 Occupational Radiation Exposure for Boiling Water Reactors (BWRs)

Most of the dose to nuclear plant workers results from external exposure to radiation coming from radioactive materials outside of the body rather than from internal exposure from inhaled or ingested radioactive materials. Experience shows that the dose to nuclear plant workers varies from reactor to reactor and from year to year. For environmental-impact purposes, it can be projected by using the experience to date with modern BWRs. Recently licensed 1000-MWe BWRs are operated in accordance with the post-1975 regulatory requirements and guidance that place increased emphasis on maintaining occupational exposure at nuclear power plants ALARA. These requirements and guidance are outlined primarily in 10 CFR 20, Standard Review Plan Chapter 12 (NUREG-0800), and Regulatory Guide 8.8, "Information Relevant To Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be As Low As Is Reasonably Achievable."

The applicant's proposed implementation of these requirements and guidelines is reviewed by the NRC staff during the licensing process, and the results of that review will be reported in the staff's Safety Evaluation Report. The license is granted only after the review indicates that an ALARA program can be implemented. In addition, regular reviews of operating plants are performed to determine whether the ALARA requirements are being met.

Average collective occupational dose information for 154 BWR reactor years of operation is available for those plants operating between 1974 and 1980. (The year 1974 was chosen as a starting date because the dose data for years before 1974 are primarily from reactors with average rated capacities below 500 MWe.) These data indicate that the average reactor annual collective dose at BWRs has been about 740 person-rems, with some plants experiencing an average plant lifetime annual collective dose to date of 1650 person-rems (NUREG-0713, Vol. 2), and with one plant as high as 1853 person-rems. These dose averages are based on widely varying yearly doses at BWRs. For example, for the period mentioned above, annual collective doses for BWRs have ranged from 44 to 3626 person-rems per reactor. However, the average annual dose per nuclear plant worker of about 0.8 rem (NUREG-0713, Vol. 2) has not varied significantly during this period. The worker dose limit, established by 10 CFR 20, is 3 rems/quarter (if the average dose over the worker lifetime is being controlled to 5 rems/yr) or 1.25 rems/quarter if it is not.

The wide range of annual collective doses experienced at BWRs in the United States results from a number of factors such as the amount of required maintenance and the amount of reactor operations and inplant surveillance. Because these factors can vary widely and unpredictably, it is impossible to determine in advance a specific year-to-year annual occupational radiation dose for a particular plant over its operating lifetime. There may on occasion be a need for relatively high collective occupational doses, even at plants with radiation protection programs designed to ensure that occupational radiation doses will be kept ALARA.

In recognition of the factors mentioned above, staff occupational dose estimates for environmental impact purposes for PNPP are based on the assumption that the facility will experience the annual average occupational dose for BWRs to date. Thus the staff has projected that the collective occupational doses for each unit at PNPP will be 740 person-rems, but doses could average as much as 2 to 3 times this value over the life of the plant.

In addition to the occupational radiation exposures discussed above, during the period between the initial power operation of Unit 1 and the similar startup of Unit 2, construction personnel working on Unit 2 will potentially be exposed to sources of radiation from the operation of Unit 1. The applicant has estimated that the integrated dose to construction personnel, over a period of 3½ years, will be about 104 person-rems. This radiation exposure will result predominantly from radiation due to radioactive nitrogen-16 in the steam passing through the Unit 1 turbine and penetrating the turbine, the building, and the air to where workers may be, and gaseous effluents from Unit 1. Based on experience with other BWRs, the staff finds that the applicant's estimate is reasonable. A detailed breakdown of the integrated dose to the construction workers by the location of their work and its duration is given in Table 12.4-18 of the FSAR.

The average annual dose of about 0.8 rem per nuclear-plant worker at operating BWRs and PWRs has been well within the limits of 10 CFR 20. However, for impact evaluation, the NRC staff has estimated the risk to nuclear-power-plant workers and compared it in Table 5.3 to published risks for other occupations. Based on these comparisons, the staff concludes that the risk to nuclear-plant workers from plant operation is comparable with the risks associated with other occupations.

In estimating the health effects resulting from both offsite (see Section 5.9.3.2) and occupational radiation exposures as a result of normal operation of this facility, the NRC staff used somatic (cancer) and genetic risk estimators that are based on widely accepted scientific information. Specifically, the staff's estimates are based on information compiled by the National Academy of Sciences Advisory Committee on the Biological Effects of Ionizing Radiation (BEIR I). The estimates of the risks to workers and the general public are based on conservative assumptions (that is, the estimates are probably higher than the actual number). The following risk estimators were used to estimate health effects: 135 potential deaths from cancer per million person-rems and 258 potential cases of all forms of genetic disorders per million person-rems. The cancer-mortality risk estimates are based on the "absolute risk" model described in BEIR I. Higher estimates can be developed by use of the "relative risk" model along with the assumption that risk prevails for the duration of life. Use of the relative risk model would produce risk values up

Table 5.3. Incidence of job-related mortalities

Occupational group	Mortality rates (premature deaths per 10^5 person-years)
Underground metal miners*	~1300
Uranium miners*	420
Smelter workers*	190
Mining**	61
Agriculture, forestry, and fisheries**	35
Contract construction**	33
Transportation and public utilities**	24
Nuclear-plant worker***	23
Manufacturing**	7
Wholesale and retail trade**	6
Finance, insurance, and real estate**	3
Services**	3
Total private sector**	10

*The President's Report on Occupational Safety and Health, "Report on Occupational Safety and Health by the U.S. Department of Health, Education, and Welfare," E. L. Richardson, Secretary, May 1972.

**U.S. Bureau of Labor Statistics, "Occupational Injuries and Illness in the United States by Industry, 1975," Bulletin 1981, 1978.

***The nuclear-plant workers' risk is equal to the sum of the radiation-related risk and the nonradiation-related risk. The estimated occupational risk associated with the industrywide average radiation dose of 0.8 rem is about 11 potential premature deaths per 10^5 person-years due to cancer, based on the risk estimators described in the following text. The average nonradiation related risk for seven U.S. electrical utilities over the period 1970-1979 is about 12 actual premature deaths per 10^5 person-years as shown in Figure 5 of the paper by R. Wilson and E. S. Koehl, "Occupational Risks of Ontario Hydro's Atomic Radiation Workers in Perspective," presented at Nuclear Radiation Risks, a Utility-Medical Dialog, sponsored by the International Institute of Safety and Health in Washington, D.C., September 22-23, 1980. (Note that the estimate of 11 radiation-related premature cancer deaths describes a potential risk rather than an observed statistic.)

to about four times greater than those used in this report. The staff regards the use of the relative risk model values as a reasonable upper limit of the range of uncertainty. The lower limit of the range would be zero because health effects have not been detected at doses in this dose-rate range. The number of potential nonfatal cancers would be approximately 1.5 to 2 times the number of

potential fatal cancers, according to the 1980 report of the National Academy of Science's Advisory Committee in the Biological Effects of Ionizing Radiation (BEIR III).

Values for genetic risk estimators range from 60 to 1500 potential cases of all forms of genetic disorders per million person-rems (BEIR I). The value of 258 potential cases of all forms of genetic disorders is equal to the sum of the geometric means of the risk of specific genetic defects and the risk of defects with complex etiology.

The preceding values for risk estimators are consistent with the recommendations of a number of recognized radiation-protection organizations, such as the International Commission on Radiological Protection (ICRP), the National Council on Radiation Protection and Measurement (NCRP), the National Academy of Sciences (BEIR III), and the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR).

The risk of potential fatal cancers in the exposed work-force population at the PNPP facility and the risk of potential genetic disorders in all future generations of this work-force population, is estimated as follows: multiplying the annual plant-worker-population dose (about 1480 person-rems) by the risk estimators, the staff estimates that about 0.2 cancer death may occur in the total exposed population and about 0.4 genetic disorder may occur in all future generations of the same exposed population. The value of 0.2 cancer death means that the probability of one cancer death over the lifetime of the entire work force as a result of 1 year of facility operation is about 1 chance in 5. The value of 0.4 genetic disorder means that the probability of 1 genetic disorder in all future generations of the entire work force as a result of 1 year of facility operation is about 2 chances in 5.

5.9.3.1.2 Public Radiation Exposure

Transportation of Radioactive Materials

The transportation of "cold" (unirradiated) nuclear fuel to the reactor, of spent irradiated fuel from the reactor to a fuel reprocessing plant, and of solid radioactive waste from the reactor to waste burial grounds is considered in 10 CFR 51.20. The contribution of the environmental effects of such transportation to the environmental costs of licensing the nuclear power reactor is set forth in Summary Table S-4 from 10 CFR 50.20, reproduced herein as Table 5.4. The cumulative dose to the exposed population as summarized in Table S-4 is very small when compared with the annual collective dose of about 60,000 person-rems to this same population or 26,000,000 person-rems to the U.S. population from background radiation.

Direct Radiation for BWRs

Radiation fields are produced around nuclear plants as a result of radioactivity within the reactor and its associated components, as well as a result of radioactive-effluent releases. Although the components are shielded, dose rates observed around BWR plants from these plant components have varied from undetectable levels to values on the order of 100 mrems/yr at onsite locations where members of the general public were allowed. For newer BWR plants with a standardized design, dose rates have been estimated using special calculational

Table 5.4 (Summary Table S-4) Environmental impact of transportation of fuel and waste to and from one light-water-cooled nuclear power reactor

NORMAL CONDITIONS OF TRANSPORT

	Environmental impact
Heat (per irradiated fuel cask in transit)	250,000 Btu/hr.
Weight (governed by Federal or State restrictions)	73,000 lbs. per truck; 100 tons per cask per rail car.
Traffic density:	
Truck	Less than 1 per day.
Rail	Less than 3 per month.

Exposed population	Estimated number of persons exposed	Range of doses to exposed individuals [2] (per reactor year)	Cumulative dose to exposed population (per reactor year) [3]
Transportation workers	200	0.01 to 300 millirem	4 man-rem.
General public:			
Onlookers	1,100	0.003 to 1.3 millirem	3 man-rem.
Along Route	600,000	0.0001 to 0.06 millirem	

ACCIDENTS IN TRANSPORT

	Environmental risk
Radiological effects	Small [4].
Common (nonradiological) causes	1 fatal injury in 100 reactor years; 1 nonfatal injury in 10 reactor years; $475 property damage per reactor year.

[1] Data supporting this table are given in the Commission's "Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants," WASH-1238, December 1972, and Supp. I, NUREG-75/038 April 1975. Both documents are available for inspection and copying at the Commission's Public Document Room, 1717 H St. NW., Washington, D.C., and may be obtained from National Technical Information Service, Springfield, Va. 22161. WASH-1238 is available from NTIS at a cost of $5.45 (microfiche, $2.25) and NUREG-75/038 is available at a cost of $3.25 (microfiche, $2.25).

[2] The Federal Radiation Council has recommended that the radiation doses from all sources of radiation other than natural background and medical exposures should be limited to 5,000 millirem per year for individuals as a result of occupational exposure and should be limited to 500 millirem per year for individuals in the general population. The dose to individuals due to average natural background radiation is about 130 millirem per year.

[3] Man-rem is an expression for the summation of whole body doses to individuals in a group. Thus, if each member of a population group of 1,000 people were to receive a dose of 0.001 rem (1 millirem), or if 2 people were to receive a dose of 0.5 rem (500 millirem) each, the total man-rem dose in each case would be 1 man-rem.

[4] Although the environmental risk of radiological effects stemming from transportation accidents is currently incapable of being numerically quantified, the risk remains small regardless of whether it is being applied to a single reactor or a multireactor site.

modeling techniques. The calculated cumulative dose to the exposed population from such a facility would be much less than 1 person-rem/yr per unit, insignificant when compared with the natural background dose.

Low-level radioactivity storage containers outside the plant are estimated to make a dose contribution at the site boundary of less than 0.1% of that due to the direct radiation described above.

Radioactive-Effluent Releases: Air and Water

As pointed out in an earlier section, all effluents from this facility will be subject to extensive decontamination, but small controlled quantities of radioactive effluents will be released to the atmosphere and to the hydrosphere during normal operations. Estimates of site-specific radioisotope-release values

have been developed on the basis of estimates regarding fuel performance and the descriptions of operational and radwaste systems in the applicant's ER-OL and FSAR and by using the calculational models and parameters developed by the NRC staff in NUREG-0016 and NUREG-0017. These have been supplemented by extensive use of the applicant's site and environmental data in the ER-OL and in subsequent answers to NRC staff questions, and should be studied to obtain an understanding of airborne and waterborne releases from the facility.

These radioactive effluents are then diluted by the air and water into which they are released before they reach areas accessible to the general public.

Radioactive effluents can be divided into several groups. Among the airborne effluents the radioisotopes of the fission product noble gases, krypton and xenon, as well as of argon, do not deposit on the ground nor are they absorbed and accumulated within living organisms; therefore, the noble gas effluents act primarily as a source of direct external radiation emanating from the effluent plume. Dose calculations are performed for the site boundary where the highest external-radiation doses to a member of the general public as a result of gaseous effluents have been estimated to occur; these include the total body and skin doses as well as the annual beta and gamma air doses from the plume at that boundary location.

Another group of airborne radioactive effluents--the fission product radioiodines, as well as carbon-14 and tritium--are also gaseous but these tend to be deposited on the ground and/or inhaled into the body during breathing. For this class of effluents, estimates of direct external radiation doses from deposits on the ground, and of internal radiation doses to total body, thyroid, bone, and other organs from inhalation and from vegetable, milk, and meat consumption are made. Concentrations of iodine in the thyroid and of carbon-14 in bone are of particular significance here.

A third group of airborne effluents, consisting of particulates that remain after filtration of airborne effluents in the plant prior to release, includes fission products such as cesium and barium and activated corrosion products such as cobalt and chromium. The calculational model determines the direct external radiation dose and the internal radiation doses for these contaminants through the same pathways as described above for the radioiodines, carbon-14, and tritium. Doses from the particulates are combined with those of the radioiodines, carbon-14, and tritium for comparison with one of the design objectives of Appendix I to 10 CFR 50.

The waterborne-radioactive-effluent constituents could include fission products such as nuclides of strontium and iodine; activation products, such as nuclides of sodium and manganese; and tritium as tritiated water. Calculations estimate the internal doses (if any) from fish consumption, from water ingestion (as drinking water), and from eating of meat or vegetables raised near the site on irrigation water, as well as any direct external radiation from recreational use of the water near the point of discharge.

The release values for each group of effluents, along with site-specific meteorological and hydrological data, serve as input to computerized radiation-dose models that estimate the maximum radiation dose that would be received outside

the facility via a number of pathways for individual members of the public, and for the general public as a whole. These models and the radiation-dose calculations are discussed in the October 1977 Revision 1 of Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR 50, Appendix I," and in Appendix C of this Statement.

Examples of site-specific dose-assessment calculations and discussions of parameters involved are given in Appendix D. Doses from all airborne effluents except the noble gases are calculated for individuals at the location (for example, the site boundary, garden, residence, milk cow, meat animal) where the highest radiation dose to a member of the public has been established from all applicable pathways (such as ground deposition, inhalation, vegetable consumption, cow milk consumption, or meat consumption). Only those pathways associated with airborne effluents that are known to exist at a single location are combined to calculate the total maximum exposure to an exposed individual.

Pathway doses associated with liquid effluents are combined without regard to any single location, but they are assumed to be associated with maximum exposure of an individual through other than gaseous-effluent pathways.

5.9.3.2 Radiological Impact on Humans

Although the doses calculated in Appendix D are based primarily on radioactive-waste treatment system capability and are well below the design objective values of Appendix I to 10 CFR 50, the actual radiological impact associated with the operation of the facility will depend, in part, on the manner in which the radioactive-waste treatment system is operated. Based on its evaluation of the potential performance of the ventilation and radwaste treatment systems, the NRC staff has concluded that the systems as now proposed are capable of controlling effluent releases to meet the dose-design objectives of Appendix I to 10 CFR 50.

Operation of the PNPP facility will be governed by operating license Technical Specifications that will be based on the dose-design objectives of Appendix I to 10 CFR 50. Because these design-objective values were chosen to permit flexibility of operation while still ensuring that plant operations are ALARA, the actual radiological impact of plant operation may result in doses close to the dose-design objectives. Even if this situation exists, the individual doses for the member of the public subject to maximum exposure will still be very small when compared with natural background doses (~100 mrems/yr) or the dose limits (500 mrems/yr, total body) specified in 10 CFR 20 as consistent with considerations of the health and safety of the public. As a result, the staff concludes that there will be no measurable radiological impact on any member of the public from routine operation of the PNPP facility.

Operating standards of 40 CFR 190, the Environmental Protection Agency's Environmental Radiation Protection Standards for Nuclear Power Operations, specify that the annual dose equivalent must not exceed 25 mrems to the whole body, 75 mrems to the thyroid, and 25 mrems to any other organ of any member of the public as the result of exposures to planned discharges of radioactive materials (radon and its daughters excepted) to the general environment from all uranium-fuel-cycle operations and radiation from these operations that can be expected to affect a given individual. The NRC staff concludes that under normal operations the PNPP facility is capable of operating within these standards.

The radiological doses and dose commitments resulting from a nuclear power plant are well known and documented. Accurate measurements of radiation and radioactive contaminants can be made with very high sensitivity so that much smaller amounts of radioisotopes can be recorded than can be associated with any possible observable ill effects. Furthermore, the effects of radiation on living systems have for decades been subject to intensive investigation and consideration by individual scientists as well as by select committees that have occasionally been constituted to objectively and independently assess radiation dose effects. Although, as in the case of chemical contaminants, there is debate about the exact extent of the effects of very low levels of radiation that result from nuclear-power-plant effluents, upper bound limits of deleterious effects are well established and amenable to standard methods of risk analysis. Thus the risks to the maximally exposed member of the public outside of the site boundaries or to the total population outside of the boundaries can be readily calculated and recorded. These risk estimates for the PNPP facility are presented below.

The risk to the maximally exposed individual is estimated by multiplying the risk estimators presented in Section 5.9.3.1.1 by the annual dose-design objectives for total-body radiation in 10 CFR 50, Appendix I. This calculation results in a risk of potential premature death from cancer to that individual from exposure to radioactive effluents (gaseous or liquid) from 1 year of reactor operations of less than one chance in one million.* The risk of potential premature death from cancer to the average individual within 80 km (50 mi) of the reactors from exposure to radioactive effluents from the reactors is much less than the risk to the maximally exposed individual. These risks are very small in comparison with natural cancer incidence from causes unrelated to the operation of the PNPP facility.

Multiplying the annual U.S. general public population dose from exposure to radioactive effluents and transportation of fuel and waste from the operation of this facility (that is, 56 person-rems) by the preceding risk estimators, the staff estimates that about 0.008 cancer death may occur in the exposed population and about 0.014 genetic disorder may occur in all future generations of the exposed population. The significance of these risk estimates can be determined by comparing them with the natural incidence of cancer deaths and genetic abnormalities in the U.S. population. Multiplying the estimated U.S. population for the year 2000 (~260 million persons) by the current incidence of actual cancer fatalities (~20%) and the current incidence of actual genetic diseases (~6%), about 52 million cancer deaths and about 16 million genetic abnormalities are expected (BEIR I; American Cancer Society). The risks to the general public from exposure to radioactive effluents and transportation of fuel and wastes from the annual operation of the PNPP facility are very small fractions (less than one part in a billion) of the estimated normal incidence of cancer fatalities and genetic abnormalities in the year 2000 population.

On the basis of the preceding comparison (that is, comparing the risk from exposure to radioactive effluents and transportation of fuel and waste from the annual operation of this facility with the risk from the estimated incidence

*The risk of potential premature death from cancer to the maximally exposed individual from exposure to radioiodines and particulates would be in the same range as the risk from exposure to the other types of effluents.

of cancer fatalities and genetic abnormalities in the year-2000 population) the staff concludes that the risk to the public health and safety from exposure to radioactive effluents and the transportation of fuel and wastes from normal operation of the PNPP facility will be very small.

5.9.3.3 Radiological Impacts on Biota Other Than Humans

Depending on the pathway and the radiation source, terrestrial and aquatic biota will receive doses that are approximately the same or somewhat higher than humans receive. Although guidelines have not been established for acceptable limits for radiation exposure to species other than humans, it is generally agreed that the limits established for humans are sufficiently protective for other species.

Although the existence of extremely radiosensitive biota is possible and increased radiosensitivity in organisms may result from environmental interactions with other stresses (for example, heat or biocides), no biota have yet been discovered that show a sensitivity (in terms of increased morbidity or mortality) to radiation exposures as low as those expected in the area surrounding the facility. Furthermore, at all nuclear plants for which radiation exposure to biota other than humans has been analyzed (Blaylock and Witherspoon), there have been no cases of exposure that can be considered significant in terms of harm to the species, or that approach the limits for exposure to members of the public that are permitted by 10 CFR 20. Inasmuch as the 1972 BEIR Report (BEIR I) concluded that evidence to date indicated no other living organisms are very much more radiosensitive than humans, no measurable radiological impact on populations of biota is expected as a result of the routine operation of this facility.

5.9.3.4 Radiological Monitoring

Radiological environmental monitoring programs are established to provide data where there are measurable levels of radiation and radioactive materials in the site environs and to show that in many cases no detectable levels exist. Such monitoring programs are conducted to verify the effectiveness of inplant systems used to control the release of radioactive materials and to ensure that unanticipated buildups of radioactivity will not occur in the environment. Secondarily, the environmental monitoring programs could identify the highly unlikely existence of releases of radioactivity from unanticipated release points that are not monitored. An annual surveillance (land census) program will be established to identify changes in the use of unrestricted areas to provide a basis for modifications of the monitoring programs or of the Technical Specifications conditions that relate to the control of doses to individuals.

These programs are discussed in greater detail in NRC Regulatory Guide 4.1, Revision 1, "Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants," and the Radiological Assessment Branch Technical Position, Revision 1, November 1979, "An Acceptable Radiological Environmental Monitoring Program."*

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*Available from the Radiological Assessment Branch, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

5.9.3.4.1 Preoperational

The preoperational phase of the monitoring program should provide for the measurement of background levels of radioactivity and radiation and their variations along the anticipated important pathways in the areas surrounding the facility, the training of personnel, and the evaluation of procedures, equipment, and techniques. The applicant proposed a radiological environmental-monitoring program to meet these objectives in the ER-CP, and it was discussed in the FES-CP. This early program has been updated and expanded; it is presented in Section 6.1.5 of the applicant's ER-OL and is summarized here in Table 5.5.

The applicant states that the preoperational program will be implemented approximately 2 years before issuance of an operating license for Unit 1 to document background levels of direct radiation and concentrations of radionuclides that exist in the environment. The preoperational program will continue up to initial criticality of Unit 1 at which time the operational radiological monitoring program will commence.

The staff has reviewed the preoperational environmental monitoring plan of the applicant and finds that it is generally acceptable as presented.

5.9.3.4.2 Operational

The operational, offsite radiological-monitoring program is conducted to provide data on measuring levels of radiation and radioactive materials in the site environs in accordance with 10 CFR 20 and 50. It assists and provides backup support to the effluent-monitoring program recommended in NRC Regulatory Guide 1.21, "Measuring, Evaluating and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants."

The applicant states that the operational program will in essence be a continuation of the preoperational program described above. The proposed operational program will be reviewed before plant operation. Modification will be based upon anomalies and/or exposure pathway variations observed during the preoperational program.

The final operational-monitoring program proposed by the applicant will be reviewed in detail by the NRC staff, and the specifics of the required monitoring program will be incorporated into the operating license Radiological Technical Specifications.

5.9.4 Environmental Impact of Postulated Accidents

5.9.4.1 Plant Accidents

The staff has considered the potential radiological impacts on the environment of possible accidents at the PNPP Units 1 and 2 in accordance with a Statement of Interim Policy published by the NRC in the Federal Register on June 13, 1980 (45 FR 40101-40104). The following discussion reflects these considerations and conclusions.

Table 5.5

PNPP PREOPERATIONAL ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM

Sample Media	Location	Sampling Frequency	Analysis	
			Type	Frequency
Airborne radioiodine[(a)] and particulates[(b)]	ENE--Redbird E--Site Boundary S--Site Boundary SE--Site Boundary SW--Site Boundary SSW--10 to 15 miles distant (control)	Continuous sampler operation with collection weekly or as required by dust loading, whichever is more frequent	Radioiodine I-131 Particulates Gross beta[(d)] Gamma Isotopic[(e)]	Weekly following canister change Weekly following canister change Composite, by location, quarterly
Direct Radiation[(c)] (4 TLDs/location)	At each airborne monitoring location	Continuous sampling, two TLDs exchanged monthly	Gamma Dose	Monthly
	NE--Site Boundary ENE--Site Boundary ESE--Site Boundary SSE--Site Boundary SSW--Site Boundary WSW--Site Boundary ENE--5 mi. (Vicinity of Madison-on-the-Lake) E--5 mi. ESE--5 mi. SE--5 mi. SSE--5 mi. S--5 mi. SSW--5 mi. SW--5 mi. WSW--5 mi. SW--Painesville WSW--Fairport Harbor SW--Control (Greater than 10 mi.)	Continuous sampling, two TLDs exchanged annually	Gamma Dose	Annually

TABLE 5.5 (Continued)

PNPP PREOPERATIONAL ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM

Sample Media	Location	Sampling Frequency	Analysis Type	Analysis Frequency
Waterborne surface(b) drinking(b)	PNPP Cooling Water Intake Structure	Composite(f)	H-3	Composite, by location, quarterly
	Fairport Harbor Water Supply System		Gross	Monthly
			Gamma Isotopic	Monthly
	Redbird/Madison-on-the-Lake Water Supply System			
	Control--Ashtabula Water Supply Facility (approximately 20 miles ENE of PNPP)			
Sediment from shoreline(c)	NNW--PNPP Discharge	Semiannually--Spring and Fall as weather permits	Gamma Isotopic	Semiannually
	ENE--Vicinity of Redbird WSW--Vicinity of Fairport Harbor WSW--Control--Vicinity of Mentor-on-the-Lake			
Ingestion Milk(g)	ENE--Approximately 2.0 miles	Monthly when animals are not on pasture	Gamma Isotopic(b)	All samples

TABLE 5.5 (Continued)

PNPP PREOPERATIONAL ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM

Sample Media	Location	Sampling Frequency	Analysis Type	Analysis Frequency
	E--Approximately 4.0 miles	Semimonthly when animals are on pasture	I-131[a]	All samples
	SE--Approximately 4.0 miles			
	SSW--Approximately 10-15 miles (Control)			
Fish[c]	NNW--Vicinity of PNPP Discharge	Semiannually--Spring and Fall as weather permits	Gamma Isotopic (edible portion)	Semiannually
	WSW--Control--Vicinity of Mentor-on-the-Lake			

[a] Sampling begins at least six months prior to PNPP operation, including one pasture season.

[b] Sampling begins at least one year prior to PNPP operation.

[c] Sampling begins at least two years prior to PNPP operation.

[d] Particulate sample filters will be analyzed for gross beta 24 hours or more after sampling to allow for radon and thoron daughter decay. If gross beta activity in air or water is greater than ten times the mean of control samples for any medium, gamma isotopic analysis will be performed on the individual samples.

[e] Gamma isotopic analysis means the identification and quantification of gamma-emitting radionuclides that may be attributable to the effluents from the facility.

[f] Composite samples will be collected with equipment that is capable of collecting an aliquot at time intervals that are very short (e.g., hourly) relative to the compositing period (e.g., monthly).

[g] Definitive sampling locations will be determined by a milk-animal census prior to initiation of preoperational monitoring.

The first section deals with general characteristics of nuclear power plant accidents including a brief summary of safety measures to minimize the probability of their occurrence and to mitigate their consequences if they should occur. Also described are the important properties of radioactive materials and the pathways by which they could be transported to become environmental hazards. Potential adverse health effects and impacts on society associated with actions to avoid such health effects are also identified.

Next, actual experience with nuclear power plant accidents and their observed health effects and other societal impacts are then described. This is followed by a summary review of safety features of PNPP and of the site that act to mitigate the consequences of accidents.

The results of calculations of the potential consequences of accidents that have been postulated in the design basis are then given. Also described are the results of calculations for PNPP site using probabilistic methods to estimate the possible impacts and the risks associated with severe accident sequences of exceedingly low probability of occurrence.

5.9.4.1.1 General Characteristics of Accidents

The term accident, as used in this section, refers to any unintentional event not addressed in Section 5.9.3 that results in a release of radioactive materials into the environment. The predominant focus, therefore, is on events that can lead to releases substantially in excess of permissible limits for normal operation. Normal release limits are specified in 10 CFR 20 and 10 CFR 50, Appendix I.

There are several features which combine to reduce the risk associated with accidents at nuclear power plants. Safety features in the design, construction, and operation, comprising the first line of defense are to a very large extent devoted to the prevention of the release of these radioactive materials from their normal places of confinement within the plant. There are also a number of additional lines of defense that are designed to mitigate the consequences of failures in the first line. Descriptions of these features for PNPP may be found in the applicant's FSAR and the SER. The most important mitigative features are described in Section 5.9.4.1.3.1 below.

These safety features are designed taking into consideration the specific locations of radioactive materials within the plant, their amounts, their nuclear, physical, and chemical properties, and their relative tendency to be transported into, and for creating biological hazards in, the environment.

5.9.4.1.1.1 Fission Product Characteristics

By far the largest inventory of radioactive material in a nuclear power plant is produced as a byproduct of the fission process and is located in the uranium oxide fuel pellets in the reactor core in the form of fission products. During periodic refueling shutdowns, the assemblies containing these fuel pellets are transferred to a spent fuel storage pool so that the second largest inventory of radioactive material is located in this storage area. Much smaller inventories of radioactive materials are also normally present in the water that circulates in the reactor coolant system and in the systems used to process gaseous and liquid radioactive wastes in the plant.

These radioactive materials exist in a variety of physical and chemical forms. Their potential for dispersion into the environment is dependent not only on mechanical forces that might physically transport them, but also upon their inherent properties, particularly their volatility. The majority of these materials exist as nonvolatile solids over a wide range of temperatures. Some, however, are relatively volatile solids and a few are gaseous in nature. These characteristics have a significant bearing upon the assessment of the environmental radiological impact of accidents.

The gaseous materials include radioactive forms of the chemically inert noble gases krypton and xenon. These have the highest potential for release into the atmosphere. If a reactor accident were to occur involving degradation of the fuel cladding, the release of substantial quantities of these radioactive gases from the fuel is a virtual certainty. Such accidents are very low frequency but credible events (Section 5.9.4.1.2). It is for this reason that the safety analysis of each nuclear power plant analyzes a hypothetical design basis accident that postulates the release of the entire contained inventory of radioactive noble gases from the fuel into the containment system. If these gases are further released to the environment as a possible result of failure of safety features, the hazard to individuals from these noble gases would arise predominantly through the external gamma radiation from the airborne plume. The reactor containment system is designed to minimize this type of release.

Radioactive forms of iodine are formed in substantial quantities in the fuel by the fission process and in some chemical forms may be quite volatile. For these reasons, they have traditionally been regarded as having a relatively high potential for release from the fuel. If released to the environment, the principal radiological hazard associated with the radioiodines is ingestion into the human body and subsequent concentration in the thyroid gland. Because of this, its potential for release to the atmosphere is reduced by the use of special systems designed to retain the iodine.

The chemical forms in which the fission product radioiodines are found are generally solid materials at room temperature, however, so that they have a strong tendency to condense (or "plate out") upon cooler surfaces. In addition, most of the iodine compounds are quite soluble in, or chemically reactive with, water. Although these properties do not inhibit the release of radioiodines from degraded fuel, they do act to mitigate the release from containment systems that have large internal surface areas and that contain large quantities of water as a result of an accident. The same properties affect the behavior of radioiodines that may "escape" into the atmosphere. Thus, if rainfall occurs during a release, or if there is moisture on exposed surfaces (such as dew), the radioiodines will show a strong tendency to be absorbed by the moisture.

Other radioactive materials formed during the operation of a nuclear power plant have lower volatilities and therefore, by comparison with the noble gases and iodine, a much smaller tendency to escape from degraded fuel unless the temperature of the fuel becomes very high. By the same token, such materials, if they escape by volatilization from the fuel, tend to condense quite rapidly to solid form again when transported to a lower temperature region and/or dissolve in water when present. The former mechanism can have the result of producing some solid particles of sufficiently small size to be carried some distance by a moving stream of gas or air. If such particulate materials are dispersed into the atmosphere as a result of failure of the containment barrier,

they will tend to be carried downwind and deposit on surface features by gravitational settling or by precipitation (fallout), where they will become "contamination" hazards in the environment.

All of these radioactive materials exhibit the property of radioactive decay with characteristic half-lives ranging from fractions of a second to many days or years (see Table 5.6). Many of them decay through a sequence or chain of decay processes and all eventually become stable (nonradioactive) materials. The radiation emitted during these decay processes is the reason that they are hazardous materials.

5.9.4.1.1.2 Exposure Pathways

The radiation exposure (hazard) to individuals is determined by their proximity to the radioactive material, the duration of exposure, and factors that act to shield the individual from the radiation. Pathways for the transport of radiation and radioactive materials that lead to radiation exposure hazards to humans are generally the same for accidental as for "normal" releases. These are depicted in Figure 5.2. There are two additional possible pathways that could be significant for accident releases that are not shown in Figure 5.2. One of these is the fallout onto open bodies of water of radioactivity initially carried in the air. The second would be unique to an accident that results in temperatures inside the reactor core sufficiently high to cause melting and subsequent penetration of the basemat underlying the reactor by the molten core debris. This creates the potential for the release of radioactive material into the hydrosphere through contact with ground water. These pathways may lead to external exposure to radiation, and to internal exposures if radioactivity is inhaled, or ingested from contaminated food or water.

It is characteristic of these pathways that during the transport of radioactive material by wind or by water, the material tends to spread and disperse, like a plume of smoke from a smokestack, becoming less concentrated in larger volumes of air or water. The result of these natural processes is to lessen the intensity of exposure to individuals downwind or downstream of the point of release, but they also tend to increase the number who may be exposed. For a release into the atmosphere, the degree to which dispersion reduces the concentration in the plume at any downwind point is governed by the turbulence characteristics of the atmosphere which vary considerably with time and from place to place. This fact, taken in conjunction with the variability of wind direction and the presence or absence of precipitation, means that consequences of accidental releases to the atmosphere would be very much dependent upon the weather conditions existing at the time.

5.9.4.1.1.3 Health Effects

The cause and effect relationships between radiation exposure and adverse health effects are quite complex (CONAES p. 517-34), but they have been more exhaustively studied than any other environmental contaminant.

Whole-body radiation exposure resulting in a dose greater than about 10 rems for a few persons and about 25 rems for nearly all people over a short period of time (hours) is necessary before any physiological effects to an individual are clinically detectable. Doses about 10 to 20 times larger than the latter

Table 5.6 Activity of radionuclides in a PNPP reactor core at 3834 MWt

Group/radionuclide	Radioactive inventory (millions of curies)	Half-life (days)
A. NOBLE GASES		
Krypton-85	0.67	3,950
Krypton-85m	29	0.183
Krypton-87	56	0.0528
Krypton-88	82	0.117
Xenon-133	200	5.28
Xenon-135	41	0.384
B. IODINES		
Iodine-131	100	8.05
Iodine-132	140	0.0958
Iodine-133	200	0.875
Iodine-134	230	0.0366
Iodine-135	180	0.280
C. ALKALI METALS		
Rubidium-86	0.031	18.7
Cesium-134	9.0	750
Cesium-136	3.6	13.0
Cesium-137	5.6	11,000
D. TELLURIUM-ANTIMONY		
Tellurium-127	7.1	0.391
Tellurium-127m	1.3	109
Tellurium-129	37	0.048
Tellurium-129m	6.4	34.0
Tellurium-131m	16	1.25
Tellurium-132	140	3.25
Antimony-127	7.3	3.88
Antimony-129	40	0.179
E. ALKALINE EARTHS		
Strontium-89	110	52.1
Strontium-90	4.4	11,030
Strontium-91	130	0.403
Barium-140	190	12.8
F. COBALT AND NOBLE METALS		
Cobalt-58	0.94	71.0
Cobalt-60	0.35	1,920
Molybdenum-99	190	2.8
Technetium-99m	170	0.25
Ruthenium-103	130	39.5
Ruthenium-105	86	0.185
Ruthenium-106	30	366
Rhodium-105	59	1.50

Table 5.6 (Continued)

Group/radionuclide	Radioactive inventory (millions of curies)	Half-life (days)
G. RARE EARTHS, REFRACTORY OXIDES AND TRANSURANICS		
Yttrium-90	4.7	2.67
Yttrium-91	140	59.0
Zirconium-95	180	65.2
Zirconium-97	180	0.71
Niobium-95	180	35.0
Lanthanum-140	190	1.67
Cerium-141	180	32.3
Cerium-143	160	1.38
Cerium-144	100	284
Praseodymium-143	160	13.7
Neodymium-147	72	11.1
Neptunium-239	2,000	2.35
Plutonium-238	0.068	32,500
Plutonium-239	0.025	8.9×10^6
Plutonium-240	0.025	2.4×10^6
Plutonium-241	4.1	5,350
Americium-241	0.0020	1.5×10^5
Curium-242	0.60	163
Curium-244	0.028	6,630

NOTE: The above grouping of radionuclides corresponds to that in Table 5.8.

value, also received over a relatively short period of time (hours to a few days), can be expected to cause some fatal injuries. At the severe, but extremely low probability end of the accident spectrum, exposures of these magnitudes are theoretically possible for persons in the close proximity of such accidents if measures are not or cannot be taken to provide protection (for example, by sheltering or evacuation).

Lower levels of exposures may also constitute a health risk, but the ability to define a direct cause and effect relationship between a known exposure to radiation and any given health effect is difficult given the backdrop of the many other possible reasons why a particular effect is observed in a specific individual. For this reason, it is necessary to assess such effects on a statistical basis. Such effects include randomly occurring cancer in the exposed population and genetic changes in future generations after exposure of a prospective parent. Occurrences of cancer in the exposed population may begin to develop only after a lapse of 2 to 15 years (latent period) from the time of exposure and then continue over a period of about 30 years (plateau period). However, in the case of exposure of fetuses (in utero), occurrences of cancer may begin to develop at birth (no latent period) and end at age 10 (that is, the plateau period is 10 years). The health consequences model currently being used is based on the 1972 BEIR Report of the National Academy of Sciences

(BEIR I). The occurrence of cancer itself is not necessarily an indication of fatality.

Most authorities are in agreement that a reasonable and probably conservative estimate of the randomly occurring number of health effects of low levels of radiation exposure to a large number of people is within the range of about 10 to 500 potential cancer deaths per million person-rems (although zero is not excluded by the data). The range comes from the latest NAS Report (BEIR III), which also indicates a probable value of about 150. This value is virtually identical to the value of about 140 used in the current NRC health effects models. In addition, approximately 220 randomly occurring genetic changes per million person-rems would be projected by BEIR III over succeeding generations. That also compares well with the value of about 260 per million person-rems currently used by the NRC staff.

5.9.4.1.1.4 Health Effects Avoidance

Radiation hazards in the environment tend to disappear by the natural process of radioactive decay. Where the decay process is a slow one, however, and where the material becomes relatively fixed in its location as an environmental contaminant (such as, in soil), the hazard can continue to exist for a relatively long period of time--months, years, or even decades. Thus, a possible consequential environmental societal impact of severe accidents is the avoidance of the health hazard rather than the health hazard itself, by restrictions on the use of the contaminated property or contaminated foodstuffs, milk, and drinking water. The potential economic impacts that this can cause are discussed below.

