NUREG-1094

Final Environmental Statement

related to the operation of Beaver Valley Power Station, Unit 2

Docket No. 50-412

Duquesne Light Company, et al.

U.S. Nuclear Regulatory Commission

Office of Nuclear Reactor Regulation

September 1985

NOTICE

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ABSTRACT

This Final Environmental Statement contains the second assessment of the environmental impact associated with Beaver Valley Power Station Unit 2 pursuant to the National Environmental Policy Act of 1969 (NEPA) and Title 10 of the Code of Federal Regulations, Part 51, as amended, of the Nuclear Regulatory Commission regulations. This statement examines the environment, environmental consequences and mitigating actions, and environmental benefits and costs, and concludes that the action called for is the issuance of an operating license for Beaver Valley Unit 2.

SUMMARY AND CONCLUSIONS

This Final Environmental Statement (FES) was prepared by the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation.

(1) This action is administrative.

(2) The proposed action is the issuance of an operating license to Duquesne Light Company, applicant and agent for the owners, for operation of the Beaver Valley Power Station Unit 2 (NRC Docket No. 50-412). Beaver Valley Unit 2 is adjacent to Beaver Valley Unit 1, which was licensed in January 1976. The site is on the south bank of the Ohio River in Shippingport Borough, Beaver County, Pennsylvania.

The unit will employ a three-loop pressurized water reactor with a net calculated electrical output of approximately 836 MW. The circulating water system is a pumped, closed-loop system utilizing an air-cooled, natural draft hyperbolic cooling tower as a heat sink. The Ohio River serves as the ultimate heat sink and provides makeup cooling water.

(3) The information in this statement represents an assessment of the environmental impacts of station operation pursuant to the Commission's regulations as 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). After docketing, in October 1972, an application to construct the facility and subsequent amendments thereto, the staff reviewed the impacts that would occur during construction and operation. That evaluation was issued as the Final Environmental Statement-Construction Permit phase (FES-CP) in July 1973. After that environmental review, a safety review, and an evaluation by the Advisory Committee on Reactor Safeguards, the Nuclear Regulatory Commission issued Construction Permit No. CPPR-105 on May 3, 1974 for construction of the facility. The applicant submitted an application for an operating license by letter dated January 26, 1983. The NRC conducted a predocketing acceptance review and determined that sufficient information was available to start detailed environmental and safety reviews. The applicant's operating license application was docketed on May 18, 1983.

(4) The staff has reviewed the activities associated with the proposed operation of the station and the potential impacts, both beneficial and adverse. The staff's conclusions are summarized as follows:

   (a) The total land area of the plant site is approximately 203 ha (501 acres). Unit 2 will occupy about 23 ha (56 acres); construction activities have disturbed about 41 ha (101 acres). This is an increase in the acreage anticipated in the FES-CP, but does not represent a significant land use change. Operational impacts to land use on the site are insignificant (Sections 4.2.2 and 5.2.1).

(b) There are no significant impacts associated with the transmission system because for the most part it will utilize the vacant side of existing towers on existing rights-of-way (Sections 4.2.7 and 5.2.2).

(c) On an average annual basis, consumptive use of Ohio River water will be about 0.05% of the flow at the site. This small consumptive use is judged to be a negligible impact on downstream users (Section 5.3.2).

(d) The water quality of the Ohio River in the vicinity of Beaver Valley Unit 2 has improved somewhat over that reported in the FES-CP. However, some constituents are present in the river at concentrations above those specified as acceptable by applicable criteria. The concentrating effect of the Unit 2 cooling system will aggravate these concentrations in the river. However, comparisons of the maximum discharge concentrations with those associated with aquatic organism mortality data indicates that, for most constituents, adverse effects would not be expected. Discharge of residual chlorine, un-ionized ammonia, and manganese at the maximum expected concentrations could produce localized short-term adverse effects on receiving water biota (Sections 5.3.1 and 5.5.2).

(e) The effects of thermal discharges in the cooling system blowdown to the Ohio River are judged to be a small and negligible impact on the riverine community of aquatic biota. Because the Shippingport facility will no longer be operating when Unit 2 becomes operational, the thermal discharges to the river will be less than previously evaluated at the CP stage. Some localized effects may be expected during winter, with attraction of some fish to the thermal mixing zone, and during summer, with avoidance of the mixing zone by some species (Section 5.5.2).

(f) Entrainment of biota in makeup water for the closed cycle cooling system is projected to be small and a negligible impact on the riverine biotic community. Percentage losses are expected to be equal to the ratio of the makeup flow to river flow. Losses of ichthyoplankton (fish eggs and larvae) will be very small because of their period of peak occurrence and susceptibility during high river flows in spring and early summer (Section 5.5.2).

(g) Impingement will affect some fish species preferentially, but losses are not expected to impact the populations of these species (Section 5.5.2).

(h) The operation of the plant and transmission system will have no impacts on endangered and threatened species (Sections 4.3.5 and 5.6).

(i) The operation and maintenance of the plant and associated facilities is not anticipated to have any effect on any sites or properties eligible for or listed in the National Register of Historic Places (Sections 4.3.6 and 5.7).

(j) The risks to the general public from the exposure to radioactive effluents and the transportation of fuel and wastes from annual operation of the facility are very small fractions of the estimated normal incidence of cancer fatalities and genetic abnormalities (Section 5.9.3.1).

(k) The risk to the public health and safety from exposure to radioactivity associated with the normal operation of the facility will be small (Section 5.9.3.2).

(l) No measurable radiological impact on the populations of biota is expected as a result of routine operation of the plant (Section 5.9.3.3).

(m) The environmental impacts that have been considered in the staff's evaluation of the postulated plant accidents 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 (a) the fact that considerable experience has been gained with the operation of similar facilities without significant degradation of the environment; (b) the fact that, to obtain a license to operate, Beaver Valley Unit 2 must comply with the applicable Commission regulations and requirements; and (c) a probabilistic assessment of the risk for similar plants based upon the methodology developed in the reactor safety study (RSS) (WASH-1400, NUREG-75/014). Accidents have a potential for early fatalities and economic costs that cannot arise from normal operations; however, the risks of early fatality from potential accidents at the site are small in comparison with risks of early fatality from other human activities in a comparably sized population, and the accident risk will not add significantly to population exposure and cancer risks. Accident risks from Beaver Valley Unit 2 are expected to be a small fraction of the risks the general public incurs from other sources. Further, the best estimate calculations show that the risks of potential reactor accidents at Beaver Valley are within the range of such risks from other nuclear power plants. Based on the foregoing considerations of environmental impacts of accidents, which have not been found to be significant, the staff has concluded that there are no special or unique circumstances about the Beaver Valley site and environs that would warrant special consideration of alternatives for Beaver Valley Unit 2 (Section 5.9.4.6).

(n) The environmental impact on the U.S. population from radioactive gaseous and liquid releases resulting from the uranium fuel cycle is very small when compared with the impact of natural background radiation (Section 5.10).

(o) Radiation doses to the public as a result of end-of-life decommissioning activities are expected to be small (Section 5.11).

(p) The staff predicts that offsite noise levels consisting of broadband noise from the Unit 2 cooling towers, tonal noise from station transformers, and intermittent noise from outdoor loudspeakers (part of the plant paging security systems) during unit operation will be equal to or below ambient levels near the site, except for an area near Ferry Road and in the vicinity of a cluster of private residences east of the station boundary. Depending on ambient noise levels, operational phase noise levels could be high enough to cause annoyance and complaints. A monitoring program to determine actual noise levels, to be followed by an assessment of their impact and the need for mitigative actions will be included in the Environmental Protection Plan for the station (Sections 5.12 and 5.14.4).

(q) There is little potential for impacts on terrestrial ecosystems as a result of operation of the cooling tower. However, the applicant will continue an infrared aerial photography program to assess potential salt drift impacts to vegetation (Section 5.14.1). The threat to bird populations as a result of collisions are insignificant (Section 5.5.1).

(5) 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. Where appropriate, a specific operating life of 40 years has been assumed.

(6) The personnel who participated in the preparation of this document are identified in Section 7.

(7) The Draft Environmental Statement was made available for comment to the public, to the Environmental Protection Agency, and to other agencies as specified in Section 8. Comments received are addressed in Section 9, and the comment letters are reproduced in Appendix A.

(8) On the basis of the analysis and evaluations set forth in this statement, after weighing the environmental, technical, and other benefits against the environmental costs at the operating license stage, the staff concludes that the action called for under NEPA and 10 CFR 51 is the issuance of an operating license for Beaver Valley Unit 2, subject to the following conditions for protection of the environment:

(a) Before engaging in additional construction or operation activities that may result in a significant adverse impact that was not evaluated or that is significantly greater than that evaluated in this statement, the applicant shall provide written notification of such activities to the Director of the Office of Nuclear Reactor Regulation and shall receive written approval from that office before proceeding with such activities.

(b) The applicant shall carry out the environmental monitoring programs outlined in Section 5 of this statement, as modified and approved by the staff, and implemented in the Environmental Protection Plan and Technical Specifications that will be incorporated in the operating

license for Beaver Valley Unit 2. Monitoring of the aquatic environment shall be as specified in the National Pollution Discharge Elimination System (NPDES) Permit.

(c) If adverse environmental effects or evidence of impending irreversible environmental damage occurs during the operating life of the plant, the applicant shall provide the staff with an analysis of the problem and a proposed course of corrective action.

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FOREWORD

This Final Environmental Statement-Operating License Stage (FES-OL) was prepared by the U.S. Nuclear Regulatory Commission (NRC), Office of Nuclear Reactor Regulation (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 that 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 the preparation of a statement on

- the environmental impact of the proposed action
- any adverse environmental effects that cannot be avoided should the proposal be implemented
- alternatives to the proposed action
- the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity
- any irreversible and irretrievable commitments of resources that would be involved in the proposed action should it be implemented

An Environmental Report (ER-OL) accompanied the application for an operating license. In conducting the required NEPA review, the staff met with the applicant to discuss items of information in the ER-OL, to seek new information from the applicant that might be needed for an adequate assessment, and to ensure that the staff has a thorough understanding of the proposed project. In addition, the staff has obtained information from other sources that have assisted in this evaluation, and visited the project site and the surrounding vicinity. Members of the staff met 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 were deemed useful and appropriate, the staff made an independent assessment of the considerations specified in Section 103(2)(c) of the NEPA and 10 CFR 51.

The evaluation led to the publication of the DES, which was circulated to Federal, state, and local government agencies for comment. A notice of the availability of the ER-OL and the DES was published in the Federal Register (January 18, 1985). Interested persons were also invited to comment on the proposed action and on the draft statement.

This Final Environmental Statement (FES) includes a discussion of questions and concerns raised by the commenters and the disposition thereof. This FES also contains the conclusions reached by the staff as to whether--after the environmental, economic, technical, and other benefits are weighed against environmental costs--the action called for, with respect to environmental issues, is the issuance or denial of the proposed license, or its appropriate conditioning to protect environmental values. The format used in the DES also is used in the FES to facilitate review.

The information to be found in the various sections of this statement updates the environmental statement issued at the construction permit stage (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 that would enhance as well as degrade the environment) than those projected during the pre-construction 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 that are to be resolved by means of license conditions.

Copies of this FES are available for inspection at the Commission's Public Document Room, 1717 H Street, NW, Washington, DC 20555 and at the Local Public Document Room at the B. F. Jones Memorial Library, 663 Franklin Avenue, Aliquippa, Pennsylvania 15001.

Ms. Marilyn Ley is the NRC project manager for the environmental review of Beaver Valley Unit 2. Should there be any questions regarding the content of this statement, Ms. Ley may be contacted by telephone at (301) 492-7000 or by writing to

Division of Licensing
Nuclear Regulatory Commission
Washington, DC 20555

1 INTRODUCTION

The proposed action is the issuance of an operating license to Duquesne Light Company, as applicant and agent for the owners, for operation of the Beaver Valley Power Station Unit 2 (NRC Docket No. 50-412). The site is on the south bank of the Ohio River in Shippingport Borough, Beaver County, Pennsylvania. It is approximately 1.6 km (1 mile) from Midland, Pennsylvania; 8 km (5 miles) from East Liverpool, Ohio; and 40 km (25 miles) from Pittsburgh, Pennsylvania.

The unit will employ a three-loop pressurized water reactor (PWR) with a net calculated electrical output of approximately 836 MW. Beaver Valley Unit 1, licensed in January 1976, uses a three-loop PWR with a net electrical output of 810 MW.

Beaver Valley Unit 2 has a pumped, closed-loop circulating water system that uses an air-cooled natural draft hyperbolic cooling tower as a heat sink. The Ohio River provides makeup cooling water and serves as the ultimate heat sink.

1.1 Administrative History

Joint ownership of Beaver Valley Unit 2 is held by the Central Area Power Coordinating Group (CAPCO), which is comprised of Ohio Edison Company, the Cleveland Electric Illuminating Company, the Toledo Edison Company, and Duquesne Light Company. However, Duquesne Light Company retains overall responsibility for the project.

On October 20, 1972, an application for a license to construct and operate the proposed Beaver Valley Power Station Unit 2 was docketed with the Atomic Energy Commission (AEC, now the Nuclear Regulatory Commission, NRC). In July 1973, the AEC issued a Final Environmental Statement, Construction Permit stage (FES-CP) related to Beaver Valley Unit 2, which reported the results of a pre-construction environmental review. Following a public hearing before an Atomic Safety and Licensing Board, Construction Permit No. CPPR-105 was issued on May 3, 1974.

By letter dated January 26, 1983, the applicant filed an application for an operating license. Following a predocketing acceptance review by the NRC, the application was docketed on May 18, 1983. The applicant's Environmental Report-Operating License stage (ER-OL) and Final Safety Analysis Report (FSAR) were also docketed then.* The staff's Draft Safety Evaluation Report was issued in March 1984, and a second Draft Safety Evaluation Report (DSER) was issued in June 1985. The SER is scheduled for issuance in late 1985.

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*These documents are cited in this report as ER-OL or FSAR, followed by a section, table, or figure number. They are available for review at the NRC Public Document Room, 1717 H Street, NW, Washington, DC and at the Local Public Document Room at the B.F. Jones Memorial Library, 663 Franklin Avenue, Aliquippa, Pennsylvania 15001.