5.9.4.1.2 Accident Experience and Observed Impacts

The evidence of accident frequency and impacts in the past is a useful indicator of future probabilities and impacts. As of mid-1981, there were 71 commercial nuclear power reactor units licensed for operation in the United States at 50 sites, with power generating capacities ranging from 50 to 1130 MWe. (Each PNPP unit is designed for 1252 MWe.) The combined experience with these units represents approximately 500 reactor years of operation over an elapsed time of about 20 years. Accidents have occurred at several of these facilities (Bertini et al., NUREG-0651). Some of these have resulted in releases of radioactive material to the environment ranging from very small fractions of a curie to a few million curies. None is known to have caused any radiation injury or fatality to any member of the public, nor any significant individual or collective public radiation exposure, nor any significant contamination of the environment. This experience base is not large enough to permit a reliable quantitative statistical inference. It does, however, suggest that significant environmental impacts due to accidents are very unlikely to occur over time periods of a few decades.

Melting or severe degradation of reactor fuel has occurred in only one of these units, during the accident at Three Mile Island, Unit 2 (TMI-2) on March 28, 1979. In addition to the release of a few million curies of xenon-133, it has been estimated that approximately 15 Ci of radioiodine were also released to the environment at TMI-2. This amount represents an extremely minute fraction of the total radioiodine inventory present in the reactor at the time of the

accident. No other radioactive fission products were released in measurable quantity.

It has been estimated that the maximum cumulative offsite radiation dose to an individual was less than 100 mrems (Rogovin, President's Commission). The total population exposure has been estimated to range from about 1000 to 5000 person-rems. This exposure could produce between none and one additional fatal cancer over the lifetime of the exposed population. The same population receives each year from natural background radiation about 240,000 person-rems and approximately a half-million cancers are expected to develop in this group over its lifetime (Rogovin, President's Commission), primarily from causes other than radiation. Trace quantities (barely above the limit of detectability) of radioiodine were found in a few samples of milk produced in the area. No other food or water supplies were impacted.

Accidents at nuclear power plants have also caused occupational injuries and a few fatalities but none attributed to radiation exposure. Individual worker exposures have ranged up to about 4 rems as a direct consequence of reactor accidents (although there have been higher exposures to individual workers as a result of other unusual occurrences). However, the collective worker exposure levels (person-rems) as a result of accidents are a small fraction of the exposures experienced during normal routine operations that average about 500 person-rems per reactor year.

Accidents have also occurred at other nuclear reactor facilities in the United States and in other countries (Bertini, NUREG-0651). As a result of inherent differences in design, construction, operation, and purpose of most of these other facilities, their accident record has only indirect relevance to current nuclear power plants. Melting of reactor fuel occurred in at least seven of these accidents, including the one in 1966 at the Enrico Fermi Atomic Power Plant Unit 1. This was a sodium-cooled fast breeder demonstration reactor designed to generate 61 MWe. The damages were repaired and the reactor reached full power in 4 years following the accident. It operated successfully and completed its mission in 1973. This accident did not release any radioactivity to the environment.

A reactor accident in 1957 at Windscale, England released a significant quantity of radioiodine, approximately 20,000 Ci, to the environment. This reactor, which was not operated to generate electricity, used air rather than water to cool the uranium fuel. During a special operation to heat the large amount of graphite in this reactor, the fuel overheated and radioiodine and noble gases were released directly to the atmosphere from a 122-m (405-ft) stack. Milk produced in a 200-mi^2 area around the facility was impounded for up to 44 days. This kind of accident cannot occur in a water-cooled reactor like PNPP, however.

5.9.4.1.3 Mitigation of Accident Consequences

Pursuant to the Atomic Energy Act of 1954, the staff has conducted a safety evaluation of the application to operate the PNPP. Although this evaluation contains more detailed information on plant design, the principal design features are presented in the following section.

5.9.4.1.3.1 Design Features

PNPP Units 1 and 2 are essentially identical. Each unit contains features designed to prevent accidental release of fission products from the fuel and to lessen the consequences should such a release occur. These accident-preventive and mitigative features are referred to collectively as engineered safety features (ESF). To establish design and operating specifications for ESF, postulated events referred to as design-basis accidents are analyzed.

An emergency core cooling system (ECCS) is provided to supply cooling water to the reactor core during an accident to prevent or minimize fuel damage. Means of removing heat energy from the containment to prevent its overpressurization following an accident are also provided. The containment system itself is a passive ESF, designed to prevent direct escape of released fission products to the environment.

The PNPP containment structures consist of an inner primary containment and an outer secondary containment. The primary containment is designed to withstand internal pressures resulting from reactor accidents. The secondary containment surrounds the primary containment and all equipment outside primary containment which could handle fission products in the event of an accident. The secondary containment is designed to collect, delay, and filter any leakage from the primary containment prior to its release to the environment.

The secondary containment encloses plant areas which are accessible and, therefore, ventilated during normal operation. Upon detection of a release of radioactivity, normal ventilation is automatically isolated, and an ESF--the annulus exhaust gas treatment system (AEGTS)--assumes control of air flow within and from the secondary containment. The AEGTS filters the secondary containment atmosphere and exhausts sufficient filtered air to establish and maintain an internal pressure less than the outside atmospheric pressure. This negative pressure is sufficient to prevent unfiltered air leakage from the building. Radioactive iodine and particulate fission products would be substantially removed from the AEGTS flow by safety-grade activated charcoal and high-efficiency particulate air filters. A filtered exhaust system also encloses the spent fuel pool.

The main steamlines pass through the secondary containment in going from the reactor to the turbine building. Any leakage of the main steamline isolation valves, therefore, could pass through those lines without being intercepted by the AEGTS. To prevent this passage, a leakage control system is designed to collect main steamline isolation valve leakage and direct it into the secondary containment atmosphere and sumps, so that any airborne emissions are processed by the AEGTS.

All mechanical systems mentioned above are designed to perform their functions given single failures, and are supplied with emergency power from onsite diesel generators if normal offsite and station power is interrupted.

Much more extensive discussions of these design features may be found in the applicant's FSAR. In addition, the implementation of the lessons learned from the TMI-2 accident--in the form of improvements in design, procedures, and operator training--will significantly reduce the likelihood of a degraded core accident that could result in large releases of fission products to the containment.

The applicants will be required to meet the TMI-related requirements specified in NUREG-0737. As noted in Section 5.9.4.1.4, no credit has been taken for these actions and improvements in discussing the radiological risk of accidents in this statement.

5.9.4.1.3.2 Site Features

The NRC reactor site criteria, in 10 CFR 100, require that the site for every power reactor have certain characteristics that tend to reduce the risk and potential impact of accidents. The discussion that follows briefly describes the PNPP site characteristics and how they meet these requirements.

First, the site has an exclusion area as required by 10 CFR 100. The exclusion area, located within the 445-ha (1100-acre) site owned by the Cleveland Electric Illuminating Company, is a circular area with a 884-m (2900-ft) radius measured from the center of PNPP Unit 1. There are no residents within the exclusion area. The applicant owns all of the land within the exclusion area, and has control of all the mineral rights both on land and within 550 m (1800 ft) of all safety-related structures in the portion of Lake Erie that traverses the exclusion area. Therefore, the applicant has the authority, required by 10 CFR 100, to determine all activities in this area. Activities unrelated to Plant operation that occur within the exclusion area include activity associated with the construction of Unit 2, and water-related activities on Lake Erie. There are no railroads or highways traversing the exclusion area, but in case of an emergency a formal arrangement has been made with the Coast Guard to control the activity on Lake Erie.

Second, beyond and surrounding the exclusion area is a low population zone (LPZ), also required by 10 CFR 100. The LPZ for the PNPP site is a circular area with a 4023-m (2-1/2-mi) radius centered on a line midway between Units 1 and 2. The LPZ consists mostly of farmland and wooded areas. Within the zone the applicant must ensure that there is a reasonable probability that appropriate protective measures could be taken on behalf of the residents and other members of the public in the event of a serious accident. The applicant has indicated that 4225 persons resided in the LPZ in 1978, and projects the population to increase to 4745 by the year 2020. In case of a radiological emergency, the applicant has made arrangements to carry out protective actions, including evacuation of personnel in the vicinity of the PNPP. (See also the following section on Emergency Preparedness.)

Third, 10 CFR 100 also requires that the distance from the reactor to the nearest boundary of a densely populated area containing more than about 25,000 residents be at least one and one-third times the distance from the reactor to the outer boundary of the LPZ. Because accidents of greater potential hazards than those commonly postulated as representing an upper limit are conceivable, although highly improbable, it was considered desirable to add the population center distance requirement in 10 CFR 100 to provide for protection against excessive exposure doses to people in large centers. The city of Painesville, Ohio, located about 10 km (6 mi) southwest of the site, with a population of 17,407 persons in 1975, is the nearest population center. The distance from the site to Painesville is at least one and one-third times the distance to the outer boundary of the LPZ. The nearest major city within 80 km (50 mi) is Cleveland, Ohio, which had a population of 638,793 in 1975 and is located 53 km (33 mi) southwest of the site. The population density within 50 km (30 mi) of

the site when the plant is scheduled to go into operation (1983) is projected to be 95 persons per km^2 (245 persons/mi^2), and is not expected to exceed 106 persons per km^2 (275 persons/mi^2) during the life of the plant.

The safety evaluation of the PNPP site has also included a review of potential external hazards (that is, activities offsite that might adversely affect the operation of the nuclear plant and cause an accident). This review encompassed nearby industrial, transportation, and military facilities that might create explosive, missile, toxic gas, or similar hazards. The risk to the PNPP facility from such hazards has been found to be negligibly small. A more detailed discussion of the compliance with the Commission's siting criteria and the consideration of external hazards is given in the SER.

5.9.4.1.3.3 Emergency Preparedness

Emergency preparedness plans including protective action measures for the PNPP facility and environs are in an advanced, but not yet fully completed stage. In accordance with the provisions of 10 CFR 50.47, effective November 3, 1980, no full-power operating license will be issued to an applicant unless a finding is made by the NRC that the state of onsite and offsite emergency preparedness provides reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency. Among the standards that must be met by these plans are provisions for two emergency planning zones (EPZs). A plume exposure pathway EPZ of about 16 km (10 mi) in radius and an ingestion exposure pathway EPZ of about 80 km (50 mi) in radius are required. Other standards include appropriate ranges of protective actions for each of these zones, provisions for dissemination to the public of basic emergency planning information, provisions for rapid notification of the public during a serious reactor emergency, and methods, systems, and equipment for assessing and monitoring actual or potential offsite consequences in the EPZs of a radiological emergency condition.

NRC and the Federal Emergency Management Agency (FEMA) have agreed that FEMA will make a finding and determination as to the adequacy of state and local government emergency response plans. NRC will determine the adequacy of the applicant's emergency response plans with respect to the standards listed in 10 CFR 50.47(b), the requirements of Appendix E to 10 CFR 50, and the guidance contained in NUREG-0654/FEMA-REP-1, Revision 1, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," dated November 1980. After the above determinations by NRC and FEMA, the NRC will make a finding in the licensing process as to the overall and integrated state of preparedness. The NRC staff findings will be reported in a supplement to the SER. Although the presence of adequate and tested emergency plans cannot prevent an accident, it is the staff's judgment that such plans can and will substantially mitigate the consequences to the public if an accident should occur.

5.9.4.1.4 Accident Risk and Impact Assessment

5.9.4.1.4.1 Design-Basis Accidents

As a means of ensuring that certain features of PNPP meet acceptable design and performance criteria, both the applicant and the staff have analyzed the potential consequences of a number of postulated accidents. Some of these could lead

to significant releases of radioactive materials to the environment, and calculations have been performed to estimate the potential radiological consequences to persons offsite. For each postulated initiating event, the potential radiological consequences cover a considerable range of values depending upon the particular course taken by the accident and the conditions, including wind direction and weather, prevalent during the accident.

In the safety analysis and evaluation of the PNPP, three categories of accidents have been considered by the applicant and the staff. These categories are based upon their probability of occurrence and include (1) incidents of moderate frequency, (events that can reasonably be expected to occur during any year of operation); (2) infrequent accidents (events that might occur once during the lifetime of the plant); and (3) limiting faults (accidents not expected to occur but that have the potential for significant releases of radioactivity). The radiological consequences of incidents in the first category, also called anticipated operational occurrences, are discussed in Section 5.9.3. Some of the initiating events postulated in the second and third categories for PNPP unit are shown in Table 5.7. These events are designated design-basis accidents in that specific design and operating features as described above in Section 5.9.4.1.3.1 are provided to limit their potential radiological consequences. Approximate radiation doses that might be received by a person at the nearest site boundary (884 m (2900 ft) from the Plant) are also shown in the

Table 5.7 Approximate doses during a 2-hour exposure at the exclusion area boundary*

Accidents and faults	Duration of release	Whole-body dose (rem)
<u>Infrequent accidents</u>		
<u>Category 2</u>		
Offgas system failure	<2 hours	0.03
Release of waste gas storage tank contents	<2 hours	0.12
Small-break LOCA	hrs-days	<0.0005
Fuel-handling accident	<2 hours	0.001
<u>Limiting faults</u>		
<u>Category 3</u>		
Main steamline break	<2 hr	0.006
Control rod drop	hrs-days	0.002
Large-break LOCA	hrs-days	0.026

*884 m (2900 ft)

table, along with a characterization of the time duration of the releases. The results shown in the table reflect the expectation that engineered safety and operating features designed to mitigate the consequences of the postulated accidents would function as intended. An important implication of this expectation is that the radioactive releases considered are limited to noble gases and radioiodines and that any other radioactive materials (such as, in particulate form) are not expected to be released. The results are also quasi-probabilistic in nature in the sense that the meteorological dispersion conditions are taken to be neither the best nor the worst for the site, but rather an average value determined by actual site measurements. In order to contrast the results of these calculations with those using more pessimistic, or conservative, assumptions described below, the doses shown in Table 5.7 are sometimes referred to as "realistic" doses. These are extremely small compared with the 25-rem whole-body guidelines of 10 CFR 100.

The staff has also carried out calculations to estimate the potential upper bounds for individual exposures from the same initiating accidents in Table 5.7 for the purpose of implementing the provisions of 10 CFR 100. For these calculations, much more pessimistic (conservative or worst case) assumptions are made as to the course taken by the accident and the prevailing conditions. These assumptions include much larger amounts of radioactive material released by the initiating events, additional single failures in equipment, operation of ESFs in a degraded mode,* and very poor meteorological dispersion conditions. The results of these calculations show that, for these events, the limiting whole-body exposures are not expected to exceed 7.0 rems to any individual at sequences and sequence groups referred to above, and more fully described in the site boundary. They also show that radioiodine releases have the potential for offsite exposures ranging up to about 88 rems to the thyroid. For such an exposure to occur, an individual would have to be located at a point on the site boundary where the radioiodine concentration in the plume has its highest value and inhale at a breathing rate characteristic of a person jogging, for a period of 2 hours. The health risk to an individual receiving such a thyroid exposure is the potential appearance of benign or malignant thyroid nodules in about 3 out of 100 cases, and the development of a fatal cancer in about 1 out of 1000 cases.

None of the calculations of the impacts of design-basis accidents described in this section take into consideration possible reductions in individual or population exposures as a result of taking any protective actions.

5.9.4.1.4.2 Probabilistic Assessment of Severe Accidents

In this and the following three sections, there is a discussion of the probabilities and consequences of accidents of greater severity than the design-basis accidents identified in the previous section. As a class, they are considered less likely to occur, but their consequences could be more severe, both for the plant itself and for the environment. These severe accidents, heretofore frequently called Class 9 accidents, can be distinguished from design-basis accidents in two primary respects: they involve substantial physical

*The containment system, however, is assumed to prevent leakage in excess of that which can be demonstrated by testing, as provided in 10 CFR 100.11(a).

deterioration of the fuel in the reactor core, including overheating to the point of melting, and they involve deterioration of the capability of the containment system to perform its intended function of limiting the release of radioactive materials to the environment.

The assessment methodology employed is that described in the Reactor Safety Study (RSS) which was published in 1975 (NUREG-75/014).* However, the sets of accident sequences that were found in the RSS to be the dominant contributors to the risk in the prototype BWR (Peach Bottom Unit 2) have recently been updated (NUREG-0715) ("rebaselined"). The rebaselining has been done largely to incorporate peer group comments (NUREG/CR-0400), and better data and analytical techniques resulting from research and development after the publication of the RSS. Entailed in the rebaselining effort was the evaluation of the individual dominant accident sequences as they are understood to evolve. The earlier technique of grouping a number of accident sequences into the encompassing release categories as was done in the RSS has been largely eliminated.

The PNPP units are General Electric-designed BWRs having similar design and operating characteristics as the RSS prototype BWR. Therefore, the present assessment for PNPP has used as its starting point the rebaselined accident sequences and sequence groups referred to above, and more fully described in Appendix E. Characteristics of the sequences and sequence groups used (all of which involve partial to complete melting of the reactor core) are shown in Table 5.8. Sequences initiated by natural phenomena such as tornadoes, floods, or seismic events and those that could be initiated by deliberate acts of sabotage are not included in these event sequences. The radiological consequences of such events would not be different in kind from those which have been treated. Moreover, there are design requirements of 10 CFR 50, Appendix A, and 10 CFR 100 relating to effects of natural phenomena, and safeguards requirements of 10 CFR 73 ensuring that these potential initiators are in large measure taken into account in the design and operation of the plant. The data base for assessing the probabilities of events more severe than the design basis for natural phenomena or sabotage is small. Hence, inclusion of accident sequences initiated by natural phenomena and sabotage in an accurate manner is beyond the state of the art of probabilistic risk assessment. In addition, the staff judges that the additional risk from severe accidents initiated by natural events or sabotage is within the uncertainty of risks for the sequences considered here.

Calculated probability per reactor year associated with each accident sequence or sequence group used is shown in the second column in Table 5.8. As in the RSS there are substantial uncertainties in these probabilities. This is due, in part, to difficulties associated with the quantification of human error and to inadequacies in the data base on failure rates of individual plant components that were used to calculate the probabilities (NUREG/CR-0400). (See also Section 5.9.4.1.4.7 below.) The probability of accident sequences from the Peach Bottom Plant were used to give a perspective of the societal risk at PNPP because, although the probabilities of particular accident sequences may be substantially different or even improved for PNPP, the overall effect of all sequences taken together is likely to be within the uncertainties (see Section 5.9.4.1.4.7 for discussion of uncertainties in risk estimates).

*Because this report has been the subject of considerable controversy, a discussion of the uncertainties surrounding it is provided in Section 5.9.4.1.4.7.

Table 5.8 Summary of atmospheric releases in hypothetical accident sequences in a BWR (rebaselined)

Accident Sequence or Sequence Group[b]	Probability/ reactor-yr	Fraction of core inventory released[a]						
		Xe-Kr	I	Cs-Rb	Te-Sb	Ba-Sr	Ru[c]	La[d]
TCγ'	2.0×10^{-6}	1.0	0.45	0.67	0.64	0.073	0.052	0.0083
TWγ'	3.0×10^{-6}	1.0	0.098	0.27	0.41	0.025	0.028	0.005
TQUVγ' AEγ' S_1Eγ' S_2Eγ'	3.0×10^{-7}	1.0	0.095	0.3	0.36	0.034	0.027	0.005
TCγ	8.0×10^{-6}	1.0	0.07	0.14	0.12	0.015	0.01	0.002
TWγ	1.0×10^{-5}	1.0	0.003	0.11	0.083	0.011	0.007	0.001
TQUVγ AEγ S_1Eγ S_2Eγ	1.0×10^{-6}	1.0	0.02	0.055	0.11	0.006	0.007	0.0013

(a)Background on the isotope groups and release mechanisms is in NUREG-75/014, Appendix VII.
(b)See Appendix E for description of the accident sequences and sequence groups.
(c)Includes Ru, Rh, Co, Mo, Tc.
(d)Includes Y, La, Zr, Nb, Ce, Pr, Nd, Np, Pu, Am, Cm.

NOTE: See Section 5.9.2.1.4.7 for a discussion of uncertainties in risk estimates.

The magnitudes (curies) of radioactivity releases for each accident sequence or sequence group are obtained by multiplying the release fractions shown in Table 5.8 by the amounts that would be present in the core at the time of the hypothetical accident. These are shown in Table 5.6 for a PNPP unit at a core thermal power level of 3834 MW, the power level used in the safety evaluation.

The potential radiological consequences of these releases have been calculated by the consequence model used in the RSS (NUREG-0340) and adapted to apply to a specific site. The essential elements are shown in schematic form in Figure 5.3. Environmental parameters specific to the PNPP site have been used and include the following:

(1) meteorological data for the site representing a full year of consecutive hourly measurements and seasonal variations

(2) projected population for the year 2000 extending throughout regions of 80- and 560-km (50- and 350-mi) radius from the site

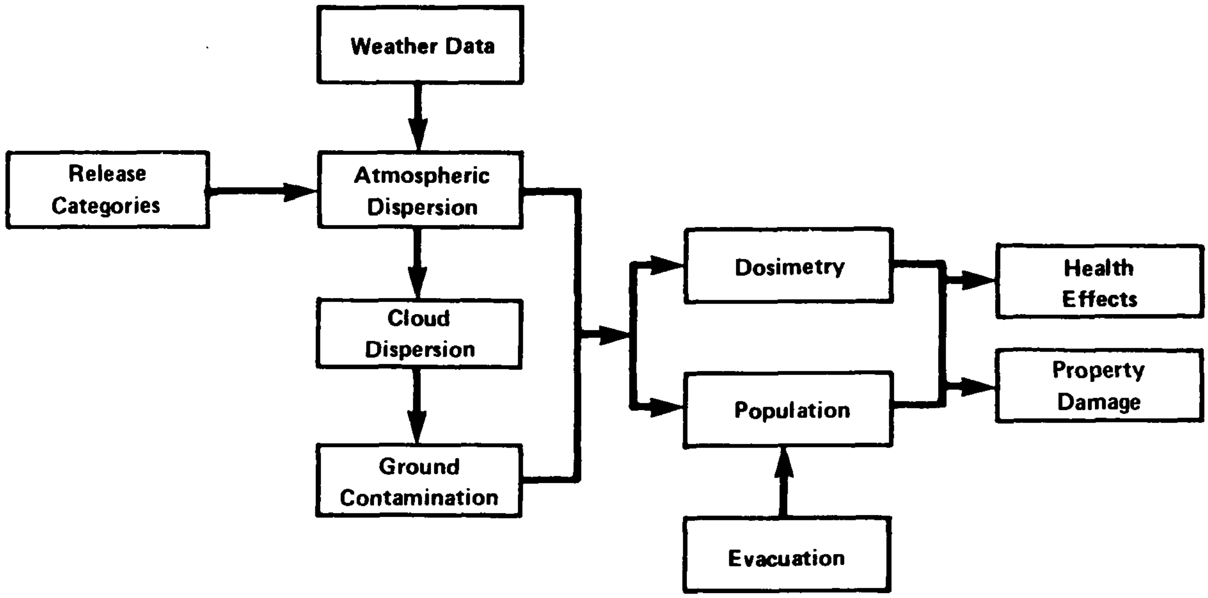

Figure 5.3 Schematic outline of atmospheric pathway consequence model

(3) the habitable land fraction within the 560-km (350-mi) radius

(4) land-use statistics, on a state-wide basis, including farm land values, farm product values including dairy production, and growing season information, for the State of Ohio and each surrounding state within the 560-km region

(5) land-use statistics including farm land values, farm product values including dairy production, and growing season information for the adjoining regions of Canada, within 560-km, based on comparison with the values for the nearby states of the U.S.

For the region beyond 560 km (350 mi) the U.S. average population was assumed.

To obtain a probability distribution of consequences, the calculations are performed assuming the occurrence of each accident release sequence at each of 91 different "start" times throughout a 1-year period. Each calculation utilizes the site-specific hourly meteorological data and seasonal information for the time period following each "start" time. The consequence model also contains provisions for incorporating the consequence reduction benefits of evacuation, relocation, and other protective actions. Early evacuation and relocation of people would considerably reduce the exposure from the radioactive cloud and the contaminated ground in the wake of the cloud passage.

The evacuation model used, which is more fully discussed in Appendix F has been revised from that used in the RSS for better site-specific application. The quantitative characteristics of the evacuation model used for the PNPP site are estimates made by the staff and are partly based upon preliminary evacuation time estimates prepared by the applicant. There normally would be certain facilities near a plant, such as schools or hospitals, for which special equipment

or personnel may be required to effect evacuation. Several such facilities have been identified near the PNPP site, such as the Lake County Jail, Lake County Memorial Hospital - East, and numerous nursing homes. Further, there may be some people who either do not receive the notification to evacuate, or who choose not to evacuate. Therefore, actual evacuation effectiveness could be greater or less than that characterized but would not be expected to be very much less. A sensitivity of consequences to evacuation parameters in the model can be found by comparison of Appendix F with Section 5.9.4.1.4.3.

The other protective actions include: (1) either complete denial of use (interdiction), or permitting use only at a sufficiently later time after appropriate decontamination of foodstuffs such as crops and milk, (2) decontamination of severely contaminated environment (land and property) when it is considered to be economically feasible to lower the levels of contamination to protective action guide (PAG) levels, and (3) denial of use (interdiction) of severely contaminated land and property for varying periods of time until the contamination levels reduce to such values by radioactive decay and weathering so that land and property can be economically decontaminated as in (2) above. These actions would reduce the radiological exposure to the people from immediate and/or subsequent use of or living in the contaminated environment.

Early evacuation within and early relocation of people from outside the plume exposure pathway EPZ (see Appendix F) and other protective actions as mentioned above are considered as essential sequels to serious nuclear reactor accidents involving significant release of radioactivity to the atmosphere. Therefore, the results shown for a PNPP reactor include the benefits of these protective actions.

There are also uncertainties in each facet of the estimates of consequences, and the error bounds may be as large as they are for the accident probabilities (see Figure 5.3).

The results of the calculations using this consequence model are radiological doses to individuals and to populations, health effects that might result from these exposures, costs of implementing protective actions, and costs associated with property damage by radioactive contamination.

5.9.4.1.4.3 Dose and Health Impacts of Atmospheric Releases

The results of the calculations of dose and health impacts performed for the PNPP facility and site are presented in the form of probability distributions in Figures 5.4 through 5.7 and are included in the impact summary table, Table 5.9. All of the six accident sequences and sequence groups shown in Table 5.8 contribute to the results, the consequences from each being weighted by its associated probability.

Figure 5.4 shows the probability distribution for the number of persons who might receive whole-body doses equal to or greater than 200 rems and 25 rems, and thyroid doses equal to or greater than 300 rems from early exposure,* all

*Early exposure to an individual includes external doses from the radioactive cloud and the contaminated ground, and the dose from internally deposited radionuclides from inhalation of contaminated air during the cloud passage. Other pathways of exposure are excluded.

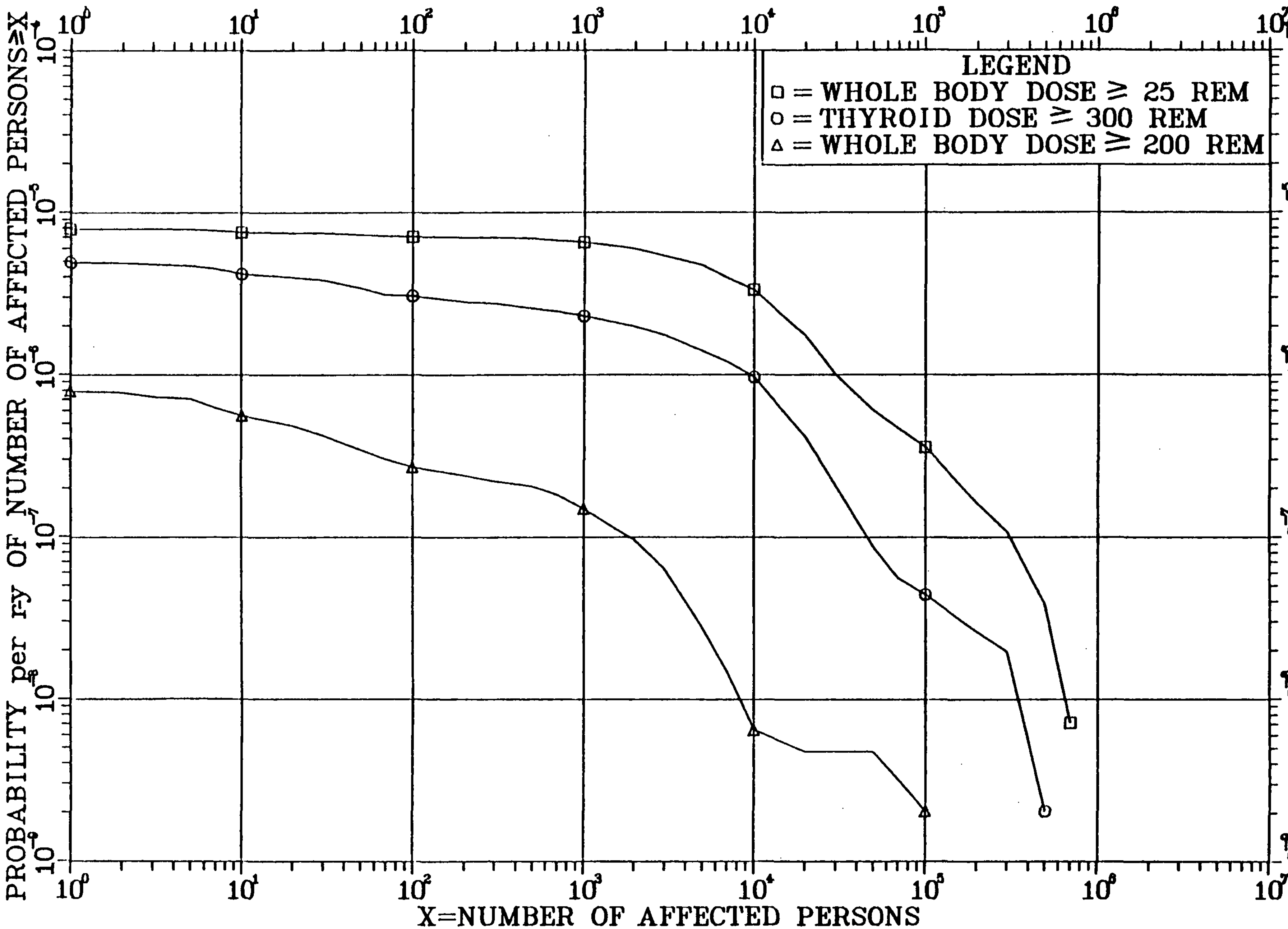

Figure 5.4 Probability distributions of individual dose impacts

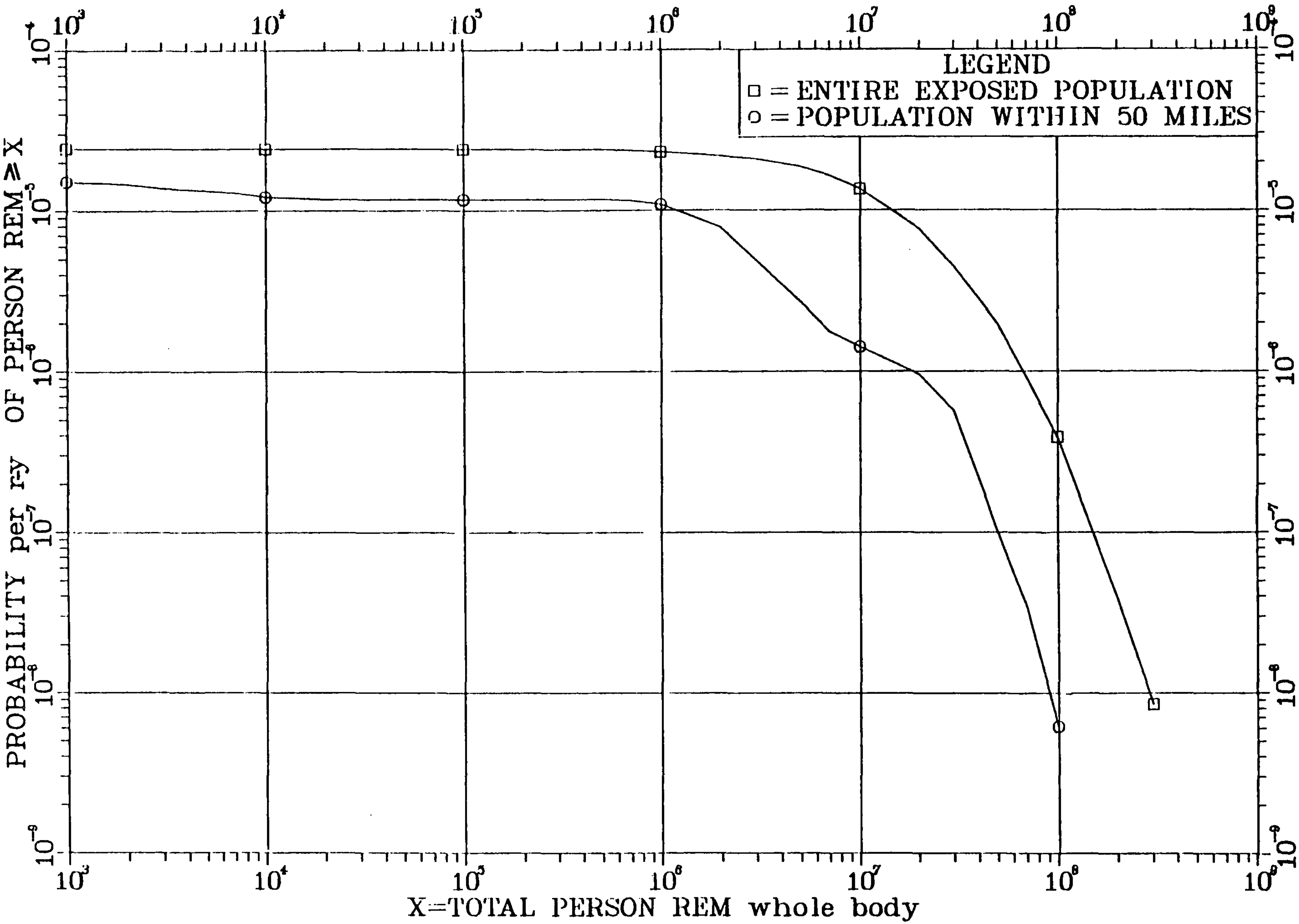

Figure 5.5 Probability distributions of population exposures

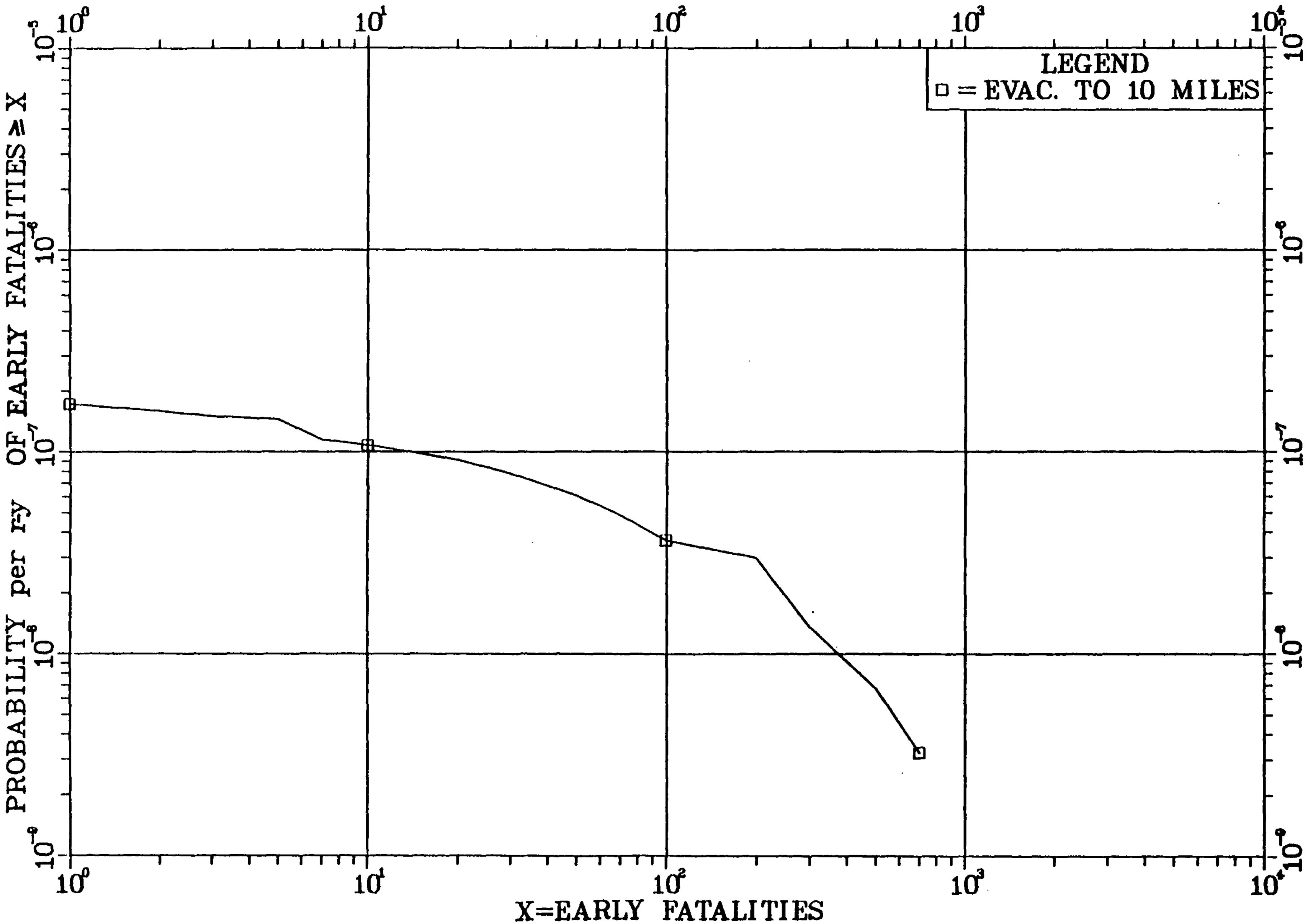

Figure 5.6 Probability distribution of early fatalities

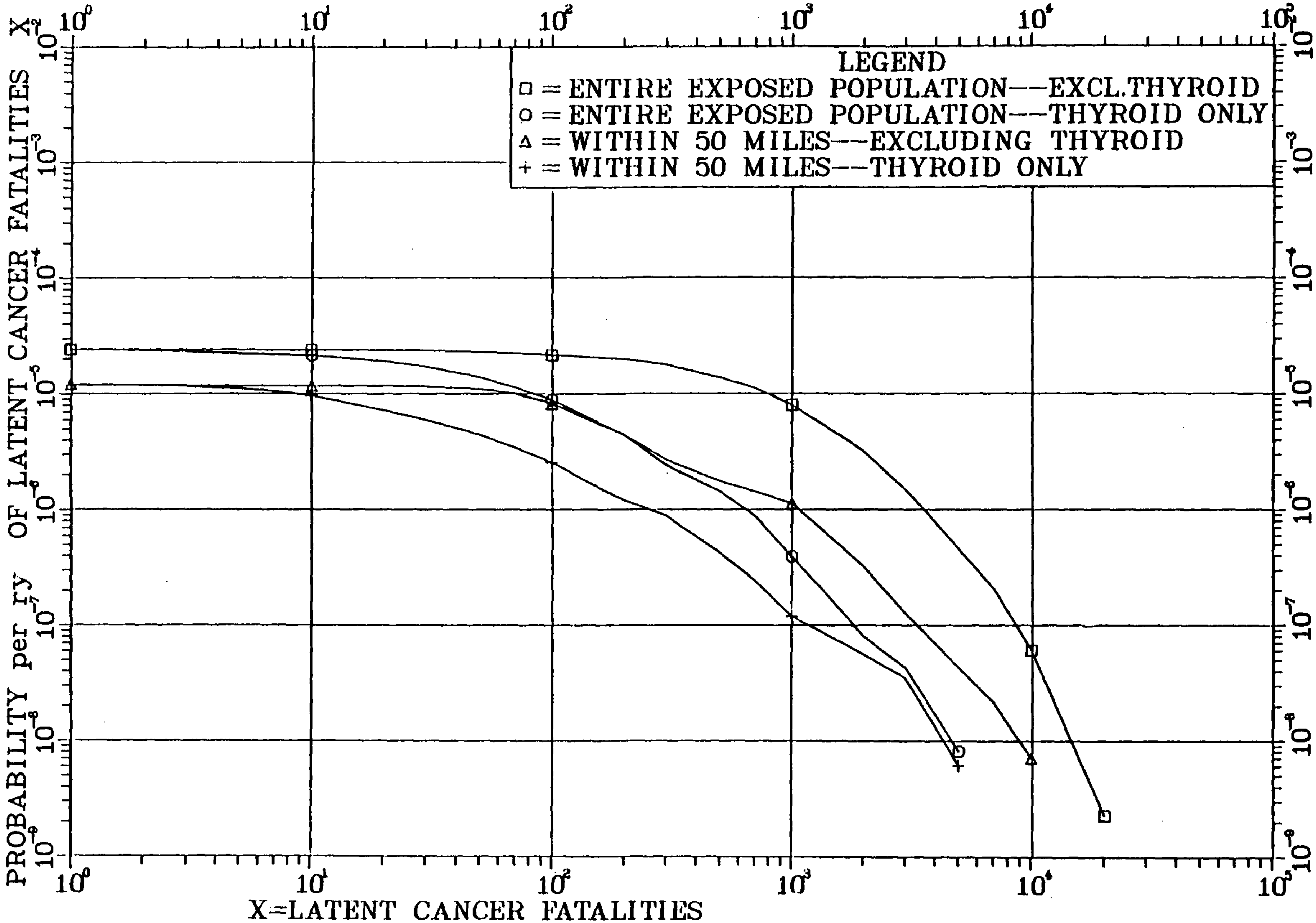

Figure 5.7 Probability distribution of cancer fatalities

Table 5.9 Summary of environmental impacts and probabilities

Probability of impact/ reactor-year	Persons exposed over 200 rems	Persons exposed over 25 rems	Early fatal-ities	Population exposure, millions of person-rems*	Latent cancers*,**	Cost of offsite mitigating actions, millions
10^{-4}	0	0	0	0/0	0/0	0
10^{-5}	0	0	0	1.2/14	83/890	140
5×10^{-6}	0	4,900	0	3.0/29	210/1,500	400
10^{-6}	0	30,000	0	17/69	1,200/4,000	1,300
10^{-7}	2,000	310,000	13	50/130	4,000/11,000	4,100
10^{-8}	8,100	650,000	370	90/300	13,000/18,000	10,000
Related Figure	5.4	5.4	5.6	5.5	5.7	5.8

*80 km/total

**Includes cancers of all organs. Genetic effects might be approximately twice the number of latent cancers.

NOTE: Please refer to Section 5.9.4.1.4.7 for a discussion of uncertainties in risk estimates.

on a per-reactor-year basis. The 200-rem whole-body dose figure corresponds approximately to a threshold value for which hospitalization would be indicated for the treatment of radiation injury. The 25-rem whole-body dose (which has been identified earlier as the lower limit for a clinically observable physiological effect in nearly all people) and 300-rem thyroid dose figures correspond to the Commission's guideline values for reactor siting in 10 CFR 100.

The figure shows in the left-hand portion that there is less than 1 chance in 100,000 (that is, 10^{-5}) per reactor-year that one or more persons may receive doses equal to or greater than any of the doses specified. The fact that each of the three curves approaches a horizontal line shows that if one person were to receive such doses the chances are about the same that several tens to hundreds would be so exposed. The chances of larger numbers of persons being exposed at these levels are seen to be considerably smaller. For example, the chances are less than 1 in 10,000,000 (10^{-7}) that several thousand or more people might receive whole-body doses of 200 rems or greater. A majority of the exposures reflected in this figure would be expected to occur to persons within a 48-km (30-mi) radius of the plant. Virtually all would occur within a 160-km (100-mi) radius.

Figure 5.5 shows the probability distribution for the total population exposure in person-rems, that is, the probability per year that the total population exposure will equal or exceed the values given.

For perspective, population doses shown in Figure 5.5 may be compared with the annual average dose to the population within 80 km (50 mi) of the PNPP site due to natural background radiation of 252,000 person-rems, and to the anticipated annual population dose to the general public (total U.S.) from normal station operation of about 28 person-rems (excluding plant workers) (see Section 5.9.3).

Figure 5.6 shows the probability distributions for early fatalities, representing radiation injuries that would produce fatalities within about 1 year after exposure. All of the early fatalities would be expected to occur within a 24-km (15-mi) radius and the majority within a 5-km (3-mi) radius. The results of the calculations shown in this figure and in Table 5.9 reflect the effect of evacuation within the 16-km (10-mi) plume exposure pathway EPZ only. For the very low probability accidents having the potential for causing radiation exposures above the threshold for early fatality at distances beyond 16 km, it would be realistic to expect that authorities would evacuate persons at all distances at which such exposures might occur. Early fatality consequences would therefore reasonably be expected to be slightly less than the numbers shown.

Figure 5.7 represents the statistical relationship between population exposure and the induction of fatal cancers that might appear over a period of many years following exposure. The impacts on the total population and the population within 80 km are shown separately. Further, the fatal, latent cancers have been subdivided into those attributable to exposures of the thyroid and all other organs.

5.9.4.1.4.4 Economic and Societal Impacts

As noted in Section 5.9.4.1.1, various measures for avoidance of adverse health effects including those as a result of residual radioactive contamination in the environment are possible consequential impacts of severe accidents. Calculations of the probabilities and magnitudes of such impacts for the PNPP facility and environs have also been made. Unlike the radiation exposure and adverse health effect impacts discussed above, impacts associated with adverse health effects avoidance are more readily transformed into economic impacts.

The results are shown as the probability distribution for costs of offsite mitigating actions in Figure 5.8 and are included in Table 5.9. The factors contributing to these estimated costs include the following:

- evacuation costs
- value of crops contaminated and condemned
- value of milk contaminated and condemned
- costs of decontamination of property where practical
- indirect costs due to loss of use of property and incomes derived therefrom*

*These costs would derive from the necessity for interdiction to prevent the use of property until it is either free of contamination or can be economically decontaminated.

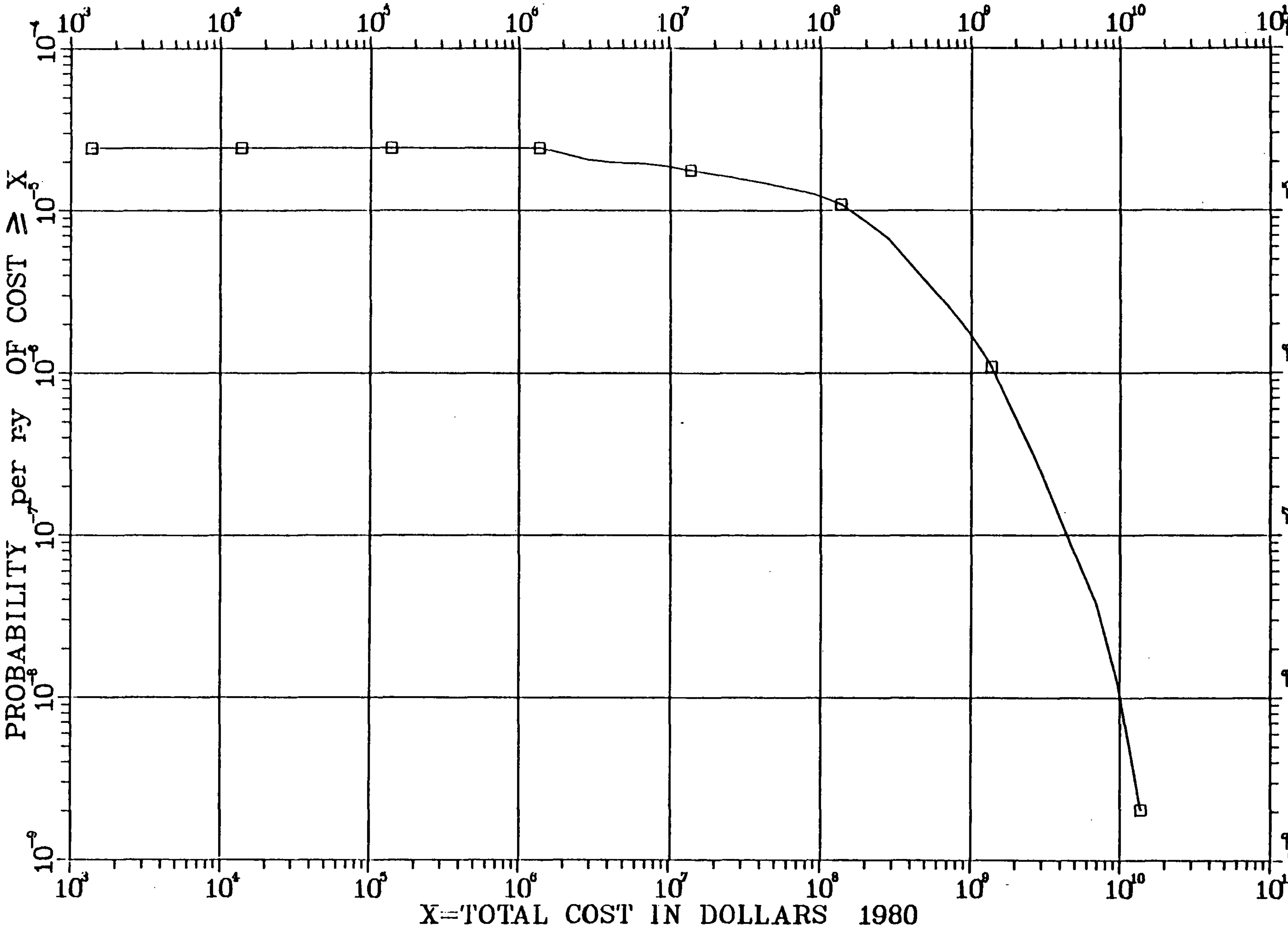

Figure 5.8 Probability distribution of mitigation measures cost

Figure 5.8 shows that at the extreme end of the accident spectrum these costs could exceed several billion dollars but that the probability that this would occur is exceedingly small, less than 1 chance in 10 million per reactor-year.

Additional economic impacts that can be monetized include costs of decontamination of the facility itself and the costs of replacement power. Probability distributions for these impacts have not been calculated, but they are included in the discussion of risk considerations in Section 5.9.4.1.4.6 below.

Section 6.1.4.6 and Table 6.5 of the Fermi 2 FES (NUREG-0769) identify average annual risks in several categories. Included are the costs of interdiction and mitigation. In computing the values stated, however, no costs, consequences, and risks were assessed for the areas occupied by the Great Lakes. The surface areas of the Great Lakes at distances 400 and 850 km (250 mi and 550 mi) from the Fermi 2 site are small percentages of the total land areas at the same distances.* As indicated, the principal health impacts from fallout on the Great Lakes are through fish ingestion and, to a much lesser extent, through drinking water.

However, the costs per unit area of mitigating the potential consequences of such radioactivity would not be expected to vary materially (by less than a factor of 2) from the costs expected for land areas. By neglecting the risks from fallout on water, therefore, the average annual risks identified in the Fermi FES could have been underestimated by less than a factor of 2. Finally, even if it is assumed that the risks identified in the Fermi FES were a factor of 2 greater, the staff's conclusions are not changed. These conclusions are that the risks of fatalities from accidents are small with respect to the risks of fatalities from other human activities in a comparatively sized population.

For PNPP, the staff could have also underestimated the consequences (including the costs of interdiction and mitigation) and risks from a spectrum of reactor accidents by not considering fallout on the Great Lakes. As the staff concluded with Fermi, however, the magnitude of the underestimate does not alter the staff's conclusions for PNPP that the risks of accidents are comparable to those from normal operation and that the health risks are small compared to the risks of fatalities from other human activities in a comparatively sized population.

5.9.4.1.4.5 Releases to Groundwater

A pathway through the groundwater for public radiation exposure and environmental contamination that would be unique for severe reactor accidents was identified above. Consideration has been given to the potential environmental impacts of this pathway for PNPP. The principal contributers to the risk are the core-melt accidents. The penetration of the basemat of the containment building can release molten core debris to the strata beneath the Plant. The soluble radionuclides in the debris can be leached and transported with groundwater to downgradient domestic wells used for drinking water or to surface water

*At 400 km the surface area of all of Lake Erie and portions of the other Great Lakes within such a radius is less than 25% of the total land area within a circle of the same radius. At 850 km all of the Great Lakes surface area is about 10% of the total area in a circle of similar radius.

bodies used for drinking water, aquatic food, and recreation. Releases of radioactivity to the groundwater underlying the site could also occur via depressurization of the containment atmosphere or the release of radioactive ECCS and suppression pool water through the failed containment.

An analysis of the potential consequences of a liquid pathway release of radioactivity for generic sites was presented in the "Liquid Pathway Generic Study" (LPGS) (NUREG-0440). The LPGS compares the risk of accidents involving the liquid pathway (drinking water, irrigation, aquatic food, swimming, and shoreline usage) for four conventional, generic, land-based nuclear plants and a floating nuclear plant (for which the nuclear reactor would be mounted on a barge and moored in a water body). Parameters for each generic land-based site were chosen to represent averages for a wide range of real sites and were thus "typical," but they represented no real sites in particular. The study concluded that the individual and population doses from the liquid pathway range from fractions to very small fractions of those that can arise from the airborne pathway.

The discussion in this section is a summary of an analysis performed to determine whether or not the liquid pathway consequences of a postulated accident at the PNPP site would be unique when compared with the generic Great Lakes land-based site considered in the LPGS. The method of comparison consists of a direct scaling up or down of the LPGS population doses based on the relative values of key parameters characterizing the LPGS Great Lakes site and the PNPP site. The parameters that were evaluated include the amounts and rate of release of radioactive materials to the ground, holdup in the underdrain, sorption on geological media, surface water transport, drinking water usage, aquatic food consumption, swimming, and shoreline usage.

Drinking water usage was estimated for users living along Lake Erie, Lake Ontario, the Niagara River, and the St. Lawrence River, and conservatively included some users not obtaining water from these water bodies. Aquatic food consumption was estimated directly from the LPGS values identified for Lake Erie and Lake Ontario. Near field fish catch estimates were taken as being equal to the LPGS estimates for lack of site-specific data. It is worth noting that aquatic food would account for a very small fraction of the total population dose, so a refined quantitative estimate of fish catch is probably unwarranted. This is in contrast to the situation for the contamination of the lake by the atmospheric pathway described above, because relatively little of the radioactive cesium escapes in this case. Populations for shoreline exposure and swimming dose estimates were derived from comprehensive studies on the Great Lakes (Perez).

Doses to individuals and populations were calculated in the LPGS without consideration of interdiction methods such as isolating the contaminated groundwater or denying use of the water. In the event of surface water contamination, alternative sources of water for drinking, irrigation, and industrial uses would be expected to be found, if necessary. Commercial and sports fishing, as well as many other water-related activities, might be restricted. The consequences would, therefore, be largely economic or social, rather than radiological.

The PNPP site is located on the southern shore of Lake Erie. Groundwater at the site exists mainly in lacustrine soils which are of low permeability.

Glacial tills underlying the lacustrine soil are essentially impermeable. There is no groundwater usage which could be affected by contamination at the plant.

All of the reactors considered in the LPGS were Westinghouse PWRs with ice condenser containments. There are likely to be significantly different mechanisms and probabilities of releases of radioactivity for the PNPP BWRs. No known studies indicate the probabilities or magnitudes of liquid releases for BWRs; it is unlikely, however, that the liquid release for a BWR would be any larger than that conservatively estimated for similarly sized PWRs in the LPGS. The radionuclide inventory used for the analysis was adjusted upward by a factor of 1.045 of the LPGS reactor inventory to account for the slightly higher thermal power rating of the PNPP. Both a "prompt" release of radioactivity from contaminated suppression pool water and a leach release ("delayed release") from contact of the core debris with the groundwater were considered in the analysis. The prompt release was scaled directly from the PWR/7 release scenario considered in the LPGS. The leach release or delayed release would be the most probable BWR liquid pathway event. The applicant considered highly conservative instantaneous leaching of the radioactivity in the core debris. The LPGS analyses were based on a wide range of core debris leaching rates, most of which amounted to much smaller total releases from the debris than would be the case with either an instantaneous leach or a prompt liquid release.

The PNPP site has an underdrain system that is used to lower the water table below the basemat. Water is pumped from the underdrain and discharged to Lake Erie. There is a provision, however, for unpumped drainage via the gravity system if the water table rises above a certain level because of pump failure. Radioactivity released from a core-melt accident could contaminate the underdrain system, and subsequently be released to Lake Erie through the unpumped gravity flow. Unintentionally pumped discharge of radioactively contaminated water is highly unlikely because inline-type radiation monitors located in the underdrain discharge line will automatically stop the underdrain pumps upon detection of high radioactivity. The underdrain system is the most likely pathway for the transport of contaminated water released from the plant, since the natural materials underlying the site are of low permeability. The mode of this groundwater transport differs from that at most other nuclear plants where groundwater flow through the rocks and soils underneath the plant would be the mechanism by which contaminated water could reach the biosphere. The presence of the dewatering system and how it would be operated after the hypothetical accident would significantly affect the pathway analyses. The applicant, with the staff's guidance, considered three modes of operation of the underdrain:

Mode 1 Underdrain operating in passive mode only. No administrative action is required for the scenario other than turning off the pumps.

Mode 2 Same as Mode 1, but stand pipes connecting the plant buildings to the underdrain would be manually opened, permitting additional storage volume for contaminated groundwater.

Mode 3 Underdrain totally closed by physically sealing the connecting tunnels with concrete or installing control devices.

The underdrain system under normal operating conditions lowers the water table to below elevation 568 ft U.S. Geological Survey (USGS) Datum.* With the underdrain pumps turned off, contaminated water in the underdrain would not escape until the water level has reached 582.6 ft, USGS, which is the elevation of the gravity discharge invert. The applicant conservatively estimated that groundwater would recharge the underdrain at a rate of about 1.8 l/m (0.5 gpm). The staff concurs in this estimate. The available storage volume in the porous concrete between the 568 and 582.6 ft USGS levels is approximately 6.44×10^6 l (1.7×10^6 gal), which is greater than the volume of assumed contaminated suppression pool water. Therefore, the underdrain system would conservatively not fill to capacity for about 6.6 years. If the Mode 2 operation were available, the storage volumes of the underdrain and connecting plant buildings would be about 3.8×10^7 l (10^7 gal), which would indicate a filling time before overflow of about 39 years.

If sealing of the underdrain under Mode 3 were chosen, the only pathway for contaminated water to reach the lake would be through groundwater seepage. The very impermeable nature of the soils under the plant, coupled with their high sorptive capacities, virtually eliminates the possibility of contamination through groundwater seepage. Therefore, only Mode 1 and 2 operation will be considered for further discussion.

It has been demonstrated for the LPGS cases that for holdup times on the order of years, virtually all of the liquid pathway population doses come from Cs-137 and Sr-90. Therefore, the population dose estimates for the PNPP site consider only these two isotopes.

Contaminated debris or water entering the underdrain system would mix with other water in the underdrain, and would be adsorbed onto the porous concrete to a degree. Continued seepage of groundwater into the underdrain would displace the contaminated water which ultimately would be transported toward Lake Erie. It is assumed for the purpose of this analysis that nothing would be done to stop the contaminated water from entering Lake Erie.

Because of the unquantified properties of mixing and sorption in the underdrain, it is difficult to estimate the fraction of Cs-137 or Sr-90 which would ultimately enter the lake. The applicant estimated that 67% of the Sr-90 and 69% of the Cs-137 would be released from the underdrain under Mode 1 operation. For Mode 2 operation, 9.5% of the Sr-90 and 11% of the Cs-137 would be released from the augmented underdrain system. This compares with 87% Sr-90 release and 31% Cs-137 release determined for the LPGS case. The staff has considered the bases for the applicant's estimates for release from the underdrain and considers them to be conservative.

Doses to the population using Lake Erie, Lake Ontario, the Niagara River, and the St. Lawrence River were estimated from drinking water usage, swimming, shoreline exposure, and fish consumption. Both the near-field and far-field concentrations were taken into account. For each pathway, scaling factors were assigned for source strength, transport to the lake, transport within the lake, and population affected. Table 5.10 summarizes the scaling factors for each

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*USGS Datum: mean sea level, mean tide, New York City; equal to International Great Lakes Datum plus 1.9 ft.

Table 5.10 Summary of scaling multipliers for PNPP and LPGS site comparisons

Pathway consideration	Scaling factor PNPP/LPGS	Basis for factor
Source term	1.045	Higher thermal power for PNPP reactor.
Transport from site to lakes		PNPP site holdup in underdrain as compared with LPGS holdup in groundwater pathway.
Mode 1 operation	2.23 Cs-137 0.77 Sr-90	
Mode 2 operation	0.35 Cs-137 0.11 Sr-90	
Far-field transfer from lake to population		Consideration of Lake Erie and Lake Ontario in series for PNPP case, whereas LPGS considered only Lake Ontario.
Lake Erie	0.23 Cs-137 0.91 Sr-90	Physical parameter values taken from NUREGs-0440 and -1596.
Lake Ontario	0.038 Cs-137 0.47 Sr-90	NUREG/CR-1596.
Near-field transfer in lake	0.28	Drinking water users for PNPP site are relatively farther away or less affected because of prevailing lake current.
Population usage factors		
Drinking water	2.09 near field 1.65 Lake Erie 0.41 Lake Ontario	Higher population in Lake Erie Basin and lower in Lake Ontario Basin than LPGS case. Higher population in near field for Perry.
Aquatic food	1.0 near field 1.25 Lake Erie 0.25 Lake Ontario	Larger fish catch in Lake Erie and smaller in Lake Ontario than LPGS. Assumed same in near field.
Shoreline exposure	0.32 near field 0.32 Lake Erie 0.07 Lake Ontario	Smaller population affected in Lake Erie and Lake Ontario than LPGS case.
Swimming exposure	0.22 near field 0.22 Lake Erie 0.04 Lake Ontario	Smaller population affected in Lake Erie and Lake Ontario than LPGS case.

component of the population dose. The bases for these factors are in Perez. The staff has reviewed the bases and has determined that the factors chosen are either reasonable or conservative.

The relative population dose consequences for Mode 1 and 2 dewatering system operation are summarized in Table 5.11. The estimated doses from Table 5.11 demonstrate that the liquid pathway contribution to risk from a core meltdown release at the PNPP site are of the same order of magnitude or smaller than that predicted for the LPGS Great Lakes site. Thus the PNPP site is not unique in its liquid pathway contribution to risks.

Finally, there are measures which could be taken to minimize the impact of the releases. The conservatively estimated 6.6-year minimum time for the underdrain to fill would afford adequate time for such measures as Mode 2 or Mode 3 modifications to the underdrain system. The underdrain system, in fact, might be operated to collect contaminated groundwater and treat it to remove the radioactivity and therefore could represent a positive feature of the site in the event of a core-melt accident.

5.9.4.1.4.6 Risk Considerations

The foregoing discussions have dealt with both the frequency (or likelihood of occurrence) of accidents and their impacts (or consequences). Because the ranges of both factors are quite broad, it is useful to combine them to obtain average measures of environmental risk. Such averages can be particularly instructive as an aid to the comparison of radiological risks associated with accident releases and with normal operational releases.

A common way in which this combination of factors is used to estimate risk is to multiply the probabilities by the consequences. The resultant risk is then expressed as a number of consequences expected per unit of time. Such a quantification of risk does not at all mean that there is universal agreement that people's attitudes about risk, or what constitutes an acceptable risk, can or should be governed solely by such a measure. At best, it can be a contributing factor to a risk judgment, but not necessarily a decisive factor.

Table 5.11 Relative population doses for PNPP site core-melt accident by pathway

Event	Ratio PNPP/LPGS dose
Prompt release underdrain in Mode 1	0.62
Delayed release underdrain in Mode 1	1.20*
Prompt release underdrain in Mode 2	0.099
Delayed release underdrain in Mode 2	0.170*

*Note, however, that for realistic leach rates, the consequences of the delayed release were shown in NUREG-0440 to be much smaller than those of the prompt release.

Table 5.12 shows average values of risk associated with population dose, early fatalities, latent fatalities, and costs for early evacuation and other protective actions. These average values are obtained by summing the probabilities multiplied by the consequences over the entire range of the distributions. Since the probabilities are on a per-reactor-year basis, the averages shown are also on a per-reactor-year basis.

The population exposure risk due to accidents may be compared with that for normal operations. These are shown in Section 5.9.3, for one PNPP reactor. The radiological dose to the population from normal operation may result in about 28 person-rems per year which may result in about 0.004 latent cancer in the exposed population.

There are no early fatality nor economic risks associated with protective actions and decontamination for normal releases; therefore, these risks are unique for accidents. For perspective and understanding of the meaning of the early fatality risk of about 0.00002 per year, however, it can be noted that to a good approximation the population at risk is that within about 10 mi of the Plant, about 80,000 persons in the year 2000. Accidental fatalities per year for a population of this size, based upon overall averages for the United States, are approximately 18 for motor vehicle accidents, 6 from falls, 2 from drowning, 2 from burns, and 1 from firearms (CONAES p. 577). The early fatality risk of 0.000016 per reactor year is thus a very small fraction of the total risk embodied in the above-considered accident modes.

Figure 5.9 shows the calculated risk expressed as whole-body dose to an individual from early exposure as a function of the distance from the plant within the plume exposure pathway EPZ. The values are on a per-reactor-year basis and all accident sequences and sequence groups in Table 5.7 contributed to the dose, weighted by their associated probabilities.

Table 5.12 Average values of environmental risks due to accidents, per reactor-year

Risk	Value
Population exposure	
Person-rems within 50 miles	69
Person-rem total	470
Early fatalities	0.000016
Latent cancer fatalities	
All organs excluding thyroid	0.025
Thyroid only	0.0035
Cost of protective actions and decontamination	$7,300

NOTE: See Section 5.9.4.1.4.7 for discussions of uncertainties in risk estimates.

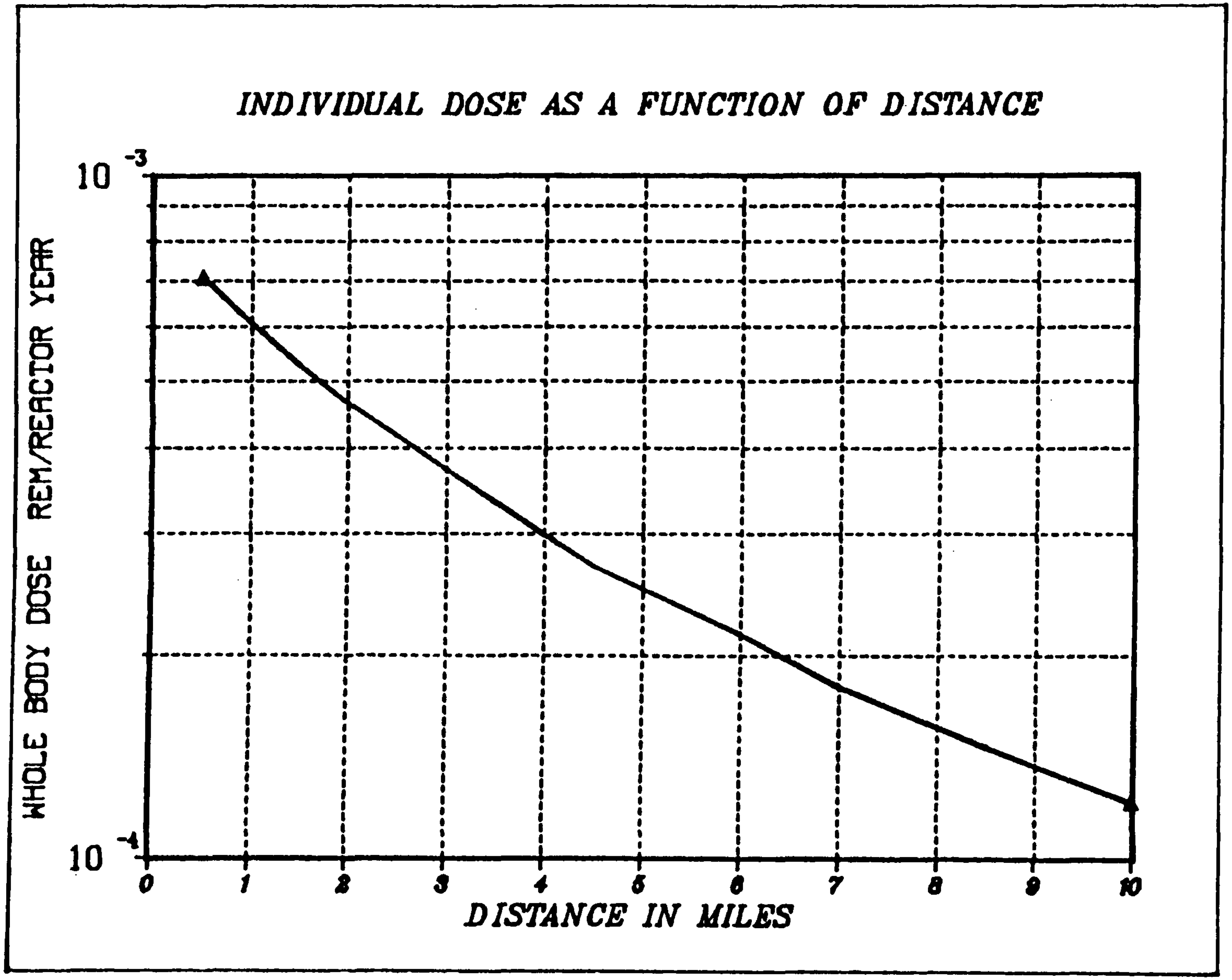

Figure 5.9 Calculated risk as whole-body dose to an individual from early exposure as a function of distance

Evacuation and other protective actions reduce the risks to an individual of early and latent cancer fatalities. Figure 5.10 shows curves of constant risk per reactor-year of early fatality to an individual within the 16-km (10-mi) radius plume exposure pathway EPZ as functions of distance due to potential accidents in the reactors. Figure 5.11 shows curves of constant risk per reactor-year to an individual living within the plume exposure pathway EPZ of death from latent cancer. Directional variation of these curves reflects the variation in the average fraction of the year the wind would be blowing in different directions from the plant. For comparison the following risks of fatality per year to an individual living in the United States may be noted (CONAES p. 577); automobile accident 2.2×10^{-4}, falls 7.7×10^{-5}, drowning 3.1×10^{-5}, burning 2.9×10^{-5}, and firearms 1.2×10^{-5}.

The economic risk associated with protective actions and decontamination could be compared with property damage costs associated with alternative energy generation technologies. The use of fossil fuels, coal or oil, for example, would emit substantial quantities of sulfur dioxide and nitrogen oxides into the atmosphere, and, among other things, lead to environmental and ecological damage through the phenomenon of acid rain (CONAES p. 559-60). This effect has not, however, been sufficiently quantified to draw a useful comparison at this time.

There are other economic impacts and risk that can be monetized that are not included in the cost calculations discussed in Section 5.9.4.1.4.4. These are accident impacts on the facility itself that result in added costs to the public (ratepayers, taxpayers, and/or shareholders). These costs would be for decontamination and repair or replacement of the facility, and replacement power. Experience with such costs is currently being accumulated as a result of the Three Mile Island accident. If an accident occurs during the first full year of PNPP Unit 1 operation (1985), the economic penalty associated with the initial year of the unit's operation is estimated at between $950 and $1600 million (Comptroller General) for decontamination and restoration, including replacement of the damaged nuclear fuel. For purposes of this analysis, staff used the conservative (high) estimate of $1600 million and in addition assumed the total cost occurs during the first year of the accident. In reality the costs would be spread over several years thereafter. Although insurance would cover $300 million of the $1600 million, the insurance is not credited against the $1600 million because the $300 million times the risk probability should theoretically balance the insurance premium. In addition, staff estimates additional fuel costs of $173 million (1985 dollars) for replacement power during each year the plant is being restored. This estimate assumes that the 75% of the energy that would have been forthcoming from PNPP Unit 1 (assuming 60% factor) will be replaced by coal-fired generation and 25% by oil-fired generation in the Ohio-Pennsylvania area. Assuming the nuclear unit does not operate for 8 years, the total additional replacement power costs would be approximately $1400 million in 1985 dollars.

If the probability of sustaining a total loss of the original facility is taken as the sum of the occurrences of a core-melt accident (the sum of the probabilities for the categories in Table 5.8), then the probability of a disabling accident happening during each year of the unit's service life is 2.43×10^{-5}. Multiplying the previously estimated costs of $3000 million for an accident to PNPP Unit 1 during the initial year of its operation by the above 2.43×10^{-5}

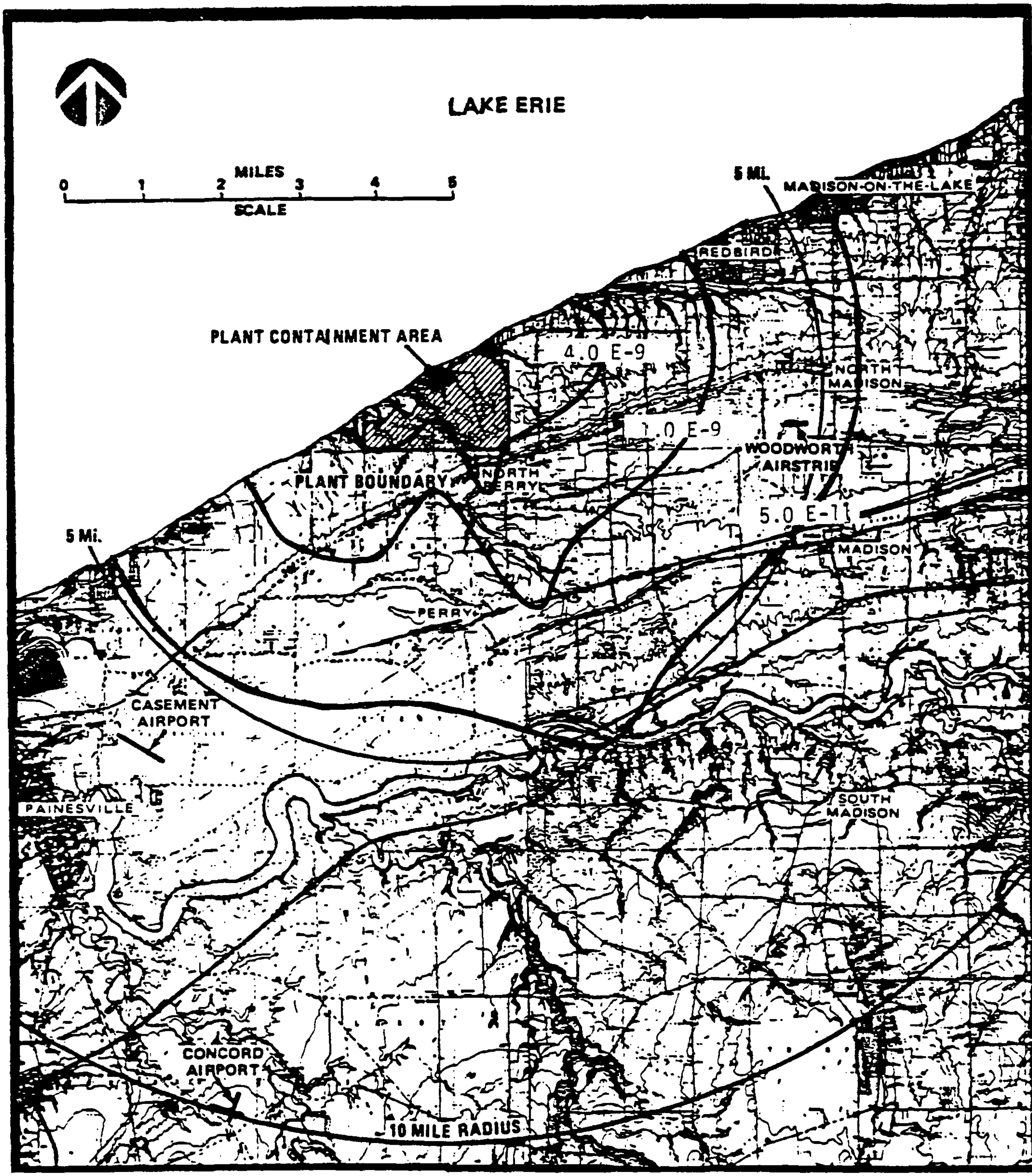

Figure 5.10 Isopleths of risk of early fatality per reactor-year to an individual

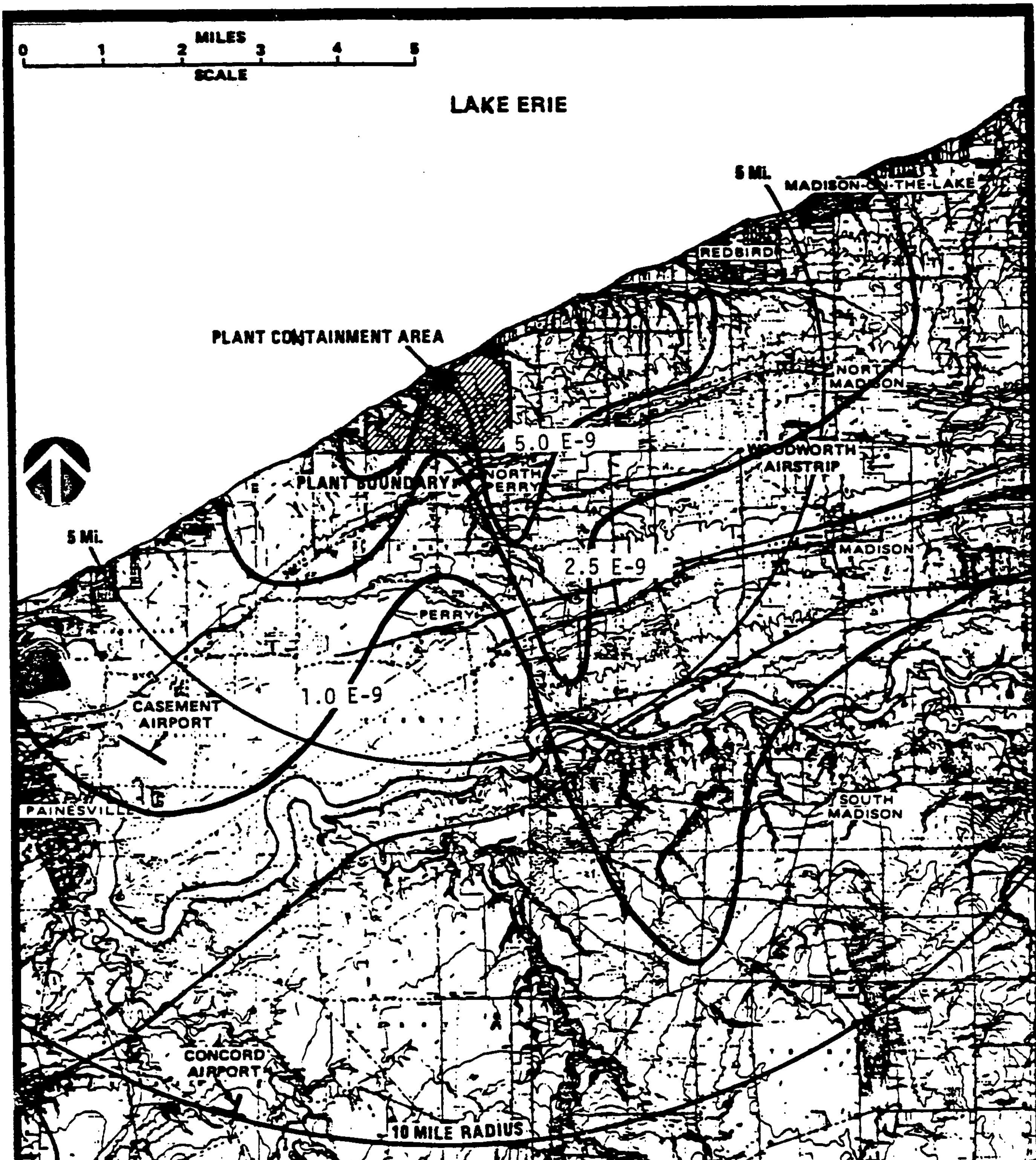

Figure 5.11 Isopleths of risk of latent cancer fatality per reactor-year to an individual

probability results in an economic risk of approximately $73,000 (in 1985 dollars) applicable to PNPP Unit 1 during its first year of operation. This is also approximately the economic risk (in 1985 dollars) to PNPP Unit 1 during the second and each subsequent year of its operation. Although nuclear units depreciate in value and may operate at reduced capacity factors so that the economic consequences due to an accident become less as the units become older, this is considered to be offset by higher costs of decontamination and restoration of the units in the later years due to inflation.