The results of the staff review of the ER-OL were published in the Draft Environmental Statement (DES), issued for public comment in December 1984. This statement contained the second assessment of the environmental impact associated with the operation of Beaver Valley Unit 2, pursuant to the National Environmental Policy Act of 1969 (NEPA) and Title 10 of the Code of Federal Regulations, Part 51, as amended, of the Nuclear Regulatory Commission regulations. It examined the environment, environmental consequences and mitigating actions, and environmental and economic benefits and costs.

The DES was sent to Federal, state, and local government agencies, as listed in Section 8, and a notice of availability was published in the Federal Register (January 18, 1985). Interested persons also were invited to comment.

After receipt and consideration of these comments, the staff has prepared this Final Environmental Statement (FES), which includes, in Section 9, a discussion of the questions and concerns raised by the commenters and the disposition thereof. The comment letters are reproduced in Appendix A; they are arranged chronologically in order of the date on the letter. This FES also includes conclusions as to whether--after the environmental, technical, and other benefits are weighed against environmental costs--the action called for with respect to environmental issues is the issuance or denial of the proposed license or its appropriate conditioning to protect environmental values.

The FES follows the same format as the DES. To facilitate review, all changes are marked by a bar in the margin next to the change (except in Section 9 and Appendices A and G, which are entirely new material). In the discussion of the staff response to comments in Section 9, the comments are arranged according to subject matter, following the format of the rest of the statement; for example, comments relating to Section 4.2.4 on the cooling system are addressed in Section 9.4.2.4. Although the FES contains some changes from the DES, the conclusions--supporting issuance of the operating license--remain unchanged.

Appendix B contains the NEPA population dose assessment, Appendix C discusses impacts of the uranium fuel cycle, and Appendix D contains examples of site-specific dose assessment calculations. Appendix E addresses rebaselining of the reactor safety results for pressurized water reactors (PWRs), and Appendix F addresses consequence modeling considerations. Appendix G reproduces the National Pollutant Discharge Elimination System permit, and Appendix H contains correspondence regarding historical and archeological sites.

1.2 Permits and Licenses

ER-OL Table 12.1-1 lists the status of environmentally related permits, approvals, and licenses required from Federal and state agencies in connection with the proposed project. The staff has reviewed the listing and other information and is not aware of any potential non-NRC licensing difficulties that would significantly delay or preclude the proposed operation of the plant. Pursuant to Section 401 of the Clean Water Act, the issuance of a water quality certification, or waiver therefrom, by the Pennsylvania Department of Environmental Resources (PDER) is a necessary prerequisite to the issuance of an operating license by the NRC. This Section 401 certification was granted on January 23, 1974 (ER-OL Section 12.3). The National Pollutant Discharge Elimination System (NPDES) permit for operation of Beaver Valley Units 1 and 2, pursuant to Section 402 of the Clean Water Act, was issued by the PDER on November 26, 1984 (Appendix G).

2 PURPOSE OF AND NEED FOR ACTION

The Commission 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 (Federal Register, March 1982). Need-for-power 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 51.53, 51.95(e), and 51.106(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.

The Commission has determined that substantial information exists to support the contention that nuclear plants cost less to operate than do conventional fossil-fueled 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 (Federal Register, August 1981 and March 1982).

Accordingly, this environmental statement does not consider "need for power." Section 6 does, however, consider the savings associated with the operation of Beaver Valley Unit 2.

2.1 References

Federal Register, 46 FR 39440, August 3, 1981.

---, 47 FR 12940, March 26, 1982.

3 ALTERNATIVES TO THE PROPOSED ACTION

The Commission 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 (Federal Register, March 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 51.53, 51.95, and 51.106(c) and (d)).

The Commission has concluded that alternative energy source issues are resolved at the construction permit stage, and the construction permit is granted only after a finding that, on balance, no superior alternative to the proposed nuclear facility exists. 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 (Federal Register, August 1981 and March 1982). By an 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, according to 10 CFR 2.758. Thus, this environmental statement does not consider alternative energy sources or alternative sites.

3.1 References

Federal Register, 46 FR 28630, May 28, 1981.

---, 46 FR 39440, August 3, 1981.

---, 47 FR 12940, March 26, 1982.

4 PROJECT DESCRIPTION AND AFFECTED ENVIRONMENT

4.1 Résumé

This section compares the plant design and operating characteristics given in the FES-CP with those given in the ER-OL. This résumé highlights the changes that have occurred.

Changes to the external appearance and station layout are discussed in Section 4.2.1. Section 4.2.2 identifies changes in both the total site area and total area affected by construction. Section 4.2.3 discusses four changes in water use and treatment: a decrease in annual water consumption, a considerable decrease in drift, the use of groundwater for domestic purposes, and the use of additional chemicals for water treatment. The following changes to the cooling system are described in Section 4.2.4: an increase in maximum water velocity across the bar racks in the primary intake structure, the addition of an auxiliary intake structure and emergency outfall structure, a change in blowdown rate, and a decrease in the maximum temperature difference between the ambient and discharge temperatures of the combined blowdown from Units 1 and 2. Section 4.2.5 discusses the radioactive waste management system. In Section 4.2.6, which addresses the nonradioactive waste management system, the addition of a separate sewage treatment facility is addressed. Section 4.2.7 discusses the new circuit to the power transmission system.

Section 4.3.1 provides supplemental information on hydrology, including material on the construction of a culvert to enclose Peggs Run. Section 4.3.2 discusses the improvements in water quality observed for the Ohio River near the station. A discussion of some of the severe weather phenomena experienced in the region of the Beaver Valley plant is included in Section 4.3.3, and Section 4.3.4 contains additional data on both terrestrial biota and fish species. Both terrestrial and aquatic endangered and threatened species are discussed in Section 4.3.5. Historical and archeological sites and socioeconomic characteristics are discussed in Sections 4.3.6 and 4.3.7, respectively.

4.2 Facility Description

4.2.1 External Appearance and Plant Layout

A general description of the external appearance and plant layout is in FES-CP Section 3, and a sketch of the proposed layout for Beaver Valley Unit 2 is in Figure 3.2 of that report.

Since the publication of the FES-CP, the major changes that have occurred include the addition of the south office building and primary access facility. Other permanent structures that have been added to the combined Unit 1 and Unit 2 site area include a north office building, an east parking facility, a sewage treatment facility, a solid waste handling structure, a training center, an emergency response facilities building, an emergency outfall structure, and an auxiliary intake structure (see ER-OL Figure 3.1-1 for detailed layout).

4.2.2 Land Use

The Beaver Valley site covers approximately 203 ha (501 acres). About 21 ha (52 acres) have been added to the site since the FES-CP was issued; however the site boundary is essentially the same, except for the 4.5-ha (11-acre) addition shown in Figure 4.1. The remaining acquired acreage was within the site boundary shown in ER-CP Figure 2.4-1 and includes (1) a parcel along the railroad right-of-way and other right-of-way areas, and (2) survey differences that have been reconciled. Unit 2 facilities occupy 23 ha (56 acres). Construction affected 41 ha (101 acres) instead of the 24 ha (58 acres) estimated in the FES-CP (ER-OL Section 5.7.1). On the site, immediately west of Unit 2, are Beaver Valley Unit 1 and the Shippingport Atomic Power Station, which is being decommissioned. The secure area for the three facilities is about 44.5 ha (110 acres); 29 ha (71 acres) of this area that is not occupied by permanent facilities will be planted in grass. Support facilities (the training center and emergency response facility) occupy 6 ha (15 acres) outside the secure area (ER-OL Figure 3.1-1). More than half the site (140 ha, 346 acres) is upland forest and old field habitat, but this natural area is interrupted by transmission corridors, roads, pipelines, and spoil areas, so that the undisturbed area is about 113 ha (279 acres) (Table 4.1).

The exclusion area, shown on Figure 4.2, has a 690-m (2000-foot) radius centered on the Unit 1 containment building. The nearest distance to the exclusion area boundary is 547 m (1794 feet).

The 100-year flood elevation in the site area--211.9 m msl (695 feet msl)--is shown on Figure 5.1 of this FES. The 100-year floodplain at the site ranges from 27.4 m (90 feet) to 106.7 m (350 feet) wide (ER-OL Section 2.1.3.1.4). Major alterations in the onsite floodplain include filling the relocated Peggs Run outlet to provide foundation for the Unit 1 cooling tower and filling on the north side of Unit 2 to provide a parking lot. The total fill area is approximately 51.8 m (170 feet) wide and 182.9 m (600 feet) long, and is parallel to the Ohio River.

Most of the plant facilities are built on ancient floodplains and are underlain by fine textured loams, silt loams, or silty clay loams (ER-OL Section 2.2.1.1 and Figure 2.2-2). These soil types are rated fair to excellent for woodland productivity, wildlife potential, and crop production (USDA, 1982). Table 4.2 lists the soil mapping units on the site that qualify as prime farmland and farmland of statewide importance (USDA, 1984). However, much of the site is overlain by fill placed during construction of Unit 1 and the Shippingport station. In addition, during construction of Unit 2, a zone of loose granular material was found, and it was subsequently densified (FSAR Sections 2.5.4.1 and 2.5.4.2). Thus, this land is essentially irreversibly committed, because it is unlikely to be suitable for agricultural uses at the end of the project. The upland soils onsite are mostly Gilpin and Wharton silt loams (USDA, 1982) that will remain generally undisturbed during operation. The upland Gilpin soil units with 3% to 8% slopes qualify as prime farmland, and the Gilpin and Wharton soil units with 8% to 15% slopes qualify as farmland of statewide importance.

4.2.3 Water Use and Treatment

4.2.3.1 Water Use

Figure 4.3 shows the water use now anticipated for the Unit 2 as well for Unit 1. Unit 2 will withdraw a total of about 104,375 L/m (27,570 gpm) from the Ohio River (ER-OL Section 3.3.1), which is similar to the approximately 102,000 L/m (27,000 gpm) anticipated in FES-CP Section 3.4. During temporary shutdowns, water will be withdrawn at a rate of 56,780 L/m (15,000 gpm) (ER-OL Table 3.3-1).

When the FES-CP was prepared, water consumption by Unit 2 as a result of evaporation was expected to range from 22,710 to 45,425 L/m (6000 to 12,000 gpm), depending on weather conditions (FES-CP Section 3.3). A similar range--25,170 to 42,775 L/m (6650 to 11,300 gpm)--is expected now, with the minimum in December and the maximum in July and August (ER-OL Table 3.3-4). The annual average for Unit 2 is now expected to be 32,970 L/m (8710 gpm) (ER-OL Table 3.3-3), similar to the rate of 33,500 L/m (8850 gpm) expected earlier (FES-CP Section 3.3). Unit 2 is now expected to consume 8% less water, on an annual basis, than Unit 1 (ER-OL Table 3.3-3), whereas in FES-CP Section 3.3, consumption by the two units was expected to be equal.

Drift from the Unit 2 cooling tower is now expected to be 245 L/m (65 gpm) (ER-OL Table 3.3-3), considerably less than the 945 L/m (250 gpm) anticipated in FES-CP Section 3.3.

No use of groundwater was anticipated in the FES-CP (Section 3.3). However, the support buildings are now expected to use well water for domestic purposes, rather than treated river water from the Unit 1 domestic water system (ER-OL Section 3.3). This use is expected to average 105 L/m (28 gpm), with a maximum of 415 L/m (110 gpm) (ER-OL Table 3.3-1).

4.2.3.2 Water Treatment

Potable water from onsite wells will be softened and chlorinated (ER-OL Section 3.3.2). (A backup system could provide clarified, filtered, and softened river water from Unit 1.) All other high purity water used by Unit 2 will be clarified and filtered in the existing Unit 1 water treatment system (Figure 4.3). (When water use calls for higher quality water, that water will also be demineralized).

Circulating water will be chlorinated (to prevent biofouling) upstream of the condenser to maintain a free available chlorine (FAC) concentration at the discharge to the river of no more than 0.5 mg/L. The Unit 1 chlorination system will chlorinate both units, although not simultaneously. A mechanical cleaning system will assist the chlorination system in preventing biofouling, by injecting and retrieving sponge rubber balls in the condenser tubes (ER-OL Section 3.4.1). Each half of the condenser will be chlorinated twice a day in two one-half-hour periods (ER-OL Section 3.6.1), for a total chlorination time of 2 hours a day. The National Pollutant Discharge Elimination System (NPDES) permit (Appendix G) limits chlorine in the discharge to 0.2 mg/L average and 0.5 mg/L maximum FAC. Service water is also chlorinated to maintain a maximum of 0.5 mg/L FAC (ER-OL Section 3.6.3).

Although the applicant expects the total residual chlorine (TRC) concentration to be approximately twice the FAC concentration (ER-OL Section 3.6.1), a more detailed analysis of the data underlying this expectation (Duquesne, 1978) reveals considerable variability in this ratio. The chlorination study, which took place at Unit 1, measured maximum levels of TRC and FAC in the cooling tower discharge on a daily basis from July 1, 1977 to April 28, 1978. Using a concentration of 0.10 mg/L as a practicable limit of detectability of all forms of chlorine residuals, TRC was detectable in about 84% of the study samples, while FAC was detectable in about 37% of the samples. FAC concentration was measured at 0.20 mg/L (the current Unit 1 NPDES limit) or above in only 9% of the samples. TRC concentrations reached this level in about 40% of the samples. The calculated average FAC and TRC concentrations in the study were 0.08 mg/L and 0.20 mg/L, respectively. For samples in which the FAC was at least 0.20 mg/L (the maximum recorded concentration was 0.32 mg/L), the ratio of TRC to FAC ranged from 1.10:1 to 2.00:1, respectively. However, on the 2 days when the highest TRC concentrations were recorded (greater than 0.60 mg/L), the ratio of TRC to FAC was much greater than 2.00:1.

On November 17, 1977, the maximum concentrations of FAC and TRC were 0.07 and 0.65 mg/L, respectively, yielding a ratio of 9.3:1. On December 9, 1977, when the TRC concentration was 0.61 mg/L, no FAC was detected (detection limit not specified). If a detection limit of 0.01 mg/L (equal to the lowest concentration reported in the study) is assumed, the ratio of TRC to FAC is greater than 61:1. Overall the average ratio of TRC to FAC was 2.5:1. This ratio was 2.0:1 or less in about 43% of the samples, but 10:1 or more in about 19% of the samples. This variability demonstrates the complexity of chlorine chemistry (Mattice and Zittel, 1976) and the difficulty of predicting TRC from FAC. Although the ratio of 2.00:1 expected by the applicant appears to be reasonable on most occasions, it appears that on some days the ratio may be considerably larger.

The clarifier will use hydrated lime, ferric sulfate, and (perhaps) a coagulant aid and/or clay, followed by sand filtration (ER-OL Section 3.6.5.1), as discussed in FES-CP Section 3.6.3. Also, as discussed in the FES-CP, a demineralizer train of ion exchange beds will remove dissolved solids to produce high purity water.

Hydrazine, morpholine, and ammonium hydroxide will be used to treat condensate; potassium chromate will be used to treat primary component cooling water; the proprietary substances Corrshield K-8 and Betz DUQ.01 will treat secondary component cooling water; and Betz DUQ.01 will treat the cooling tower water (ER-OL Table 3.6-3). Of these, only the use of hydrazine and morpholine was anticipated, when the FES-CP was issued.

4.2.4 Cooling System

As described in FES-CP Section 3.4, Unit 2 will use a closed-cycle cooling system with a natural draft cooling tower, with makeup water from the Ohio River.

The primary intake structure, shared with Unit 1, was described in the FES-CP. Important features of the structure include subsurface intake openings, coarse bar racks, and vertical traveling screens with 1-cm (3/8-inch) mesh openings (Figure 4.4 and ER-OL Section 3.4). A motorized trash rake and a screen wash

will collect trash for disposal (ER-OL Section 3.4.2.7). Unit 2 will draw water from two of the four intake bays. The maximum velocity across the bar racks will be 0.10 m/s (0.34 fps) (ER-OL Section 3.4) or slightly higher than the highest intake velocity mentioned in the FES-CP (Section 3.4), which was 0.07 m/s (0.24 fps). Unit 2 will also have an auxiliary intake structure (shared with Unit 1) (Figure 4.5) for emergency use, to be equipped with traveling screens with mesh of a size identical to that of the primary intake structure. The auxiliary intake structure was not discussed in the FES-CP. The location of both structures is shown in Figure 4.9.

The 153-m (502-foot) tall natural-draft cooling tower will operate at a circulating water flow rate of 1.921×10^6 L/m (507,400 gpm) (ER-OL Table 3.4-2) which is similar to the 1.913×10^6 L/m (506,600 gpm) flow rate anticipated in FES-CP Figure 3.3.

The service water system uses the 104,375 L/m (27,575 gpm) of water withdrawn from the Ohio River to provide once-through cooling of primary and secondary heat exchangers, control room refrigerant condensing units, safeguards area air conditioners, main steam valve area cooling coils, motor control center cooling units, and charging pump coolers. After this once-through cooling, 72,580 L/m (19,170 gpm) is discharged to the circulating water system as makeup (ER-OL Section 3.4.2) and 31,797 L/m (8400 gpm) is discharged via the emergency outfall structure (described below) (ER-OL Section 3.4.2.7). An additional 4430 L/m (1170 gpm) of cooling water is discharged during emergency diesel generator testing for at least 2 hours per month (ER-OL Section 3.4.2.7).

Unit 2 blowdown is released to the Ohio River via a discharge structure that is shared with Unit 1 (Figure 4.6). Discharge velocity will be about 0.3 to 0.6 m/sec (1 to 2 fps) during normal operation of Units 1 and 2 (ER-OL Section 3.4.1), which is similar to the 0.4 m/sec (1.2 fps) velocity given in FES-CP Figure 3.5. An emergency outfall structure (Figures 4.7 and 4.8 will provide the capability to discharge up to 151,415 L/m (40,000 gpm) during emergencies (ER-OL Section 3.4.2). The emergency outfall structure was not described in the FES-CP. The location of both discharge structures is shown in Figure 4.9.

Ordinarily, Unit 2 will release blowdown at a rate ranging from 29,800 to 47,405 L/m (7875 to 12,525 gpm), with an average of 43,020 L/m (10,463 gpm), via the discharge structure, and 31,800 L/m (8400 gpm) via the emergency outfall structure (to reduce silt accumulation (ER-OL Table 3.3-1). FES-CP Section 3.4 estimated a discharge of about 56,780 L/m (15,000 gpm). During shutdowns, the station will release a maximum of 56,780 L/m from the discharge structure and 946 L/sec from the emergency outfall structure (ER-OL Table 3.3-1).

The temperature difference between ambient and discharge temperatures of the combined blowdown from Units 1 and 2 (ΔT) will range from 1.3C° (2.4F°) in August to 15.9C° (28.6F°) in January (ER-OL Table 5.1-6). The maximum ΔT discused in the FES-CP (Section 5.2) was 22C° (40F°). The chemical constituents of the station discharge are discussed in Section 4.2.6 below.

4.2.5 Radioactive Waste Management Systems

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 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 (LWRs) 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 will be presented in Chapter 11 of the staff's Safety Evaluation Report (SER), which is scheduled to be issued in early 1985. The quantities of radioactive material that the NRC staff calculates will be released from the plant during normal operations, including anticipated operational occurrences, are presented in Appendix D of 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 Chapter 11 of the SER.

On the basis of its evaluation, the staff concludes that the designs of the radwaste systems and effluent control measures are capable of meeting the design objectives of the annex to Appendix I, RM-50-2. Therefore, no cost-benefit analysis for adding additional treatment systems is required.

As part of the operating license for this facility, 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 facility operates in conformance with the radiation-dose-design objectives of the annex, RM-50-2, to Appendix I.

4.2.6 Nonradioactive Waste Management Systems

4.2.6.1 Liquid Effluents

The only major change from the description in the FES-CP is that a separate sewage treatment facility has been built to handle the increased sanitary load

imposed by the support buildings for Units 1 and 2 (ERF, training building, south office shops, and primary access facility). The earlier design (FES-CP Section 3.7.1) called for the existing Unit 1 facility to handle the sewage treatment for both units. A summary of important features of nonradioactive waste management is given below. Radioactive waste management is described in Section 4.2.5 above.

Wastes from Unit 2 may be divided into two categories: wastes that will be discharged to existing Unit 1 treatment and discharge systems, and wastes that will be discharged to separate Unit 2 waste management systems. The former category includes clarifier blowdown, settling basin overflow, makeup demineralizer regeneration wastes, water softener regeneration wastes, and trash from the intake structures. The latter category includes cooing tower blowdown; floor, equipment, and roof drainage; service water discharge; auxiliary boiler blowdown; and sanitary wastes (ER-OL Section 3.6). All these discharges are to the Ohio River, except for sanitary wastes and the discharge from the oil/water separator serving the fuel oil unloading facility (released to Peggs Run, a tributary of the Ohio River) and intake structure trash (disposed off the site). Silt dredged from inside and in front of the intake structures and silt cleaned from the cooling tower basin will be disposed at approved locations off the site (ER-OL Section 3.4.2.7). The applicant states that during Unit 1 operation silt has been cleaned from inside the main intake structure twice a year, while silt has been removed from in front of the main intake structure only once (ER-OL Response to Question E291.8). Oil will be removed from any oil-contaminated drainage by oil separators and disposed off the site; otherwise, nonradioactive floor, equipment, and roof drainage will be discharged to the Ohio River via the storm sewer system (ER-OL Section 3.6.2). Major paths of waste management are shown in Figure 4.3.

The new Unit 2 sewage treatment facility will provide secondary treatment of sanitary wastes from the support buildings of Units 1 and 2, whereas the Unit 1 facility (expanded in capacity from 37,855 L/d (10,000 gpd) to 87,065 L/d (23,000 gpd)) will treat sanitary waste from the permanent plant buildings of Units 1 and 2. The station facility has a design flow of 1.6×10^6 L/d (42,400 gpd), and is expected to handle 84,510 L/d (22,325 gpd) during normal operation. Treatment consists of screening, pre-aeration (equalization), and primary settling, followed by waste oxidation/aeration in a rotating biological contactor, clarification, and chlorination (ER-OL Section 3.7.1). Sewage treatment sludge will be disposed at approved locations off the site (ER-OL Section 3.7.1).

Table 4.3 give the average and maximum expected concentration of selected water quality constituents in the Unit 2 blowdown stream. Table 4.3 shows constituents that will or could be affected by corrosion control or other water treatments (Section 4.2.3), rather than those constituents affected only by evaporative concentration in the makeup water. Average blowdown concentrations are based on an evaporative concentration factor of 1.8 and maximum concentrations are based on a factor of 2.4 (ER-OL Table 5.3-3). The 1.8 concentration factor is identical to that assumed in FES-CP Section 3.4.

The NPDES permit that regulates discharges from Units 1 and 2 is reproduced in Appendix G.*

4.2.6.2 Gaseous Effluents

Nonradioactive gaseous emissions from operation of the plant will be negligible. The unit has two 68,039 Kg/hour (150,000-lb/hour) oil-fired auxiliary boilers that operate alternately. These supplement the two 19,505 Kg/hour (43,000 lb/hour) oil-fired auxiliary boilers installed in Unit 1, which may operate simultaneously. Additional fossil-fueled auxiliary equipment includes a diesel-driven fire pump and a standby diesel generator, both common to Units 1 and 2, and four emergency diesel generators, two 2600-kW generators for Unit 1 and two 4238-kW generators for Unit 2. The boilers are used several days a year for testing purposes, and about 6 to 8 weeks a year for supplying steam during shutdown and refueling of Unit 2. The emergency diesel generators are tested once a month for 1 hour; the fire pump is tested once a week for about one-half hour. Annual air emissions from these sources are minimal (ER-OL Table 3.7-1), and no Federal, state, or local emission standards are applicable. However, to track minor source emissions, the State of Pennsylvania requires an operational permit for auxiliary equipment.

4.2.7 Power Transmission System

The power transmission system is described in ER-OL Section 3.9. The one new circuit and three new connections identified in the ER-OL for Unit 2 differ from the single Beaver Valley-to-Hanna line proposed in the FES-CP. This change is required to increase power system stability and reduce potential overloads. The 25.4-km (15.8-mile), 345-kV Beaver Valley-to-Crescent circuit will be installed on the vacant side of (1) the existing 19.3-km (12-mile) Beaver Valley-to-Collier 345-kV circuit right-of-way, which is 45.7 m (150 feet) wide, and (2) the existing 6.1-km (3.8-mile) Collier-to-Crescent 345-kV circuit right-of-way, which is 25.9 m (85 feet) wide. The other two circuits will be short segments that will connect the Beaver Valley switchyard with the existing Hanna-to-Mansfield 345-kV circuit (ER-OL Figure 3.9-1). These latter two circuits will require the construction of 853 m (2800 feet) of line and one tower. Land use along the Beaver Valley-to-Crescent right-of-way is listed in Table 4.7. The proposed circuits will be installed using ground vehicles on existing access roads and helicopters in inaccessible areas to minimize damage to the right-of-way. No additional rights-of-way are required.

4.3 Project-Related Environmental Descriptions

4.3.1 Hydrology

4.3.1.1 Surface Water

The surface water descriptions in FES-CP Section 2.6 are still valid, as supplemented by the following discussion. In addition, Section 5.3.3 below discusses the hydrologic effects of alterations in the floodplain, in compliance with the guidelines for implementing Executive Order 11988 on floodplain management (Federal Register, 1978).

*DES Tables 4.4, 4.5, and 4.6 have been deleted from the FES because they are superseded by the NPDES permit.

As shown on Figures 4.9 and 4.10, the Beaver Valley station is located on the south side of the Ohio River in southwest Pennsylvania about 40 km (25 miles) northwest of Pittsburgh. The head of the Ohio River is at Pittsburgh, where the Allegheny and Monongahela Rivers merge. From Pittsburgh, the Ohio River flows in a northwesterly direction for about 40 km (25 miles). Then it flows westerly for another 40 km (25 miles) and finally southerwesterly for about 1456 km (905 miles) to Cairo, Illinois, where it joins the Mississippi River.

The Ohio River is highly regulated by many reservoirs on its tributaries and by numerous locks and dams. The nearest locks and dams to the Beaver Valley site are the New Cumberland Locks and Dam located about 31.7 km (19.7 miles) downstream of and the Montgomery Lock and Dam located about 4.8 km (3.0 miles) upstream. The New Cumberland Dam creates a pool in the Ohio River that extends upstream past the station site. Thus the water level in the Ohio River (New Cumberland Pool) at the site is dependent on the New Cumberland Dam, which is operated by the U.S. Army Corps of Engineers. Normally the pool elevation is maintained at elevation 202.5 m (664.5 feet) for river flows up to 566.3 m^3/sec (20,000 cfs). Flows in excess of 566.3 m^3/sec (20,000 cfs) will cause the level in the New Cumberland Pool to increase as follows:

Flood stage	Elevation m (ft) msl
Normal water level	202.5 (664.5)
25-year flood	210.3 (690.0)
100-year flood	211.8 (695.0)
Standard project flood	214.9 (705.0)
Probable maximum flood	222.5 (730.0)

The major tributary to the Ohio River upstream of the Beaver Valley site, in addition to the Allegheny and Monongahela Rivers, is the Beaver River, which flows into the Montgomery Pool about 15.3 km (9.5 miles) from the plant site. Average flows in the Allegheny, Monongahela and Beaver Rivers are 545 m^3/sec (19,270 cfs), 347 m^3/sec (12,260 cfs), and 100 m^3/sec (3,530 cfs), respectively. For the Ohio River at the site, the average flow is about 1040 m^3/sec (36,700 cfs). The lowest flow of record occurred during the record drought of 1930 when a minimum flow of 35 m^3/sec (1250 cfs) flowed past the site. Since that time, however, eight reservoirs with low flow augmentation capability have been constructed. The Corps of Engineers estimates that, based on the present system of reservoirs in the Ohio River basin, a minimum flow of about 113 m^3/sec (4000 cfs) could be expected at the site for hydrologic conditions similar to the record drought of 1930. The once-in-10-year, 7-day-duration low flow is estimated to be about 147 m^3/sec (5200 cfs). The river stage for both the drought of record and the 7-day 10-year low flow is 202.5 m (664.5 feet) msl because, as stated above, the New Cumberland Pool is maintained at this elevation for flows up to 566 m^3/sec (20,000 cfs). At elevation 202.5 m (664.5 feet) msl, the river is about 457 m (1500 feet) wide and has an average depth of about 6 m (20 feet).