The economic risk to PNPP Unit 2 (in 1985 dollars) is also approximately $73,000 during its first year and each subsequent year of operation due to the balancing effect of escalation and the present worth discount factor. The $73,000 annual risk for each unit in 1985 dollars is equivalent to a $45,000 annual risk in 1980 dollars, assuming a 10% discount rate.

In Section 5.9.4.1.1.2, the staff recognized that fallout of radioactivity released to the atmosphere on open bodies of water could lead to radiation exposure to humans via a liquid pathway. The staff has not made a separate analysis of such consequences and risks from atmospheric fallout of radionuclides on the Great Lakes and runoff to the lakes as a result of severe accidents in the PNPP Units 1 and 2 reactors. However, as noted in Section 5.9.4.1.4.4, the staff has made a detailed analysis of these types of consequences and risks for the Fermi Unit 2 reactor, which is situated on the western end of Lake Erie. Four exposure pathways originating from contamination of the Great Lakes by fallout from the Fermi 2 reactor were analyzed: consumption of drinking water, consumption of fish, swimming, and shoreline usage (NUREG-0769, Add. 1). (The Fermi analysis is Addendum No. 1 to the Final Environmental Statement related to the operation of the Enrico Fermi Atomic Power Plant, Unit No. 2.) This Addendum shows that the unmitigated consequences and risks from the atmospheric fallout on the Great Lakes as a result of accidents in the Fermi 2 reactor would be dominated by those arising from the fish consumption pathway subsequent to contamination of Lake Erie, which is largely due to its proximity to the Fermi 2 site. This is also the staff's conclusion relative to each of the PNPP reactors.

The consequences and risks derived for the contamination of Lake Erie as a result of atmospheric fallout from severe accidents in the Fermi 2 reactor would be applicable to each of the PNPP reactors after simple adjustments are made. Adjustments are necessary because

(1) The power level of each PNPP unit is about 10% higher than that of the Fermi 2 reactor (that is, there is a 10% higher release magnitude of radionuclides for a PNPP unit).

(2) The radial spans of Lake Erie relative to the PNPP site (which is on the southern shore of the lake) are shorter than the radial span of the lake relative to the Fermi 2 site (which is on the western end of the lake). This would lower the magnitude of the fallout on the lake if a release were to occur when the wind is blowing towerd the lake.

(3) The larger angular span of Lake Erie relative to the PNPP site results in a higher probability of wind blowing toward the lake from the Perry site. The difference in prevailing winds increases the likelihood of fallout.

The first two of the factors noted above produce a combined adjustment factor of about unity (1.0). This implies that, given the release from a severe accident sequence in a PNPP reactor (such as $TC\gamma'$, the dominant accident sequence in Table 5.8 and the sequence used in the Fermi 2 analysis), with the wind blowing toward Lake Erie, the lake would be contaminated to the same extent as it would be by the release from the same sequence in the Fermi 2 reactor with the wind blowing toward the lake. Therefore, the dose to an individual and the societal consequences of population exposure, such as delayed cancer fatalities from unrestricted use of Lake Erie after contamination by atmospheric fallout from each PNPP reactor, would be the same order of magnitude as calculated in the supplement to the Fermi 2 FES.

However, there is a factor of about 2 higher for the probability of the wind blowing from the PNPP site toward Lake Erie relative to that of wind blowing from the Fermi 2 site toward the lake. Therefore, the risks of latent cancer fatality to an individual and society from unrestricted use of Lake Erie contaminated by fallout from a PNPP reactor would be about twice these risks from the Fermi 2 reactor.

The consequences and risks to society and an individual of delayed cancer fatalities from unrestricted (without any decontamination or interdiction of exposure pathways) use of Lake Erie contaminated by fallout from atmospheric releases from each PNPP reactor would be of the same orders of magnitude as those resulting from the exposure pathways from the air and ground contamination following these releases shown in Tables 5.9 and 5.12 and Figure 5.11. These latter consequences and risks were calculated only after exposure pathways interdiction or decontamination was assumed. If similar interdiction of or decontamination in exposure pathways arising from Lake Erie and the other Great Lakes were assumed, then the consequences and risks from fallout on the Great Lakes would be negligible compared with those from air and ground contamination.

5.9.4.1.4.7 Uncertainties

The foregoing probabilistic and risk assessment discussion has been based upon the methodology presented in the RSS, which was published in 1975 (NUREG-75/014). There are substantial uncertainties associated with the numerical estimates of the likelihood, as well as the consequences of, severe reactor accidents that are evaluated using this methodology.

In the consequence calculations, uncertainties arise from an oversimplified analysis of the magnitude and timing of the fission-product release, from uncertainties in calculated energy release, from radionuclide transport from the core to the receptor, from lack of precise dosimetry, and statistical variations of health effects. Recent investigations of accident source terms, for example, have shown that a number of physical phenomena affecting fission product transport through the primary cooling system and the reactor containment have been neglected. Some of these processes have the potential for substantially reducing the quantity of fission products predicted to be released from the containment for some accident sequences. Such a reduction in the source term would result in substantially lower estimates of health effects, particularly the estimate of early fatalities.

One area given considerable recent thought, with respect to uncertainty, is atmospheric dispersion. Although recent developments in the area of atmospheric

dispersion modeling used in CRAC (the computer code developed in the RSS) indicates that an improved meteorological sampling scheme would reduce the uncertainties arising from this source (including the effect of washout by precipitation), large uncertainties would still remain in the calculations of radionuclide concentrations in the air and the ground from which radiological exposures to an individual and the population are calculated. These uncertainties arise from lack of precise knowledge about the particle size distribution of the radionuclides released in particulate forms and about their chemical behavior. Therefore, the parameters of particulate deposition which exert considerable influence on the calculated results have uncertain values. The vertical rise of the radioactive plume is dependent on the heat and momentum associated with the release categories, and calculations of both factors have considerable uncertainty. The duration of release which determines the cross-wind spread of the plume is another example of considerable uncertainty. Warning time before evacuation also has considerable impact on the effectiveness of offsite emergency response; and this parameter is not precisely calculated because of its dependence on other parameters (e.g., time of release) which are not precisely known.

The state of the art for quantitative evaluation of the uncertainties in the probabilistic risk analysis such as the type presented here is not well developed. Therefore, although the staff has made a reasonable analysis of the risks presented herein, there are large uncertainties associated with the results shown. It is the judgment of the staff that the uncertainty bounds could be well over a factor of 10, but are not likely to be so large as a factor of 100.

The accident at Three Mile Island occurred in March 1979 at a time when the accumulated experience record was about 400 reactor years. It is of interest to note that this was within the range of frequencies estimated by the RSS for an accident of this severity (CONAES p. 533). It should also be noted that the Three Mile Island accident has resulted in a very comprehensive evaluation of reactor accidents like that one, by a significant number of investigative groups both within NRC and outside of it. Actions to improve the safety of nuclear power plants have come out of these investigations, including those from the President's Commission on the Accident at Three Mile Island, and NRC staff investigations and task forces. A comprehensive "NRC Action Plan Developed as a Result of the TMI-2 Accident" (NUREG-0660, Vol. I, May 1980) collects the various recommendations of these groups and describes them under the subject areas of: Operational Safety; Siting and Design; Emergency Preparedness and Radiation Effects; Practices and Procedures; and NRC Policy, Organization and Management. The action plan presents a sequence of actions, some already taken, that will result in a gradually increasing improvement in safety as individual actions are completed. The PNPP units are receiving and will receive the benefit of these actions on the schedule indicated in NUREG-0660. The improvement in safety from these actions has not been quantified, however, and the radiological risk of accidents discussed in this chapter does not reflect these improvements.

5.9.4.1.5 Conclusions

The foregoing sections consider the potential environmental impacts from accidents at the PNPP. These have covered a broad spectrum of possible accidental releases of radioactive materials into the environment by atmospheric and

groundwater pathways. Included in the considerations are postulated design-basis accidents and more severe accident sequences that lead to a severely damaged reactor core or core melt.

The environmental impacts that have been considered include potential radiation exposures to individuals and to the population as a whole, the risk of near- and long-term adverse health effects that such exposures could entail, and the potential economic and societal consequences of accidental contamination of the environment. These impacts could be severe, but the likelihood of their occurrence is judged to be small. This conclusion is based on (1) the fact that considerable experience has been gained with the operation of similar facilities without significant degradation of the environment; (2) that, in order to obtain a license to operate PNPP, it must comply with the applicable Commission regulations and requirements; and (3) a probabilistic assessment of the risk based upon the methodology developed in the Reactor Safety Study. The overall assessment of environmental risk of accidents shows that it is roughly comparable to the risk for normal operational releases although accidents have a potential for early fatalities and economic costs that cannot arise from normal operations. The risks of early fatality from potential accidents at the site are small in comparison with the risks of early fatality from other human activities in a comparably sized population.

The staff has concluded that there are no special or unique features about the PNPP site and environs that would warrant special mitigation features for PNPP Units 1 and 2.

5.10 Impacts from the Uranium Fuel Cycle

The uranium fuel cycle rule, 10 CFR 51.20 (44 FR 45362), reflects the latest information relative to the reprocessing of spent fuel and to radioactive waste management as discussed in NUREG-0116, "Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle," and NUREG-0216, which presents staff responses to comments on NUREG-0116. The rule also considers other environmental factors of the uranium fuel cycle, including aspects of mining and milling, isotopic enrichment, fuel fabrication, and management of low- and high-level wastes. These are described in the AEC report WASH-1248, "Environmental Survey of the Uranium Fuel Cycle." The NRC staff was also directed to develop an explanatory narrative that would convey in understandable terms the significance of releases in the table. The narrative was also to address such important fuel cycle impacts as environmental dose commitments and health effects, socioeconomic impacts and cumulative impacts, where these are appropriate for generic treatment. This explanatory narrative was published in the Federal Register on March 4, 1981 (46 FR 15154-15175). Appendix C to this report contains a number of sections that address those impacts of the LWR-supporting fuel cycle that reasonably appear to have significance for individual reactor licensing sufficient to warrant attention for NEPA purposes.

Table S-3 of the final rule is reproduced in its entirety as Table 5.13. Specific categories of natural resource use included in the table relate to land use, water consumption and thermal effluents, radioactive releases, burial of transuranic and high- and low-level wastes, and radiation doses from transportation and occupational exposures. The contributions in the table for reprocessing, waste management, and transportation of wastes are maximized for either

Table 5.13 (Summary Table S-3) Uranium-fuel-cycle environmental data[1]

[Normalized to model LWR annual fuel requirement [WASH-1248] or reference reactor year [NUREG-0116]]

Environmental considerations	Total	Maximum effect per annual fuel requirement or reference reactor year of model 1,000 MWe LWR
NATURAL RESOURCES USE		
Land (acres):		
Temporarily committed [2]	100	
Undisturbed area	79	
Disturbed area	22	Equivalent to a 110 MWe coal-fired power plant.
Permanently committed	13	
Overburden moved (millions of MT)	2.8	Equivalent to 95 MWe coal-fired power plant.
Water (millions of gallons):		
Discharged to air	160	=2 percent of model 1,000 MWe LWR with cooling tower
Discharged to water bodies	11,090	
Discharged to ground	127	
Total	11,377	<4 percent of model 1,000 MWe LWR with once-through cooling.
Fossil fuel:		
Electrical energy (thousands of MW-hour)	323	<5 percent of model 1,000 MWe LWR output
Equivalent coal (thousands of MT)	118	Equivalent to the consumption of a 45 MWe coal-fired power plant.
Natural gas (millions of scf)	135	<0.4 percent of model 1,000 MWe energy output.
EFFLUENTS—CHEMICAL (MT)		
Gases (including entrainment): [3]		
SO_x	4,400	
NO_x [4]	1,190	Equivalent to emissions from 45 MWe coal-fired plant for a year.
Hydrocarbons	14	
CO	29.6	
Particulates	1,154	
Other gases.		
F	.67	Principally from UF_6 production enrichment, and reprocessing. Concentration within range of state standards—below level that has effects on human health.
HCl	.014	
Liquids:		
SO^-_4	9.9	From enrichment, fuel fabrication, and reprocessing steps. Components that constitute a potential for adverse environmental effect are present in dilute concentrations and receive additional dilution by receiving bodies of water to levels below permissible standards. The constituents that require dilution and the flow of dilution water are:
NO^-_3	25.8	
Fluoride	12.9	
Ca^{++}	5.4	
Cl^-	8.5	
Na^+	12.1	
NH_3	10.0	
Fe	.4	
		NH_3—600 cfs.
		NO_3—20 cfs.
		Fluoride—70 cfs.
Tailings solutions (thousands of MT)	240	From mills only—no significant effluents to environment.
Solids	91,000	Principally from mills—no significant effluents to environment.

Table 5.13 (Summary Table S-3) (Continued)

[Normalized to model LWR annual fuel requirement [WASH-1248] or reference reactor year [NUREG-0116]]

Environmental considerations	Total	Maximum effect per annual fuel requirement or reference reactor year of model 1,000 MWe LWR
EFFLUENTS—RADIOLOGICAL (CURIES)		
Gases (including entrainment):		
Rn-222		Presently under reconsideration by the Commission.
Ra-226	.02	
Th-230	.02	
Uranium	.034	
Tritium (thousands)	18.1	
C-14	24	
Kr-85 (thousands)	400	
Ru-106	.14	Principally from fuel reprocessing plants.
I-129	1.3	
I-131	.83	
Tc-99		Presently under consideration by the Commission.
Fission products and transuranics	.203	
Liquids:		
Uranium and daughters	2.1	Principally from milling—included tailings liquor and returned to ground—no effluents; therefore, no effect on environment.
Ra-226	.0034	From UF_6 production
Th-230	.0015	
Th-234	.01	From fuel fabrication plants—concentration 10 percent of 10 CFR 20 for total processing 26 annual fuel requirements for model LWR
Fission and activation products	5.9×10^{-6}	
Solids (buried on site):		
Other than high level (shallow)	11,300	9,100 Ci comes from low level reactor wastes and 1,500 Ci comes from reactor decontamination and decommissioning—buried at land burial facilities. 600 Ci comes from mills—included in tailings returned to ground. Approximately 60 Ci comes from conversion and spent fuel storage. No significant effluent to the environment.
TRU and HLW (deep)	1.1×10^{7}	Buried at Federal Repository
Effluents—thermal (billions of British thermal units)	4,063	<5 percent of model 1,000 MWe LWR
Transportation (person-rem):		
Exposure of workers and general public	2.5	
Occupational exposure (person-rem)	22.6	From reprocessing and waste management

[1] In some cases where no entry appears it is clear from the background documents that the matter was addressed and that, in effect, the Table should be read as if a specific zero entry had been made. However, there are other areas that are not addressed at all in the Table. Table S-3 does not include health effects from the effluents described in the Table, or estimates of releases of Radon-222 from the uranium fuel cycle or estimates of Technetium-99 released from waste management or reprocessing activities. These issues may be the subject of litigation in the individual licensing proceedings.

Data supporting this table are given in the "Environmental Survey of the Uranium Fuel Cycle," WASH-1248, April 1974; the "Environmental Survey of the Reprocessing and Waste Management Portion of the LWR Fuel Cycle," NUREG-0116 (Supp. 1 to WASH-1248), the "Public Comments and Task Force Responses Regarding the Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle," NUREG-0216 (Supp. 2 to WASH-1248), and in the record of the final rulemaking pertaining to Uranium Fuel Cycle Impacts from Spent Fuel Reprocessing and Radioactive Waste Management, Docket RM-50-3. The contributions from reprocessing, waste management and transportation of wastes are maximized for either of the two fuel cycles (uranium only and no recycle). The contribution from transportation excludes transportation of cold fuel to a reactor and of irradiated fuel and radioactive wastes from a reactor which are considered in Table S-4 of § 51.20(g). The contributions from the other steps of the fuel cycle are given in columns A-E of Table S-3A of WASH-1248.

[2] The contributions to temporarily committed land from reprocessing are not prorated over 30 years, since the complete temporary impact accrues regardless of whether the plant services one reactor for one year or 57 reactors for 30 years.

[3] Estimated effluents based upon combustion of equivalent coal for power generation.

[4] 1.2 percent from natural gas use and process.

of the two fuel cycles (uranium only and no recycle); that is, the cycle that results in the greater impact is used.

Appendix C to this report contains a description of the environmental impact assessment of the uranium fuel cycle as related to the operation of the PNPP facility. The environmental impacts are based on the values given in Table S-3, and on an analysis of the radiological impact from radon-222 and technetium-99 releases. The NRC staff has determined that the environmental impact of this facility on the U.S. population from radioactive gaseous and liquid releases (including radon and technetium) due to the uranium fuel cycle is very small when compared with the impact of natural background radiation.

In addition, the nonradiological impacts of the uranium fuel cycle have been found to be acceptable.

5.11 Decommissioning

The purpose of decommissioning is to safely remove nuclear facilities from service and to remove or isolate the associated radioactivity from the environment so that part of the facility site that is not permanently committed can be released for other uses. Alternative methods of accomplishing this purpose and the environmental impacts of each method are discussed in NUREG-0586.

Since 1960, 68 nuclear reactors, including 5 licensed reactors that had been used for the generation of electricity, have been or are in the process of being decommissioned. Although to date no large commercial reactor has undergone decommissioning, the broad base of experience gained from smaller facilities is generally relevant to the decommissioning of any type of nuclear facility.

Radiation doses to the public, as a result of decommissioning activities, at the end of commercial power reactor's useful life, should be small and will come primarily from the transportation of waste to appropriate repositories. Radiation doses to decommissioning workers should be well within the occupational exposure limits imposed by regulatory requirements.

The NRC is currently conducting a generic rulemaking that will develop a more explicitly overall policy for decommissioning commercial nuclear facilities. Specific licensing requirements are being considered that include the development of decommissioning plans and financial arrangements for decommissioning nuclear facilities.

Estimates of the economic cost of decommissioning are provided in Section 6 of this Statement.

5.12 Emergency Planning

Emergency preparedness facilities will be established by the applicant to meet the Commission's upgraded emergency planning requirements contained in Appendix E to 10 CFR 50, "Emergency Planning and Preparedness for Production and Utilization Facilities." A technical support center located in the basement of the service building will accommodate 25 persons. An emergency operations facility (EOF) will be set up in a new training center, which will be built within the site boundary across the relocated Center Road from the present visitors center. The EOF will accommodate 30 persons. Any construction

involved with these facilities will not cause disturbances to the area any larger than those previously evaluated for construction of the plant. An off-site backup EOF will be designated in accordance with the requirements of NUREG-0696.

5.13 References

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6 EVALUATION OF THE PROPOSED ACTION

6.1 Unavoidable Adverse Impacts

The staff has reassessed the physical, social, biological, and economic impacts that can be attributed to the future operation of the PNPP, Units 1 and 2. With the exception of a reanalysis of the impacts of the cooling system as a result of the change from once-through to closed-cycle cooling and a reanalysis of the effect of accidents, these impacts are, for the most part, as stated in Section 5 of the FES-CP. Actions taken by the applicant since the FES-CP stage have resulted in adequate mitigation of future operating impacts. The staff's benefit-cost summary of the residual impacts is presented in Table 6.1.

6.2 Irreversible and Irretrievable Commitments of Resources

The significant resource commitments were identified in detail in Section 8.5 of the FES-CP. These commitments have not changed in a significant manner since the CP review.

6.3 Relationship Between Short-Term Uses and Long-Term Productivity

This analysis appears in Section 8.4 of the FES-CP, and there have been no significant changes since the CP review.

6.4 Benefit-Cost Summary

6.4.1 Summary

Sections below summarize the economic, environmental, and socioeconomic benefits and costs which are associated with the operation of PNPP. The benefits and costs are shown in Table 6.1.

6.4.2 Benefits

A major benefit from the operation of the PNPP Units 1 and 2 is the approximately 11.6 billion kWh of baseload electrical energy that will be produced annually (this projection assumes that both units will operate at annual average capacity factors of 55%). The addition of the plant will also improve the applicant's ability to supply system load requirements by contributing 2410 MW of generating capacity to the Central Area Power Coordination (CAPCO) bulk power system.

Another benefit is the savings in overall system production costs that would result from operation of PNPP Units 1 and 2. An estimate of additional costs from delaying operation of PNPP was made by the applicant (CEI, "Operating License Environmental Report," Table 1.3-16). Fuel costs with and without PNPP Unit 1 were estimated with a computer program that viewed CAPCO as a single system. According to this analysis a 3-year delay in operating PNPP Unit 1 results in increased fuel expenditures of $263.5 million in 1984, $414.0 million in 1985, $458.1 million in 1985, $199.1 million in 1987, $43.2 million in 1988,

Table 6.1 Benefit-cost summary

Primary impact and effect on population or resources (applicable report section)	Magnitude	Staff assessment of benefit or cost*
Direct Benefit		
Electrical energy (6.4.2)	11.6 billion kWh/yr	Moderate
Capacity (6.4.2)	2410 MW	Moderate
Reduced generating costs (6.4.2)	$325 million/yr	Large
Indirect Benefit**		
Local taxes (ad valorem) (5.8.1)	Potentially $15.9-$22.9 million/yr	Large
Annual employment (5.8.1)	399 employees	Moderate
Annual payroll (5.8.1)	$10 million	Moderate
Economic Cost of Operating		
Fuel (6.4.3)	9.5 mills/kWh (initial year of operation)	Small
Operation and maintenance (6.4.3)	7 mills/kWh (initial year of operation)	Small
Decommissioning (5.11)	$29 to $58 million in January 1981 $	Small
Economic Risk of Accident		
Expected value for decontamination, repair, and replacement energy costs (5.9.4.1.4.6)	$73,000 (1985 $)	Small
Environmental Cost		
Resources committed		
Land (CP-FES 4.1)	450 ha (1100 acres)	Small
Water (5.3.1.1)	1400 l/sec	Small
Damages suffered by other water users because of		
Surface water consumption (5.3.1.1)	1400 l/sec	Small
Surface water contamination (5.3.2)	Negligible	Small
Groundwater consumption (5.3.1.2)	Minor	Small
Groundwater contamination (5.3.1.2)	No discharge	None
Damage to aquatic biota from		
Intake losses (5.5.2.1)	Minor	None
Surface water discharges - heat (5.5.2.2)	Minimal plume	None
Surface water discharges - chemical (5.3.2)	Minor	Small

See footnotes on last page of this table.

Table 6.1 (continued)

Primary impact and effect on population or resources (applicable report section)	Magnitude	Staff assessment of benefit or cost*
Damage to terrestrial resources from		
Fog (5.4.1)		Small
Drift (5.4.2.1 and 5.5.1.1)		Small
Bird impaction (5.5.1.3)		Small
Human health effect (nonradiological) from		
Air quality changes (5.4)		Small
Water quality changes (5.3.2)		Small
Human health effect (radiological) from		
Effects of reactor operation on general population (5.9.3)		Small
Effects of reactor operation on workers at site (5.9.3)		Small
Effects of balance of fuel cycle (5.10)		Small
Accident risk (5.9.4)		Small
Societal cost in terms of		
Historic and archeological resources (5.7)		Small
Noise (5.8.2)		Small
Increased demands on public facilities and services (5.8.1)		Small
Increased demands on private facilities and services (5.8.1)		Small

*The basis for the assignments of descriptors used by the staff to make judgmental comparative assessments of quantitatively incommensurable benefits and costs is as follows:

None: Absolutely none, or too small to have detectable consequences and to be estimated by a credible procedure.

Small: Benefits or costs for which impacts are of such a minor nature that based on currently available information, detailed consideration of the relevant adverse impacts or mitigative actions is not warranted.

Moderate: Benefits or costs for which the relevant impacts are likely to be clearly evident. Mitigation alternatives are usually considered for moderate adverse impacts.

Large: Major benefits or costs for which the relevant adverse impacts require careful consideration of all reasonable mitigation alternatives and, if mitigation is not feasible, must be offset by overriding project considerations.

**Indirect benefits are presented for informational purposes only and are not included in the cost-benefit balance.

$19.9 million in 1989, and $9.2 million in 1990. Furthermore, it indicates that the net difference in operation and maintenance expense over these years is relatively insignificant at less than $10 million for any year (CEI, "Operating License Environmental Report," Table 1.3-16).

The staff has also estimated production cost differentials from operating PNPP. If 100% potential generation from PNPP Unit 1 could be replaced by generation from CAPCO's coal-fired capacity, about $50 million in additional annual fuel costs would be incurred by not operating Unit 1. If 75% of potential generation were replaced from coal-fired capacity and the remaining 25% with generation from oil-fired capacity and outside purchases, then about $165 million in additional annual fuel costs would be incurred by not operating Unit 1. The cost differential for operating Unit 2 would be approximately the same. Because of an anticipated shortage of reserve margins in the CAPCO system, staff considers the higher estimates of increased costs more likely.

The staff's estimate of cost savings is significantly lower than the applicant's. This in large part can be attributed to the applicant's assumption that PNPP Unit 1 will operate at a capacity factor significantly higher than the 55% capacity factor assumed by staff. Also the staff's cost assumptions are based on January 1981 prices and do not account for any general inflation; the applicant has projected costs which do account for inflation after 1981.

6.4.3 Economic Costs

The economic costs associated with station operation include fuel costs and operating and maintenance costs, which are expected to average 9.5 mills per kWh and 7.0 mills per kWh, respectively (1981 dollars).

The staff's estimate of decommissioning costs for each PNPP unit ranges from $29 to $58 million (1981 dollars) (NUREG-0586).

6.4.4 Socioeconomic Costs

No significant socioeconomic costs are expected from the normal operation of the Plant or from the number of Plant personnel and their families living in the area. The socioeconomic impacts of possible accidents are described in Section 5.9.4.1.4. The socioeconomic impacts of a severe accident could be large; however, the probability of such an accident is small.

6.4.5 Environmental Costs

The operational environmental costs previously evaluated in the FES-CP have not significantly changed because no significant environmental costs are expected from the normal operation of the plant, including considerations of the uranium fuel cycle and Plant accidents. The economic impact of possible accidents is described in Section 5.9.4.1.4.

As a result of the analysis and review of potential environmental, technical, economic, and social impacts, the NRC staff has prepared an updated forecast of the effects of the operation of the Plant. No new information has been obtained that alters the overall balancing of the benefits of Plant operation versus the environmental costs. The staff has determined that the Plant can be operated with minimal environmental impact.

6.5 References

Cleveland Electric Illuminating Company, "Operating License Environmental Report," August 1981.

U.S. Nuclear Regulatory Commission, NUREG-0586, "Draft Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities," January 1981.

7 LIST OF CONTRIBUTORS

This environmental statement was prepared by the following people:

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R. Struckmeyer, Radiological Assessment
A. Toalston, Economic Impacts of Accidents
M. Wohl, Accident Analysis

<u>Oak Ridge National Laboratory</u>

J. Van Dyke, Purpose of and Need for Plant, Cost-Benefit

8 AGENCIES AND ORGANIZATIONS TO WHICH COPIES OF THE DRAFT ENVIRONMENTAL STATEMENT WERE SENT

Copies of the Draft Environmental Statement were sent to the following:

Advisory Council on Historic Preservation
Atomic Energy Control Board (Canada)
Department of Agriculture
Department of the Army, Corps of Engineers
Department of Commerce
Department of Energy
Department of Health and Human Services
Department of Housing and Urban Development
Department of the Interior
Department of Transportation
Environmental Protection Agency
Federal Emergency Management Agency
Great Lakes Basin Commission
International Joint Commission
Mayor, Village of Perry
Mayor, Village of Perry Township Board of Trustees
Northeast Ohio Areawide Coordinating Agency (NOACA)
Ohio Environmental Protection Agency
Ohio State Clearinghouse
Ohio Department of Environmental Resources
Ohio State Historic Preservation Officer
Pennsylvania Department of Environmental Resources

9 DISCUSSION OF COMMENTS RECEIVED ON THE DRAFT ENVIRONMENTAL STATEMENT

9.1 Background

Pursuant to 10 CFR 51.25, the Draft Environmental Statement (DES) related to the operation of the Perry Nuclear Power Plant (Perry) was transmitted with a request for comment to the agencies, councils, etc. listed in Section 8 of this Final Environmental Statement (FES). In addition, the NRC staff (the staff) asked for comments from interested persons by notice in the Federal Register on March 26, 1982 (47 FR 13067). All comments received are included in chronological order in Appendix A of this FES. The NRC responded to comments from the following Federal and State agencies, the applicant (Cleveland Electric Illuminating Company or CEI), and interested citizens, intervenors, and a Canadian group.

Russel M. Bimber (Bimber)
Patty Blubaugh (Blubaugh)
Cleveland Electric Illuminating Company (CEI)
Ohio Citizens for Responsible Energy (OCRE)
Ohio Department of Natural Resources (ODNR)
Stephen Sass (Sass)
Sunflower Alliance Inc. et al. (Sunflower)
U.S. Department of Health and Human Services (HHS)
U.S. Department of the Interior (DOI)
U.S. Environmental Protection Agency, Region V (EPA)
Western Reserve Alliance (Western)

The staff's response to the comments received from these respondents, and the disposition of the issues involved, are reflected in part by text revisions in other sections of this FES and in part by the following discussion. Comments addressed have been numbered and are identified by the use of the abbreviations indicated above and the bracketed citation of the page number in Appendix A on which the specific comment occurs. Some of the comments received suggested changes and/or corrections to the text of the DES. Where not discussed in the material that follows, these were incorporated into the text of this FES as appropriate.

The following respondents commented that the DES was acceptable as written and/or provided guidance/information to the staff for which a response was deemed to be unnecessary:

Atomic Energy Control Board of Canada
Federal Energy Regulatory Commission
Connie Kline
Ohio Office of Budget and Management, State Clearinghouse
State of Ohio Environmental Protection Agency
U.S. Department of Agriculture, Economic Research Service
U.S. Department of Agriculture, Soil Conservation Service

U.S. Department of the Army, Corps of Engineers, Ohio River Division
U.S. Environmental Protection Agency

9.2 Need for Power (Western [A-15]; OCRE 1, 2, 3 [A-33]; Bimber 5, 6, 7 [A-26])

These comments pertained directly or indirectly to questions on the need-for-power issue. In response, the NRC has determined that the need for power is fully considered at the construction permit (CP) stage of the regulatory review process, where a finding of insufficient need could factor into denial of issuance of a CP. At the operating license (OL) review stage, the proposed plant is substantially constructed and a finding of insufficient need would not, in itself, result in denial of the operating license. The NRC was further influenced by the substantial information which supports the conclusion that nuclear plants are lower in operating costs than conventional fossil plants. If conservation or other factors lowers anticipated demand, utilities remove generating facilities from service according to their cost of operation, with the most expensive facilities removed first. Thus, a completed nuclear plant would serve to substitute for less economical generating capacity. Section 2 of the DES has accordingly been rewritten to reflect this determination in this Statement.

9.2.1 Production Costs (Bimber 1 [A-25])

Bimber contends in part that the benefit-cost evaluations for Perry are often superficial, speculative, and influenced by personal corporate gain; and that Cleveland Electric Illuminating Company (CEI or the applicant) grossly overestimated the need for power and population growth prior to receiving a CP. Since receiving the CP, CEI has underestimated the need for power and population growth within the 10-mi radius (emergency planning zone or EPZ) to minimize its costs for emergency planning. Bimber argues that the 1980 Census results should be added to this planning base, and that no population projections less than a linear extrapolation from 1970 and 1980 projections should be allowed.

The staff has reviewed the population projections presented by CEI in its OL Environmental Report (OL-ER) amendments and responses to questions raised on the initial OL-ER and finds them acceptable. CEI estimated the 0-5-mi population radius based on a 1980 house count and the 5-to-10-mi population radius on 1980 Census data, and projections published by the Ohio Department of Health (Battelle Columbus Laboratories). As stated in Section 4.3.1 of the DES, the staff compared the OL-ER 1980 population projections with the 1980 Census results, where possible, and found the CEI estimates to be within 10% of the 1980 Census data. In any event, the need-for-power issues need not be addressed by operating licensees in environmental reports to the NRC per 10 CFR 51.21, 10 CFR 51.23(c), and 10 CFR 51.23(e).

9.3 Alternative Energy Sources (OCRE 4, 6 [A-33]); Bimber 7 [A-26]; Blubaugh 1 [A-7])

These comments pertain to the need to consider alternative energy sources. In response, the NRC has noted that alternative energy source issues are resolved at the CP stage of the regulatory review process, and the CP is granted only after a finding that, on balance, no obviously superior alternative to the proposed nuclear facility exists. The NRC concluded that this determination is

unlikely to change even if an alternative is shown to be marginally environmentally superior over available alternative sources. Section 3 of this Statement has been written to reflect this determination.

9.4 Cooling Systems

9.4.1 Intake System (DOI 3 [A-10, 11]; ODNR 1 [A-13, 14])

Both DOI and ODNR commented on inconsistencies in the locations of the intake and discharge structures as presented in Sections 4.2.4.1 and 4.3.3 of the DES. The staff has concluded that the locations cited in Section 4.2.4.1 are correct. The text of Section 4.3.3 of this Statement corrects that inconsistency.

9.4.2 Nonradioactive Waste Management (ODNR 2, 3 [A-14])

ODNR expressed a concern regarding the fate of the lime-phosphate sludge resulting from the cleaning of reactor flow passages, piping, and equipment as described in Section 4.2.6 of the DES. It was suggested that the staff clarify the final disposition of the sludge material. A concern was also expressed that 8300 kg/day of 93% sulfuric acid will be added to the closed-cycle system to prevent formation of scale on the condenser tubes. They consider this to be a large amount of acid and note that it is not stated in the DES if all of this amount, or just a portion of it, will be added to the secondary system. The FES should better quantify the pH of the cooling water that will be discharged to Lake Erie. Table 4.2 only specifies the limits of the National Pollutant Discharge Elimination System (NPDES) Permit, expected to be issued for the discharge effluent, and not what is actually expected.

With regard to sludge disposal, the applicant's OL-ER (page 3.6-3) indicates that the lime-phosphate sludge will be disposed of off site by a licensed waste hauler. To clarify the second concern, the daily dosage (8300 kg) of sulfuric acid will be added to the cooling tower circulating water systems. As pure water evaporates from the cooling towers, the solids left behind increase in concentration. If concentration were allowed to increase without control, solubility limits would be reached and chemicals would precipitate out of solution. Since solubilities of carbonates and sulfates (the most abundant anions) are inversely related to temperature, precipitation would occur first at the warmest point in the system--the condenser tubes. It is this "scaling" of the condensers which is to be avoided. Carbonates have the lower solubility and thus are of first concern. Concentration of carbonates can be controlled either by adjusting the blowdown and makeup rates or by adding acid to change the carbonates to carbon dioxide which is released to the atmosphere. Sulfate concentrations can only be controlled practically by adjusting blowdown and makeup rates. It is the control of solids buildup which is the necessity. The use of acid as part of the control system is an option which usually is cost effective.

The pH of the cooling tower blowdown is likely to be at or close to, the upper limit specified in the NPDES Permit because the effect of evaporation is to increase pH. Just enough acid would be added to keep pH below the level at which carbonate precipitation would occur.

9.5 Project-Related Environmental Description

9.5.1 Community Characteristics (OCRE 8 [A-35])

OCRE questions the projected population growth around Perry stated in Section 4.3.1 of the DES, and disagrees with the statement therein that Lake County will remain predominantly non-rural with slow population growth. They maintain that the eastern end of the county is currently the site of increasing commercialization which is in close proximity to the Perry Plant.

The staff finds that, according to the 1980 U.S. Census of Population and Housing, Lake County's 1980 population was 212,801 compared with a 197,200 population in 1970. These data represent a growth rate of 7.9% over the decade which results in an annual rate of 0.76%. Madison, Ohio had a 36.5% increase over the same decade giving a 1980 population of 2,291. Madison Township, Ohio had a 1980 population of 15,378 and a population of 14,133 in 1970 (an 0.85% annual rate over the decade). Therefore, the staff sees no need for any changes in the demographic descriptions for this Statement.

9.5.2 Groundwater Hydrology (Western 2 [A-15])

Western commented that wells in the Perry construction area are drying up and the water table is falling. Western commented further that erosion of the Lake Erie shoreline is increasing steadily each year.

In regard to the water table issue, the staff has found that Perry uses no groundwater for its operation. A small amount of groundwater, estimated to be less than 0.5 gpm for the site, leaks into the underdrain system and is discharged into Lake Erie. Therefore, Perry will have no measureable effect on the groundwater resources of the area. As for the shoreline erosion issue, the staff finds that the existence of Perry will have no effect on the lake shoreline. It is a natural process and is a widespread problem along the Great Lakes. There are provisions, however, to protect the plant from the effects of shoreline erosion, if safety-related structures are threatened at some future time (see Section 5.3.3 of this Statement). Section 2.5.5 of the Perry Safety Evaluation Report (NUREG-0887) states that the applicant will be required to stabilize any erosion of the Lake Erie shoreline which is the result of construction or operational activities. NUREG-0887 states in part:

> The staff concludes that adequate margins of safety exist for the shoreline bluff on a 3H:1V slope configuration for both the static and dynamic case. In the event that the toe of the bluff recedes to 250 ft of the emergency service water pumphouse, the applicant proposes, then, to initiate a slope protection design which would significantly widen the margins of safety against slope failure and encroachment of the lake toward the plant. The staff requires this to be a licensing condition in the operating license issued.

9.5.3 Water Use (Bimber 9 [A-26])

Bimber claims that the staff did not consider potable water intakes in its assessment of water used by Perry, and appears ignorant of Lake County's ownership of the former Industrial Rayon Corporation intake, and the county's plans

for this facility. The mention of very little irrigation in Section 4.3.5 of the DES overlooks the significant addition to groundwater from lakewater furnished to unsewered areas by Painesville and by Ohio Water Service as examples.