The finished station grade elevation varies from 222.6 m (730.3 feet) msl to 224 m (735 feet) msl except along the river where the intake and outlet

structures are located. In this area, the grade elevation is about 205.7 m (675 feet) msl. The majority of the station is located about 20 m (66 feet) above the normal water level. The intake and outlet structures are by necessity located at the river's edge.

Before the start of construction of the station, Peggs Run flowed through the site from the south. To provide space for the cooling towers, a portion of Peggs Run had to be relocated closer to the fill supporting the south approach to the Shippingport bridge. As shown in Figures 4.9 and 4.11, a 427-m (1400-foot) portion of Peggs Run is now enclosed in a 4.6-m (15-foot) culvert. This culvert is being lengthened an additional 122 m (400 feet) at the northern end. The culvert empties into an open channel before it enters the Ohio River.

4.3.1.2 Groundwater

The groundwater descriptions in FES-CP Section 2.6.2 are still valid with the inclusion of the following discussion. The station is located on a terrace of alluvial deposits that were deposited by the higher stages of the ancestral Ohio River drainage system during the Pleistocene period. The terrace is about 1219 m (4000 feet) long and 549 m (1800 feet) wide at its widest point. It is more than 30 m (100 feet) thick and consists predominantly of sands and gravels. The hydraulic conductivity of these alluvial deposits has been estimated to range from 1.7×10^{-3} to 6.1×10^{-3} cm/sec (5.7×10^{-5} to 2.0×10^{-4} fps).

Underlying the terrace deposits is bedrock of Pennsylvanian age. This bedrock is a carbonaceous shale, which dips southeastward at about 2.8 to 3.8 m/km (15 to 20 feet/mile) and has a surface elevation of about 189 m (620 feet) msl at the site.

The sands and gravels in the terrace deposit on which the station is located form the only significant aquifer in the site area. Downstream of the station, the terrace pinches out against the steep bedrock valley wall. To the northeast, it is limited by a buried bedrock bench that extends almost to the river's edge. The bedrock and the upland region south of the station effectively isolate the terrace and direct the groundwater flow toward the river.

Recharge to the terrace aquifer is primarily from precipitation in the immediate area. Additional recharge occurs during periods of rising river levels because the terrace aquifer and the river are hydraulically connected. Groundwater occurs under hydrostatic conditions with the phreatic surface having a contour in subdued relief approximating the ground surface. Beneath the station, the groundwater elevation is normally at about 203 m (665 feet) msl and movement is directed in a northwest direction towards the Ohio River.

Groundwater wells within the site boundary consist of two construction wells, two wells which supply water to the Shippingport Atomic Station (which is located adjacent to and southwest of the station), and two wells that will supply domestic water to the support buildings. None of these wells are located downgradient from Unit 2.

4.3.2 Water Quality

Data on water quality in the Ohio River near the station has improved, based on a review of 1976-1980 data presented to update the 1968-1970 data used in the

FES-CP (see Table 4.8). The increase in alkalinity and decreases in sulfate, iron, and manganese may be attributed to reduced inputs of acid mine drainage (ER-OL Section 2.4.5.13), which was felt to dominate water quality in the New Cumberland Pool when the FES-CP was prepared (FES-CP Section 2.6.1). Reduced concentrations of ammonia and nitrate nitrogen may be attributed to reduced discharges of pollutants from sewage treatment (ER-OL Section 2.4.5.11) and industrial sources (EPA, 1976). It appears that the "further improvements" in water quality anticipated by the FES-CP have been realized. Water quality data from river samples collected near the station site are presented in Table 4.8.

Data presented by the applicant in the ER-OL on water temperature in the Ohio River are similar to those given in the FES-CP. The range of average monthly water temperatures given in the FES-CP was 3.2°C (37.7°F) (January) to 26.2°C (79.2°F) (July and August), based on 1946-1966 data; more recent data (1964-1977) produced a range of 2.5°C (36.5°F) (January) to 26.4°C (79.5°F) (August) (ER-OL Section 2.4.4). Data presented by the applicant for 1964-1977) (ER-OL Figure 2.4-11) are similar to those given in FES-CP Table 2.2 for the percent of time a given water temperature is equaled or exceeded: for each data set, the maximum is about 30°C (86°F) with a temperature of 27°C (80°F) equaled or exceeded 10% of the time, and a temperature of 10°C (50°F) equaled or exceeded 63% of the time.

FES-CP Section 2.6.3 listed Pennsylvania water quality criteria for the Ohio River as follows: dissolved oxygen to exceed 5.0 mg/L as a daily average, with a minimum of 4.0 mg/L at any time; pH to be within the range of 6.0 to 8.5 standard units, except where higher values result from photosynthesis; temperature not to exceed specified limits that range monthly from 10°C (50°F) in January and February to 32°C (89°F) in July and August; and total dissolved solids (TDS) not to exceed 500 mg/L as a monthly average and 750 mg/L at any time. Current Pennsylvania and ORSANCO (Ohio River Valley Water Sanitation Commission) criteria (ER-OL Tables 5.1-4 and 5.1-5) are identical for TDS and dissolved oxygen and slightly more lenient for pH (maximum of 9.0 permitted). ORSANCO monthly temperature maxima are similar to the earlier Pennsylvania criteria, but also allow only a maximum rise of 2.8C° (5F°) rise above ambient. The current Pennsylvania criteria allow no more than a 2.8C° (5F°) rise above ambient (no temperature increase when ambient temperature is at least 31°C (87°F)), with temperature change not to exceed 1.1C° (2F°) per hour. In addition, the current Pennsylvania and ORSANCO criteria cover a variety of other variables, including trace elements, nutrients, organics, bacteria.

As noted by the applicant (ER-OL Section 5.3.2 and Table 5.3-4), maximum 1974 ambient river concentrations of aluminum, fecal coliform bacteria, copper, total iron, lead, phenolics, zinc, total cyanide, and mercury exceeded the Pennsylvania criteria. Annual mean concentrations from 1976-1980 of phenolics, copper, total iron, lead, mercury, and zinc for some years also exceeded the state criteria (ER-OL Table 2.4-10).

4.3.3 Meteorology

The discussion of the general climatology of the site and vicinity in the FES-CP remains essentially unchanged. However, the FES-CP did not include a discussion of some of the severe weather phenomena experienced in the region of the Beaver Valley plant. A variety of severe weather phenomena--including thunderstorms, tornadoes, and hurricanes--occurs in the region. About 53

thunderstorms can be expected to occur on about 36 days each year. Hail often accompanies severe thunderstorms. During the period 1955 to 1967, eight occurrences of hail with diameters 19 mm (3/4 inch) or greater were reported in the 1-degree latitude-longitude square containing the site. Tornadoes are not uncommon in the region. For a 1-degree latitude-longitude square (9323 km^2) containing the site, an average of about 1.04 tornadoes per year were reported for the period 1954 to 1981. Using an average tornado path area of 1.42 km^2, the computed probability of occurrence for a tornado at the plant site is about 1.6×10^{-4} per year. The applicant has computed a lower probability of occurrence (about 1.4×10^{-4} per year) based on a much smaller tornado path area (1.04 km^2) and a higher annual frequency (1.22 tornadoes per year) using the period 1950 to 1981.

High wind speed occurrences in the area are usually associated with severe thunderstorms and extratropical cyclones. The highest "fastest mile" wind speed reported at Greater Pittsburgh Airport was 93.3 km/hour (58 mph) in February 1967.

Since the issuance of the FES-CP, the applicant has collected additional onsite meteorological data. Wind data taken from the 10.7-m level of the onsite meteorological tower for a 5-year period (January 1976 to December 1980), as summarized by the applicant, indicate prevailing winds from the southwest (10.5%) and west-southwest (10.2%), with a secondary peak frequency from the southeast (9.2%). Winds from the north-northeast and north-northwest for this period occurred least frequently; each occurred less than 4% of the time. The mean annual wind speed observed at the 10.7-m level of the onsite meteorological tower for the period 1976 to 1980 was about 1.9 m/sec (4 mph), with calm conditions (defined as wind speeds less than the starting threshold of the anemometer) occurring almost 0.8% of the time.

Wind data taken from the 152-m level of the onsite tower for the 5-year period (1976 to 1980) indicate prevailing winds from the southwest, west-southwest, and west (totaling 37.7%). Winds from the north-northeast direction occurred least frequently, 2.7% of the time. The mean annual wind speed observed at the 152-m level of the tower for the 1976 to 1980 period of record was about 4.5 m/sec (10 mph), with calm conditions occurring about 0.2% of the time.

Atmospheric stability assessments based on vertical temperature difference measurements for the 5-year period (1976-1980) have been summarized by the applicant for a shallow (45.7-m to 10.7-m) layer and a deep (152-m to 10.7-m) layer. Unstable conditions (indicating rapid diffusion rates) occur 21.6% and 5.0% of the time in the shallow and deep layers, respectively. Neutral and slightly stable conditions predominate and occur 53.2% and 80.1% of the time in the shallow and deep layers, respectively. Moderately stable and extremely stable conditions (indicating slow diffusion rates) occur 25.3% and 14.9% of the time in the shallow and deep layers, respectively.

A complete description of local and meteorological conditions, including summaries of onsite data, is in both the ER-OL and FSAR.

4.3.4 Terrestrial and Aquatic Resources

4.3.4.1 Terrestrial Resources

The plant facilities are located mostly on ancient Ohio River floodplains, surrounded by forested uplands (Figures 4.1 and 4.2). The vegetation and wildlife of the site are characteristic of disturbed wooded and shrubby areas in southwestern Pennsylvania. The deciduous upland forest communities (ER-OL Table 2.2-5) are early successional or subclimax forests. The area has been affected by coal mining, maintenance of pipeline and transmission corridors, selective logging and farming on the more level uplands, and natural perturbations (fall webworm, locust leaf miner, Dutch elm disease, and ice and wind storms). Nevertheless, the unused areas of the site provide habitat for many species of wildlife (ER-OL Tables 2.2-11 through 2.2-16).

ER-OL Section 2.2-1 presents substantially more data on the terrestrial biota of the site than were in FES-CP Section 2.8-1. These data were obtained from April 1974 to June 1975 (NUS, 1976). The white-footed mouse (Peromyscus leucopus) and short-tailed shrew (Blarina brevicauda) were the most common small mammals sampled on the site. The white-tailed deer (Odocoileus virginianus) is the only big game animal that occurs on the site. During the study period, tracks of raccoon (Procyon lotor), muskrat (Ondatra zibethicus), opossum (Didelphis virginiana), and fox (Urocyron cinereoargenteus) were observed (ibid). The site is not an important waterfowl breeding area, nor is it in a major flyway. Mallards (Anas platyrhynchos) were the only waterfowl observed in the Ohio River adjacent to the site during the study period (ibid).

Sixty-three species of birds were recorded on the Beaver Valley site during the summer of 1974; 48 were presumed to be breeding there (ibid).

Most of the area adjacent to the Beaver Valley-to-Crescent transmission line right-of-way is woodland (Table 4.7). The right-of-way clearing was completed in 1974 (ER-OL response to question E290.3). ER-OL Section 5.5.1 states that the right-of-way is maintained by spraying for broadleaf species with adjustable handguns from trucks on existing access roads. After this treatment, the area will be covered by grasses, herbs, weedy shrubs, and blackberries. In deep wooded valleys where there is adequate clearance between the tops of trees and the electrical lines, vegetation is not cleared.

4.3.4.2 Aquatic

As shown in Table 4.9, a much greater number of fish species have been collected recently (1980 to 1983) at the Beaver Valley site than were listed in FES-CP Tables 2.8 and 2.10 as having been taken in 1968 and 1971. At least 24 species that were collected in 1980 to 1982 were not taken in the 1968 and 1971 collections discussed in the FES-CP. Of the five species listed in the FES-CP but not collected in 1980-1983, all but one were collected from 1975 to 1979 (Duquesne, 1981).

Three factors seem to account for this recorded increase in species diversity over a decade. First, the data reported in the FES-CP were based on relatively limited sampling (1 month in each of 2 years), while the applicant's operational monitoring program has involved a much greater effort. Second, the data reported in the FES-CP were based on rotenone surveys and gill-net sampling, while the more recent data were obtained with gill netting, electrofishing,

cast seining, baited minnow trapping, plankton netting, and collecting fish impinged on the traveling screens. Third, many fish populations that had been eliminated in the upper Ohio River by deteriorating water quality have since 1970 begun to return as water quality improves (Pearson and Krumholz, 1984). (The improved water quality at the Beaver Valley site is discussed in Section 4.3.2.) This recovery of Ohio River fisheries confirms the relationship between water quality and fish distribution that had been observed during a short-term study in 1957-1959 (Krumholz and Minckley, 1964).

Numerically dominant fish in the 1968 and 1971 collections were channel catfish, carp, and yellow and brown bullhead. Fish that dominated the more recent collections may reflect not only actual changes in the species of the fish community, but also differences in sampling methods. Thus, the electrofishing collections were numerically dominated by emerald shiner, sand shiner, bluntnose minnow, and gizzard shad; the gill-netting collections by channel catfish, carp, walleye, sauger, spotted bass, and gizzard shad; the cast-seining collections by emerald shiner; and the minnow trap collections by emerald shiner, sand shiner, bluntnose minnow, and spotfin shiner (Duquesne, 1981, 1982, 1983, and 1984).

The applicant and the staff have developed independent estimates of the fish harvest potential for the Ohio River in the vicinity of the plant site. The applicant reports that no commercial fishing is allowed in the Pennsylvania portion of the river near the site and that no commercial fishing licenses have been issued in the West Virginia portion within an 80-km (50-mile) radius of the site (ER-OL Section 2.1.3.2.3.1). The applicant estimates the recreational (sport) fish harvest for the Pike Island Pool and the West Virginia portion of the New Cumberland Pool to be about 13,800 kg/yr (30,400 lb/yr). Of the estimated recreational harvest, about 55% is carp, 22% catfishes, and 15% centrarchids (i.e., sunfishes, crappies, and bass) (ER-OL Table 2.1-14). For use in liquid pathway dose calculation, the applicant assumes the edible weight of the recreational catch to be 6200 kg/yr (13,700 lb/yr) (ER-OL Table 5C-4).