In response to this claim, the staff is aware that the former Industrial Rayon Corporation intake is now owned by Lake County and that it is being developed to serve the towns of Madison, Perry, and part of Geneva. The intake will draw about 3 million gpd and is scheduled for operation by November 1982. With respect to groundwater recharge from Public Water Supply, the staff finds that the water table in areas supplied with municipal water, but without sanitary sewers, would probably be recharged to some extent by the effluent from septic tanks.

9.5.4 Aquatic Ecology (DOI 1 [A-10])

DOI suggested that supporting data be included in the FES regarding the mean concentration of each species or taxa or larvae for each depth contour sampled in the applicant's 1974 ichthyoplankton survey.

Data used by the staff in its assessment of icthyoplankton resources of the Perry site are found in the Ichthyoplankton Study Report, dated 1975, prepared for the applicant by NUS, and referenced in the DES at the end of Section 4. The area of study bounding Perry was 3.2 km (2 mi) alongshore by 1.6 km (1 mi), and included 11 stations and 5 depth contours. This was discussed in summary form in the DES (Section 4.3.6.2), since providing a mean concentration for each of 17 taxa at five depth contours (with time) would have been cumbersome. Nonetheless, the following table (Table 9.1) summarizes the densities (number per m^3) of eggs and larvae (all species) for three depths--surface(S), middepth(M), and bottom(B)--at sampling Station F, located near the offshore intake, and the mean densities ($\bar{X}$) for all stations combined during 1974.

Table 9.1. Egg and larva densities at three Lake Erie depths vs time

	Eggs				Larvae			
Dates	S	M	B	$\bar{X}$	S	M	B	$\bar{X}$
April 11	0	0	0	0	0	0	0	0
April 26	0	-	-	0	0	-	-	0.1
May 9-11	0	-	-	0.2	0	-	-	0.1
May 19-22	0	0	0	0.3	0.6	0	0.6	0.3
June 12-16	0	0.5	0.5	0.6	5.8	35.8	16.3	16.7
June 26	0	0	0	0.4	19.9	40.0	9.3	48.3
July 12	7.7	3.8	1.0	5.8	85.3	55.8	10.0	66.1
July 26	0	0	0	0	13.4	61.6	17.0	47.6
August 21	0	0	0	<0.1	0	1.5	0.4	0.4

9.6 Water Use and Hydrology Impacts

9.6.1 Water Quality (EPA 2 [A-23]; Western 3 [A-15])

Western objects to the operation of Perry because water from the cooling plants will come from a fragile Lake Erie which is already recovering from a dying condition. Water from the cooling plants with its chemicals from routine cleanup and radioactive particulates (even in small quantities) will gradually build up to an intolerable toxic load from which the lake can never recover. This will affect the marine life necessary for its own symbiotic environment, food supply, and potability for people living in the area.

In regard to Western's concern, the staff finds that there will be no intentional discharge of a toxic substance at a toxic concentration into Lake Erie. Discharges from Perry will be regulated by the NPDES Permit Program administered by the Ohio EPA.

The EPA commented that proposed effluent discharges of nonradioactive wastes have been provided by the applicant to assess impacts on water quality. A formal application for a National Pollutant Discharge Elimination System Permit was received by the State of Ohio Environmental Protection Agency on June 21, 1982. As noted in Section 5.3.2 of the DES, the actual effluent releases will be constrained by the State of Ohio water quality standards and technology-based effluent limits established by the United States EPA. (See page A-37 in Appendix A to this Statement for further information on the NPDES Permit).

At the present time, effluent limits for steam electric generation stations have not been determined. These effluent guidelines will be ready in final form in March 1983. This Statement notes, and the applicant is aware, that these standards will apply to the Perry Plant discharge.

By inclusion of the EPA letter, NEPA-DE-NRC-F06015-OH (82036) dated May 7, 1982 (which related EPA comments on the DES) in Appendix A of this statement [A-23, -24] and discussed here, the staff concludes that this Statement serves to record the EPA's current intent. It is appropriate that the EPA and the State of Ohio advise the applicant directly of the standards which will be applied in developing effluent limits for inclusion in the NPDES Permit.

9.7 Terrestrial Ecology Impacts

9.7.1 Bird Impaction (DOI 1 [A-10])

DOI commented that Section 5.5.1.3 of the DES be expanded to include the average number of birds and species killed by identifying the dominant species of birds involved.

In response to this comment, the staff found that data provided at the referenced Davis-Besse Nuclear Power Station can be summarized as follows:

- Species composition of impacted birds remains relatively constant: warblers (70%); kinglets (12%); and red-eyed vireos (8%).

- Spring and fall migratory surveillance data of bird mortalities on cooling towers indicated that, on average, less than 200 birds collided with cooling towers.

9.7.2 Monitoring - NPDES Permit (CEI 16 [A-30])

CEI requested that the statement "as Appendix B of the PNPP operating license" be changed to read "An Environmental Protection Plan will be included in a supplement to the PNPP operation permit" in paragraph 2, line 1 of Section 5.5.2.3.

The staff considers the Environmental Protection Plan (EPP) not to be a supplement to the operating license. It is appended to the license as Appendix B and will contain binding requirements for reporting of important events that potentially could result in significant environmental impact. Violation of requirements imposed under the NPDES Permit (should they occur) could result in environmental impact at a facility reviewed and licensed by NRC. To keep the NRC abreast of all environmental impacts at licensed facilities, the EPP will require the licensee to report to NRC all violations of the NPDES Permit. A copy of the notice provided to the permitting agency will satisfy EPP reporting requirements. Therefore, the text is correct as stated.

9.8 Socioeconomic Impacts (Bimber 11 [A-26]; Sunflower 2 [A-20])

Bimber questions the potential tax benefit of $22 million per year stated in Section 5.8.1 of the DES and counters that, according to the Lake County Coastal Energy Impact Study, the potential benefit should be only $1 million per year.

The staff expressed its findings that the $22.9 million per year in tax revenues was high and used that figure in Table 6.1 for informational purposes only. This figure was not used in performing the benefit-cost balance. The text of Section 5.8.1 and Table 6.1 in this Statement clarifies this point.

9.8.1 Psychological Stress (Sunflower 1 [A-18-20])

In commenting on the DES, Sunflower submitted a copy of its motion to the Atomic Safety Licensing Board (the Board) for leave to submit psychological stress as a contention issue for Perry. The Board's Memorandum and Order, dated July 12, 1981, admitted this issue as Contention No. 10 on the basis that the DES did not adequately consider whether Perry's operation would cause people in the vicinity of the Plant to suffer anxieties of such severity as to be medically recognized as impairment of their psychological health. In its Memorandum and Order, dated July 19, 1982, the Board dismissed psychological stress as a contention issue based on the Commission's policy statement entitled "Considerations of Psychological Stress Issues," 7590-1, dated July 16, 1982. The staff believes that the Commission's policy statement constitutes an adequate response to Sunflower's comments on psychological stress and that this is not an issue in regard to the Perry Plant.

9.9 <u>Radiological Impacts</u>

9.9.1 Operational Overview (CEI 17 [A-30])

CEI commented that it will follow all specifications in the Radiological Environmental Technical Specifications (RETS) and will meet the intent of 10 CFR 50, Appendix I, Section IV.B.3, and that the last paragraph of Section 5.9.2 (page 5-17) implies more than may be specified in the applicant's RETS.

The staff disagrees and finds the paragraph in question appropriate in that it clearly states how changes in the use of unrestricted areas will be identified, and what will be done (i.e., revised calculations) to ensure that potential dose estimates are maximized.

9.9.2 Radiation Exposure Pathways (Sass II.5 [A-42])

Sass questions NRC methodology for estimating internal dose commitments resulting from consumption of locally grown produce and meat. It is claimed that many people who live in the Perry site area either grow most of their own fresh vegetables and fruit, produce most of their own eggs, honey, milk, meat, and fruit or buy a majority of these items from local sources. Every element from hydrogen to calcium to carbon, used by living beings, will be released as a radioactive poison from Perry (see Perry FSAR and <u>Methodologies for the Study of Low-level Radiation in the Midwest</u>, Dr. Charles Hulver and Land/Leaf Research Team.)

The staff is not clear about what the objection is with regard to the calculation of internal dose commitments. Regarding the issue of locally grown produce and meat, the DES (Section 5.9.3.1) states that the exposure pathways include drinking milk from a cow or eating meat from an animal that feeds on open pasture near the Perry site on which iodines or particulates may have been deposited, eating vegetables from a garden near the site that may be contaminated by similar deposits, and drinking water from the point of discharge of liquid effluents (or eating fish caught near that point of discharge), as well as eating animals and food crops raised near the site using irrigation water that may contain liquid effluents. Regarding the issue of radioactive elements from Perry, see the response to comment Sass II.4 [A-42] in Section 9.11 of this Statement for an explanation as to the nuclides which are released from Perry and which may subsequently contribute to internal dose commitments.

9.9.3 Occupational Radiation Exposure (CEI 18, 19 [A-30]; OCRE 7 [A-35])

CEI finds the staff has projected that the collective occupational dose for each unit at Perry stated in Section 5.9.3.1.1 of the DES will be 740 person-rems. This estimate is much higher than the 404 person-rems stated in the FSAR (page 12.4.2).

The staff estimate of occupational exposure was based entirely on experience that has shown that although 740 person-rems/yr has been the average annual dose for all BWRs for the years of record between 1974 and 1980, and there have been a few plants that have averaged 2 to 3 times that value during their operating history in the same time period. The value and range given for environmental impact purposes is a recognition that occupational exposures may be higher than the average for all BWRs. They may also be lower. To be prudent in projecting

environmental impact, however, the staff has quoted this experience rather than attempting to estimate what the dose rate would be during operation of a particular plant.

CEI also comments that the staff has used BEIR I radiation health risk estimates in Section 5.9.3.1.1 rather than using the more current BEIR III estimates. In using BEIR I, the staff had to ignore the BEIR I "relative risk" model. If BEIR III were used, the "relative risk" model could be included and the final results would be reduced by 11%.

Contrary to CEI's comment, the staff did not ignore the "relative risk" model. In fact, the staff did indicate that higher estimates can be developed by use of the "relative risk" model (see BEIR III, page 147, Table V-4). It is not evident how CEI determined that the final results could be reduced by 11% in using the relative risk model, for as Table V-4 shows, the estimates of the number of excess deaths per million person-rems are greater for the relative risk model when compared with the "absolute risk" model; i.e., this is true for both BEIR I and BEIR III models.

OCRE contends that the staff's analysis of occupational radiation exposure for BWRs is faulty because it neglects the latest data which show that such exposure in nuclear plants is increasing dramatically. Average exposures at BWRs rose 55% in 1980, from 733 to 1136 person-rems. (Critical Mass Energy Journal, October/November 1981 (pages 8 and 9).)

The staff's analysis of the impact of occupational radiation dose was based on the average collective doses for BWRs operating between 1974 and 1980. The collective average did include the 1980 information. In addition, the staff noted in the DES that the average collective dose for some BWRs with increased amounts of special maintenance has been three times the current average over the life of those plants.

9.9.4 Radiological Impact on Humans (CEI 20 [A-30])

CEI comments that a total population dose of 56 person-rems/yr to the general U.S. population is given by the staff and used for cancer risk estimates. The value of 56 person-rems/yr is obtained from Table D-9 (Appendix D) which includes a general U.S. public exposure from gaseous effluents of 43 person-rems/yr outside 80 km (50 mi). The value of 43 person-rems is unsubstantiated and seems very high. Appendix D, which is supposed to describe this calculation, does not.

In response, the staff points out that Appendix B indicates the general assumptions used in determining population doses, and references Regulatory Guides 1.109 and 1.111 which contain the methodology for performing these calculations. As indicated in Appendix B, the dose to the entire U.S. population is determined for both the first-pass and worldwide dispersion regimes. This number is of the same order of magnitude for other nuclear power plants, as shown in the respective FESs for each of those facilities.

9.9.5 Radiological Monitoring (DOI 2 [A-10]; HHS 4 [A-39])

DOI comments that plans for radiological monitoring, as described in Section 5.9.3.4 of the DES, apparently do not include groundwater sampling, since this

sample medium is not shown in Table 5.5. It is suggested that shallow groundwater, which is used as a source of domestic supply by those living in the vicinity of the plant, as noted on page 4-15 of the DES (Section 4.3.4), should be included in the monitoring program, both to establish background information and to guard against the possibility of unforeseen contamination.

The staff's response is that discharge of liquid effluent from the Perry Plant will be into Lake Erie. As mentioned in Table 5.5, two water supply systems having intakes into Lake Erie will be monitored. Any radioactive contaminants entering the biosphere via liquid effluents would be detected in these water supplies long before their detection in groundwater. Section 4.3.4 of the DES states that the principal direction of groundwater movement is toward Lake Erie, and toward natural stream channels when the aquifer fills to capacity. Therefore, the possibility of groundwater becoming contaminated because of operation of the Perry facility is extremely small.

HHS comments that the radiological monitoring program, as presented in this section of the DES, and summarized in Table 5.5, appears to provide adequate sampling frequency in expected critical pathways. Analyses for specific radionuclides are considered sufficiently inclusive to (1) measure the extent of emissions from the plant, and (2) verify that such emissions meet applicable radiation protection standards. However, although adequate, the program should be assessed to determine if it meets the needs imposed on it in the event of an accident. In particular, HHS suggests reevaluation of the airborne radioiodine sampling analysis program. Possibly, it should be modified to address the problem of monitoring radiohalogens in the presence of radionoble gases. This could be accomplished by reference to FEMA-REP-2, a document on instrumentation systems prepared with NRC input. A paragraph could be added at the end of Section 5.9.3.4.2 that addresses this issue. Such a discussion would provide assurance that the monitoring problems identified during the Three Mile Island Unit 2 (TMI-2) accident are recognized, and that positive steps have been taken to provide the instrumentation needed to adequately detect releases of radiohalogens under accident conditions.

In Section 5.9.3.4 and Table 5.5 of the DES, the staff's primary intent was to address preoperational monitoring and operational monitoring under normal operating conditions. Table 5.5 indicates that thermoluminescent dosimeters (TLDs) will be used at designated sites for detecting airborne gamma radiation, and that a charcoal cartridge will be used at these sites for collecting I-131. The use of these separate methods allows for the determination of radiohalogens in the presence of radionoble gases under normal operatng conditions, including anticipated operational occurrences.

References to methods and equipment for assessing and monitoring actual or potential offsite consequences under emergency conditions is made in Section 5.9.4.1.3.3, "Emergency Preparedness." This section states in part:

> NRC and the Federal Emergency Management Agency (FEMA) have agreed that FEMA will make a finding and determination as to the adequacy of State and local government emergency response plans. NRC will determine the adequacy of the applicant's emergency response plans with respect to the standards listed in 10 CFR 50.47(b), the requirements of Appendix E to 10 CFR 50, and the guidance contained in

NUREG-0654/FEMA-REP-1, Revision 1, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," dated November 1980.

Section II.I.9 of NUREG-0654 contains a requirement for monitoring radioiodine in the presence of noble gases under accident conditions. FEMA-REP-2 is intended as guidance for State and local governments to meet this criterion.

9.9.5.1 Preoperational Monitoring (CEI 25 [A-31])

CEI comments that paragraph 2 of Section 5.9.3.4.1 in the DES is confusing as written. The DES states that the NRC staff finds the preoperational environmental monitoring program acceptable as presented; however, it also states that the NRC position is that 40 dosimetry stations should be placed in each of the 16 sectors of the inner and outer rings. The remaining 8 stations should be placed at special interest areas. The intent is not clear for CEI fully meets the intent of this position. Thirteen of the radial sectors are located on Lake Erie. This eliminates the possibility of installing 13 dosimetry stations. Eliminating a proportionate number of the special stations to be installed accounts for 3 more stations. From the 40 stations mentioned by the staff, subtracting the 16 stations eliminated by Lake Erie leaves 24 stations for installation which CEI has met. This should be clarified in the FES.

In response to this comment, the cited paragraph is a generic requirement, subject to modification as warranted by local conditons; e.g., Perry's location on Lake Erie. The reference to 40 dosimetry stations has been eliminated in this Statement.

9.9.5.2 Accident Experience and Observed Impacts (Bimber 8, 10 [A-26])

Bimber comments that Section 5.9.4.1.2 of the DES (page 5-39) includes the impossible statement, "This (TMI) exposure could produce between none and one additional fatal cancer over the lifetime of the exposed population."

As noted in the fourth paragraph of Section 5.9.4.1.1.3, using the probable value of 135 cancer deaths per million person-rems, and the estimated range of the population exposure (1000 to 5000 person-rems) cited in the third paragraph of Section 5.9.4.1.2, a range of 0.14 to 0.70 cancer death in the exposed population is observed. Since these numbers are approximations, the staff's position is that the actual number of cancer deaths resulting from releases from TMI-2 during the accident is probably zero, but most likely not more than one. It is possible to contrive mathematically a situation where large numbers of people might die from the stated exposure, however, the probability of that result is extremely small.

Bimber also takes issue with the statement (on page 5-38 of the DES) that the release of millions of curies is not significant is inconsistent with the known dangers of ionizing radiation, and the NRC's regulation of even millicurie amounts of radioactive materials.

The statement regarding the absence of significant health effects caused by actual reactor accidents is true. The chemical and physical attributes of the

nuclides emitted in power plant accidents, as well as the amounts, were considered. Also entering into the evaluation of health effects are the locations of actual receptors, meteorological conditions that actually occurred at the time of the accident, and dose to the receptor, given that amount and kind of activity in the plume.

9.9.5.3 Risk Considerations (OCRE 5 [A-34])

OCRE contends that Section 5.9.4.1.4.6 of the DES is deficient in several respects. The attempted comparison of the economic risks of nuclear accidents with the risks of accidents and continual emissions from the use of fossil fuels to generate electricity, neglects several important differences. A fossil-fuel-generating plant does not accumulate the fission product inventory present in nuclear plants. An accident at a coal plant would never require evacuation of the public, as no danger of prompt fatalities would exist. The continual emission of sulfur dioxide and nitrogen oxides which can cause acid rain can be controlled through the use of scrubbers. Utilities, however, have resisted the installation of such equipment at their fossil-fuel plants.

In response to this comment, the staff notes that the emissions from fossil-fired plants cause economic costs to the public. Today, such emissions are released from plants and cause property damage, albeit slowly occurring damage, but costly nonetheless. Were the technology available to remove all of these emissions, there still would be costs to the public--costs for the equipment and for safe disposal of the solid or liquid wastes. The magnitudes of these costs are, as noted in the text, not quantified with accuracy, but they are real and are associated with power production. Costs that are incurred slowly can and should be compared with costs that will be incurred relatively quickly, but with a relatively low likelihood.

OCRE further considers the comparison of nuclear risks with other accident risks encountered by the public to be reprehensible. People engaging in activities involving risk, such as driving automobiles, flying in an airplane, using firearms, smoking cigarettes, etc., do so voluntarily with an understanding of the risks involved, and perhaps even some degree of control over them. The Perry Plant was forced upon the people of northeast Ohio without their knowledge or consent. The people did not ask the applicant to build a nuclear plant at Perry. There is still no significant unbiased national debate or educational program on the full risks of nuclear power (nor are these risks fully known, even to the experts). Public participation afforded by the NRC licensing process has been ineffective, largely due to the vast economic inequities between the parties involved. The public is forced to either accept living near a nuclear plant such as Perry, or move away. Obviously not everyone is in a position to do so.

The staff considers that the comparison made with fatalities from other types of accidents to which the general public is exposed provides a reasonable perspective. For each of the activities noted by OCRE there are persons exposed to fatality risks involuntarily as well as voluntarily.

9.10 <u>Evaluation of Proposed Action</u> (OCRE 6 [A-34, 35]; Sunflower 2 [A-20, 21] Bimber 6 [A-26])

These comments pertain to Section 6.2 (Irreversible and Irretrievable Commitments of Resources) and Section 6.3 (Relationships Between Short-Term Uses and Long-Term Productivity) of the DES in which OCRE, Sunflower, and Bimber question the staff's assumption regarding 55% capacity factor for Perry.

In response, the staff approximates a capacity factor that, on average, large nuclear units have experienced over their commercial operation. In general, wide variations in capacity factors have been experienced across nuclear units of similar design, and from year to year, over the operating life of the same unit. Because of these variations, it would be inappropriate to rely on the limited experience with operation of nuclear units on the Central Area Power Coordination Group (CAPCO) systems to predict what factors Perry (Units 1 and 2) is likely to attain.

9.11 <u>Examples of Site-Specific Dose Assessment Calculation</u> (Sass II.4 [A-42])

Sass comments that nuclear plants produce about 169 radionuclides. NRC has not considered about two-thirds of the fission products in its dose estimates (see Tables 5.6 of the DES and Tables D-4 and D-7 of Appendix D to the DES in which Sass counts 60).

The Evaluated Nuclear File Data, Version IV, has data for about 750 radionuclides which are generated in the reactor core by the fission process. Relative to Tables D-4 and D-7, only 60 or so of these radionuclides appear in statistically significant quantities or concentrations in plant process fluids and in plant liquid and gaseous effluents. Many radionuclides are relatively immobile and remain fixed in place in the fuel and do not migrate into the reactor coolant system where they could potentially became effluents. Other radionuclides have very short half-lives and decay into stable (nonradioactive) nuclides in a short period of time, and are no longer radioactive by the time they could potentially appear in plant effluents. Still other radionuclides are removed from plant process streams by such treatment or holdup (decay) so that effluent quantities are reduced to very small values. Printouts of calculations of effluent releases made using NRC's GALE computer code (see NUREG-0016, Revision 1, January 1980) "dropout" any effluent values below 1.0 Ci/yr of noble gases, 10^{-4} Ci/yr of iodines in gaseous effluents, and less than 10^{-5} Ci/yr of radionuclides in liquid releases. In regard to Table 5.6 (on pages 5-36 and 5-37 of the DES), the large number of radionuclides were reduced to manageable numbers for computation of health effects from severe accidents by considering the possible impacts. The attributes of each nuclide considered included (1) half life; (2) total core content; and (3) relative dose contributions within a chemical group. The factors considered in the relative dose contribution included radiation type and energy and daughters produced. The loss of accuracy by considering only a small fraction of the nuclides actually produced is trivial in comparison with other uncertainties in the consequence calculations.

Sass further comments that the NRC lists are simply Perry FSAR (page 3.5-37) material reprinted, compiled originally by CEI, and questions whether the operators of nuclear plants or the NRC set the standards.

In response, Tables D-4 and D-7 contain source terms calculated by CEI in its OL-ER in accordance with the guidance in Section 11.1 of the NRC Standard Review Plan (NUREG-0800) using the NRC BWR-GALE Code computer program, and utilizing computer program tapes provided to the nuclear industry by NRC. The Perry OL-ER source term was reviewed for discrepancies and was compared with several staff-generated source terms for other BWRs of comparable size. No significant discrepancies or deviations from comparable computer printouts were observed by the staff in the Perry OL-ER source term, and it was decided to use the applicant's source term for the staff's consideration. Since the Perry design uses state-of-the-art radioactive waste treatment systems and ventilation treatment systems throughout the plant, and there were no significant plant innovations in the control and treatment of radioactive plant effluents, the staff considered this approach to be acceptable. In regard to Table 5.6, the core content was calculated by the staff by scaling the WASH-1400 (NUREG-75/014) core content to the appropriate power level for Perry. The WASH-1400 inventory was originally based on a point depletion calculation which considered a three-region core in the equilibrium cycle. No comparable table of inventories is found in either the Perry FSAR or OL-ER.

9.12 Rebaselining Reactor Safety Study Results for BWRs (Sass II.6 [A-42])

Sass comments that NRC has increased the probability and severity of accidents for BWRs as a result of TMI-2. The accident sequences listed all result in overpressurizing and breaching of containment accompanied by core melt. These sequences are especially significant for Perry because the containment is a prototype and remains substantially untested.

The rebaselining effort (Appendix E to the DES) was undertaken for the purpose of a comparative study on Indian Point (NUREG-0715). The rebaselining effort for BWRs resulted in changed sequences which, overall, tend to predict slightly higher health effects than the RSS sequences. The sequences used do all release radioactive material due to overpressure of the containment. By the time the Perry Plant operates, the containment will be tested to exactly the same extent as other containments for comparable plants. The design criteria for the containment are no different for Perry, and the applicant will provide a hydrogen control system. Furthermore, the containment is larger for Perry than for the surrogate plant (Peach Bottom), even on a per-megawatt-thermal basis. Therefore, the staff considered that, were a probabilistic risk assessment available for the Perry design, the results would not be outside of the error bounds for the present calculations, and the conclusions would not be different from those presented in the DES.

9.13 Underground Storage of Propane (Bimber 2, 3 [A-25])

This comment pertains to the proposed underground storage of propane for the Perry Plant. Bimber states, in part, that the Lake Underground Storage (LUS) is about 1.5 mi from the Morton Salt mine shafts, on the surface, but the separation in the salt stratum they share, 2000 ft below, may be dangerously small. Up to 500 million gallons of liquid propane at about 150 psi pressure in one or more solution-mined cavities could find their way into the atmospheric pressure air of the mine. The mine is replete with electrical equipment, machinery, and other potential sources of ignition, and the possibility of a catastrophe is envisioned. As a minimum, Bimber suggests that Morton Salt

should be monitoring for propane in excess of what may come from Morton's propane-fueled earthmovers and natural gas in the mine.

In response to Bimber's concern, the staff extensively evaluated the potential hazards resulting from underground storage of propane at the CP stage of review. As a result the staff required that no underground storage of propane be permitted within 1 mi of the Perry Plant, and the applicant has acquired all of the propane storage rights within at least 1 mi of PNPP.

The staff did evaluate an underground propane explosion and concluded that at separation distances beyond 2 mi, the consequences would not affect the safe operation of the Perry Plant, even if such an explosion occurred. The staff also concluded, however, that the probability of such an explosion was sufficiently unlikely that it need not be considered. The 1-mi restriction on underground storage of propane was based on a conservative analysis of a low probability accident which postulated an uncontrolled release of propane at the surface coincident with the wind blowing toward the plant.

With regard to a possible accidental interaction between the Lake Underground Storage facility and the Morton Salt mine which might allow propane under pressure to leak into the salt mine and explode, the staff notes the following:

1. Both facilities are about 7 mi west of the Perry Plant.

2. Since the LUS wells and the Morton mine shafts are separated by about 1.5 mi (7900 ft) on the surface, and descend about 2000 ft, both shafts would have to deviate severely from the vertical in order to reduce significantly their separation in the salt stratum. For example, if both the LUS and Morton shafts were each 20 degrees off-vertical and inclined toward each other, the separation in the salt stratum would be about 6400 ft, rather than 7900 ft. Deviations of this magnitude would be readily noticeable and are not likely to occur, yet the resulting separation distance would not be dangerously small.

3. Mining activites at the Morton Salt mine are conducted underneath the surface of Lake Erie, and away from the LUS wells. Hence, the Morton mine shaft is the closest Morton mining activity to the LUS wells.

In view of the above, the staff concludes that an adverse interaction between the LUS facility and the Morton Salt mine resulting in a release of propane into the Morton mine is highly unlikely. Finally, even if it occurs, the separation distance is adequate to preclude damage to the safety structures and systems of the Perry Plant.

9.14 <u>Emergency Planning</u> (Blubaugh 2 [A-7]; Bimber 4 [A-25])

Blubaugh questions the adequacy and physical capacity of the proposed accident shelter at Perry for onsite employees. Bimber questions the ability of the Lake County Emergency Operations Center (EOC) to respond to emergencies arising from the Perry Plant; e.g., could an explosion in the Perry underground propane storage disable the EOC.

In response to Blubaugh's question on emergency planning, in the event of a serious radiological emergency situation at the Perry Nuclear Power Plant, nonessential PNPP personnel will be evacuated from the site to a prearranged offsite assembly area where they would stand by or be released to return home. Plant operations and emergency response personnel will function in designated emergency response facilities including the control room, the onsite technical support center, and the near-site emergency operations facility. NRC design criteria will require these facilities to have appropriate provisions, to assure that they remain habitable under accident conditions.

In response to Bimber's question on the proposed location of Lake County Emergency Operations Center near an underground propane storage facility, the Federal Emergency Management Agency (FEMA) is responsible for the review and evaluation of offsite emergency preparedness. FEMA will review State and local emergency plans to verify that they are adequate and capable of being implemented in the event of a radiological emergency. FEMA's findings and determinations will be provided to the NRC for use in arriving at a decision concerning the adequacy of the overall state of emergency preparedness for the Perry facility. During the course of their review, FEMA will evaluate the suitability of the proposed Lake County Emergency Operations Center to perform its assigned function during an emergency. Although there are no specific criteria concerning the location of State and local emergency operations centers in relation to industrial hazards, it is expected that such facilities will be located in a reasonably secure and safe area. In addition, if there was cause for concern about a particular offsite emergency facility, a backup facility could be designated during the planning process. The nuclear plant site was reviewed by the NRC staff with respect to area propane storage during the construction permit licensing review and found not to be adversely affected by this potential hazard.

9.15 References

Advisory Committee on the Biolgical Effects of Ionizing Radiations, BEIR I, "The Effects on Populations of Exposure to Low Levels of Ionizing Radiation," National Academy of Sciences/National Research Council, November 1972.

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Atomic Safety and Licensing Board, Memorandum and Order (Concerning Motions to Admit Late Contentions), July 12, 1982.

---, Memorandum and Order (Concerning Psychological Stress Contention), July 19, 1982.

Cleveland Electric Illuminating Company, "Perry Nuclear Power Plant Final Safety Evaluation Report," January 1981.

---, "OL - Environmental Report," August 1981.

Critical Mass Journal, October/November 1981, pp. 8-9.

Federal Emergency Management Agency, FEMA-REP-2 on instrumentation systems.

Federal Register Notice, 47 FR 13067, "Draft Environmental Statement Related to Operation of the Perry Nuclear Power Plant, Units 1 & 2," U.S. Nuclear Regulatory Commission, March 27, 1982.

Hulver, Charles, "Methodologies for the Study of Low-level Radiation in the Midwest."

NUS Corportion, "Ichthyoplankton Study Report, 1974 Data, Perry Nuclear Power Plant," prepared for the Cleveland Electric Illuminating Company, 1975.

U.S. Bureau of the Census, "Census of Population and Housing, 1980."

U.S. Nuclear Regulatory Commission, "Consideration of Psychological Stress Issues," 7590-1, July 16, 1982.

---, NUREG-0016, "Calculations of Releases of Radioactive Materials in Gaseous and Liquid Effluents for BWRs (BWR-GALE Computer Code)," Rev. 1, January 1980.

---, NUREG-0654/FEMA-REP-1, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," Rev. 1, November 1980.

---, NUREG-0715, "Task Force Report on Interim Operation of Indian Point," August 1980.

---, NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants--LWR Edition," July 1981.

---, NUREG-0884, "Draft Environmental Statement Related to the Operation of Perry Nuclear Power Plant, Units 1 and 2," March 1982.

---, NUREG-0887, "Safety Evaluation Report Related to the Operation of Perry Nuclear Power Plant, Units 1 and 2," May 1982.

---, NUREG-75/014 (formerly WASH-1400), "Reactor Safety Study--An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants," October 1975.

---, Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases From Light-Water-Cooled Reactors," Rev. 1.

---, Regulatory Guide 1.109, "Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance With 10 CFR Part 50, Appendix I," Rev. 1.

APPENDIX A

COMMENTS ON THE DRAFT ENVIRONMENTAL STATEMENT

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON 20426

IN REPLY REFER TO:

March 24, 1982

U. S. Nuclear Regulatory Commission
Washington, D. C. 20555
ATTN: Director, Division of Licensing

Dear Sir·

I am replying to your request of March 19, 1981, to the Federal Energy Regulatory Commission for comments on the Draft Environmental Impact Statement for Operation of the Perry Nuclear Power Plant, Units 1 and 2. This Draft EIS has been reviewed by appropriate FERC staff components upon whose evaluation this response is based.

This staff concentrates its review of other agencies' environmental impact statements basically on those areas of the electric power, natural gas, and oil pipeline industries for which the Commission has jurisdiction by law, or where staff has special expertise in evaluating environmental impacts involved with the proposed action. It does not appear that there would be any signifciant impacts in these areas of concern nor serious conflicts with this agency's responsibilities should this action be undertaken.

Thank you for the opportunity to review this statement.

Sincerely,

Jack M. Heinemann
Advisor on Environmental Quality

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

MAR 24 1982

OFFICE OF
THE ADMINISTRATOR

Dear Mr. Stefano:

I am writing to verify the official filing of the EIS entitled:

Draft: Perry Nuclear Power Plant, Units 1 and 2, Lake Erie, Lake County, Ohio (NUREG-0884) (#820150)

This EIS was received by the Office of Federal Activities on March 19, 1982. It has been determined the above document meets the requirements for filing an EIS as set forth under Section 1506.9 of the CEQ Regulations. Accordingly, EPA has scheduled publication of the Notice of Availability in the Federal Register dated March 26, 1982 and the public review period is scheduled to terminate on May 10, 1982.

If you have any questions or concerns relating to this matter, please do not hesitate to contact me or Ms. Jan Lott of my staff on 245-3006.

Sincerely,

Kathi L. Wilson
Management Analyst
Office of Federal Activities (A-104)

Mr. John J. Stefano
NRC Project Manager
Division of Licensing
Office of Nuclear Reactor Regulation
US Nuclear Regulatory Commission
Washington, DC 20555

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United States Department of Agriculture
Economic Research Service
Washington, D.C. 20250

March 26, 1982

RECEIVED
MAR 30 1982
US NUCLEAR REGULATORY COMMISSION
DOCUMENT MANAGEMENT BR
TIDC

Mr. A. Schwencer, Chief
Licensing Branch No. 2
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Schwencer:

Thank you for forwarding the material relating to the proposed operation of the Perry Nuclear Power Plant, Units 1 and 2, to be operated by the Cleveland Electric Illuminating Company, located on the southern shore of Lake Erie, Ohio.

We have reviewed Docket Nos. 50-440 and 50-441 and have no comments.

Sincerely,

Velmar W. Davis

VELMAR W. DAVIS
Associate Director
Natural Resource
Economics Division

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Atomic Energy Control Board
Commission de contrôle de l'énergie atomique

P.O. Box 1046
Ottawa, Canada
K1P 5S9

C.P. 1046
Ottawa, Canada
K1P 5S9

REACTOR REGULATION DIRECTORATE

Your file Votre référence

31 March,1982

Our file Notre référence 26-2-0-0-0

Mr. A. Schwencer, Chief,
Licensing Branch No.2,
Division of Licensing,
United States Nuclear Regulatory Commission,
WASHINGTON, D.C.
20555

Dear Mr. Schwencer:

Receipt is acknowledged of a copy of the Draft Environmental Statement related to the operation of the Perry Nuclear Power Plant, Units 1 and 2 and also the Federal Register Notice.

Sincerely yours,

Z. Domaratzki per M. Kavanagh
Z. Domaratzki
Director-General

/mk

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Canada

DEPARTMENT OF THE ARMY
OHIO RIVER DIVISION, CORPS OF ENGINEERS
P. O. BOX 1159
CINCINNATI, OHIO 45201

ORDED-W

2 April 1982

Mr. A. Schwencer
Division of Licensing
Nuclear Regulatory Commission
WASH DC 20555

RECEIVED
APR 7 1982

Dear Mr. Schwencer:

Reference is made to your letter, dated March 19, 1982, forwarding the draft Environmental Statement, Perry Nuclear Power Plant, Units 1 and 2.

The site of this power facility is located outside of our area of responsibility. It is suggested that the appropriate point of contact is: CDR, North Central Division, 536 S. Clark Street, Chicago, Illinois 60605.

FOR THE COMMANDER:

Richard C. Armstrong

Incl

RICHARD C. ARMSTRONG
Chief, Engineering Division

C002
B1/0

United States Department of Agriculture

Soil Conservation Service

200 North High Street
Room 522
Columbus, Ohio 43215

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APR 12 1982
US NUCLEAR REGULATORY COMMISSION
DOCUMENT MANAGEMENT BR
TIDC

April 8, 1982

Mr. A. Schwencer, Chief
Licensing Branch No. 2
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington D.C. 20555

Dear Mr. Schwencer:

We received the Draft Environmental Statement related to the operation of Perry Nuclear Power Plant Units 1 and 2, near Painesville, Ohio.

We have reviewed this report and have no comments to submit.

We appreciate the opportunity to review and comment on this project.

Sincerely,

Harry W. Smith Acting for
Robert R. Shaw
State Conservationist

cc: P. Myers, Chief SCS
V. Hicks, SCS, Washington D.C.
E. Pope, SCS, Lincoln
T. Anderson, DC, Wickliffe, Ohio
M. Giles, SCS, Columbus

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April 21, 1982

U.S. Nuclear Regulatory Commission
Washington D.C. 20555
Att'n: Director, Tech. Info. & Doc. Control

RECEIVED APR 28 1982 US NUCLEAR REGULATORY COMMISSION DOCUMENT MANAGEMENT BR

Dear Director;

This letter is a comment on Draft Environmental Statement (DES) related to the operation of Perry Nuclear Power Plant (PNPP) Units 1 + 2 Docket # 50-440 + 50-441. (NUREG-0884)

1. There is a discrepancy which I feel should be cleared up before any radioactive components are brought into the area. On pg. 6-2, under the heading "INDIRECT BENEFITS", Cleveland Electric Illuminating (CEI) states that 399 people will be employed annually by Perry.

Yet on page 5-74 under "EMERGENCY PLANNING" there is shelter for only 55 people in case of accident. I was under the impression that CEI was building a safe facility that would provide protection to all on-site employees.

2. A second question that comes to mind is this: What kind of accident is this shelter supposed to protect the workers from? If it is an explosion, will these shelters be adequate? If the air is contaminated, will these shelters hold a second source of oxygen and for how long? Will these shelters be equipped with emergency equipment such as protective clothing, food, water, etc., or will we walk-in?

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page 2

These things must be resolved before placing any radioactive materials at Perry.

CEI has a responsibility to its workers to see that they are protected.

Sincerely,

Patty Blubaugh

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APR 27 1982

10685 Longview Trail
Chagrin Falls, OH 44022
4/21/82

Nuclear Regulatory Commission
Washington, D.C. 20555

RE: Perry Nuclear Power Plant
NUREG 0884, Docket # 50-440/441

ATTENTION: Director of Licensing

To Whom It May Concern:

I wish to request an extension on the comment period for the Draft Environmental Statement of the Perry Plant. I am respectfully requesting this extension for the following reasons:

1. I wrote for the DES on 3/30/82 the very day I received the NRC News Announcement that it was available but did not receive the DES until Mon. 4/12/82 almost 2 weeks later.
2. It is very likely I will have to undergo surgery in the near future.
3. I am a teacher and due to my work committment, my time to devote to the DES has been limited.

Thank you for your time and consideration. I'll look forward to your reply.

Sincrely yours,

Connie Kline

Connie Kline

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United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

50-440

ER 82/528

APR 28 1982

APR 30 1982
US NUCLEAR REGULATORY COMMISSION
DOCUMENT MANAGEMENT BR
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A. Schwencer, Chief
Licensing Branch No. 2
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Schwencer:

Thank you for your letter of March 19, 1982, transmitting copies of the draft environmental impact statement related to the operation of Perry Nuclear Power Plant, Units 1 and 2, Lake County, Ohio. Our comments are presented according to the format of the statement or by subject.