The staff's estimates for commercial and recreational harvests have been developed for the river segment approximately 80 km (50 miles) from the Beaver Valley site (at Ohio River mile 35.0) downstream to Pike Island Dam (at Ohio River mile 84.3). The water surface area for this segment is 3408 ha (8420 acres), as estimated by the applicant (response to staff question E291.7).

The staff estimates the potential annual harvest to range from 60,660 kg/yr (133,700 lb/yr) to 927,300 kg/yr (2,044,400 lb/yr). Of the estimated total, the range of potential commercial harvest is from 13,290 kg/yr (29,300 lb/yr) to 766,800 kg/yr (1,690,500 lb/yr), and the range of potential recreational harvest is from 47,370 kg/yr (104,400 lb/yr) to 160,520 kg/yr (353,900 lb/yr). No harvest of shellfish for human consumption is expected from this river segment.

The lower end of the range for the commercial harvest estimate is based on a mean value of 3.9 kg/ha for rate of yield reported for reservoirs in the Ohio River basin (Leidy and Jenkins, 1977); the upper end is based on a yield of 225 kg/ha derived by McLean (1983) using lock chamber rotenone data taken between Ohio River miles 500 and 600. The staff gives the range in lieu of site-specific data and believes that the potential for commercial harvest, if

a fishery were allowed to develop as water quality improves, is more likely to be toward the lower end of the range. The upper end of the range can be used in a conservative worst case estimate of the liquid pathway dose.

The range for the recreational harvest estimate is based on potential yields of 13.9 kg/ha reported by Leidy and Jenkins (1977) and the 47.1 kg/ha derived by McLean (1983) from cove rotenone data in the vicinity of the Marble Hill Nuclear Station site. As with the commercial harvest estimate, the actual yield for recreational fishing is expected to be nearer the lower end of the range, but the upper end is provided for a conservative estimate of dose.

The difference between the applicant's and staff's estimates of total fish harvest near the site results from the staff's inclusion of a commercial fishery in the estimate. Although no commercial fishery presently exists, the staff takes the optimistic view that, with improved water quality, and reestablishment of native fish stocks, a commercial fishery could develop during the operational life of Unit 2.

In the FES-CP, the staff speculated that the Ohio River fish at the site "probably spawn primarily in the tributaries or near the mouths of the tributaries where the substrate and water quality are desirable, although some undoubtedly spawn in the slack water afforded by nearby Phillis Island." Pearson and Krumholz (1984) felt that channels behind islands are important areas for speleophils (a group that includes bluntnose minnow, yellow bullhead, and channel and flathead catfish) and phytophils (a group that includes white crappie, largemouth bass, goldfish, carp, and banded killifish). They also concluded, however, that spawning in the river was more important to the species found there than was spawning in or at the mouths of tributaries.

A comparison of ichthyoplankton densities in the back channel of Phillis Island with those measured along a transect across the Ohio River perpendicular to the main intake structure (Table 4.10) shows that densities in the back channel were consistent with those in the main channel. Had the back channel been a particularly productive spawning area, this might have been reflected in higher ichthyoplankton densities relative to the main channel; this does not appear to have been the case. Cyprinids constituted the majority of the ichthyoplankton collected from 1980 to 1982 both in the back channel (85% to 89%) and in the main channel (79% to 96%) (Duquesne, 1981, 1982, and 1983). This provides further evidence that this back channel is not a unique spawning area in the Ohio River.

Corbicula fluminea has been present in the waters of the Ohio River at or near the Beaver Valley Unit 2 site since 1975 (Duquesne, 1981 and 1983). Although most populations of these bivalves are found downstream of the Unit 2 site (Taylor, 1980; Counts, 1983), other populations are located upstream of the site. Taylor (1980) reported C. fluminea in the Ohio River at Pittsburgh. However, he did not find these bivalves in significant numbers upstream of Williamstown, West Virginia. Zeto (1982) reported C. fluminea from the Monongahela River in West Virginia. According to personnel at the University of Delaware, an examination of the zoogeographic data base for C. fluminea at the university revealed specimens were also collected at Lock and Dam 8, near New Geneva, Pennsylvania. None of the populations contained high numbers of bivalves.

Although the Ohio River at the Unit 2 site is near the northernmost zoogeographic limits of Corbicula fluminea, water temperatures are sufficiently warm to allow survival and successful reproduction of these bivalves. It is anticipated that two spawning seasons per year are to be expected in the Ohio River Corbicula fluminea populations near the plant site.

The applicant expects continued contribution of Corbicula to the benthic community in the Ohio River at the site (ER-OL Section 2.2.2). Although no Corbicula were collected in 1979 and 1980, the applicant reports that Corbicula were found in 1981 sampling and are unlikely to disappear from the river near the site unless major long-term changes in physical habitat conditions occur (response to staff question E291.6).

Corbicula fluminea has been found within the Unit 1 cooling system (Duquesne, 1981). Approximately 30 shells were removed from the reactor plant component cooling water heat exchangers in 1981. Although the applicant did not state whether these "shells" were alive or dead, their size (12.7 mm, 0.5 inch) indicate they were relatively young. No other fouling of water systems was noted in that report, and no operational problems have been reported as a result of biofouling by these bivalves at Unit 1.

Plans for biofouling control are described in ER-OL Section 3.4.2.7 and are evaluated by the staff in the SER (scheduled to be published in late 1985). The primary control scheme for the service water system components utilizes the Unit 1 chlorination system (see Sections 4.2.3, 5.3.2, and 5.5.2.2 of this statement).

Peggs Run, the tributary of the Ohio River that receives the effluent from the Unit 2 sewage treatment plant (Section 4.2.6), is a highly disturbed stream. At the station, much of Peggs Run is underground in a culvert or is contained in an artificial channel of steel sheet piling (ER-OL Section 2.4.3). Mine drainage from the upper watershed has apparently produced a substrate degraded by an oxidized iron floc and supportive of only limited macrobenthic populations, according to a personal observation during a site visit by an NRC staff member on April 3, 1984. The stream is isolated from its embayment on the Ohio River by an artificial waterfall near the Unit 1 cooling tower.

4.3.5 Endangered and Threatened Species

4.3.5.1 Terrestrial

No plant or animal species listed as endangered or threatened by the U.S. Fish and Wildlife Service (U.S. Department of the Interior, 1983a) or the State of Pennsylvania (Western Pennsylvania Conservancy, 1984) was found at the site or on the transmission corridor (ER-OL Section 2.2.1.2). The small whorled pogonia (Isotria medeoloides), an endangered plant on the Federal list, occurs in mixed second growth hardwood forests; in Pennsylvania it is currently reported in Centre County (Kulp, 1983) about 282 km (175 miles) from the site.

Three Federally listed endangered birds may be found as transient species in the Beaver Valley area. They are the bald eagle (Haliaeetus leucocephalus), peregrine falcon (Falco peregrinus), and Kirtland's warbler (Dendroica kirtlandii). There is no listed critical habitat for these species in the project area (ibid). A bald eagle has inhabited the general area (FES-CP Section 2.8.1)

but was not seen during the 1974-1975 ecological studies. Unit 2 is also within the historic range of the endangered Indiana bat (Myotis sodalis), but there are no populations known to occur in the area.

4.3.5.2 Aquatic

No Federally listed endangered or threatened species have been collected at the Beaver Valley site from 1970-1983, nor were any such species listed in the site description portion of the FES-CP (U.S. Fish and Wildlife, 1983).

Four fish species being considered for listing by the U.S. Fish and Wildlife Service (1982) may have been found historically in the area but have not been taken in recent collections: lake sturgeon (Acipenser fulvescens) has not been reported from the Ohio River in the last 30 years; paddlefish (Polyodon spathula) has not been reported from above river mile 429 since 1970; eastern sand darter (Ammocrypta pellucida) has not been reported from above river mile 200 since 1920; and longhead darter (Percina macrocephala) has not been reported from the Ohio River since 1920 (Pearson and Krumholz, 1984).

No fish species considered endangered or threatened by the State (Pennsylvania Fish Commission, 1979) have been taken in recent collections at the site (Table 4.9). Three fish species considered "status indeterminate" (insufficient data to assess status) by the State have been taken in recent sampling at the site: channel darter, sauger, and spotted bass. Skipjack herring, listed in the project area in the FES-CP, had not been collected recently at the site; it was believed that skipjack herring was not found in the state (as of 1979). However, DOI (see Appendix A) states that this species has been collected "upstream from the site." Consequently, it is possible that skipjack herring is now found in the project area. Black bullhead, also listed in the FES-CP but not recently collected at the site, is considered "status indeterminate."

The U.S. Fish and Wildlife Service reports that three Federally listed species of endangered molluscs have historically occurred in the upper Ohio River; these are the orange footed pearly mussel (Plethobasus cooperianus, renamed Plethobasus striatus), pink mucket pearly mussel (Lampsilis orbiculata, renamed Lampsilis abrupta), and the rough pig toe (Pleurobema plenum) (Kulp, 1983). The first two species are reported to have included Pennsylvania in their historic range (U.S. Fish and Wildlife Service, 1983). Although there have been no recent collections of these endangered species from the Ohio River, the Fish and Wildlife Service notes that significant changes have taken place in the river since these molluscs were last collected, resulting in improved water quality and conditions for mussels (Kulp, 1984).

4.3.6 Historic and Archeological Sites

FES-CP Section 2.4 discusses historic and archeological sites. At present, in the 16-km (10-mile) area around the plant, there are 12 sites that are included in the National Register of Historic Places. Five of the listings are in Pennsylvania, two in Beaver and one each in Bridgewater, Aliquippa, and Industry. The six sites in Ohio are all in or near East Liverpool. One site is in New Manchester, West Virginia. With the exception of the marker designated as Beginning Point of U.S. Public Land Survey on the Pennsylvania-Ohio boundary (7.68 km west-northwest from the station), all of the sites are more than 8-km from the station. The operation and maintenance of the plant is not expected to affect any of the properties.

4.3.7 Socioeconomic Characteristics

The general socioeconomic characteristies of the region, including demography and land use, are in FES-CP Section 2.3. As indicated in the FES-CP, the plant is on the south bank of the Ohio River in Beaver County, Pennsylvania, about 40 km northwest of Pittsburgh.

The 16-km area surrounding the station site includes portions of Beaver County, Pennsylvania; Columbiana County, Ohio; and Hancock County, West Virginia. The river valley portions of the area are highly industrialized and include steel mills, zinc smelting, petroleum refining, and plastic, glassware and electrical equipment manufacturing. In the area removed from the river valley, the country side is rural, consisting of scattered farms, small communities, forestland, and open space. The nearby major residential areas include East Liverpool, Ohio (1980 population 16,687), which is about 8 km west of the station, and Aliquippa Borough, Pennsylvania (1980 population 17,094), which is about 13 km east of the site. According to U.S. Bureau of Census data, the Beaver County population declined from 208,418 persons in 1970 to 204,441 persons in 1980. The Aliquippa Borough population fell from 22,277 in 1970 to 16,687 during the same decade.

According to the applicant, the 1980 residential population within 16 km of the site was estimated to be 141,286 persons. More than 124,000 persons are in the 8-16 km area around the plant. Of these, more than three-fourths are in the west, northeast, east-northeast, east, and east-southeast sectors (FSAR Table 2.1-3). The residential population in the year 2010 within 16-km is estimated to be 148,600 (FSAR Table 2.1-7).

The staff has reviewed the applicant's demography data by comparing its estimates with independent sources and has found the applicant's estimates reasonable.

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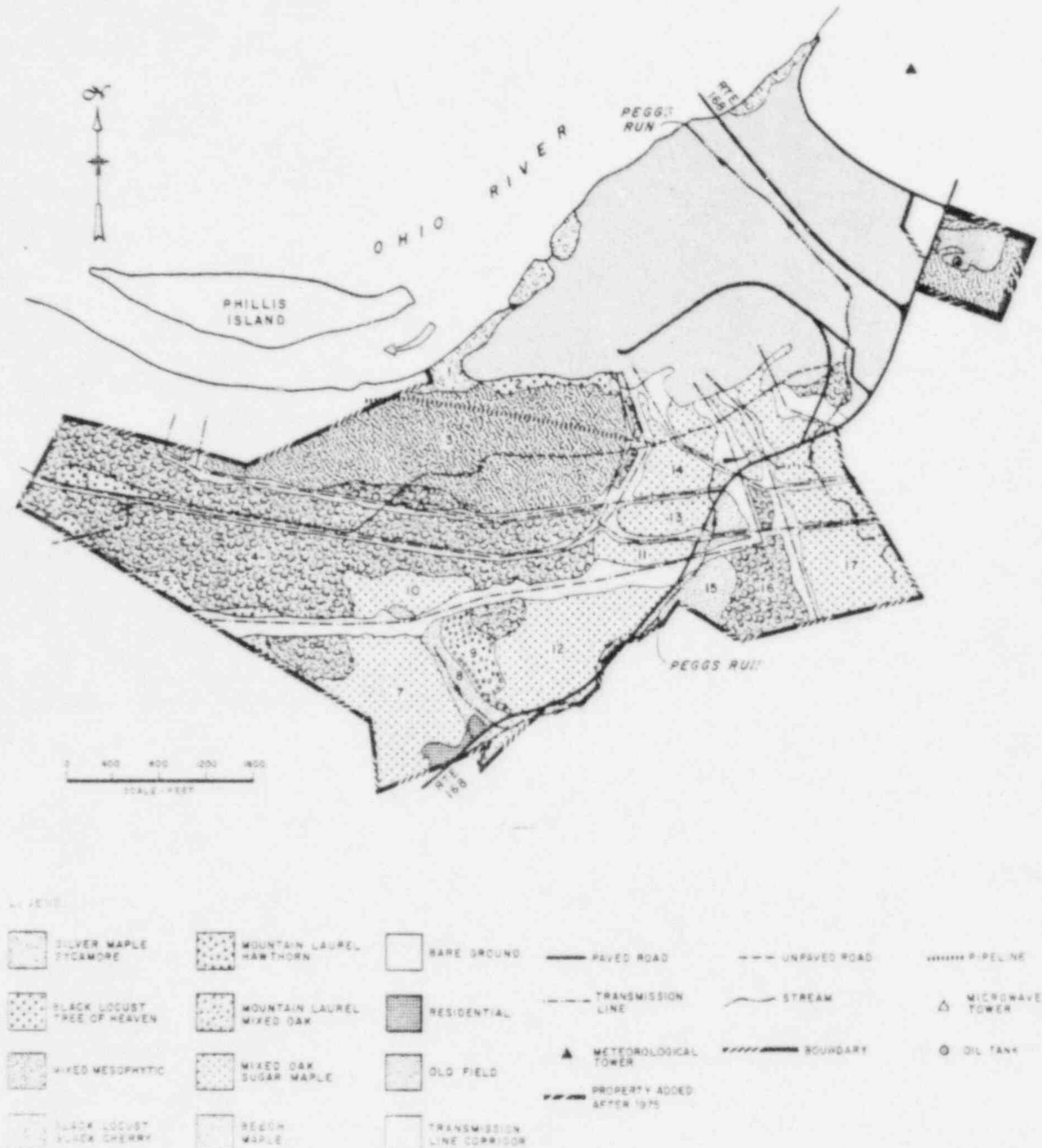


Figure 4.1 Site layout (to change ft to m, multiply values shown by 0.3048)

Note: Numbers indicate vegetation study areas shown in ER-OL Tables 2.2-1, 4, and 5.