1. Fish and Wildlife Resources

In several areas of concern the draft statement referenced supporting data but did not supply sufficient data in the text. In the Ichthyoplankton part of Section 4.3.6.2, a summary (e.g., the mean concentration of each species or taxa of larvae for each depth contour sampled in the applicant's 1974 ichthyoplankton survey) should be provided. Likewise, in Section 5.5.1.3, the monitoring by Jackson and Temme of bird impaction at the Davis-Besse cooling tower is referenced but data are not provided. It would be helpful if the average annual number of birds and species killed was provided in the text along with the dominant species of birds involved.

Overall, the document provided sufficient accurate information for our review of potential adverse impacts to fish and wildlife resources as a result of the operation of the Perry Nuclear Power Plant and we agree with your conclusions.

2. Radiological Monitoring

Plans for monitoring apparently do not include ground water, since this sample media is not shown on Table 5.5. We suggest that the shallow ground water, which is used as a source of domestic supply by those living in the vicinity as noted on page 4-15, should be included in the monitoring program—both to establish background information and to guard against the possibility of unforeseen contamination.

3. Internal Inconsistencies

In addition, we believe the statement contains a number of discrepancies that should be resolved prior to issuance of the final environmental impact statement. Section 4.2.4.1 indicates that the intake structures are located 2,550 feet from shore in 21 feet of water, but Section 4.3.3 indicates that the intakes are 3,500 feet offshore in 26 feet of water. The discharge structure is indicated as being 1,650 feet from shore in 19 feet of water in Section 4.2.4.2, but 2,500 feet offshore in 22 feet of water in Section 4.3.3. Sections

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4.2.3 and 4.2.4.1, and Tables 4.1 and 5.1 provide information on water withdrawal rates, discharge rates, evaporation rates, makeup rates, blowdown rates, and drift rates that do appear to be totally consistent.

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

Sincerely,

Bruce Blanchard, Director
Environmental Project Review

ODNR
Ohio Department of Natural Resources
OFFICE OF OUTDOOR RECREATION SERVICES
Fountain Square · Columbus, Ohio 43224 · (614) 265-6395

RECEIVED
MAY 6 1982
U.S. NUCLEAR REGULATORY COMMISSION
DOCKET MANAGEMENT BR
TIDC

May 3, 1982

Mr. John J. Stefano
Division of Licensing
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Re: Draft Environmental Statement - Operation Licensing Stage
Perry Nuclear Power Plant, Units 1 and 2, Ohio
(Docket Numbers 50-440 and 50-441)

Dear Mr. Stefano:

The Ohio Department of Natural Resources has completed a review of the above-referenced document. The attached comments were generated by an interdisciplinary review process conducted and coordinated by the Office of Outdoor Recreation Services. Should any question arise, please contact me or John Rupert of the Environmental Review Section of this office.

We appreciate the opportunity to provide these comments.

Sincerely,

Roger D. Hubbell

Roger D. Hubbell, Chief
Office of Outdoor Recreation Services

RDH/dlw
Attachment

cc: Ohio State Clearinghouse
(SAI #36-472-0003)

C002 Add: John Stefano
B/1

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D PDR

JAMES A. RHODES, Governor • ROBERT W. TEATER, Director • ROGER D. HUBBELL, Chief

ODNR
Ohio Department of Natural Resources
Fountain Square · Columbus, Ohio 43224 · (614[redacted]265-6886

May 3, 1982

COMMENTS ON DRAFT ENVIRONMENTAL STATEMENT
OPERATING LICENSE STAGE PERRY NUCLEAR POWER PLANT, UNITS 1 AND 2
(Cleveland Electric Illuminating Company, U.S. Nuclear Regulatory Commission, March, 1982)

The Perry Nuclear Power Plant (PNPP) Draft Environmental Statement - Operating License Stage (DES-OL) addresses issues involved with the startup and operation of Units 1 and 2 of the plant. Issues raised earlier, evaluated in the Final Environmental Statement - Construction Permit Stage (FES-CP) are not readdressed in this document.

Many of the concerns of the Department of Natural Resources have been addressed both in FES-CP and through the certification procedure for the plant by the Ohio Power Siting Commission (OPSC, now the Ohio Power Siting Board). The Department, represented on the Commission and its technical staff, provided input into the assessment of the application, which resulted in the "Secretary's Report of Investigation and Recommended Findings" for the Commission. This report provided a basis, along with other documents, for the certification of the plant.

The DES-OL adequately addresses most of the impacts associated with the startup and operation of the PNPP. However, certain aspects of concern to this Department, need further comment.

The Department is in complete agreement with the planned use of the closed-cycle cooling system instead of the once-through system as originally proposed for the PNPP. This system will reduce water consumption, thermal pollution and fish impingement and entrainment. This approach utilizes best available technology and is the preferred choice for such a plant.

1 The locations of the intake and discharge structures are also greatly important in reducing impacts. Sections 4.2.4.1 and 4.2.4.2 state that the intake and discharge structures will be approximately 777m and 503m offshore, respectively, in 6.4m and 5.8m of water. Section 4.3.3 describes the placement of underwater instrument towers in the vicinity of the intake

JAMES A. RHODES, *Governor* • ROBERT W. TEATER, *Director*

and discharge structures at 1070m and 760m offshore. It is unclear as to whether these towers were not necessarily "in the vicinity" of the structures, or whether the placement of the structures were changed during design, or whether some calculation or typographic error is present. This should be clarified.

2. Section 4.2.6 describes the cleaning of the reactor flow passages, piping and equipment with a number of phosphate based compounds. It is stated that these cleaning products will be "neutralized" with lime and that the supernate will be discharged to Lake Erie. This solution will contain about 50% more phosphate than the ambient lake water. Although this proposal seems reasonable, no mention is made in the document regarding the fate of the lime-phosphate sludge. It is our understanding that the sludge will be placed upland in an on-site sludge lagoon. The document needs to clarify the final deposition of this material. This sludge should not ultimately end up in the lake.

3. Also in Section 4.2.6, the DES-OL states that 8300kg/day of 93% sulfuric acid will be added to the closed-cycle cooling system to prevent formation of scale on the condenser tubes. This appears to be a large amount of acid. It is not stated if all of this amount will be added to the secondary system, or just a portion of it. The FES-OL should identify the necessity for such quantities of the sulfuric acid as well as to which sub-systems it will be added. Furthermore, the FES-OL should better quantify the pH of the cooling water that will be discharged to Lake Erie. Table 4.2 only specifies the limits of the NPDES permit, expected to be issued for the discharge effluent, and not what is actually expected. This should be stated.

In summary, we feel that the operation of the PNPP poses no significant avoidable impacts to resources of concern to this Department. We concur with the Summary and Conclusions as presented in the DES-OP.

WESTERN RESERVE ALLIANCE
10916 MAGNOLIA DRIVE
CLEVELAND, OHIO 44106
Area Code 216
732-8542 321-8806
281-6161 932-3097
231-4245

4 May 1982

Director, Division of Lcensing
Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Sir:

Please accept our comments on the Draft Environmental Statement due in your department 10 May. Though for obvious reasons, the following comments are brief, they can be substantiated in greater detail.

Western Reserve Alliance is opposed to the operation of the two-unit nuclear power plant at Perry, Ohio, for the following reasons:

1. Wall Street financiers emphatically state that there should be no nuclear power plants for commercial use. They give several reasons, one of which is the uncontrollable, rapidly escalating cost in their construction and operation.

2. Water scarcity, both in quantity and quality, is rapidly becoming a national hazard. Our existing water supply should be treated with caution and respect. Wells in the area of the Perry Power plants under construction are already drying up and the water table is lowered. Erosion of the Lake Erie shore line is increasing steadily, relentlessly and consistently each year;

3. Water from the cooling plants will come from a fragile Lake Erie which is already recovering from a dying condition. Water from the cooling plants with its chemicals from routine clean-ups and radioactive particulants, even in tiny quantities will gradually build up to an intolerable toxic load from which the lake can never recover. This will affect the marine life so necessary for its own symbiotic environment, food supply and potability for people living in the area;

4. The Perry units are located on an old post glacial lake beach with shifting sands. The depth of bed rock below the surface of the earth to which the pilings must descend and the nature of the bed rock should be carefully examined. Specifically, is the Chagrin shale and its thickness at this locale sufficiently strong?

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5. It is very wrong to assume that this whole region, the snow belt, will inevitably become a "ghost" area and written off as such. The area has a great potential for a booming comeback and should be so considered. A poisoned lake and poisoned salt are no assets in the process of recovery.

6. Finally, it should not be forgotten that reluctant utilities were pressured

into the situation years ago by the government without the public's awareness and consent. Great governments make mistakes. This was one. Now the government and the people should get together to do away with nuclear power plants and solve the financial quagmire into which the utilities are sinking more and more.

Donald Schlemmer

Donald Schlemmer, President
WESTERN RESERVE ALLIANCE

50-440
50-441

STATE CLEARINGHOUSE

30 EAST BROAD STREET • 39TH FLOOR • COLUMBUS, OHIO 43215 • 614 / 466-7461

82-05-03 P
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Mr. A. Schwencer, Chief
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Attn: Director, Division of Licensing

RE: Review of Environmental Impact Statement/Assessment
Title: Draft Environmental Impact Statement - Perry Nuclear Power Plant, Units 1 and 2.
SAI Number: 36-472-0003

Dear Schwencer:

The State Clearinghouse coordinated the review of the above referenced environmental impact statement/assessment.

This environmental report was reviewed by all interested State agencies. No reviewer has stated concerns relating to this report.

Thank you for the opportunity to review this statement/assessment.

Sincerely,

Judith Y. Brachman

Judith Y. Brachman
Administering Officer

JYB:lr

cc: DNR, Mike Colvin
EPA, Anthony Sasson

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
CLEVELAND ELECTRIC ILLUMINATING COMPANY, et al.	)	Docket Nos. 50-440
	)	50-441
	)	(OL)
(Perry Nuclear Power Plant, Units 1 and 2)	)	
	)	

MOTION FOR LEAVE TO SUBMIT ADDITIONAL CONTENTIONS

Intervenor Sunflower Alliance et al. hereby moves the Licensing Board to grant it leave to amend its Petition for Leave to Intervene by submitting the two additional contentions detailed below. These contentions are based on the Draft Environmental Statement for Perry, NUREG-0884, which was just issued in late March; therein lies the good cause for this late filing.

1. Psychological Stress

On January 7, 1982 the U.S. Court of Appeals ruled that the NRC must conduct an environmental assessment, under the National Environmental Policy Act (NEPA), of the psychological effects on residents living near the Three Mile Island nuclear plant before Unit 1 of that facility may be allowed to restart (People Against Nuclear Energy (PANE) v NRC, exact citation unknown). Although the TMI-1 restart case involved the special circumstances of restarting the undamaged reactor on the same site of the worst commercial nuclear accident in history, this

decision is presumably applicable to all nuclear plant sites, since the same potential for catastrophic accidents exists at all nuclear facilities. With the widespread publicity the TMI-2 accident received, most people are aware of this accident potential, and thus living in close proximity to a nuclear reactor may well cause stress. Indeed, the mere prospect of being forced to leave one's home at a moment's notice in an evacuation, the lack of adequate property insurance (under the Price-Anderson Act) to cover any damage caused by a nuclear accident, and concerns regarding the effects of low-level radiation effluents emitted during normal plant operation are all grounds for anxiety around <u>any</u> nuclear facility.

Considerations of the health effects of nuclear plant operation, under both NEPA and the Atomic Energy Act, have traditionally been limited to physiological effects. However, the medical consensus today is that mental and physical health are closely allied. The deleterious effects of psychological stress on physical health are well known. These facts alone would mandate the study of the psychological effects of nuclear plant operation on the public. This recent court decision gives legal sanction to these medical concerns by explicitly declaring psychological effects to be under the scope of NEPA.

This court decision addressed one of the fundamental questions of the modern era: the tensions between man's technological ability to create ever more complicated and dangerous devices, presumably for his own welfare, and the impact on his psychological health and his fundamental sense of harmony with the environment if those devices should fail

and pose a potentially unthinkable threat of widespread disaster. The actual threat itself is a separate matter. As such, this case sets precedent for all NRC licensing actions; indeed, it may have ramifications extending far beyond the nuclear power industry. This proceeding should thus be bound by the court's decision.

An examination of the DES for Perry indicates that psychological stress effects have not even been mentioned, let alone evaluated.

Both the Atomic Energy Act and NEPA require the NRC to consider the psychological effects of nuclear plant operation on the local community surrounding such facilities. This recent court decision affirms this. The NRC must comply with the law and prepare an evaluation of the psychological effects of plant operation on residents living near the Perry plant. This evaluation must be performed, and its results incorporated into the cost-benefit analysis required by NEPA, before Perry can be licensed to operate.

2. Local Economic Effects in the Cost-Benefit Analysis

Sunflower Alliance et al. contends that the cost-benefit analysis in the Perry DES is skewed to favor operation of Perry due to the improper inclusion of increased employment and tax revenues to the local community as benefits.

Table 6.1, entitled "Benefit-Cost Summary," pp. 6-2 and 6-3 of the DES lists as "indirect benefits" local taxes of $22 million/year, annual employment of 399 persons, and annual payroll of $10 million. The NRC Staff has assessed these "benefits" to be "large" (taxes) and "moderate" (employment and

payroll).

The Atomic Safety and Licensing Appeal Board has ruled that increased employment and tax revenues to the affected community may not be counted on the benefit side of the cost-benefit balance (Public Service Company of New Hampshire (Seabrook Station, Units 1 and 2), ALAB-471, 7 NRC 477, 479 (1978)).

Sunflower Alliance et al. therefore contends that the NRC Staff has not complied with the law in preparing the DES. The cost-benefit analysis should be redone, this time in conformance with ALAB-471, before Perry can be licensed to operate.

Requirements for Late filing Under 10 CFR 2.714

Sunflower Alliance et al. has met the requirements for late-filed contentions under 10 CFR 2.714. Both of these contentions are based on the recently issued Perry DES; in addition, the psychological stress contention is based on a recent court ruling. These factors constitute abundant good cause for late filing. Sunflower Alliance has only this proceeding in which to protect its interests; the issues considered herein are specific to the Perry facility, and therefore cannot be properly resolved by any other means. Sunflower in addition knows of no other party that is raising these issues. The inclusion of these contentions will certainly aid in the development of a sound record. Although the issues will be somewhat broadened by the admission of these contentions, the amount of delay, if any, caused thereby is unknown. The above factors clearly favor the admission of these two contentions into this

proceeding, and Sunflower Alliance et al. prays that the Board is so moved.

Daniel D. Wilt, Esq.
Attorney for Sunflower Alliance Inc., et al
7301 Chippewa Rd.
Brecksville, Ohio 44141
(216) 526-2350

SERVICE

A copy of this Motion has been sent to all persons on the Service List by First Class, United States Mail, on this 5th day of May, 1982.

Daniel D. Wilt, Esq.
Attorney for Sunflower Alliance Inc., et al

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION V
230 SOUTH DEARBORN ST
CHICAGO, ILLINOIS 60604

RECEIVED MAY 11 1982

REPLY TO ATTENTION OF

7 MAY 1982

Mr. A. Schwencer, Chief
Licensing Branch No. 2
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

RE: NEPA-DE-NRC-F06015-OH
(82036)

Dear Mr. Schwencer:

We have completed our review of the Draft Environmental Impact Statement (EIS) Related to the Operation of Perry Nuclear Power Plant Units 1 and 2. The Perry Nuclear Power Plant is located on Lake Erie in Lake County, Ohio approximately 7 miles northeast of Painesville, Ohio. Both units will use boiling water reactors to produce 1250 megawatts of electricity each. Makeup water for the condenser cooling system will be obtained from Lake Erie via a submerged multiport capped intake. Cooling water will be recirculated through the condensers and two natural draft cooling towers will dissipate excess heat to the atmosphere. Blowdown and other nonradioactive wastes will be discharged to Lake Erie via a submerged differser located on the bottom of Lake Erie approximately one quarter of a mile offshore.

1. The cooling system for the Perry Nuclear Power Plant was originally designed with a once-through system with all the excess heat being dissipated through a discharge into Lake Erie. However, the Ohio Environmental Protection Agency denied a 401 certification and the approval of 316(a) and (b) demonstration for the once-through cooling pursuant to the Federal Water Pollution Control Act of 1972. This certification denial resulted in the condenser cooling being redesigned to a closed cycle cooling system. This closed cycle system should reduce the impacts to the aquatic environment significantly.

2. Proposed effluent discharges of nonradioactive wastes have been provided by the applicant to assess impacts on water quality. A formal application for a National Pollutant Discharge Elimination System permit from the State of Ohio has not yet been applied for by the applicant. As noted in the draft EIS, the actual effluent releases will be constrained by the State of Ohio water quality standards and technology-based effluent limits established by our Agency. At the present time, effluent limits for Steam Electric Generating Stations have not been finalized. These effluent guidelines will be finalized in March of 1983. The final EIS should note and the applicant should be aware that these standards will apply to the Perry Nuclear Power Plant discharge.

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We do not anticipate any additional adverse environmental impacts occurring within the field of our expertise. Therefore, in accordance with our responsibility under Section 309 of the Clean Air Act, we have rated the

EIS as LO-1 (Lack of Objection - sufficient information). A notice of the availability of our comments will be published in the Federal Register. We appreciate the opportunity to review this draft EIS. If you or your staff has any questions regarding our comments, please contact Mr. Bill Franz, at 886-6687 (FTS) or 312/886-6687 (Commercial).

Sincerely yours,

Barbara Taylor Buckley

Barbara Taylor Backley, Chief
Environmental Review Branch
Planning and Management Division

Tel. (216) 352-1680

RUSSELL M. BIMBER
10471 Prouty Road
PAINESVILLE, OHIO 44077

RECEIVED MAY 13 1982 US NUCLEAR REGULATORY COMMISSION DOCUMENT MANAGEMENT BR. TIDC

May 9, 1982

Att'n: Director, Div'n of Licensing
Nuclear Regulatory Commission
Washington, D. C. 20555

COMMENT ON NUREG 0884 (DES-OL, PERRY)

1. Benefit-cost evaluations are often superficial, speculative, and influenced by hope of personal and/or corporate gain. Page 2-1 shows CEI grossly overestimated the need for power (and population growth) until it got the Construction Permit. Now it seems to be underestimating future population in the ten mile radius EPZ, presumably to minimize its costs for emergency planning and preparedness. This may increase the risk to people in the EPZ, so I suggest the 1980 Census results be added to the planning base, and no population projection less than a linear extrapolation from 1970 and 1980 populations be allowed.

2. Page 5-42 says the risk to PNPP from nearby explosions from other industries, etc is negligibly small. My letter on page A-17 of the FES-CP envisioned a massive explosion of propane from Lake Underground Storage in the nearby Morton Salt mine, which has never been evaluated. The Staff evaluated an above ground explosion, but said an underground explosion was not credible. In view of Texaco's drilling into a salt mine in Louisiana with disastrous consequences (Science 81, November, 1981), I must disagree with the NRC Staff, and explain why I think a propane explosion in the Morton Mine is a credible event.

3. The wells of L.U.S. are about 1½ miles from Morton's mine shafts, on the surface, but the separation in the salt stratum they share 2000 feet below may be dangerously small. Up to 500 million gallons of liquid propane at about 150 psi in one or more solution-mined cavities could find its way into the atmospheric pressure air of the mine. The mine is replete with electrical equipment, machinery, and other potential sources of ignition. The mined height is typically eighteen feet, and crosshatched tunnels may provide an airspace equivalent to 30 square miles. It is to be expected that L.U.S. and Morton will deny any possibility of the catastrophe I have envisioned, but what, if any monitoring are they doing? As a minimum, I think Morton should be monitoring for propane in excess of what may come from their propane-fuelled earthmovers and natural gas in the mine. Some well-logging techniques might also be tried in the mine at the expected closest points to the propane storage.

4 The proposed site of Lake County's Emergency Operations Center for responding to emergencies arising from the Perry Nuclear Power Plant is underground, in a former Nike Site, above the propane storage. Could an explosion both cause trouble at PNPP and disable Lake County's E.O.C.?

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5. On page 6-1, the Staff assumes PNPP will generate 11.6 billion KWH/YR, or 55% of its nameplate capacity. I think this is much too optimistic. The same group of utilities, "CAPCO", operates the Davis-Besse plant, which has about the poorest record of any nuclear power plant in the country. Has it ever reached even 27.5% of nameplate capacity IN ANY OF THE FOUR YEARS IT HAS BEEN STRUGGLING TO OPERATE?

6. It seems deceptively redundant to cite the peak generating capacity expected and several items depending on that as if they were separate benefits. The 11.6billion KWH/YR is only 55% of 2410 MW. At 27.5% of 2410, or 666MW, the generating costs may be increased, not reduced, and the system reliability may not be improved.

7. Page 6-2 says only fuel costs and operation and maintenance costs must be considered to find the reduced generating costs. Plant construction, decommissioning, and perpetual management of radioactive fission and activation products were assumed negligible, even though the latter two are still not known. (Somewhere, CEI has estimated decommissioning Perry will be much cheaper than the $500 million estimate I've heard for Indian Point I.) The TVA's experts were quoted in the Christian Science Monitor, May 5, 1982, page 3, saying coal power was cheaper than nuclear power!

8. Page 5-39 includes the impossible statement, "This [TMI] exposure could produce between none and one additional fatal cancer over the lifetime of the exposed population." Such a fractional fatality is impossible, but there is a minute possibility that the entire exposed population could die from the exposure.

9. Page 4-15, considering potable water intakes, appears ignorant of Lake County's ownership of the former Industrial Rayon intake, and plans for it. A mention of very little irrigation overlooks the significant addition to groundwater from lakewater furnished to unsewered areas by Painesville and by Ohio Water Service, for example. I have managed my own well from 1953 until a sewer project recently lowered the water table; I attribute a two foot rise in my water table to public water service to areas uphill from me. The Lake County Sanitary Engineer has been quoted in the local paper as saying most of the flow of the Kellogg creek, near my home, is due to similar sources.

10. Page 5-13 overlooks the fact that man is an endangered species, threatened by nuclear power, including even the routine, deliberate releases from nuclear power plants. The statement on page 5-38 that the release of millions of Curies is not significant is inconsistent with the known dangers of ionizing radiation and the NRC's regulation of even millicurie amounts of radioactive materials.

11. Page 5-14 shows the Staff knows better than to allow listing a potential tax benefit of $22 million.* According to the Lake County Coastal Energy Impact Study, which cost the County Planning Commission $60,000., the potential benefit should be only $1 million per year.

The anticipated benefits of PNPP accrue heavily to CAPCO, whereas the costs fall in a less identifiable manner, even on generations yet unborn. Even if the opponents of PNPP were to be given funds to state their case, a fair benefit-cost evaluation seems improbable.

Sincerely, Russell M. Bimber

Russell M. Bimber

*ON PAGE 6-2

CLEVELAND ELECTRIC ILLUMINATING COMPANY
P.O. BOX 97 ■ PERRY, OHIO 44081 ■ TELEPHONE (216) 259-3737 ■ ADDRESS-10 CENTER ROAD
Serving The Best Location in the Nation

May 10, 1982

Mr. A. Schwencer
Chief, Licensing Branch No. 2
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Perry Nuclear Power Plant
Docket Nos. 50-440; 50-441
Comments on the Draft
Environmental Statement for PNPP

Dear Mr. Schwencer:

The Cleveland Electric Illuminating Company has completed its evaluation of NUREG 0884, "Draft Environmental Statement Related to the Operation of the Perry Nuclear Power Plant, Units 1 and 2." Our comments resulting from this evaluation are enclosed for your review and inclusion in the Nuclear Regulatory Commission's Final Environmental Statement.

The comments on the enclosed attachment are prefixed by the page number and location.

Very Truly Yours,

Dalwyn R. Davidson

Dalwyn R. Davidson
Vice President
System Engineering and Construction

DRD: mlb

cc: Jay Silberg
John Stefano
Max Gildner

1. Chapter 2

Due to the recent Commission vote to drop the need for power evaluation at the operating license stage, it is the applicant's position that the Final Environmental Statement should reflect this and that Chapter 2 should not be included in this document.

2. Chapter 3

Due to the recent Commission vote to drop the need to discuss alternative sites and alternative energy sources at the operating license stage, it is the applicant's position that the Final Environmental Statement should reflect this and that Chapter 3 should not be included in this document.

3. Pages 4-1, 4-3, 5-5; Sections 4.2.2 and 5.5.1

More recent field data on land use has been obtained. The ER-OL will be updated to reflect this new data.

	New Data	Old Data
Site Area	421.3 ha (1041 acres)	445 ha (1100 acres)
Plant and Facilities	93.9 ha (232 acres)	101 ha (250 acres)
Temporarily Disturbed	42.9 ha (106 acres)	121 ha (300 acres)

The reference used for the applicant's data is the NUS report, Terrestrial Ecological Monitoring Program at the Perry Nuclear Power Plant Site, 1981 Annual Report, NUS-3942, December 1981.

4. Page 4-3, Section 4.2.2, Paragraph 1, Line 4

The term "unique (nursery)" is not common terminology and should be deleted.

5. Page 4-3, Section 4.2.2, Paragraph 2, Line 2

The following suggested revision should be made: The second sentence beginning "Those areas..." should be deleted and instead the following sentence should be inserted, "Disturbed areas will be revegetated."

6. Page 4-3, Section 4.2.3, Paragraph 5, Line 1

The following revision should be made: In the first line delete, "at a rate" and insert, "at an average annual rate" after "evaporate water."

7. Page 4-6, Table 4.1, Line 4

The units for air flow rate should be changed. The units of ft^3/min for 1.5175 X 10^8 should be changed to lbs/hr. The figure 4.2976 m^3/min should be changed to 6.88 X 10^7 kg/hr.

8. Page 4-7, Table 4.1, Line 1

Change "17.01" to "17."

9. Page 4-14, Table 4.3, Line 9

The September temperature of 74°F should be 70°F as stated in ER-OL Table 2.4-1. This was referenced as the source for Table 4.3 in the DES.

10. Page 4-15, Section 4.3.5, Line 4

The DES states that the nearest intake is 5.7 miles NE at Madison-on-the-Lake. It should say that the nearest intake is 4.2 miles ENE at Madison Township.

11. Page 4-15, Section 4.3.5, Line 8

According to what was previously stated in the environmental report construction permit stage, the 12.4 mgd stated in the DES should be 11.4 mgd (Section 2.2.5, Page 2.2-13 ER-CP).

12. Page 5-1, Section 5.1, Paragraph 2, Line 6

The following suggested revision should be made: The sentence, "No significant impacts were noted by the staff." should be changed to read, "No significant impacts are anticipated as a result of using a recirculatory cooling system as opposed to a once-through system."

13. Page 5-4, Paragraph 3, Lines 4 and 5

It mentions the use of upper air soundings from Buffalo, New York, were used for visible plume analysis. The applicant's calculations on visible plume analysis was done using 3 years of sequential hourly on-site data at the Perry site. This is described in the ER-OL Page 5.1-10, Section 5.1.4. The following change in the DES should be made: Delete the first part of the sentence on Lines 4 and 5 that say, "Using upper air sounding from Buffalo, New York" and insert, "Using 3 years at sequential hourly on-site data at the Perry site."

14. Page 5-5, Section 5.5.1, Last Sentence

The area given for plant and facility use at 101 ha is not consistent with more recent field data. Refer to comment Number 3 for more information.

15. Page 5-7, Section 5.5.1.2, Line 12

There is no reference given at the end of Chapter 5 for the name (Carson).

16. Page 5-13, Section 5.5.2.3, Paragraph 2, Line 1

Delete the following item: "... as Appendix B of the PNPP operating license." Add the following to have it read, "An Environmental Protection Plan will be included in a supplement to the PNPP operations permit."

17. Page 5-17, 5-18; Section 5.9.2, Paragraph 6

The applicant will follow all specifications in the Radiological Environmental Technical Specification (RETS) and will meet the intent of 10-CFR50 Appendix I, Section IV.B.3. The last paragraph on Page 5-17 implies more than what may be specified in the applicant's Radiological Environmental Technical Specifications.

18. Page 5-21, Section 5.9.3.1.1, Paragraph 1, Line 5

In the DES the staff has projected that the collective occupational doses for each unit at PNPP will be 740 person-rems. This estimate is much higher than the 404 person-rems stated in the FSAR (Page 12.4-2).

19. Page 5-21, Section 5.9.3.1.1, Paragraph 4, Line 7

The NRC staff has used BEIR I radiation health risk estimates rather than using the more current BEIR III estimates. In using BEIR I the NRC staff had to ignore the BEIR I "Relative Risk" model. If BEIR III were used, the Relative Risk Model could be included and the final results would be reduced by 11 percent.

20. Page 5-27, Section 5.9.3.2, Paragraph 2, Line 3

A total population dose of 56 person-rems/yr to the general U.S. population is given by the NRC staff and used for cancer risk estimates. The value of 56 person-rems/yr is obtained from Table D-9 which includes a general U.S. public exposure from gaseous effluent of 43 person-rems/yr outside 80 km. The value of 43 is unsubstantiated and seems very high. Appendix B, which is supposed to describe this calculation, does not.

21. Page 5-29 through 5-31, Table 5.5

The footnotes for waterborne surface and drinking samples are incorrect. They should be (b) and not (a). A new footnote "(h)" should be created to denote the minimum 6-month sampling period for air iodine. The current footnote of (a) is confusing since it has reference to one full pasture season.

22. Page 5-29, Table 5.5, Page 5-29, Line 5 and Page 5-30, Line 4

Change "gross" to "gross beta" in the Type column.

23. Page 5-29, Table 5.5, Line 17

Change "E--site boundary" to "ESE--site boundary."

24. Page 5-30, Table 5.5, Line 13

The control water location that is stated in Table 5.5 has been changed from Cleveland to Ashtabula. The ER-OL will be updated to reflect this change.

25. Page 5-32, Section 5.9.3.4.1, Paragraph 2

Paragraph 2 is somewhat confusing to the applicant. In the DES it states that the NRC staff finds the preoperational environmental monitoring program acceptable as presented; however, it states that the NRC staff's position is that 40 dosimetry stations should be placed in each of the 16 sectors of the inner and outer rings. The remaining 8 stations should be placed at special interest areas.

The intent is not clear for the applicant fully meets the intent of this position. Thirteen of the radial sectors are located on Lake Erie. This eliminates the possibility of installing 13 dosimetry stations. Eliminating a proportionate number of the special stations to be installed accounts for 3 more stations. From the 40 stations mentioned by the NRC staff subtracting the 16 stations eliminated by Lake Erie, leaves 24 stations for installation which the applicant has met.

The DES should be more clear and less confusing.

26. Page 6-2, Table 6.1, Line 3

The number of "22 million/yr" is low. It should be 22.9 million/yr as referenced in section 5.8.1.

27. Page D-1, Section 2, Paragraph 4, Line 3

The DES on Line 3 states that meteorological considerations are discussed in Section 2.4. It is not clear what document is being referenced since neither the DES nor ER-OL Section 2.4 discusses meteorology.

28. Page D-4, Table D-1, Line 27

Off-gas building vent release for Cs-136 should read ".000002" and not ".000000."

29. Page D-12, Table D-9

See Comment 21 on the "43 person-rems" number used by the NRC staff.

14/T/5/ba

May 10, 1982

U.S. Nuclear Regulatory Commission
Washington, D.C. 20555
ATTN: Director, Division of Licensing

RE: OCRE COMMENTS ON DES FOR PERRY NUCLEAR POWER PLANT, DOCKET NOS. 50-440/441. (NUREG-0884)

Ohio Citizens for Responsible Energy ("OCRE"), an Intervenor in the operating license proceeding before the Atomic Safety and Licensing Board for the Perry Nuclear Power Plant, hereby files its comments on the Draft Environmental Statement for Perry, NUREG-0884.

First, OCRE requests that the comment period on the DES be extended for the convenience of the public. Since this is one of the few instances in which the NRC has invited public comment in its review of the Perry facility, OCRE feels that the public should be accomodated to the fullest extent possible.

COMMENTS

1. OCRE disagrees that an analysis of production costs (DES Sec. 2.2) shows a strong economic justification for operation of the facility because the capacity factors used by both Staff and Applicant in the analyses are unrealistic. Based on the operating experience of the two CAPCO nuclear plants in operation, Davis-Besse and Beaver Valley, OCRE suggests using a capacity factor of 35%. Using this figure in the cost analysis would result in savings if PNPP is not operated and the same quantity of electricity were generated using coal.

2. The NRC also considers the diversity of fuel supply provided by the operation of PNPP to be a factor favoring its operation. The only problem foreseen that could cause a fuel shortage is a strike by coal miners. Such strikes could easily be averted by providing better wages and working conditions for miners. OCRE suggests that the $4 billion plus invested in PNPP could have been better spent in that manner; OCRE does not believe in investing in technology at the expense of humanity.

3. As far as the NRC's contention that operation of both PNPP units will result in "significant cost savings for area customers" (DES at p. 2-5), OCRE would suggest that the NRC explain their view to the public at the next rate hike hearing. A 17% rate hike request by CEI is currently pending before the PUCO; this is the first (but undoubtedly not the last) such rate hike to include the costs of Perry.

4. OCRE disagrees with the statement (p. 3-1, second footnote) that there have been no changes in alternative energy sources since the publication of the FES-CP. The FES-CP was released in 1974; to say that there have been no

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advances in alternative energy technology since 1974 is totally absurd. The NRC also does not seem to consider conservation to be a viable alternative to energy consumption and the construction of additional generating facilities. Conservation is the most important alternative. The Applicant could encourage conservation by the use of innovative pricing structures, e.g., time of day pricing. Unfortunately, the Applicant has encouraged the increased use of electricity through their rate structures, promotional advertising, and by providing lower rates to those owning all-electric homes.

5. Section 5.9.4.1.4.6, Risk Considerations, is deficient in several respects. First, the attempted comparision of the economic risks of nuclear accidents to the risks of accidents, and continual emissions, from the use of fossil fuels to generate electricity neglects several important differences. A fossil fuel generating plant does not accumulate the fission product inventory present in nuclear plants. An accident at a coal plant would never require evacuation of the public, as no danger of prompt fatalities would exist. The continual emissions of sulfur dioxide and nitrogen oxides which can cause acid rain can be controlled through the use of scrubbers. Utilities, however, have resisted the installation of such equipment at their fossil fuel plants.

   Secondly, OCRE considers the comparision of nuclear risks to other accident risks encountered by the public to be reprehensible. People engaging in activities involving risk such as driving automobiles, flying in airplanes, using firearms, smoking cigarets, etc. do so voluntarily with an understanding of the risks involved and perhaps even some degree of control over them. The Perry Nuclear Power Plant was forced upon the people of Northeast Ohio without their knowledge or consent. The people did not ask the Applicant to build a nuclear plant at Perry. There is still no significant unbiased national debate or educational program on the full risks of nuclear power (nor are these risks fully known, even to the experts). The public participation afforded by the NRC's licensing process has been ineffective, largely due to the vast economic inequities between the parties involved. The public is forced to either accept living near a nuclear plant such as Perry, or move away. Obviously not everyone is in a position to do so.

6. OCRE considers the relationship between short-term uses and long-term productivity (Sec. 6.3) to be a crucial issue of the nuclear power debate. The 2 Perry units will cost at least $4 billion, and will have a lifetime of 40 years, if that. This lifetime is limited by physical factors, i.e., the severe environment, with neutron activation and embrittlement of components and radiation-induced degradation of materials, found in nuclear reactors.

In comparision, fossil fuel plants do not have this severe radiation environment, and can be expected to operate for a much longer time. For example, the Painesville Municipal Light Plant is around 100 years old and is still operating. Of course, equipment and components have had to be replaced over that time, but this could be done quickly and easily without exposing workers to radiation. Fossil fuel plants are also more efficient in their conversion of chemical energy to electricity. Therefore, fossil fuel generation of electricity is advantageous from the viewpoint of the most efficient use of resources. Fossil fuel plants also do not produce radioactive wastes or require decommissioning after their useful life has ended. Fossil fuels, particularly coal, do not require the energy-intensive refinement process necessary for uranium. The 3 gaseous diffusion plants in the United States use more electricity than the entire continent of Australia. One might question whether the energy spent in enriching uranium for use in reactors is ever recovered in the operation of the reactors.

Other alternatives, e.g., solar, wind, hydroelectric, and conservation, are even more superior to nuclear than is coal in terms of commitment of resources and long-term productivity. A complete comparision of alternatives would indicate that the operation of PNPP is the least desirable option.

7. OCRE contends that the analysis of occupational radiation exposure for BWRs (Sec. 5.9.3.1.1) is faulty because it neglects the newest data which shows that occupational radiation exposure in nuclear power plants is increasing dramatically. Average exposures at BWRs rose 55% in 1980, from 733 to 1136 person-rems (Critical Mass Energy Journal, Oct./Nov. 1981, pp. 8-9).

8. OCRE questions the projected population growth around PNPP given in Sec. 4.3.1. Lake County is characterized as having slow population growth. The undersigned OCRE Representative, having been a life-long resident of Lake County, strongly disagrees with that statement; on the contrary, Lake County has experienced great growth in recent years. The eastern end of the county especially is now the site of increasing commercialization. It is the areas in closest proximity to the Perry plant which are now experiencing the greatest growth. The Madison area especially (which is down-wind from PNPP) is growing rapidly. OCRE believes that the plant is located too close to populated areas, and special emergency preparedness may be needed, or PNPP should operate at lower power levels. Of course, the latter option would make PNPP even less competitive with alternatives.

OCRE has many other differences with the Staff's analysis in NUREG-0884. However, since OCRE's objections are too numerous to pursue herein, and since most of these objections relate more to the NRC's methodology than to the specifics of the PNPP facility, OCRE will pursue other routes in addressing these concerns.

Respectfully submitted,

Susan L. Hiatt

Susan L. Hiatt
OCRE Representative
8275 Munson Rd.
Mentor, OH 44060

Ohio EPA

May 10, 1982

RECEIVED MAY 14 1982

Director
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Re: Draft Environmental Statement related to the operation of the Perry Nuclear Power Plant, Units 1 and 2

Dear Sir:

The Ohio Environmental Protection Agency (Ohio EPA) has completed review of the above statement. At this time the Agency has no comments which would result in changes in the content of the document. The Agency will have a major responsibility for this project in the determination of the effluent limits for the Perry Nuclear Power Plant's National Pollutant Discharge Elimination System (NPDES) permit.

The use of closed-cycle cooling systems at Perry will most likely be considered as Best Available Technology for the reduction of thermal discharges. The Agency presently believes that there should not be any need for operational monitoring of the thermal discharge , i.e. a 316(a) demonstration, at this facility.

As stated in the DES, the Perry Nuclear Power Plant will use an off-shore intake to provide make-up water for its closed-cycle cooling systems. An intake of this design generally results in minimal impact to aquatic biota. However, Ohio EPA is considering requirement of a one-year 316(b) study to verify the extent of the operational impact of the cooling water intake.

All non-radiological monitoring requirements for discharge parameters and the status of 316(a) and 316(b) requirements for the Perry Nuclear Power Plants will be addressed in the NPDES permit. Any questions regarding the NPDES Permit for Perry should be addressed to Mr. Robert E. Phelps, Manager, Industrial Wastewater Section, Division of Wastewater Pollution Control.