Source: ER-OL Figure 2.2-1

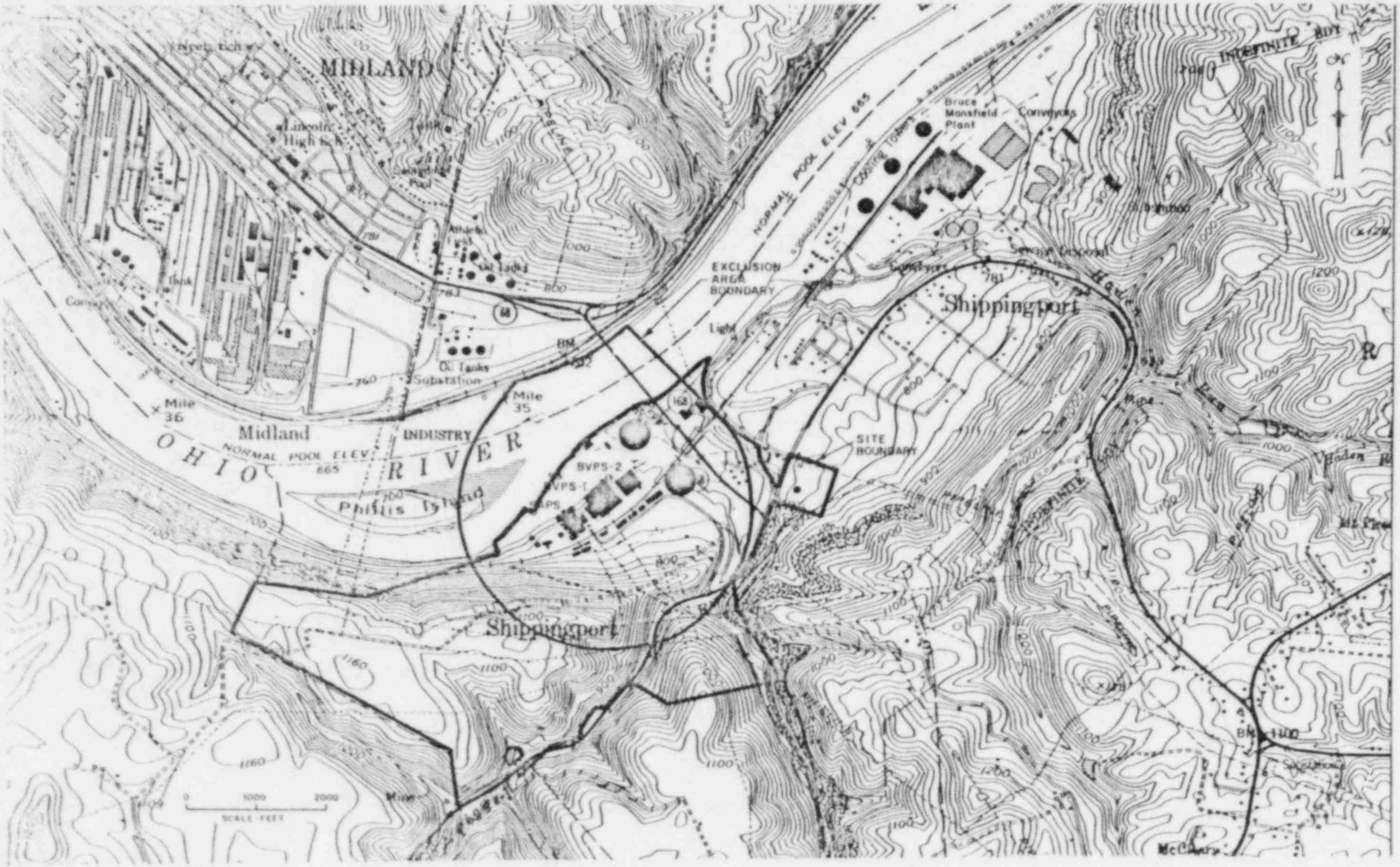


Figure 4.2 Exclusion area

Source: ER-OL Figure 2.1-2

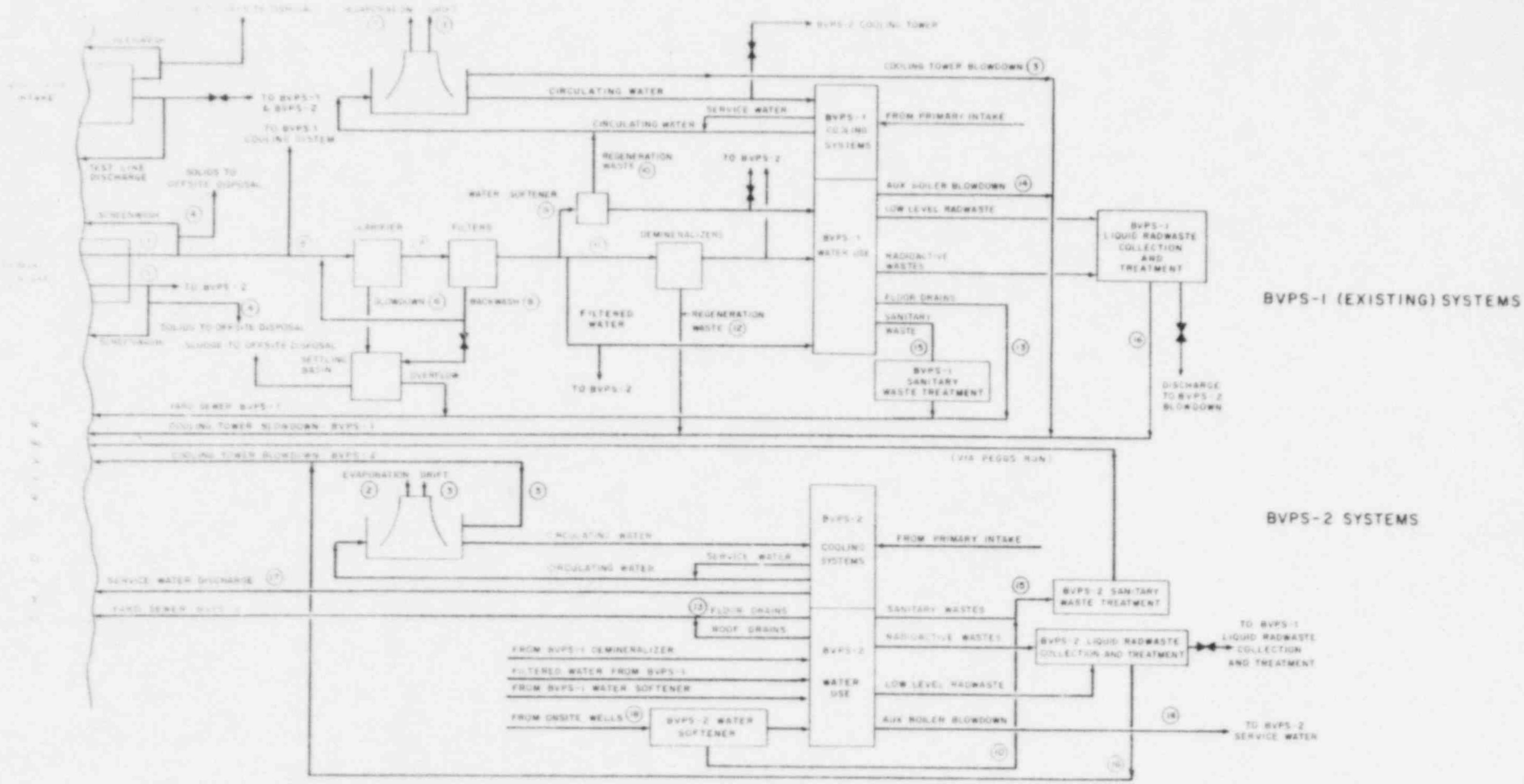


Figure 4.3 Plant water use (see ER-OL Table 3.3-1 for flow rates and definitions for circled numbers)

Source: ER-OL Figure 3.3-1

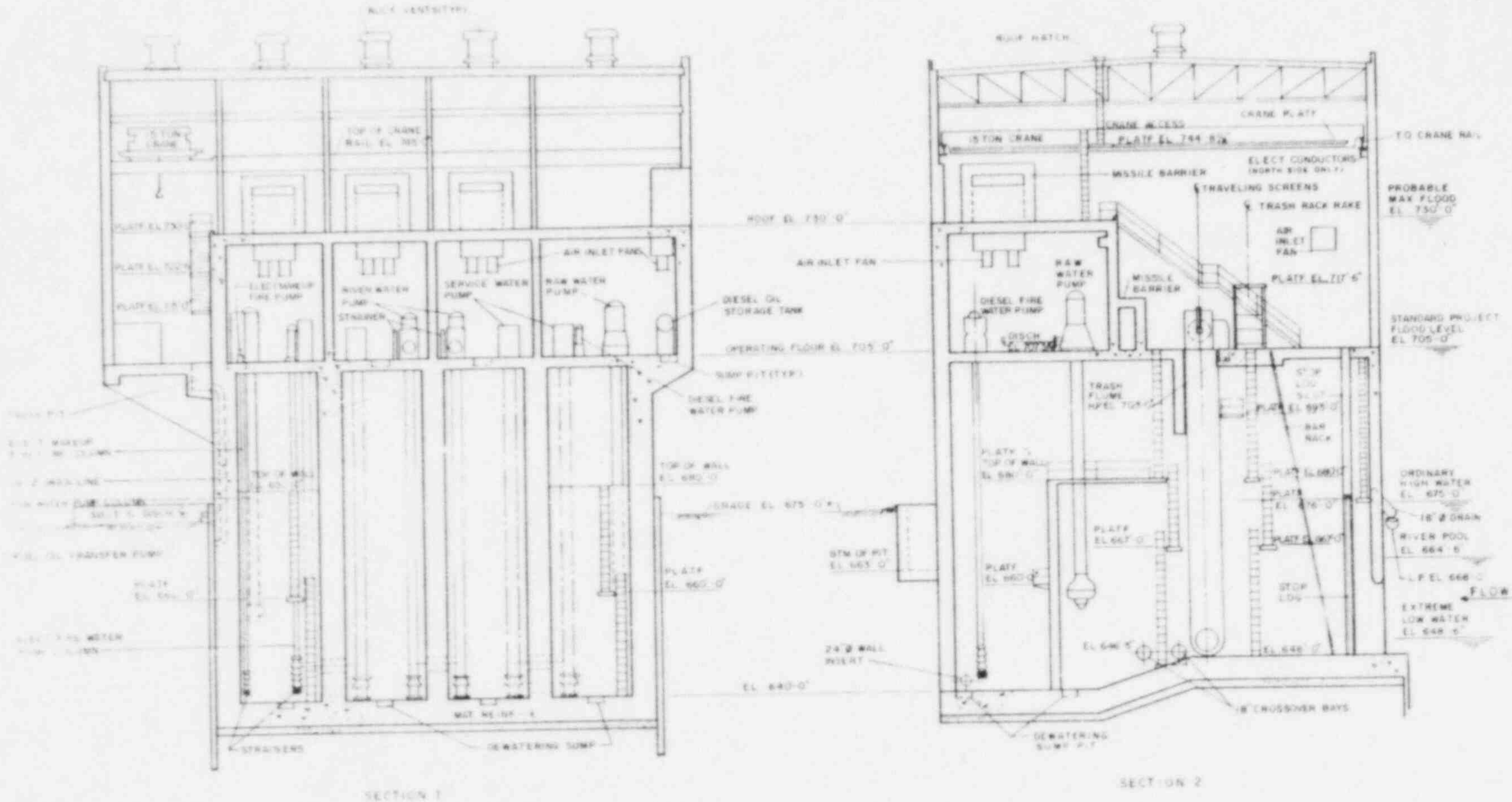


Figure 4.4 Intake structure details

Source: ER-OL Figure 3.4-1

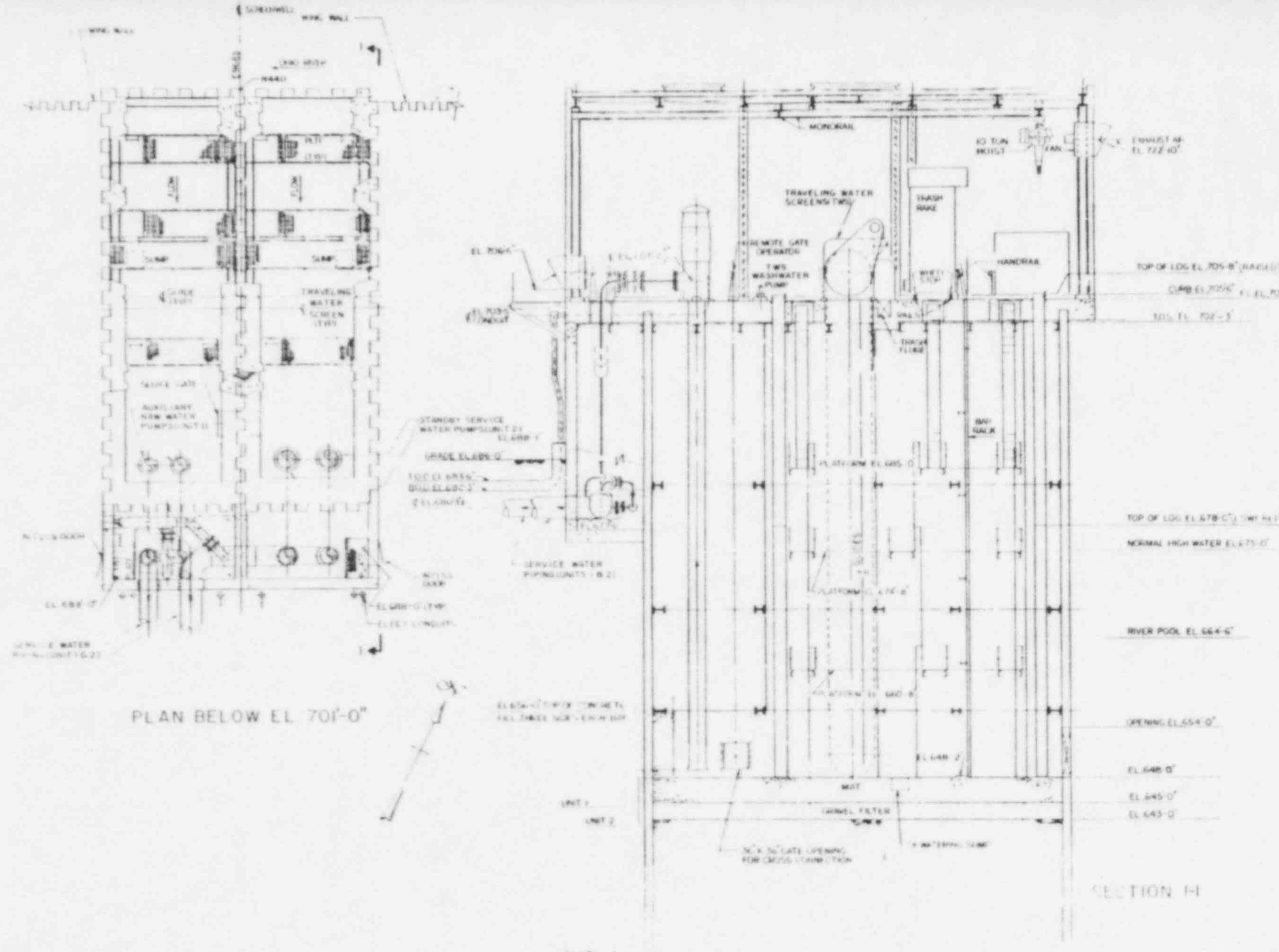


Figure 4.5 Alternate intake structure

Source: ER-OL Figure 3.4-6

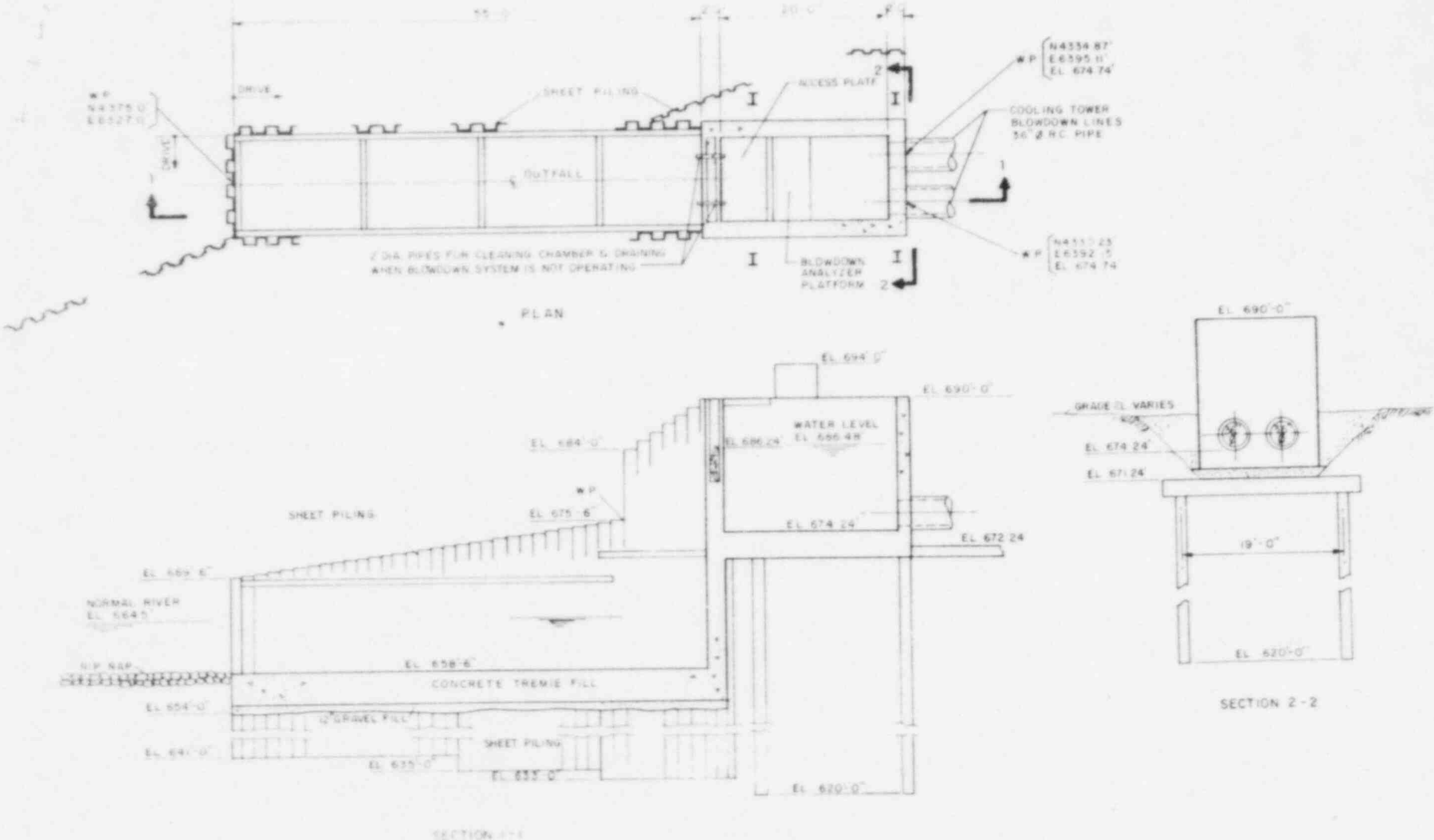


Figure 4.6 Discharge structures

Source: ER-OL Figure 3.4-2

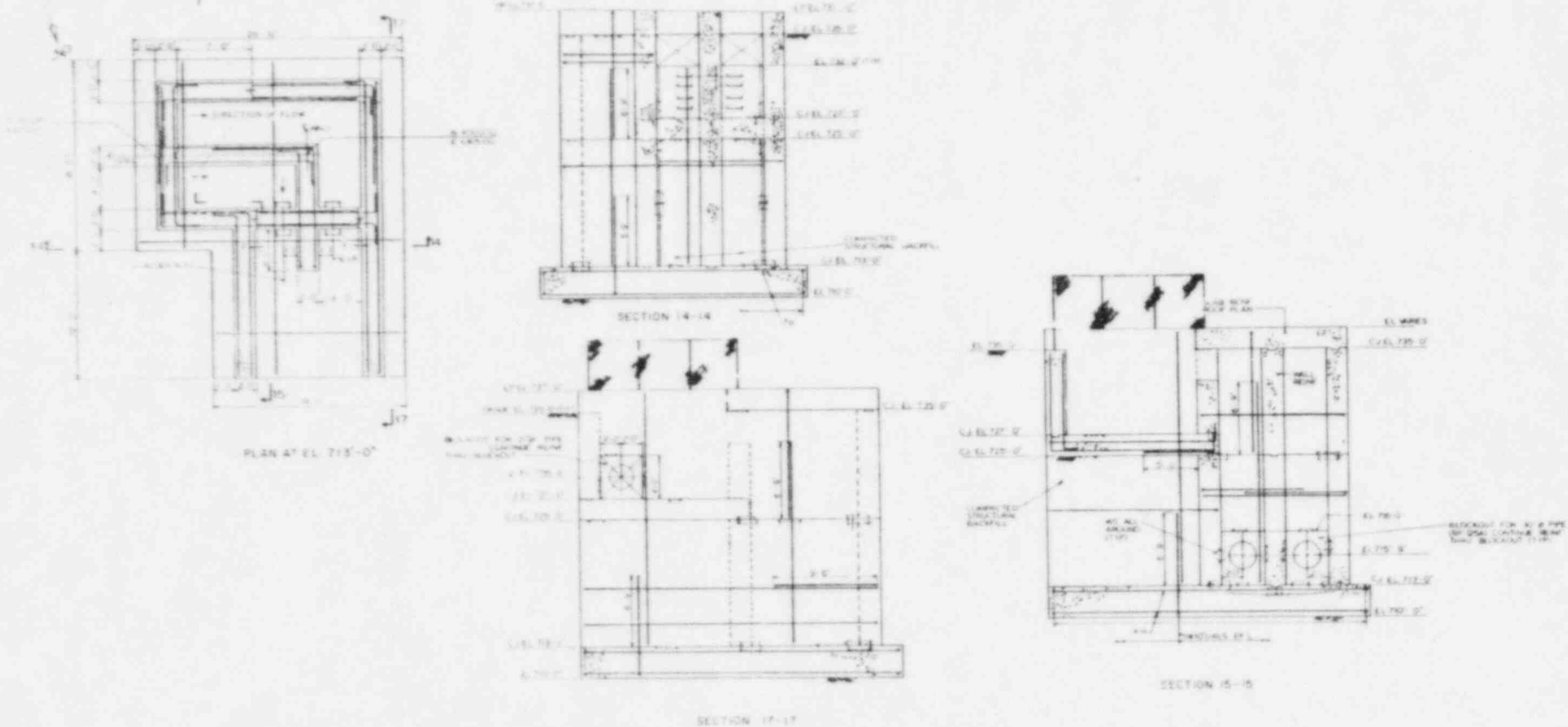
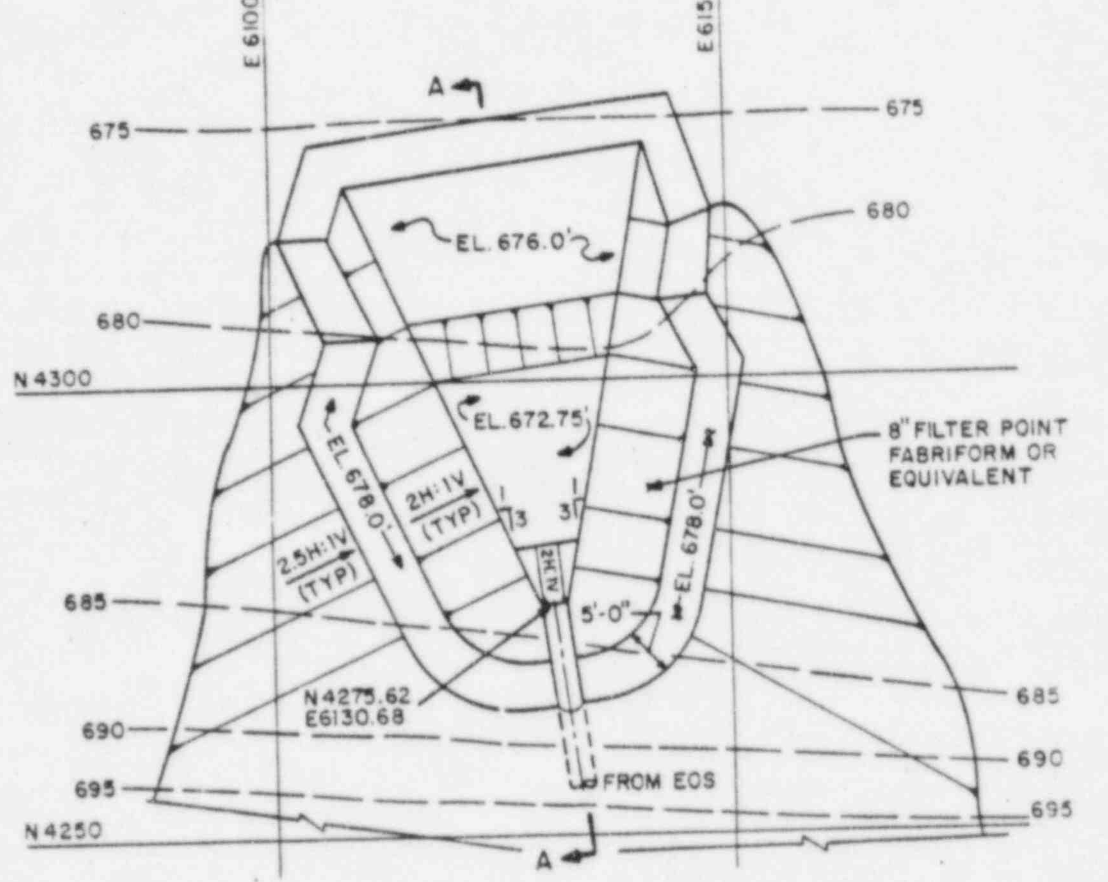
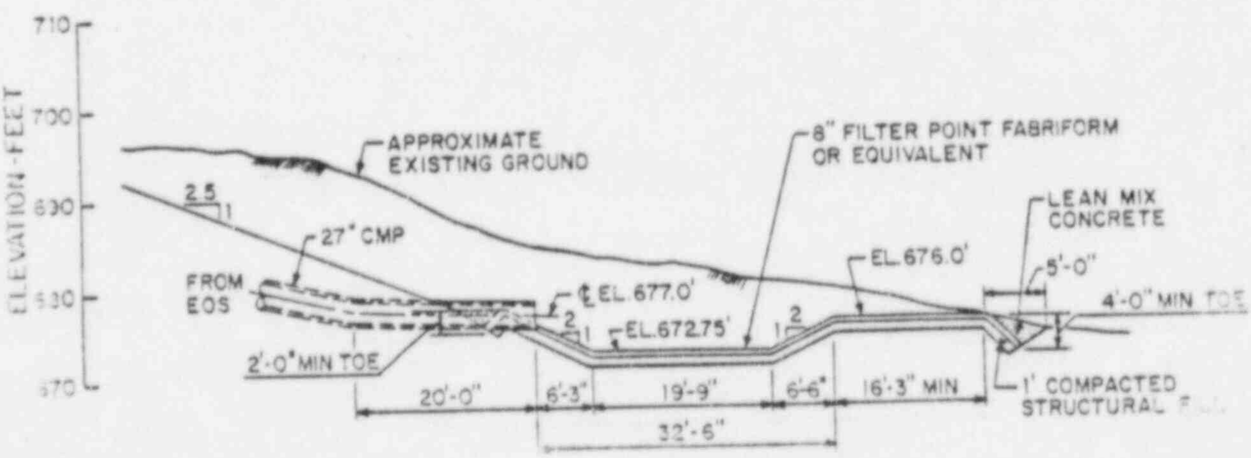