Very truly yours,

Wayne S. Nichols
Director

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cc: Reading File

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State of Ohio Environmental Protection Agency
361 E. Broad St. Columbus Ohio 43216-1049 (614) 466-8565

James A. Rhodes, Governor
Wayne S. Nichols, Director

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Food and Drug Administration
Rockville MD 20857

MAY 14 1982

Mr. John J. Stefano
Licensing Project Manager
Office of Nuclear Reactor Regulations
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Stefano:

The Bureau of Radiological Health staff have reviewed the Draft Environmental Statement (DES) related to the operation of Perry Nuclear Power Plant, Unit 1 and 2, NUREG-0884, dated March 1982.

In reviewing the DES, we note that (1) the application for a construction permit was received in 1973, (2) the Final Environmental Statement - Construction Phase was issued in April 1974, (3) the construction permit was not issued until May 1977, and (4) as of January 1982, the construction of Unit 1 was 82 percent complete and Unit 2 was 41 percent complete. The Bureau of Radiological Health staff have reevaluated the public health and safety impacts associated with the proposed operation of the plant and have the following comments to offer:

1. The design specifications of 10 CFR 50, Appendix 1, EPA's 40 CFR 190, and the applicant's proposed radioactive waste management system (Section 4.2.5), provide adequate assurance that radioactive materials in the effluents will be maintained as low as reasonably achievable (ALARA). It appears that the calculated doses to individuals and to the population resulting from effluent releases are within current radiation protection standards.

2. The environmental pathways identified in Section 5.9.3 and Figure 5.2, cover all possible emission pathways that could impact on the population in the environs of the facility. The dose computational methodology and models (Appendix B and D) used in the estimation of radiation doses to individuals and to populations within 80 km. of the plant have provided the means to make reasonable estimates of the doses resulting from normal operations and accident situations at the facility. Results of the calculations are shown in Appendix D, Tables D-6, D-7, D-8 and D-9. These results confirm that the doses meet the design objectives.

3. The discussions in Section 5.9.4 on the environmental impact of postulated accidents is considered to be an adequate assessment of the radiation exposure pathways depicted in Figure 5.2 and the dose and health impacts of atmospheric releases. We will forego comments on the emergency preparedness aspects (Section 5.9.4.1.3.3) since we realize the process of granting an operating license to the facility will include review of emergency preparedness to include the adequacy of State and local government emergency response plans (FEMA-NRC Memorandum of Understanding, Regions RAC's criteria in NUREG-0654). We have representation on the RAC's whose evaluation relative to the Perry Nuclear Power Plant will speak for this agency.

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It is noted in Section 5.12, that a Technical Support Center (TSC) and an Emergency Operation Facility (EOF) have been located on-site to coordinate activities needed to mitigate the consequences of accidents. Some mention of these facilites should be included in Section 5.9.4 to indicate one of the positive steps that the NRC has taken to improve reactor safety as a result of the TMI-2 accident.

4. The radiological monitoring program, as presented in Section 5.9.3.4 and summarized in Table 5.5, appears to provide adequate sampling frequency in expected critical exposure pathways. Analyses for specific radionuclides are considered sufficiently inclusive to (1) measure the extent of emissions from the plant, and (2) verify that such emissions meet applicable radiation protection standards.

   Although adequate for operational monitoring, the program should be assessed to determine if it is adequate to meet the needs imposed on it in the event of an accident. In particular, we suggest reevaluation of the airborne radioiodine sampling analysis program. Possibly, it should be modified to address the problem of monitoring radiohalogens (especially radioiodine) in the presence of radionoble gases. This could be accomplished by reference to FEMA-REP-2, a document on instrumentation systems prepared with considerable input from NRC. A paragraph could be added at the end of Section 5.9.3.4.2 that addresses this issue. Such a discussion would provide assurance that the monitoring problems identified during the TMI-2 accident are recognized, and that positive steps have been taken to provide the instrumentation needed to adequately detect releases of radiohalogens under accident conditions.

5. Section 5.10 and Appendix C contain descriptions of the environmental impact of the Uranium Fuel Cycle (UFC). The environmental effects presented are a reasonable assessment of the population dose commitments and health effects associated with the release of radon-222 from the UFC.

Thank you for the opportunity to review and comment on this Draft Environmental Statement.

Sincerely yours,

John C. Villforth
Director
Bureau of Radiological Health

1104 East 15th Street
Ashtabula, Ohio 44004
May 23, 1982

U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, D. C. 20555

RE: Draft Environmental Statement Perry Nuclear Power Plant Units 1 & 2
Docket Nos. 50-440 & 50-441 CEI

Gentlemen:

As a landowner and prospective farmer within the 10 mile radius of the Perry nuclear power plant, as a graduate of Ohio State University College of Agriculture, with course work directly relating to the operation of the Perry nuclear plant ie. soil chemistry, dairy science, forestry, ornithology, genetics, reproductive physiology, physics & monogastric nutrition; as a former Peace Corps. volunteer in Nepal - a culture in which human values are placed above economic (witness Alara) as a small businessman engaged in trying to improve & beautify the environment (and make a small profit) with landscaping, as a student for the past 4 years, educating myself in the construction and operation of nuclear power plants, and most importantly as a father of two - soon to be three, I feel it is my moral obligation, and responsibility to comment on the draft environmental statement.

1. General

If you permit CEI and the other members of Capco to operate Perry you will be:

1. condoning their waging of nuclear warfare on their own ratepayers. The atmospheric & liquid emissions differ only in amount, not kind, from those of a nuclear explosion.

2. Abrogating, denying & encourgaging the destruction of the rights of "life, liberty, and the pursuit of happiness" as formulated in the Declaration of Independence.

Witness: Known effects of low level radiation with resulting cancer, infant mortality, death & genetic mutation.

: Implied deaths, immediate and delayed, resulting from "normal" operation of the plant (pg. 5-20-21) (DE3)

: Unknown number of deaths from an almost certain catastropic "accident" either at Perry or at another nuclear plant.

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3. The denial of the security of one's home and prevention of unlawful seizure as guaranteed by the constitution of the United States.

   Witness: Huge chunks of American landscape rendered uninhabitable, perhaps forever as a result of an accident. Crops and food stuffs would be confiscated and destroyed. Water supplies made poisonous, homes, businesses, farms and orchards contaminated perhaps to the point where they would never again produce anything usable by any living thing - plant, animal or human. All but a small fraction uncompensated because of the Price/Anderson Act.

4. You personally will be responsible for the deaths and suffering which real human beings will suffer if this plant goes into operation - now and forever.

II. Specifics

1. Electrical demand has plummeted in the Capco area resulting in no need for Perry. As I understand it (from newspaper articles) the power generated at Perry is to be used elsewhere, making your entire Sec. 2 analysis false. Most of the economic costs have been sunk - by CEI - the public has not yet begun to pay.

2. Sec. 3 you are correct in stating; "it is not rational to consider different sites, dramatic plant modifications, or the construction of new & different energy sources or alternatives....unless a compelling safety or environmental concern which was not evident during the construction permit is discovered". Fortunately, compelling concerns have been "discovered".

   TMI - 2
   GINNA
   BIER III
   SECRET FALLOUT - Ernest Sternglass
   NUCLEAR WITNESS
   CANCER MORTALITY CHANGES AROUND NUCLEAR FACILITIES IN CONNECTICUT - Sternglass
   VOICES FROM THREE MILE ISLAND - Robert Leppzer
   etc. etc. etc.

   It is only rational to consider the new (?) evidence and blatantly immoral & criminal to ignore it.

3. The estimated releases from Perry (air & water) are too low, probably by a factor of 10. When Dr. Sternglass was informed of the material you republish in the DES concerning radioactive releases, he laughingly said they will be on the order of 300,000 - 900,000 @/year. Therefore your estimates of deaths, cancer & mutations are conveniently underestimated.

4. Nuclear plants produce about 169 Radionucides. You have not considered about 2/3 of the fission products in your dose estimates (list pg. 5-36-37 tables D-4 & D-7) in which I count-only 60.

   Your lists are simply Perry FSAR (pg. 35-37) material reprinted, compiled originally by CEI. I thought that you are the regulators - do the operators of nuclear plants now set standards for themselves ?

5. Your methodology for estimating internal dose commitments due to consumption of locally grown produce and meat are horrendous. Many people in this area either grow most of their own fresh vegetables, eggs, honey, milk, meat & fruit or buy a majority of it locally. Every element from hydrogen to calcium to carbon, used by living beings will be released as a radioactive poison from perry. (See Perry FSAR & METHODOLOGIES FOR THE STUDY OF LOW-LEVEL RADIATION IN THE MIDWEST - Dr. Charles Hulver & Land/Leaf Research Team.

6. If I understand appendix E correctly, "Rebaselining of RSS Results for BWR's", you have increased the probability and severity of accidents for BWR's as a result of TMI-2. The accident sequences listed all result in over pressurizing and breaching of containment accompanied by coremelt - lovely. These sequences are especially significant for Perry because the containment is a prototype and remains substantially untested.

For the above reasons I believe the DES is largely a very poorly reasoned and documented apology for an already accomplished decision. The facts are altered, and any contrary evidence is either buried or ignored.

Respectfully Submitted,

Stephen Sass

Stephen Sass

in behalf of: Sally, Sarah Marie, Nicholas and the unborn Sasses

APPENDIX B

NEPA POPULATION-DOSE ASSESSMENT

APPENDIX B

NEPA POPULATION-DOSE ASSESSMENT

Population-dose commitments are calculated for all individuals living within 80 km (50 mi) of the PNPP facility, employing the same dose calculation models used for individual doses (see Regulatory Guide 1.109, Revision 1), for the purpose of meeting the "as low as reasonably achievable" (ALARA) requirements of 10 CFR 50, Appendix I. In addition, dose commitments to the population residing beyond the 80-km region, associated with the export of food crops produced within the 80-km region and with the atmospheric and hydrospheric transport of the more mobile effluent species, such as noble gases, tritium, and carbon-14, are taken into consideration for the purpose of meeting the requirements of the National Environmental Policy Act, 1969 (NEPA). This appendix describes the methods used to make these NEPA-population dose estimates.

1. Iodines and Particulates Released to the Atmosphere

Effluent nuclides in this category deposit onto the ground as the effluent moves downwind; thus the concentration of these nuclides remaining in the plume is continuously being reduced. Within 80 km of the facility, the deposition model in Regulatory Guide 1.111, Revision 1, is used in conjunction with the dose models in Regulatory Guide 1.109, Revision 1. Site-specific data concerning production and consumption of foods within 80 km of the reactor are used. For estimates of population doses beyond 80 km it is assumed that excess food not consumed within the 80-km area would be consumed by the population beyond 80 km. It is further assumed that none, or very few, of the particulates released from the facility will be transported beyond the 80-km distance; thus, they will make no significant contribution to the population dose outside the 80-km region, except by export of food crops. This assumption was tested and found to be reasonable for PNPP.

2. Noble Gases, Carbon-14, and Tritium Released to the Atmosphere

For locations within 80 km of the reactor facility, exposures to these effluents are calculated with a constant mean wind-direction model according to the guidance provided in Regulatory Guide 1.111, Revision 1, and the dose models described in Regulatory Guide 1.109, Revision 1. For estimating the dose commitment from these radionuclides to the U.S. population residing beyond the 80-km region, two dispersion regimes are considered. These are referred to as the first-pass-dispersion regime and the worldwide-dispersion regime. The model for the first-pass-dispersion regime estimates the dose commitment to the population from the radioactive plume as it leaves the facility and drifts across the continental United States toward the northeastern corner of the U.S. The model for the worldwide-dispersion regime estimates the dose commitment to the U.S. population after the released radionuclides mix uniformly in the world's atmosphere or oceans.

(a) First-Pass Dispersion

For estimating the dose commitment to the U.S. population residing beyond the 80-km region as a result of the first pass of radioactive pollutants, it is assumed that the pollutants disperse in the lateral and vertical directions along the plume path. The direction of movement of the plume is assumed to be from the facility toward the northeast corner of the U.S. The extent of vertical dispersion is assumed to be limited by the ground plane and the stable atmospheric layer aloft, the height of which determines the mixing depth. The shape of such a plume geometry can be visualized as a right cylindrical wedge whose height is equal to the mixing depth. Under the assumption of constant population density, the population dose associated with such a plume geometry is independent of the extent of lateral dispersion, and is only dependent upon the mixing depth and other nongeometrical related factors (NUREG-0597). The mixing depth is estimated to be 1000 m, and a uniform population density of 62 persons/ km^2 is assumed along the plume path, with an average plume-transport velocity of 2 m/sec.

The total-body population-dose commitment from the first pass of radioactive effluents is due principally to external exposure from gamma-emitting noble gases, and to internal exposure from inhalation of air containing tritium and from ingestion of food containing carbon-14 and tritium.

(b) Worldwide Dispersion

For estimating the dose commitment to the U.S. population after the first-pass, worldwide dispersion is assumed. Nondepositing radionuclides with half-lives greater than 1 year are considered. Noble gases and carbon-14 are assumed to mix uniformly in the world's atmosphere (3.8×10^{18} m^3), and radioactive decay is taken into consideration. The worldwide-dispersion model estimates the activity of each nuclide at the end of a 15-year release period (midpoint of reactor life) and estimates the annual population-dose commitment at that time, taking into consideration radioactive decay and physical removal mechanisms (for example, C-14 is gradually removed to the world's oceans). The total-body population-dose commitment from the noble gases is due mainly to external exposure from gamma-emitting nuclides, whereas from carbon-14 it is due mainly to internal exposure from ingestion of food containing carbon-14.

The population-dose commitment as a result of tritium releases is estimated in a manner similar to that for carbon-14, except that after the first pass, all the tritium is assumed to be immediately distributed in the world's circulating water volume (2.7×10^{16} m^3) including the top 75 m of the seas and oceans, as well as the rivers and atmospheric moisture. The concentration of tritium in the world's circulating water is estimated at the time after 15 years of releases have occurred, taking into consideration radioactive decay; the population-dose commitment estimates are based on the incremental concentration at that time. The total-body population-dose commitment from tritium is due mainly to internal exposure from the consumption of food.

3. Liquid Effluents

Population-dose commitments from effluents in the receiving water within 80 km of the facility are calculated as described in Regulatory Guide 1.109, Revision 1. It is assumed that no depletion by sedimentation of the nuclides present in the receiving water occurs within 80 km. It also is assumed that aquatic biota concentrate radioactivity in the same manner as was assumed for the ALARA evaluation for the maximally exposed individual. However, food-consumption values appropriate for the average, rather than the maximum, individual are used. It is further assumed that all the sport and commercial fish and shellfish caught within the 80-km area are eaten by the U.S. population.

Beyond 80 km, it is assumed that all the liquid-effluent nuclides except tritium have deposited on the sediments so that they make no further contribution to population exposures. The tritium is assumed to mix uniformly in the world's circulating water volume and to result in an exposure to the U.S. population in the same manner as discussed for tritium in gaseous effluents.

4. References

U.S. Nuclear Regulatory Commission, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Regulatory Guide 1.109, Revision 1, October 1977.

---, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Reactors," Regulatory Guide 1.111, Revision 1, July 1977.

---, NUREG-0597, K. F. Eckerman, et al., "User's Guide to GASPAR Code," June 1980.

APPENDIX C

IMPACTS OF THE URANIUM FUEL CYCLE

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IMPACTS OF THE URANIUM FUEL CYCLE

The following assessment of the environmental impacts of the LWR-supporting fuel cycle as related to the operation of the proposed project is based on the values given in Table S-3 (see Section 5.10 of the main body of this report) and the NRC staff's analysis of the radiological impact from radon and technetium releases. For the sake of consistency, the analysis of fuel-cycle impacts has been cast in terms of a model 1000-MWe light-water-cooled reactor (LWR) operating at an annual capacity factor of 80%. In the following review and evaluation of the environmental impacts of the fuel cycle, the staff's analysis and conclusions would not be altered if the analysis were to be based on the net electrical power output of the Perry Nuclear Power Plant (PNPP) facility.

1. Land Use

The total annual land requirement for the fuel cycle supporting a model 1000-MWe LWR is about 460,000 m^2 (113 acres). Approximately 53,000 m^2 (13 acres) per year are permanently committed land, and 405,000 m^2 (100 acres) per year are temporarily committed. (A "temporary" land commitment is a commitment for the life of the specific fuel-cycle plant, such as a mill, enrichment plant, or succeeding plants. On abandonment or decommissioning, such land can be used for any purpose. "Permanent" commitments represent land that may not be released for use after plant shutdown and/or decommissioning.) Of the 405,000 m^2 per year of temporarily committed land, 320,000 m^2 are undisturbed and 90,000 m^2 are disturbed. Considering common classes of land use in the United States,* fuel-cycle land-use requirements to support the model 1000-MWe LWR do not represent a significant impact.

2. Water Use

The principal water-use requirement for the fuel cycle supporting a model 1000-MWe LWR is that required to remove waste heat from the power stations supplying electrical energy to the enrichment step of this cycle. Of the total annual requirement of 43×10^6 m^3 (11.4×10^9 gal), about 42×10^6 m^3 are required for this purpose, assuming that these plants use once-through cooling. Other water uses involve the discharge to air (for example, evaporation losses in process cooling) of about 0.6 x 106 m^3 (16×10^7 gal) per year and water discharged to the ground (for example, mine drainage) of about 0.5×10^6 m^3 per year.

On a thermal effluent basis, annual discharges from the nuclear fuel cycle are about 4% of those from the model 1000-MWe LWR using once-through cooling. The consumptive water use of 0.6×10^6 m^3 per year is about 2% of that from the

*A coal-fired plant of 1000-MWe capacity using strip-mined coal requires the disturbance of about 810,000 m^2 (200 acres) per year for fuel alone.

model 1000-MWe LWR using cooling towers. The maximum consumptive water use (assuming that all plants supplying electrical energy to the nuclear fuel cycle used cooling towers) would be about 6% of the model 1000-MWe LWR using cooling towers. Under this condition, thermal effluents would be negligible. The staff finds that these combinations of thermal loadings and water consumption are acceptable relative to the water use and thermal discharges of the proposed project.

3. Fossil Fuel Consumption

Electrical energy and process heat are required during various phases of the fuel cycle process. The electrical energy is usually produced by the combustion of fossil fuel at conventional power plants. Electrical energy associated with the fuel cycle represents about 5% of the annual electrical power production of the model 1000-MWe LWR. Process heat is primarily generated by the combustion of natural gas. This gas consumption, if used to generate electricity, would be less than 0.3% of the electrical output from the model plant. The staff finds that the direct and indirect consumptions of electrical energy for fuel-cycle operations are small and acceptable relative to the net power production of the proposed project.

4. Chemical Effluents

The quantities of chemical, gaseous, and particulate effluents associated with fuel-cycle processes are given in Table S-3. The principal species are sulfur oxides, nitrogen oxides, and particulates. On the basis of data in a Council on Environmental Quality report (1976), the staff finds that these emissions constitute an extremely small additional atmospheric loading in comparison with the same emissions from the stationary fuel-combustion and transportation sectors in the United States; that is, about 0.02% of the annual national releases for each of these species. The staff believes that such small increases in releases of these pollutants are acceptable.

Liquid chemical effluents produced in fuel cycle processes are related to fuel-enrichment, -fabrication, and -reprocessing operations and may be released to receiving waters. These effluents are usually present in dilute concentrations such that only small amounts of dilution water are required to reach levels of concentration that are within established standards. The flow of dilution water required for specific constituents is specified in Table S-3. Additionally, all liquid discharges into the navigable waters of the United States from plants associated with the fuel-cycle operations will be subject to requirements and limitations set forth in the NPDES Permit.

Tailings solutions and solids are generated during the milling process. These solutions and solids are not released in quantities sufficient to have a significant impact on the environment.

5. Radioactive Effluents

Radioactive effluents estimated to be released to the environment from reprocessing and waste-management activities and certain other phases of the fuel-cycle process are set forth in Table S-3. Using these data, the staff has calculated for 1 year of operation of the model 1000-MWe LWR, the 100-year involuntary environmental dose commitment* to the U.S. population from the LWR-supporting fuel cycle.

It is estimated from these calculations that the overall involuntary total-body gaseous dose commitment to the U.S. population from the fuel cycle (excluding reactor releases and the dose commitment due to radon-222 and technetium-99) would be approximately 400 person-rems for each year of operation of the model 1000-MWe LWR (reference reactor year, or RRY). Based on Table S-3 values, the additional involuntary total-body dose commitments to the U.S. population from radioactive liquid effluents (excluding technetium-99) as a result of all fuel-cycle operations other than reactor operation would be about 100 person-rems per year of operation. Thus, the estimated involuntary 100-year environmental dose commitment to the U.S. population from radioactive gaseous and liquid releases due to these portions of the fuel cycle is about 500 person-rems (whole-body) per RRY.

At this time the radiological impacts associated with radon-222 and technetium-99 releases are not addressed in Table S-3. Principal radon releases occur during mining and milling operations and as emissions from mill tailings; whereas principal technetium-99 releases occur from gaseous diffusion enrichment facilities. The staff has determined that radon-222 releases per RRY from these operations are as given in Table C-1. The staff has calculated population-dose commitments for these sources of radon-222 using the RABGAD computer code described in Volume 3 of NUREG-0002, Appendix A, Chapter IV, Section J. The results of these calculations for mining and milling activities prior to tailings stabilization are listed in Table C-2.

When added to the 500 person-rem total-body dose commitment for the balance of the fuel cycle, the overall estimated total-body involuntary 100-year environmental dose commitment to the U.S. population from the fuel cycle for the model 1000-MWe LWR is approximately 640 person-rems. Over this period of time, this dose is equivalent to 0.00002% of the natural-background total-body dose of about 3 billion person-rems to the U.S. population.**

The staff has considered the health effects associated with the releases of radon-222, including both the short-term effects of mining and milling, and active tailings, and the potential long-term effects from unreclaimed open-pit mines and stabilized tailings. The staff has assumed that after completion of active mining, underground mines will be sealed, returning releases of radon-222 to background levels. For purposes of providing an upper bound impact assessment, the staff has assumed that open-pit mines will be unreclaimed and has calculated that if all ore were produced from open-pit mines, releases from them would be 110 Ci per RRY. However, because the distribution of uranium-ore reserves available by conventional mining methods is 66% underground and 34% open pit (U.S. Department of Energy), the staff has further assumed that uranium to fuel LWRs will be produced by conventional mining methods in these proportions. This means that long-term releases from unreclaimed open-pit mines will be 0.34 x 110 or 37 Ci per year per RRY.

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*Based on an annual average natural-background individual dose commitment of 100 millirems and a stabilized U.S. population of 300 million.

**The 100-year environmental dose commitment is the integrated population dose for 100 years; that is, it represents the sum of the annual population doses for a total of 100 years.

Table C-1 Radon releases from mining and milling operations and mill tailings for each year of operation of the model 1000-MWe LWR*

Radon source	Quantity released
Mining**	4060 Ci
Milling and tailings*** (during active mining)	780 Ci
Inactive tailings*** (before stabilization)	350 Ci
Stabilized tailings*** (several hundred years)	1 to 10 Ci/year
Stabilized tailings*** (after several hundred years)	110 Ci/year

*After three days of hearings before the Atomic Safety and Licensing Appeal Board (ASLAB) using the Perkins record in a "lead case" approach, the ASLAB issued a decision on May 13, 1981 (ALAB-640) on the radon-222 release source term for the uranium fuel cycle. The decision, among other matters, produced new source term numbers based on the record developed at the hearings. These new numbers did not differ significantly from those in the Perkins record which are the values set forth in this table. Any health effects relative to radon-222 are still under consideration before the ASLAB. Because the source term numbers in ALAB-640 do not differ significantly from those in the Perkins record, the staff continues to conclude that both the dose commitments and health effects of the uranium fuel cycle are insignificant when compared to dose commitments and potential health effects to the U.S. population resulting from all natural background sources. Subsequent to ALAB-640, a second ASLAB decision (ALAB-654, issued September 11, 1981) permits intervenors a 60-day period to challenge the Perkins record on the potential health effects of radon-222 emissions.

**R. Wilde, NRC transcript of direct testimony given "In the Matter of Duke Power Company (Perkins Nuclear Station)," Docket No. 50-488, April 17, 1978.

***P. Magno, NRC transcript of direct testimony given "In the Matter of Duke Power Company (Perkins Nuclear Station)" Docket No. 50-488, April 17, 1978.

Based on the above, the radon released from unreclaimed open-pit mines over 100- and 1000-year periods would be about 3700 Ci and 37,000 Ci per RRY, respectively. The total dose commitments for a 100- to 1000-year period would be as shown in Table C-3.

These commitments represent a worst-case situation in that no mitigating circumstances are assumed. However, state and Federal laws currently require reclamation of strip and open-pit coal mines, and it is very probable that

Table C-2 Estimated 100-year environmental dose commitment per year of operation of the model 1000-MWe LWR

Radon source	Radon-222 releases (Ci)	Dosage (person-rems)		
		Total body	Bone	Lung (bronchial epithelium)
Mining	4100	110	2800	2300
Milling and active tailings	1100	29	750	620
Total	5200	140	3600	2900

Table C-3 Population-dose commitments from unreclaimed open-pit mines for each year of operation of the model 1000-MWe LWR

Time span (years)	Radon-222 releases (Ci)	Population dose commitments (person-rems)		
		Total body	Bone	Lung (bronchial epithelium)
100	3,700	96	2,500	2,000
500	19,000	480	13,000	11,000
1,000	37,000	960	25,000	20,000

similar reclamation will be required for open-pit uranium mines. If so, long-term releases from such mines should approach background levels.

For long-term radon releases from stabilized tailings piles, the staff has assumed that these tailings would emit, per RRY, 1 Ci per year for 100 years, 10 Ci per year for the next 400 years, and 100 Ci per year for periods beyond 500 years. With these assumptions, the cumulative radon-222 release from stabilized-tailings piles per RRY would be 100 Ci in 100 years, 4090 Ci in 500 years, and 53,800 Ci in 1000 years (Gotchy). The total-body, bone, and bronchial epithelium dose commitments for these periods are as shown in Table C-4.

Using risk estimators of 135, 6.9, and 22 cancer deaths per million person-rems for total-body, bone, and lung exposures, respectively, the estimated risk of cancer mortality resulting from mining, milling, and active-tailings emissions of radon-222 is about 0.11 cancer fatality per RRY. When the risk from radon-222 emissions from stablized tailings over a 100-year release period is added, the estimated risk of cancer mortality over a 100-year period is unchanged. Similarly, a risk of about 1.2 cancer fatalities per RRY is estimated over a

Table C-4 Population-dose commitments from stabilized-tailings piles for each year of operation of the model 1000-MWe LWR

		Population dose commitments (person-rems)		
Time span (years)	Radon-222 releases (Ci)	Total body	Bone	Lung (bronchial epithelium)
100	100	2.6	68	56
500	4,090	110	2,800	2,300
1,000	53,800	1,400	37,000	30,000

1000-year release period. When potential radon releases from reclaimed and unreclaimed open-pit mines are included, the overall risks of radon-induced cancer fatalities per RRY range as follows:

0.11 to 0.19 fatality for a 100-year period
0.19 to 0.57 fatality for a 500-year period
1.2 to 2.0 fatalities for a 1000-year period

To illustrate: a single model 1000-MWe LWR operating at an 80% capacity factor for 30 years would be predicted to induce between 3.3 and 5.7 cancer fatalities in 100 years, 5.7 and 17 in 500 years, and 36 and 60 in 1000 years as a result of releases of radon-222.

These doses and predicted health effects have been compared with those that can be expected from natural-background emissions of radon-222. Using data from the National Council on Radiation Protection and Measurements (NCRP), the staff calculates 100-year environmental dose commitment to the U.S. population from the fuel cycle for the model 1000-MWe LWR is about 740 person-rems. Over this period of the average radon-222 concentration in air in the contiguous United States to be about 150 pCi/m^3, which the NCRP estimates will result in an annual dose to the bronchial epithelium of 450 millirems. For a stabilized future U.S. population of 300 million, this represents a total lung-dose commitment of 135 million person-rems per year. Using the same risk estimator of 22 lung-cancer fatalities per million person-lung-rems used to predict cancer fatalities for the model 1000 MWe LWR, the staff estimates that lung-cancer fatalities alone from background radon-222 in the air can be calculated to be about 3000 per year, or 300,000 to 3,000,000 lung-cancer deaths over periods of 100 to 1000 years, respectively.

The staff is currently in the process of formulating a specific model for analyzing the potential impact and health effects from the release of technetium-99 during the fuel cycle. However, for the interim period until the model is completed, the staff has calculated that the potential 100-year environmental dose commitment to the U.S. population from the release of technetium-99 should not exceed 100 person-rems per RRY. These calculations are based on the gaseous and the hydrological pathway model systems described in Volume 3 of NUREG-0002,

Chapter IV, Section J, Appendix A. When these figures are added to the 640 person-rem total-body dose commitment for the balance of the fuel cycle, including radon-222, the overall estimated total-body involuntary time, this dose is equivalent to 0.00002% of the natural-background total-body dose of about 3 billion person-rems to the U.S. population.*

The staff also considered the potential health effects associated with this release of technetium-99. Using the modeling systems described in NUREG-0002, the major risks from technetium-99 are from exposure of the gastrointestinal tract and kidney, although there is a small risk from total-body exposure. Using organ-specific risk estimators, these individual organ risks can be converted to total-body risk equivalent doses. Then, by using the total-body risk estimator of 135 cancer deaths per million person-rems, the estimated risk of cancer mortality due to technetium-99 releases from the nuclear fuel cycle is about 0.01 cancer fatality per RRY over the subsequent 100 to 1000 years.

In addition to the radon- and technetium-related potential health effects from the fuel cycle, other nuclides produced in the cycle, such as carbon-14, will contribute to population exposures. It is estimated that an additional 0.08 to 0.12 cancer death may occur per RRY (assuming that no cure for or prevention of cancer is ever developed) over the next 100 to 1000 years, respectively, from exposures to these other nuclides.

The latter exposures can also be compared with those from naturally occurring terrestrial and cosmic-ray sources. These average about 100 millirems. Therefore, for a stable future population of 300 million persons, the whole-body dose commitment would be about 30 million person-rems per year, or 3 billion person-rems and 30 billion person-rems for periods of 100 and 1000 years, respectively. These natural-background dose commitments could produce about 400,000 and 4,000,000 cancer deaths during the same time periods. From the above analysis, the staff concludes that both the dose commitments and health effects of the LWR-supporting uranium fuel cycle are very small when compared with dose commitments and potential health effects to the U.S. population resulting from all natural-background sources.

6. Radioactive Wastes

The quantities of buried radioactive waste material (low-level, high-level, and transuranic wastes) associated with the uranium fuel cycle are specified in Table S-3. For low-level waste disposal at land-burial facilities, the Commission notes in Table S-3 that there will be no significant radioactive releases to the environment. The Commission notes that high-level and transuranic wastes are to be buried at a Federal repository and that no release to the environment is associated with such disposal. NUREG-0116, which provides background and context for the high-level and transuranic Table S-3 values established by the Commission, indicates that these high-level and transuranic wastes will be buried and will not be released to the biosphere. No radiological environmental impact is anticipated from such disposal.

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*Based on an annual average natural-background individual dose commitment of 100 mrems and a stablilized U.S. population of 300 million.

7. Occupational Dose

The annual occupational dose attributable to all phases of the fuel cycle for the model 1000-MWe LWR is about 200 person-rems. The staff concludes that this occupational dose will have a small environmental impact.

8. Transportation

The transportation dose to workers and the public is specified in Table S-3. This dose is small in comparison with the natural-background dose.

9. Fuel Cycle

The staff's analysis of the uranium fuel cycle did not depend on the selected fuel cycle (no recycle or uranium-only recycle), because the data provided in Table S-3 include maximum recycle-option impact for each element of the fuel cycle. Thus the staff's conclusions as to acceptability of the environmental impacts of the fuel cycle are not affected by the specific fuel cycle selected.

10. References

Atomic Safety and Licensing Appeal Board, ALAB-640, "AB Decisions," May 13, 1981.

---, ALAB-654, "AB Memorandum and Order," September 11, 1981.

Council on Environmental Quality, "The Seventh Annual Report of the Council on Environmental Quality," Figs. 11-27 and 11-28, pp. 238-239, September 1976.

Gotchy, R., testimony from "In the Matter of Duke Power Company (Perkins Nuclear Station)," U.S. Nuclear Regulatory Commission, Docket No. 50-488, filed April 17, 1978.

National Council on Radiation Protection and Measurements, "Natural Background Radiation in the United States," NCRP Report No. 45, November 1975.

U.S. Department of Energy, "Statistical Data of the Uranium Industry," GJO-100(8-78), January 1978.

U.S. Nuclear Regulatory Commission, NUREG-0002, "Final Generic Environmental Statement on the Use of Recycle Plutonium in Mixed Oxide Fuel in Light-Water-Cooled Reactors," August 1976.

---, NUREG-0116, "Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle" (Supplement 1 to WASH-1248), October 1976.

APPENDIX D

EXAMPLES OF SITE-SPECIFIC DOSE ASSESSMENT CALCULATIONS

APPENDIX D

EXAMPLES OF SITE-SPECIFIC DOSE ASSESSMENT CALCULATIONS

1. Calculational Approach

As mentioned in the main body of this report (Section 5.9) the quantities of radioactive material that may be released annually from the Perry Nuclear Power Plant (PNPP) facility are estimated on the basis of the description of the radwaste systems in the applicant's ER-OL and FSAR and by using the calculational models and parameters developed by the NRC staff in NUREG-0016 and NUREG-0017. These estimated effluent release values for normal operation, including anticipated operational occurrences, along with the applicant's site and environmental data in the ER-OL and in subsequent answers to NRC staff questions, are used in the calculation of radiation doses and dose commitments.

The models and considerations for environmental pathways that lead to estimates of radiation doses and dose commitments to individual members of the public near the plant and of cumulative doses and dose commitments to the entire population within an 80-km (50-mi) radius of the plant as a result of plant operations are discussed in detail in Regulatory Guide 1.109, Revision 1. Use of these models with additional assumptions for environmental pathways that lead to exposure to the general population outside the 80-km radius are described in Appendix B of this statement.

The calculations performed by the staff for the releases to the atmosphere and hydrosphere provide total integrated dose commitments to the entire population within 80 km of this facility based on the projected population distribution in the year 2000. The dose commitments represent the total dose that would be received over a 50-year period, following the intake of radioactivity for 1 year under the conditions existing 15 years after the station begins operation (that is, the midpoint of station operation). For younger persons, changes in organ mass and metabolic parameters with age after the initial intake of radioactivity are accounted for.

2. Dose Commitments From Radioactive Effluent Releases

The NRC staff's estimates of the expected gaseous and particulate releases (listed in Table D-1) along with the site meteorological considerations (summarized in Table D-2) were used to estimate radiation doses and dose commitments for airborne effluents. Individual receptor locations and pathway locations considered for the maximally exposed individual in these calculations are listed in Table D-3.

Annual relative concentration (χ/Q) and relative deposition (D/Q) values at specified points of interest and as functions of direction out to a distance of 80 km from PNPP, were calculated using the straight-line Gaussian atmospheric dispersion model described in Regulatory Guide 1.111, Revision 1, modified to reflect spatial and temporal variations in airflow. These modifications were

based on a comparison performed by the applicant between the results of the straight-line model and the results of variable-trajectory model for a 1-year period of record.

Because the elevation of the top of the main plant vent is below the elevation of the adjacent containment structures, and because of the nearby presence of the two large natural-draft cooling towers, all releases were considered as ground-level with mixing in the turbulent wake of plant structures. Intermittent releases were evaluated using the methodology described in NUREG-0324.

A composite 3-year period of record (May 1, 1972-April 30, 1974 and September 1, 1977-August 31, 1978) of onsite meteorological data was used for this evaluation. Wind speed and direction data were based on measurements at the 10-m level and atmospheric stability was defined by the vertical temperature gradient measured between the 10-m and 60-m levels.

The NRC staff estimates of the expected liquid releases (listed in Table D-4), along with the site hydrological considerations (summarized in Table D-5), were used to estimate radiation doses and dose commitments from liquid releases).

(a) Radiation Dose Commitments to Individual Members of the Public

As explained in the text, calculations are made for a hypothetical individual member of the public (that is, the maximally exposed individual) who would be expected to receive the highest radiation dose from all pathways that contribute. This method tends to overestimate the doses because assumptions are made that would be difficult for a real individual to fulfill.

The estimated dose commitments to the individual who is subject to maximum exposure at selected offsite locations from airborne releases of radioiodine and particulates, and waterborne releases are listed in Tables D-6, D-7, and D-8. The maximum annual total body and skin dose to a hypothetical individual and the maximum beta and gamma air dose at the site boundary are presented in Tables D-6, D-7, and D-8.

The maximally exposed individual is assumed to consume well above average quantities of the potentially affected foods and to spend more time at potentially affected locations than the average person as indicated in Tables E-4 and E-5 of Revision 1 of Regulatory Guide 1.109.

(b) Cumulative Dose Commitments to the General Population

Annual radiation dose commitments from airborne and waterborne radioactive releases from the PNPP facility are estimated for two populations in the year 2000: (1) all members of the general public within 80 km (50 mi) of the station (Table D-7) and (2) the entire U.S. population (Table D-9). Dose commitments beyond 80 km are based on the assumptions discussed in Appendix B. For perspective, annual background radiation doses are given in the tables for both populations.

3. References

Cleveland Electric Illuminating Company," Environmental Report--Operating License Stage," June 20, 1980.

---, "Perry Nuclear Power Plant, Final Safety Analysis Report, "September 12, 1980.

U.S. Department of Commerce, Bureau of the Census, "Population Estimates and Projections," Series II (P-25, No. 704), July 1977.

U.S. Environmental Protection Agency, "Natural Radiation Exposure in the United States," ORP-SID-72-1, June 1972.

U.S. Nuclear Regulatory Commission, Regulatory Guide 1.109, "Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, October 1977.

---, Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases From Light Water Reactors," Revision 1, July 1977.

---, Regulatory Guide 1.113, "Estimating Aquatic Dispersion of Effluents From Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I," Revision 1, April 1977.

---, NUREG-0016, F. P. Cardile and R. R. Bellamy (editors), "Calculation of Radioactive Materials in Gaseous and Liquid Effluents from Boiling Water Reactors," Revision 1, January 1979.

---, NUREG-0017, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Pressurized Water Reactors (PWR-GALE Code)," April 1976.

---, NUREG-0324, "XOQDOQ Program for the Meteorological Evaluation of Routine Effluent Releases of Nuclear Power Plants," Draft Report, September 1977.

Table D-1 Calculated releases of radioactive materials in gaseous effluents from the Perry Nuclear Power Plant (Ci/yr per reactor)

Nuclides	Main plant vent (cont.)	Turbine building vent (cont.)	Offgas building vent (cont.)	Offgas building vent* (intermit.)	Main plant vent** (intermit.)	Total
Ar-41	a	a	a	a	25	25
Kr-83m	a	a	a	a	a	a
Kr-85m	6	68	82	a	a	156
Kr-85	a	a	290	a	a	290
Kr-87	6	130	a	a	a	136
Kr-88	6	230	5	a	a	241
Kr-89	a	a	a	a	a	a
Xe-131m	a	a	19	a	a	19
Xe-133m	a	a	a	a	a	a
Xe-133	142	250	470	2300	a	3162
Xe-135m	92	650	a	a	a	742
Xe-135	113	630	a	350	a	1093
Xe-137	a	a	a	a	a	a
Xe-138	14	1400	a	a	a	1414
Total noble gases						7280
Cr-51	0.000096	0.013	b	b	b	0.013
Mn-54	0.00036	0.0006	b	b	b	0.00096
Fe-59	0.00016	0.0005	b	b	b	0.00066
Co-58	0.000057	0.0006	b	b	b	0.00066
Co-60	0.0011	0.002	b	b	b	0.0031
Zn-65	0.000055	0.0002	b	b	b	0.00026
Sr-89	0.0000063	0.006	b	b	b	0.006
Sr-90	0.0000031	0.00002	b	b	b	0.000023
Zr-95	0.0000085	0.0001	b	b	b	0.00011
Sb-124	0.0000047	0.0003	b	b	b	0.0003
Cs-134	0.00013	0.0003	b	b	b	0.00043
Cs-136	0.000011	0.00005	b	0.000002	b	0.000063
Cs-137	0.0002	0.0006	b	0.00001	b	0.00081
Ba-140	0.000009	0.011	b	b	b	0.011
Ce-141	0.000028	0.0006	b	b	b	0.00063
Total particulates						0.038
I-131	0.039	0.19	a	0.03	a	0.26
I-133	0.15	0.76	a	a	a	0.91
H-3	47	-	-	-	a	47
C-14	a	a	9.5	a	a	9.5

*Intermittent release, four 24-hr releases per year from mechanical vacuum pump discharge.

**Intermittent release, total of 48 hours per year from dry well purges.

[a]Less than 1.0 Ci/yr for noble gases and C-14, less than 10^{-4} Ci/yr for iodine.

[b]Less than 1% of total for this nuclide.

Table D-2 Summary of atmospheric dispersion factors (χ/Q) and relative deposition values for maximum site boundary and receptor locations near PNPP*

Location**	Source***	Relative χ/Q (sec/m^3)	Deposition (m^{-2})
Nearest site	A	4.3×10^{-6}	1.4×10^{-8}
boundary	B	1.7×10^{-5}	5.8×10^{-8}
(0.9 km WSW)	C	2.1×10^{-5}	7.1×10^{-8}
Nearest residence	A	3.4×10^{-6}	1.8×10^{-8}
and garden	B	1.3×10^{-5}	6.6×10^{-8}
(1.0 km NE)	C	1.6×10^{-5}	8.1×10^{-8}
Nearest milk cow	A	2.7×10^{-7}	1.9×10^{-9}
and meat animal	B	8.9×10^{-7}	6.2×10^{-9}
(3.1 km ENE)	C	1.1×10^{-6}	7.4×10^{-9}

*The values presented in this table are corrected for radioactive decay and cloud depletion from deposition, where appropriate, in accordance with Regulatory Guide 1.111, Revision 1.

**"Nearest" refers to that type of location where the highest radiation dose is expected to occur from all appropriate pathways.

***Sources:

A - Main plant vent, Unit 1 or 2; turbine building vent; offgas building vent: continuous releases.

B - Offgas building vent (mechanical vacuum pump discharge), intermittent release, 4 releases per year, 24 hours each release.

C - Main plant vent, Unit 1 or 2 (drywell purge), intermittent release, total of 48 hours per year.

Table D-3 Nearest pathway locations used for maximally exposed individual dose commitments for PNPP

Location	Sector	Distance (km)
Nearest site boundary*	WSW	0.9
Residence and garden**	NE	1.0
Milk cow and meat animal	ENE	3.1

*Beta and gamma air doses, total body doses, and skin doses from noble gases are determined at the effluent-control boundaries in the sector where the maximum potential value is likely to occur.

**Dose pathways including inhalation of atmospheric radioactivity, exposure to deposited radionuclides, and submersion in gaseous radioactivity are evaluated at residences. This particular location includes doses from vegetable consumption as well.

Table D-4 Calculated release of radioactive materials in liquid effluents from PNPP

Nuclide	Ci/yr per reactor*
Corrosion and activation products	
Na-24	0.00004
P-32	0.00017
Cr-51	0.0059
Mn-54	0.0001
Fe-55	0.0018
Fe-59	0.00004
Co-58	0.0003
Co-60	0.00071
Cu-64	0.00011
Zn-65	0.00034
Np-239	0.00049
Fission products	
Sr-89	0.00014
Sr-90	0.00001
Y-91	0.0001
Nb-95	0.00001
Mo-99	0.00016
Tc-99m	0.00017
Ru-103	0.00003
Rh-103m	0.00003
Ru-106	0.00001
Te-129m	0.00005
Te-129	0.00003
I-131	0.13
I-133	0.0011
Cs-134	0.0015
I-135	0.00006
Cs-136	0.00043
Cs-137	0.0034
Ba-137m	0.0032
Ba-140	0.0003
La-140	0.00034
Ce-141	0.00004
Pr-143	0.00003
Ce-144	0.00001
All others	0.0001
Total (except H-3)	0.15
H-3	47.

*Nuclides whose release rates are less than 10^{-5} Ci/yr per reactor are not listed individually but are included in "All others."

Table D-5 Summary of hydrologic transport and dispersion for liquid releases from PNPP*

Calculation and location	Transit time (hours)	Dilution factor
ALARA calculations		
Fish ingestion (at nearest site boundary, 1.1 km ENE)	3.1	35
Drinking water (at nearest intake, 2.4 km W)	7.0	48
Shoreline exposure (at nearest site boundary, 1.1 km ENE)	3.1	35
Population-dose calculations		
Commercial fishing** (16 km ENE)	44.4	136
Sport fishing** (8 km ENE)	22.2	97
Drinking water (all intakes)	7.0	48

*See Regulatory Guide 1.113, Revision 1, "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I," April 1977.

**Assumed for purposes of an upper-limit estimate; detailed information not available.

Table D-6 Annual dose commitments to a maximally exposed individual near PNPP

Location	Pathway	Doses (mrems/yr per unit, except as noted)			
		Noble gases in gaseous effluents			
		Total body	Skin	Gamma air dose, mrads/yr/unit	Beta air dose, mrads/yr/unit
Nearest site boundary* (0.9 km WSW)	Direct radiation from plume	1.7	3.7	2.6	3.0
		Iodine and particulates in gaseous effluents**			
		Total body	Organ		
Nearest*** site boundary (0.9 km WSW)	Ground deposition	0.04 (T)	0.04 (C) (thyroid)		
	Inhalation	0.01 (T)	1.2 (C) (thyroid)		
Nearest residence and garden 1.0 km NE)	Ground deposition	0.047 (C)	0.047 (C) (bone)		
	Inhalation	0.007 (C)	0.004 (C) (bone)		
	Vegetable consumption	0.72 (C)	3.6 (C) (bone)		
Nearest milk cow (3.1 km ENE)	Ground deposition	0.005 (C)	0.005 (I) (thyroid)		
	Inhalation	<0.001 (C)	0.064 (I) (thyroid)		
	Vegetable consumption	0.059 (C)	-----		
	Cow milk consumption	0.032 (C)	4.90 (I) (thyroid)		
Nearest meat animal (3.1 km ENE)	Meat consumption	0.009 (C)	0.044 (C) (bone)		
		Liquid effluents**			
		Total body	Organ		
Nearest drinking water at Ohio Water Service-East System	Water ingestion	0.0037 (A)	0.62 (I) (thyroid)		
Nearest fish at plant-site boundary	Fish consumption	0.032 (A)	0.17 (C) (liver)		
Nearest shore access near plant-site boundary	Shoreline recreation	0.0003 (T)	0.0003 (T) (bone)		

*"Nearest" refers to that site boundary location where the highest radiation doses as a result of gaseous effluents have been estimated to occur.

**Doses are for the age group and organ that results in the highest cumulative dose for the location: A=adult, T=teen, C=child, I=infant. Calculations were made for these age groups and for the following organs: gastrointestinal tract, bone, liver, kidney, thyroid, lung, and skin.

***"Nearest" refers to the location where the highest radiation dose to an individual from all applicable pathways has been estimated.

Table D-7 Calculated Appendix I dose commitments to a maximally exposed individual and to the population from operation of PNPP

	Annual Dose per Reactor Unit	
	Individual	
	Appendix I Design Objectives*	Calculated Doses**
Liquid effluents		
Dose to total body from all pathways	3 mrems	0.037 mrems
Dose to any organ from all pathways	10 mrems	0.62 mrems (thyroid)
Noble-gas effluents (at site boundary)		
Gamma dose in air	10 mrads	2.6 mrads
Beta dose in air	20 mrads	3.0 mrads
Dose to total body of an individual	5 mrems	1.7 mrems
Dose to skin of an individual	15 mrems	3.0 mrems
Radioiodines and particulates***		
Dose to any organ from all pathways	15 mrems	5.0 mrems (thyroid)
	Population Within 80 km	
	Total Body	Thyroid
	(person-rems)	
Natural-background radiation†	252,000	
Liquid effluents	3.4	36
Noble-gas effluents	0.79	0.79
Radioiodine and particulates	0.43	8.8

*Design Objectives from Sections II.A, II.B, II.C, and II.D of Appendix I, 10 CFR 50 consider doses to maximally exposed individual and to population per reactor unit.

**Numerical values in this column were obtained by summing appropriate values in Table D-6. Locations resulting in maximum doses are represented here.

***Carbon-14 and tritium have been added to this category.

†"Natural Radiation Exposure in the United States," U.S. Environmental Protection Agency, ORP-SID-72-1, June 1972; using the average background dose for Ohio of 105 mrems/yr, and year 2000 projected population of 2,403,000.

Table D-8 Calculated RM-50-2 dose commitments to a maximally exposed individual from operation of PNPP*

	Annual dose per site	
	RM-50-2 design objectives**	Calculated doses
Liquid effluents		
Dose to total body or any organ from all pathways	5 mrems	1.2 mrems
Activity-release estimate, excluding tritium	10 Ci	0.3 Ci
Noble-gas effluents (at site boundary)		
Gamma dose in air	10 mrads	5.2 mrads
Beta dose in air	20 mrads	6.0 mrads
Dose to total body of an individual	5 mrems	3.4 mrems
Dose to skin of an individual	15 mrems	6.0 mrems
Radioiodines and particulates***		
Dose to any organ from all pathways	15 mrems	10 mrems (thyroid)
I-131 activity release	2 Ci	0.5 Ci

*An optional method of demonstrating compliance with the cost-benefit Section (II.D) of Appendix I to 10 CFR 50.

**Annex to Appendix I to 10 CFR 50.

***Carbon-14 and tritium have been added to this category.

Table D-9 Annual total-body population dose commitments, year 2000 (both units)

Category	U.S. population dose commitment (person-rems/yr)
Natural background radiation*	26,000,000*
PNPP Units 1 and 2 (combined) operation	
Plant workers	1480
General public:	
Liquid effluents**	6.8
Gaseous effluents	43
Transportation of fuel and waste	6

*Using the average U.S. background dose (100 mrem/yr) and year 2000 projected U.S. population from "Population Estimates and Projections," Series II, U.S. Department of Commerce, Bureau of the Census, Series P-25, No. 704, July 1977.

**80-km (50-mi) population dose

APPENDIX E

REBASELINING OF THE RSS RESULTS FOR BWRs

APPENDIX E

REBASELINING OF THE RSS RESULTS FOR BWRs

The results of the Reactor Safety Study (RSS) have been updated. The update was done largely to incorporate results of research and development conducted after the October 1975 publication of the RSS and to provide a baseline against which the risk associated with various LWRs could be consistently compared.

Primarily, the rebaselined RSS results (NUREG/CR-1659) reflect use of advanced modeling of the processes involved in meltdown accidents, i.e., the MARCH computer code modeling for transient- and LOCA-initiated sequences and the CORRAL code used for calculating magnitudes of release accompanying various accident sequences. These codes* have led to a capability to predict the transient and small-size LOCA-initiated sequences that is considerably advanced beyond what existed at the time the Reactor Safety Study was completed. The advanced accident process models (MARCH and CORRAL) produced some changes in our estimates of the release magnitudes from various accident sequences in WASH-1400 (NUREG-75/014). These changes primarily involved release magnitudes for the iodine, cesium, and tellurium families of isotopes. In general, a decrease in the iodines was predicted for many of the dominant accident sequences; some increases in the release magnitudes for the cesium and tellurium isotopes were predicted.

Entailed in this rebaselining effort was the evaluation of individual dominant accident sequences as we understand them to evolve rather than the technique of grouping large numbers of accident sequences into encompassing, but synthetic, release categories as was done in WASH-1400. The rebaselining of the RSS also eliminated the "smoothing technique" that was criticized in the report by the Risk Assessment Review Group (sometimes known as the Lewis Report, NUREG/CR-0400).

In both of the RSS designs (PWR and BWR), the likelihood of an accident sequence leading to the occurrence of a steam explosion (α) in the reactor vessel was decreased. This was done to reflect both experimental and calculational indications that such explosions are unlikely to occur in those sequences involving small-size LOCAs and transients because of the high pressures and temperatures expected to exist within the reactor coolant system during these scenarios. Furthermore, if such an explosion were to occur, there are indications that it would be unlikely to produce as much energy and the massive missile-caused breach of containment as was postulated in WASH-1400.

For rebaselining of the RSS BWR design, the sequence TCγ' (described later) was explicitly included into the rebaselining results. The accident processes

*It should be noted that the MARCH code was used on a number of scenarios in connection with the TMI-2 recovery efforts and for post-TMI-2 investigations to explore possible alternative scenarios that TMI-2 could have experienced.

associated with the TC sequence had been erroneously calculated in WASH-1400. In general, the rebaselined results led to slightly increased health impacts being predicted for the RSS-BWR design. This is believed to be largely attributable to the inclusion of TCγ'.

In summary, the rebaselining of the RSS results led to small overall differences from the predictions in WASH-1400. It should be recognized that these small differences due to the rebaselining efforts are likely to be far outweighed by the uncertainties associated with such analyses.

The accident sequences identified in the rebaselining effort which are expected to dominate risk of the RSS-BWR design are briefly described below. These sequences are assumed to represent the approximate accident risks from the Perry BWR design.

Each of the accident sequences is designated by a string of identification characters in the same manner as in the RSS. Each character represents a failure in one or more of the important plant systems or features (see Table E-1). For example, in sequences having a γ' at the end of the string, it means a particular failure mode (overpressure) of the containment structure (and a rupture location) where a release of radioactivity takes place directly to the atmosphere from the primary containment. In the sequence having a γ at the end of the string, the containment failure mode is again by overpressure, but this time the rupture location is such that the release takes place into the reactor building (secondary containment) before discharging to the environment. In this latter (γ) case, the overall magnitude of radioactivity release is somewhat diminished by the deposition and plateout processes that take place within the reactor building.

TCγ' and TCγ Sequences

These sequences involve a transient event requiring shutdown of the reactor while at full power, followed by a failure to make the reactor subcritical (i.e., terminate power generation by the core). The containment is assumed to be isolated by these events; then, one or the other of the following chain of events is assumed to happen:

(a) High-pressure coolant injection system would succeed for some time in providing makeup water to the core in sufficient quantity to cope with the rate of coolant loss through relief and safety valves to the suppression pool of the containment. During this time, the core power level varies, but causes substantial energy to be directed into the suppression pool; this energy is in excess of what the containment and containment heat removal systems are designed to cope with. Ultimately, in about 1-1/3 hours, the containment is estimated to fail by overpressure and it is assumed that this rather severe structural failure of the containment would disable the high-pressure coolant makeup system. Over a period of roughly 1-1/2 hours after breach of containment, it is assumed the core would melt. This has been estimated to be one of the more dominant sequences in terms of accident risks to the public.

(b) A variant to the above sequence is one where the high-pressure coolant injection system fails somewhat earlier and prior to containment overpressure failure. In this case, the earlier melt could result in a

reduced magnitude of release because some of the fission products discharged to the suppression pool via the safety and relief valves could be more effectively retained if the pool remained subcooled. The overall accident consequences would be somewhat reduced in this earlier melt sequence, but ultimately, the processes accompanying melt (e.g., noncondensibles, steam, and steam pressure pulses during reactor vessel melt-through) could cause overpressure failure (γ or γ') of the containment.

TWγ' and TWγ Sequences

The TW sequence involves a transient where the reactor has been shut down and it and the containment have been isolated from their normal heat sinks. In this sequence, the failure to transfer decay heat from the core and containment to an ultimate sink could ultimately cause overpressure failure of containment. Overpressure failure of containment would take many, many hours, allowing for repair or other emergency actions to be accomplished; but, should this sequence occur, it is assumed that the rather severe structural failure of containment would disable the systems (e.g., HPI, RCIC) providing coolant makeup to the reactor core. (In the RSS design, the service water system which conveys heat from the containment via RHR system to the ultimate sink was found to be the dominant failure contribution in the TW sequence.) After breach of containment, the core is assumed to melt.

[TQUVγ', AEγ', SEγ', SEγ'] and [TQUVγ, AEγ, SEγ, SEγ] Sequence Groups

Each of the accident sequences shown grouped into the two bracketed categories above are estimated to have quite similar consequence outcomes and these would be somewhat smaller than the TCγ',γ and TWγ' sequences described above. In essence, these sequences, which are characterized as in the RSS, involve failure to deliver makeup coolant to the core after a LOCA or a shutdown transient event requiring such coolant makeup. The core is assumed to melt down and the melt processes ultimately cause overpressure failure of containment (either γ' or γ). The overall risk from these sequences is expected to be dominated by the higher frequency initiating events (i.e., the small LOCA (S_2) and shutdown transients (T)).

References

U.S. Nuclear Regulatory Commission, NUREG-75/014, "Reactor Safety Study," October 1975 (formerly WASH-1400).

---, NUREG/CR-0400, H. W. Lewis et al., "Risk Assessment Review Group Report to the U.S. Nuclear Regulatory Commission, September 1978.

---, NUREG/CR-1659, Vol 1, "Reactor Safety Study Methodology Applications Program: Sequoyah PWR Power Plant," Sandia National Laboratories, April 1981.

Table E-1 Key to BWR accident sequence symbols

A	-	Rupture of reactor coolant boundary with an equivalent diameter of greater than 6".
C	-	Failure of the reactor protection system.
E	-	Failure of emergency core cooling injection.
Q	-	Failure of normal feedwater system to provide core makeup water.
S_1	-	Small pipe break with an equivalent diameter of about 2"-6".
S_2	-	Small pipe break with an equivalent diameter of about 1/2"-2".
T	-	Transient event.
U	-	Failure of HPCI or RCIC to provide core makeup water.
V	-	Failure of low-pressure ECCS to provide core makeup water.
W	-	Failure to remove residual core heat.
α	-	Containment failure due to steam explosion in vessel.
γ	-	Containment failure due to overpressure - release through reactor building.
γ'	-	Containment failure due to overpressure - release direct to atmosphere.

APPENDIX F

CONSEQUENCE MODELING CONSIDERATIONS

APPENDIX F

CONSEQUENCE MODELING CONSIDERATIONS

F.1 Evacuation Model

"Evacuation," used in the context of offsite emergency response in the event of substantial amount of radioactivity release to the atmosphere in a reactor accident, denotes an early and expeditious movement of people to avoid exposure to the passing radioactive cloud and/or to acute ground contamination in the wake of the cloud passage. It should be distinguished from "relocation," which denotes a postaccident response to reduce exposure from long-term ground contamination. The Reactor Safety Study (RSS) (NUREG-75/014, formerly WASH-1400) consequence model contains provision for incorporating radiological consequence reduction benefits of public evacuation. The benefits of a properly planned and expeditiously carried out public evacuation would be well manifested in a reduction of acute health effects associated with early exposure; namely, in the number of cases of early fatality (see Section F.2) and acute radiation sickness which would require hospitalization. The evacuation model originally used in the RSS consequence model is described in WASH-1400 as well as in NUREG-0340. However, the evacuation model which has been used herein is a modified version (Sandia) of the RSS model and is, to a certain extent, site-emergency-planning oriented. The modified version is briefly outlined below:

The model utilizes a circular area with a specified radius (the 10-mile plume exposure pathway Emergency Planning Zone (EPZ)), with the reactor at the center. It is assumed that people living within portions of this area would evacuate if an accident should occur involving imminent or actual release of significant quantities of radioactivity to the atmosphere.

Significant atmospheric releases of radioactivity would in general be preceded by 1 or more hours of warning time (postulated as the time interval between the awareness of impending core melt and the beginning of the release of radioactivity from the containment building). For the purpose of calculation of radiological exposure, the model assumes that all people who live in a fan-shaped area (fanning out from the reactor), within the circular zone with the down-wind direction as its centerline (i.e., those people who would potentially be under the radioactive cloud that would develop following the release) would leave their residences after lapse of a specified amount of delay time* and then evacuate. The delay time is reckoned from the beginning of the warning time and is recognized as the sum of the time required by the reactor operators to notify the responsible authorities; time required by the authorities to interpret the data, decide to evacuate, and direct the people to evacuate; and time required for the people to mobilize and get under way.

*Assumed to be of a constant value which would be the same for all evacuees.

The model assumes that each evacuee would move radially out in the downwind direction* with an average effective speed** (obtained by dividing the zone radius by the average time taken to clear the zone after the delay time) over a fixed distance** from the evacuee's starting point within the 10-mile EPZ.

The evacuation distance is selected to be 15 miles (which is 5 miles more than the 10-mile plume exposure pathway EPZ radius). After reaching the end of the travel distance the evacuee is assumed to receive no further radiation exposure.

The model incorporates a finite length of the radioactive cloud in the downwind direction which would be determined by the product of the duration over which the atmospheric release would take place and the average windspeed during the release. It is assumed that the front and the back of the cloud formed would move with an equal speed, which would be the same as the prevailing windspeed; therefore, its length would remain constant at its initial value. At any time after the release, the concentration of radioactivity is assumed to be uniform over the length of the cloud. If the delay time were less than the warning time, then all evacuees would have a head start, i.e., the cloud would be trailing behind the evacuees initially. On the other hand, if the delay time were more than the warning time, then depending on initial locations of the evacuees there are possibilities that (a) an evacuee will still have a head-start, or (b) the cloud would be already overhead when an evacuee starts to leave, or (c) an evacuee would be initially trailing behind the cloud. However, this initial picture of cloud-people disposition would change as the evacuees travel depending on the relative speed and positions between the cloud and people. The cloud and an evacuee might overtake one another zero or one or more times before the evacuee would reach his or her destination. In the model, the radial position of an evacuating person, either stationary or in transit, is compared with the front and the back of the cloud as a function of time to determine a realistic period of exposure to airborne radionuclides. The model calculates the time periods during which people are exposed to radionuclides on the ground while they are stationary and while they are evacuating. Because radionuclides would be deposited continually from the cloud as it passed a given location, a person who is under the cloud would be exposed to ground contamination less concentrated than if the cloud had completely passed. To account for this, at least in part, the revised model assumes that persons are (a) exposed to the total ground contamination concentration that is calculated to exist after complete passage of the cloud, after they are completely passed by the cloud; (b) exposed to one half the calculated concentration when anywhere under the cloud; and (c) not exposed when they are in front of the cloud. Different values of the shielding protection factors for exposure from airborne radioactivity and contaminated ground have been used.

Results shown in Section 5.9.4.1.4.2 for accidents involving significant release of radioactivity to the atmosphere were based upon the assumption that all people within the 10-mile plume exposure pathway EPZ would evacuate as per

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*In the RSS consequence model, the radioactive cloud is assumed to travel radially outward only.

**Assumed to be of a constant value which would be the same for all evacuees.

the evacuation scenario described above. For the delay time before evacuation, a value of 1 hour was used. The staff believes that such a value appropriately reflects the Commission's emergency planning requirements. The staff estimated the effective speed of evacuation to be 2.4 miles per hour (1.07 meters per second) based upon the applicant's estimate of the time necessary to clear the 10-mile zone. As an additional emergency measure for the Perry Nuclear Power Plant (PNPP) site, it was also assumed that all people beyond the evacuation distance who would be exposed to the contaminated ground would be relocated after passage of the plume. For the people outside the evacuation zone and within 25 miles, a reasonable relocation time span of 8 hours has been assumed, during which each person is assumed to receive additional exposure to the ground contamination. Beyond the 25-mile distance the usual assumption of the RSS consequence model regarding the period of ground exposure was used--which is that if the calculated ground dose to the total marrow over a 7-day period would exceed 200 rems, then this high dose rate would be detected by actual field measurements following the plume passage, and people from those regions would then be relocated immediately. For this situation the model limits the period of ground dose calculation to 24 hours; otherwise, the period of ground exposure is limited to 7 days for calculation of early dose.

It is not expected that detailed inclusion of any special facility near a specific site, where not all persons may be quickly evacuated, would significantly alter the conclusions. In many cases, sheltering can provide significant mitigation of doses and their consequences.

Figure F.1 shows a pessimistic case for which no early evacuation is assumed and all persons are assumed to be exposed for the first 24 hours following an accident and are then relocated.

The model has the same provision for calculation of the economic cost associated with implementation of evacuation as in the orginal RSS model. For this purpose, the model assumes that for atmospheric releases of durations three hours or less, all people living within a circular area of 5-mile radius centered at the reactor plus all people within a 45° angular sector within the plume exposure pathway EPZ and centered on the downwind direction would evacuate and temporarily relocate. However, if the duration of release would exceed three hours the cost of evacuation is based on the assumption that all people within the entire plume exposure pathway EPZ would evacuate and temporarily relocate. For either of these situations, the cost of evacuation and relocation is assumed to be $125 (1980 dollars) per person, which includes cost of food, and temporary sheltering for a period of one week.

F.2 Early Health Effects Model

The medical advisers to the Reactor Safety Study proposed three alternative dose-mortality relationships that can be used to estimate the number of early fatalities that might result in an exposed population. These alternatives characterize different degrees of post-exposure medical treatment from "minimal," to "supportive," to "heroic," and are more fully described in NUREG-0340.

The calculational estimates of the early fatality risks presented in the texts of Section 5.9.4.1.4.3 and Section F.1 of this appendix used the dose-mortality relationship that is based upon the supportive treatment alternative. This

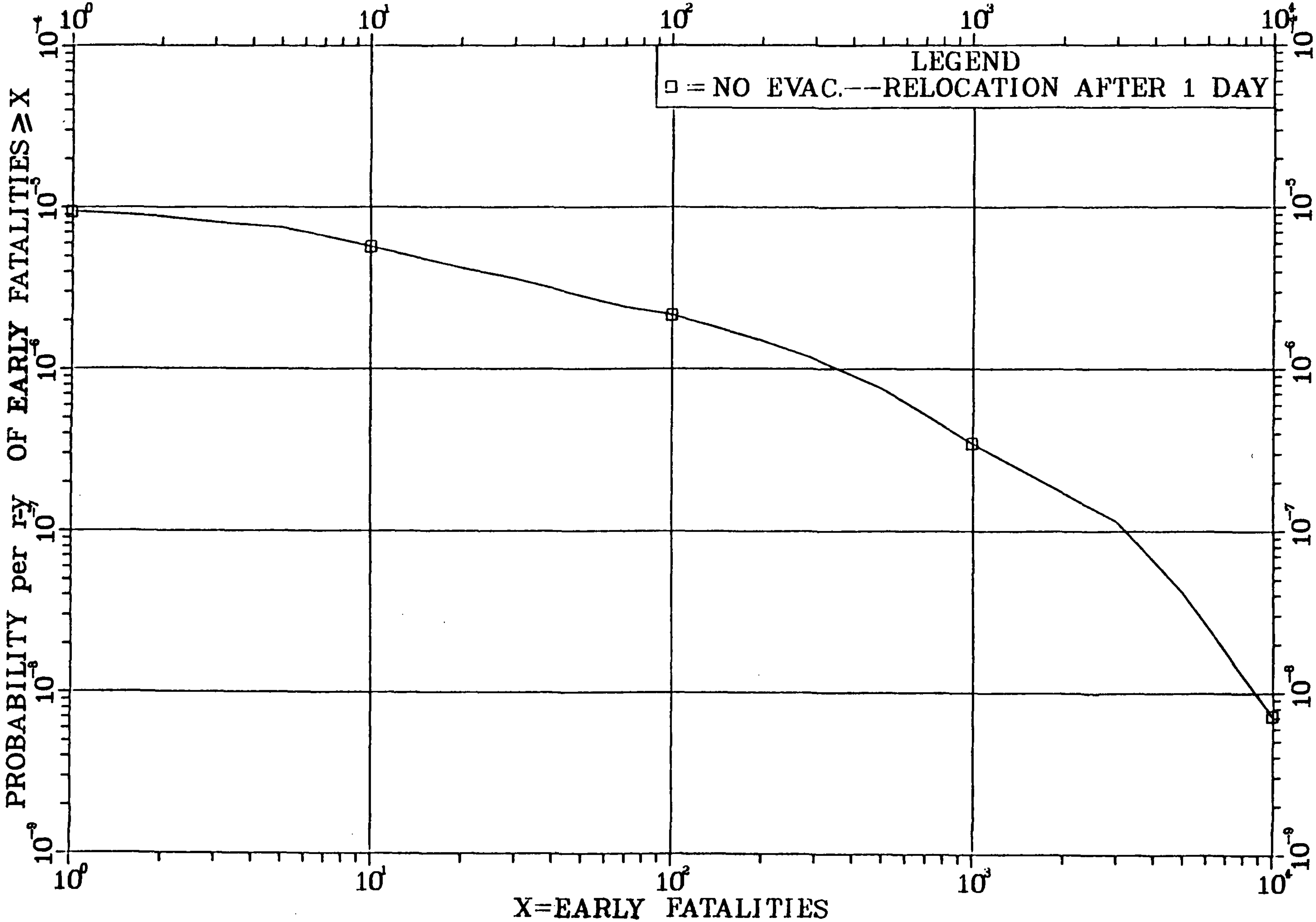

Figure F.1 Probability distribution of early fatalities for no evacuation

implies the availability of medical care facilities and services for those exposed in excess of about 200 rems. At the extreme low probability end of the spectrum, i.e., at the one chance in one hundred million per reactor-year level, the number of persons involved might exceed the capacity of facilities for such services in which case the number of early fatalities might have been somewhat underestimated. To gain perspective on this element of uncertainty, the staff has also performed calculations using the most pessimistic dose-mortality relationship based upon minimal medical treatment and using identical assumptions regarding early evacuation and early relocation as made in Section 5.9.4.1.4.3. This shows no change in early fatalities at the one chance in one million per reactor-year level, an increase from 370 to 1,300 early fatalities at the one chance in one hundred million per reactor-year level (see Table 5.9), and an overall 10-fold increase in annual risk of early fatalities (see Figure 5.6). The major fraction of the increased risk of early fatality in the absence of supportive medical treatment would occur within 5 miles and virtually all would be contained within 60 miles of the PNPP site.

F.3 References

Sandia Laboratories, "A Model of Public Evacuation for Atmospheric Radiological Releases," SAND78-0092, June 1982.

U.S. Nuclear Regulatory Commission, NUREG-0340, "Overview of the Reactor Safety Study Consequences Model," October 1977.

---, NUREG-75/014 (formerly WASH-1400), "Reactor Safety Study," October 1975.

APPENDIX G

CORRESPONDENCE FROM THE U.S. DEPARTMENT OF THE INTERIOR

United States Department of the Interior

FISH AND WILDLIFE SERVICE

IN REPLY REFER TO:

East Lansing Area Office
Manly Miles Building, Room 202
1405 South Harrison Road
East Lansing, Michigan 48823

RECEIVED MAY 13 1981 U.S. NUCLEAR REGULATORY COMMISSION

May 12, 1981

Mr. Albert Schwencer, Chief
Licensing Branch 2
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Schwencer:

This is in response to your letter of April 10, 1981 requesting our comments for an operating license for the Perry Nuclear Power Plant, Lake County, Ohio.

Based upon information currently available, the following threatened (T), endangered (E), or proposed (P) species may be found in the project area:

Indiana Bat (E) (Myotis sodalis)

There is no designated critical habitat in the project area at this time.

In accordance with the Endangered Species Act of 1973, as amended, the Federal agency responsible for actions authorized, funded, or carried out in furtherance of the project is required to conduct a biological assessment for the purpose of identifying endangered, threatened, or proposed species likely to be affected by the action. Information on suitable habitat and previous sitings may be obtained from Mr. Denis Case, Ohio Department of Natural Resources (ODNR). He may be contacted at Ohio Division of Wildlife, ODNR, Fountain Square, Columbus, Ohio 43224, (telephone 614/466-3610).

If the biological assessment indicates the presence of such species, the formal consultation process should be initiated. This can be done by writing to the Area Manager, Room 202, Manly Miles Building, 1405 S. Harrison Rd., East Lansing, MI 48823. The biological assessment is to be completed within 180 days of initiation and before contracts are entered into or construction begun.

The assessment should include the following information:

1. The results of the comprehensive survey of the area.

2. The results of any studies undertaken to determine the nature and extent of any impacts on identified species.

3. The agency's consideration of cumulative effects on the species or its critical habitat.

4. The study methods used.

5. Difficulties encountered in obtaining data and completing the proposed study.

6. Conclusions of the agency including recommendations as to further studies.

7. Any other relevant information.

This letter provides comment only on the endangered species aspect of the project. Comments on other aspects of the project under the authority of and accordance with the provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) may be sent under separate cover.

If there are any questions regarding the biological assessment or how it applies to the consultation process, please contact the Area Office Endangered Species Office at 517/337-6608.

Sincerely yours,

John Popowski
Area Manager.

Attachment

APPENDIX H

CORRESPONDENCE FROM THE OHIO STATE HISTORIC PRESERVATION OFFICER

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

FEB 1 1 1982

FEB 19

Dr. W. Ray Luce
State Historic Preservation Officer
Ohio Historical Society
Interstate 71 at 17th Avenue
Columbus, Ohio 43211

Dear Dr. Luce:

As part of the preparation of the environmental impact statement for the Perry Nuclear Station's operating license, the U. S. Nuclear Regulatory Commission is required to consult with the SHPO (36 CFR 800) to determine if the operation of the station may affect any cultural resources listed or eligible for listing in the National Register of Historic Places. Our areas of interest for the Perry Station include the site itself and the Perry-Macedonia transmission line.

To assist in your analysis, we are including copies of the archeologic surveys provided by the applicant and listings of nearby sites on the National Register.

Table 1 contains the listings of those sites on the National Register of Historic Places within 16.1 km (10 mi) of the site. It is the staff's opinion that the operation of the station will have no significant effects on these properties. The staff also notes that the conclusion of the report on the archeologic survey of the site referenced in the FES-CP (11.3.15) stated:

> "The area of the proposed CEI Perry Nuclear Power Plant has been subjected to a thorough professional archaeological reconnaissance. Analyses of previous archaeological work in the region led to the hypothesis that little, if any, evidence for significant prehistoric occupation would be encountered in the test area. The analysis of both black and white and infrared aerial photographs (provided by Kuchera Associates, Inc.) indicated nothing to alter this hypothesis. During late May and early June of 1973 field investigation of the area was carried out by crews from the Department of Anthropology, Case Western Reserve University, under the direction of Dr. David Brose with the field supervision of Alfred M. Lee. Stratified surface samples and statistically determined test excavations

were carried out. Finally earth resistivity survey was implemented to test for the presence of sub-surface features. Field investigation revealed that the PNPP area was occupied by only a small transient hunting camp some time during the Archaic Period. This component has been fully analyzed."

A copy of the survey report is attached.

The Perry-Macedonia transmission line has one site contained in the National Register listing which is within 2 km (1.2 mi) of the line. That is the Alonzo Drake House in Oakwood, Cuyahoga County. The staff does not feel the operation of the station will affect the site. The Perry-Macedonia line also has had archeologic surveys conducted on it. The conclusion of the preliminary report dated December 1977 (attached) states: "No significant archaeological resources were encountered within those areas of proposed tower locations which would suffer any adverse impact as a result of the construction activities." The conclusion also mentioned that an eight mile segment of the line had not been investigated at that time. The two attached documentes dated June 21, 1978 and August 8, 1978 discuss the results of the archeological survey done on the previously unstudied segment. The June 21, 1978 report stated that "no significant cultural materials were recovered from any of the Tower Sites 17008 to 17049, nor from any area where it was judged an access road would be constructed."

It should also be noted that the Perry-Hanna Transmission Line was not granted a certificate of environmental compatibility and public need by the Ohio Power Siting Board. That line is required for the operation of Unit #2 in 1987 and its status has not yet been determined.

Therefore, based upon the information provided, the NRC staff believes that except for the Perry-Hanna Line whose status is yet to be determined, the operation of the Perry Nuclear Power Station would not result in any significant impacts on sites listed or eligible for listing in the National Register. Based on NRC's conversations with your office, we have prepared for your consideration and concurrence a suggested statement at the end of this letter. Should you require any clarification, please contact Brian Richter at (301) 492-4877.

We thank you for your assistance and shall send a copy of the Environmental Impact Statement for your review and comment when it is issued.

Sincerely,

Robert L. Tedesco, Assistant Director
for Licensing
Division of Licensing

Enclosures:
1. Listing of National Register Properties near the site.
2. A Summary Report on the Archaeological Survey and Testing of the Perry Nuclear Power Plant Area, Lake Co., Ohio, June 21, 1973.
3. Preliminary Report on Subsurface Archaeological Investigations of the CEI kV Transmission Line: Perry-Leroy Center-Macedonia-Cleveland Inland, December 1977.
4. Report on Reconnaissance and Subsurface Archaeological Investigations of the CEI 345 kV Transmission Line: Perry-Leroy Center, June 21, 1978.
5. Letter transmitting Summary of Field Notes: CEI Perry-Macedonia 345 kV Transmission Line, August 8, 1978.

Based upon information and documentation provided by NRC, we concur with the finding that except for the Perry-Hanna Transmission Line whose status is yet to be determined, the operation of the Perry Nuclear Station will have no significant impact on any sites listed or eligible for listing in the National Register of Historic Places.

W. Ray Luce 2-16-82

Dr. W. Ray Luce
State Historic Preservation Officer

NRC FORM 335 (7-77)

U.S. NUCLEAR REGULATORY COMMISSION

BIBLIOGRAPHIC DATA SHEET

1. REPORT NUMBER *(Assigned by DDC)* NUREG-0884	
4. TITLE AND SUBTITLE *(Add Volume No., if appropriate)* Final Environmental Statement Related to the Operation of Perry Nuclear Power Plant, Units 1 and 2	2. *(Leave blank)*
	3. RECIPIENT'S ACCESSION NO.
7. AUTHOR(S)	5. DATE REPORT COMPLETED — MONTH: August, YEAR: 1982
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	6. *(Leave blank)*
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12. SPONSORING ORGANIZATION NAME AND MAILING ADDRESS *(Include Zip Code)* Same as 9 above	10. PROJECT/TASK/WORK UNIT NO.
	11. CONTRACT NO.
13. TYPE OF REPORT: Final Environmental Report	PERIOD COVERED *(Inclusive dates)*
15. SUPPLEMENTARY NOTES: Pertains to Docket Nos. 50-440 and 50-441	14. *(Leave blank)*

16. ABSTRACT *(200 words or less)*

The information in this Final Environmental Statement is the second assessment of the environmental impact associated with the construction and operation of the Perry Nuclear Power Plant, Units 1 and 2, located on Lake Erie in Lake County, about 11 km (7 miles) northeast of Painesville, Ohio. The first assessment was the Final Environmental Statement related to the construction of the plant issued in April 1974, prior to issuance of the construction permits (CPPR-148 and CPPR-149). Plant construction for Unit 1 is currently about 83% complete, and Unit 2 about 43% complete. Fuel loading for Units 1 and 2 currently estimated by the licensee (Cleveland Electric Illuminating Company) for November 1983, with Unit 2 fuel loading scheduled for May 1987. The present assessment is the result of the NRC staff review of the activities associated with the proposed operation of the plant.

17. KEY WORDS AND DOCUMENT ANALYSIS

17a. DESCRIPTORS

17b. IDENTIFIERS/OPEN-ENDED TERMS

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