Figure 4.7 Emergency outfall structure

Source: ER-OL Figure 3.4-5



PLAN



SECTION A-A

Figure 4.8 Impact basin for service water discharge
(to change ft to m, multiply by 0.3048)

Source: ER-OL Figure 3.4-8

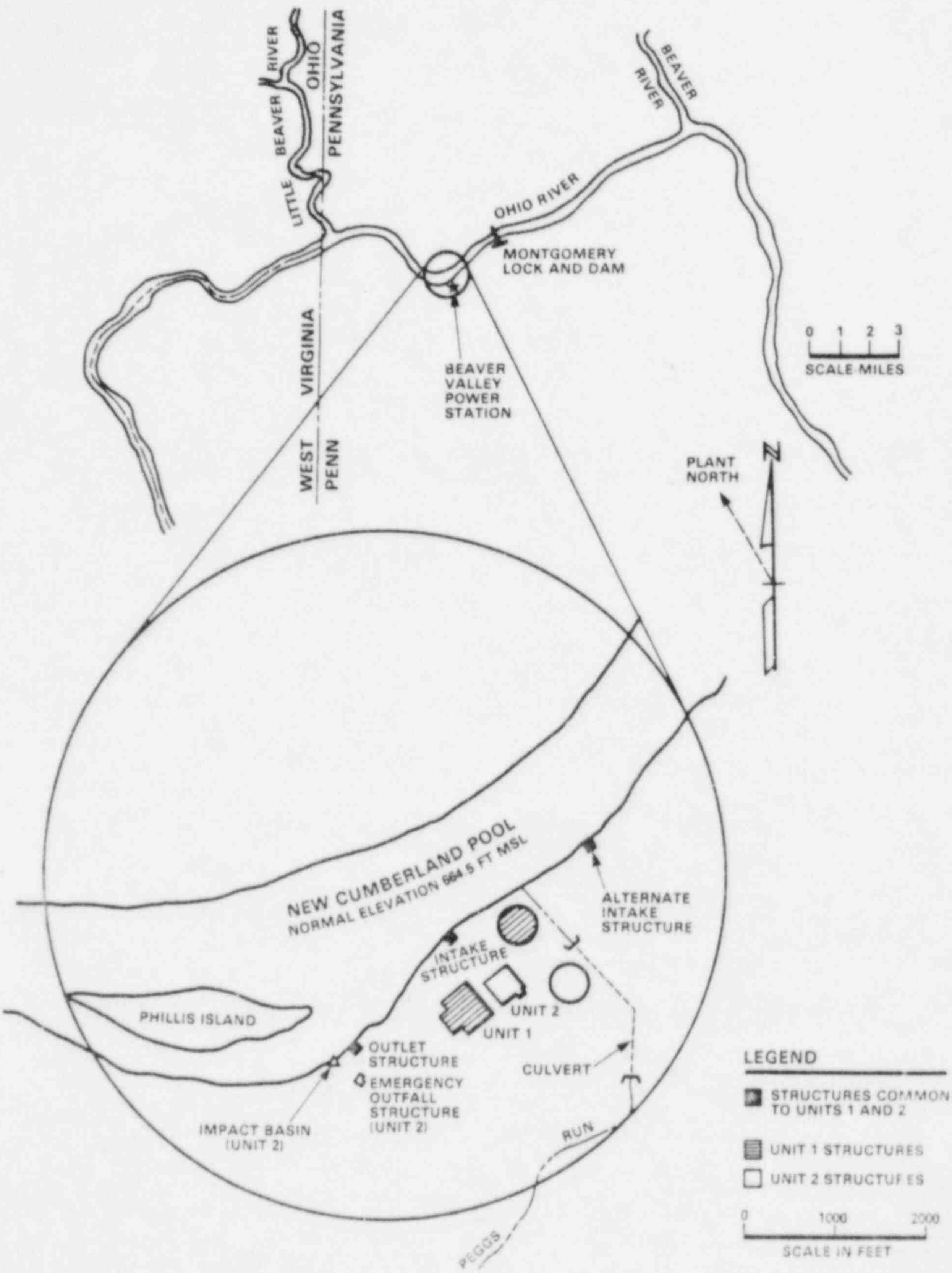


Figure 4.9 Principal hydrologic features (to change ft to m, multiply by 0.3048)

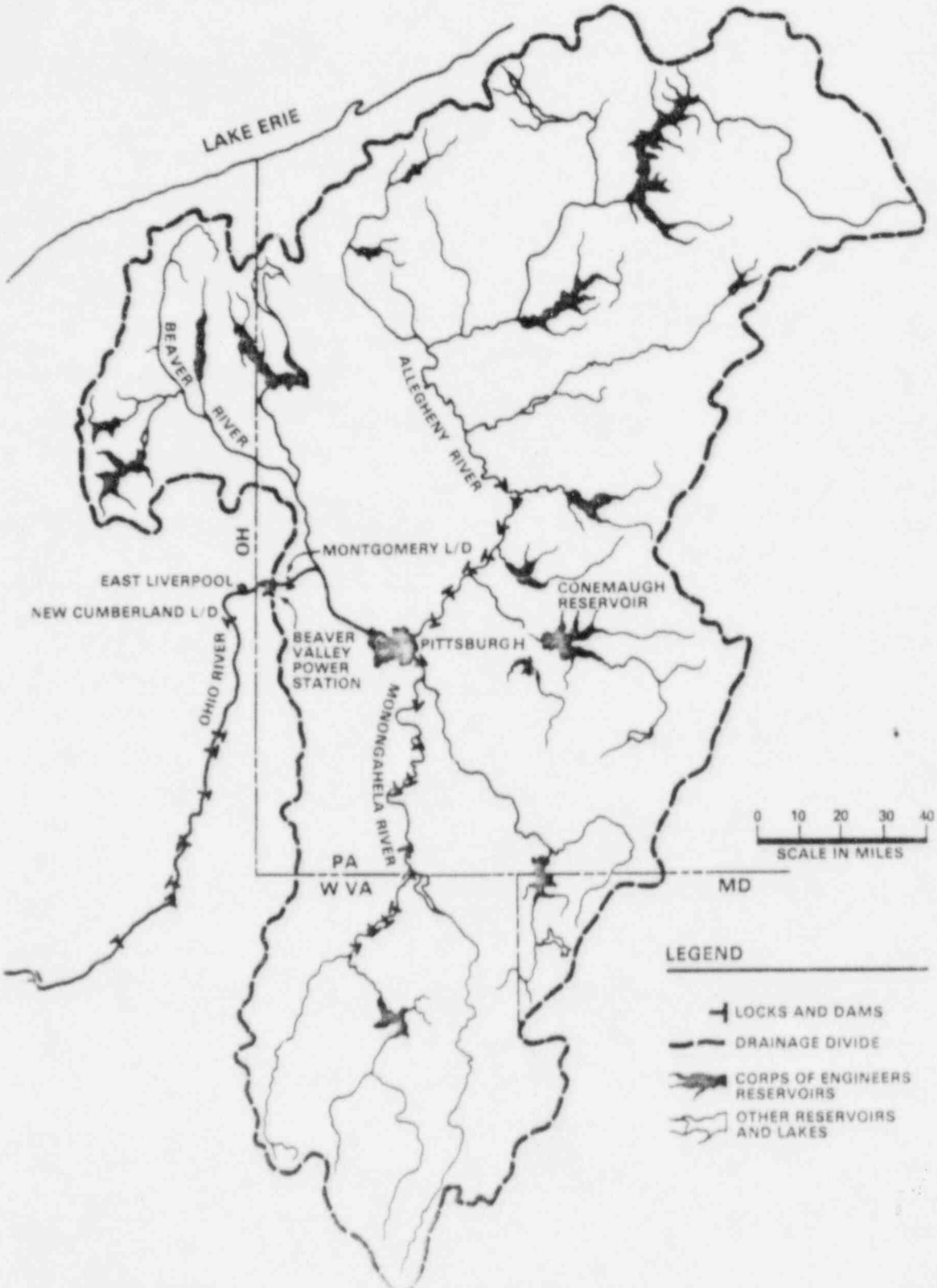


Figure 4.10 Ohio River drainage area (to change mi to km, multiply by 1.609)

Figure 4.11 Peggs Run

Table 4.1 Classification of site acreage by vegetation type and land use

Type	Subtype	Area* Ha	Area* Acres	Percent of site	Vegetation study areas**
Deciduous forest	Black locust, black cherry	37.7	93.2	18.6	4,16,18
	Mixed mesophytic	23.8	58.9	11.7	3
	Mixed oak, sugar maple	35.6	87.9	17.5	7,10-14,17
	Beech, maple	4.8	11.8	2.4	8,15
	Black locust, tree-of-heaven	0.8	1.9	0.4	2
	Moutain laurel, mixed oak	4.6	11.3	2.2	6,9
	Silver maple, sycamore	3.4	8.3	1.7	1
	Subtotal	110.6	273.3	54.5	
Scrubland	Mountain laurel, hawthorn	1.0	2.4	0.5	5
	Old field	1.4	3.5	0.7	
	Subtotal	2.4	5.9	1.2	
Power plant and associated facilities	Transmission corridors	21.8	53.8	10.7	
	Unpaved roads (not on transmission corridors)	1.3	3.1	0.6	
	Pipeline	0.8	1.9	0.4	
	Power plant	43.1	106.6	21.3	
	Spoil areas	11.7	29.0	5.8	
	Subtotal	78.7	194.4	38.8	
Other disturbed areas	Rights-of-way (paved roads)	10.5	25.9	5.2	
	Oil tank	0.08	0.2	<0.1	
	Abandoned single-family dwelling (removed)	0.6	1.5	0.3	
	Subtotal	11.2	27.6	5.5	
TOTAL		202.8	501.2	100.0	

*Subtotals may not add up to the totals shown because individual numbers have been rounded.

**Indicated on Figure 4.1.

Source: ER-OL Table 2.2-1

Table 4.2 Soil mapping units onsite that qualify as prime farmland and farmland of statewide importance as designated by the Soil Conservation Service (USDA 1984)

ER-OL (Fig. 2.2-2) mapping unit	SCS mapping unit	SCS mapping unit name	Slope %
02 A1, 2A1	PO	Pope silt loam[a]	0-3
45 B2	GnB	Wellston silt loam[a]	3-8
14 C2	GnC	Gilpin silt loam[b]	8-15
45 C2	GnC	Wellston silt loam[b]	8-15
57 C2	WhC	Wharton silt loam[b]	8-15
73 B2	CoB	Conotton gravelly loam[a]	3-8
340 B2	AgB	Allegheny silt loam[a]	2-8
342 B2	MoB	Monongahela silt loam[b]	3-8
342 C2	MoC	Monongahela silt loam[b]	8-15
MS CD	UgD	Urbanland-Gilpin complex[b,c]	8-25
MT AB	UfB	Urbanland-Conotton complex[a,c]	0-8
MT CD	UfD	Urbanland-Conotton complex[b,c]	8-25
MA AB	Ub	Urban and fill land[d]	0-3

[a]Prime farmland.

[b]Farmland of statewide importance.

[c]Soil types upon which the plant facilities are located.

[d]If described, this unit with 0-3% slopes would probably include soil types that qualify as prime farmland such as Pope, Philo, Monongahela, and Allegheny silt loams and Conotton gravelly loam.

Source: USDA, 1982, 1984

Table 4.3 Estimated water quality of Unit 2 blowdown, average and maximum concentrations

Constituent	Blowdown concentration, mg/L	
	average	maximum
Total dissolved solids	365.0	832.8
Total chromium	<0.05	0.07
Hexavalent chromium	<0.0036	0.0072
Nickel	<0.02	0.05
Free available chlorine*	0.2	0.5
Calcium	49.5	120.0
Total iron	2.7	9.1
Dissolved iron	<0.09	<0.12
Hardness (as $CaCO_3$)	180.7	417.6
Methyl orange alkalinity (as $CaCO_3$)	41.6	79.2
Total acidity (as $CaCO_3$)	9.7	28.8
Sulfate	155.9	388.8

*Will be released only during the period of chlorination (see Section 4.2.3).

Source: ER-OL Table 5.3-3

Table 4.4 Deleted from the FES

Table 4.5 Deleted from the FES

Table 4.6 Deleted from the FES

Table 4.7 Beaver Valley-to-Crescent transmission line right-of-way land use

Land use classification	Length		Area		Percent of total area
	km	miles	ha	acres	
Woodland	17.4	10.84	74.7	184.49	71.72
Pasture	1.3	0.79	4.7	11.66	4.53
Cropland	4.2	2.60	17.3	42.85	16.66
Commercial	0.2	0.13	0.6	1.37	0.53
Residential	0.8	0.50	2.1	5.17	2.01
Water bodies	0.03	0.02	0.1	0.27	0.10
Roads	0.4	0.23	1.4	3.41	1.33
Strip mines	1.1	0.69	3.2	8.02	3.12
TOTAL	25.4	15.80	104.1	257.24	100.0

Source: ER-OL Table 3.9-1

Table 4.8 Comparison of water quality in the Ohio River near the station: 1968-1970 data cited in the FES-CP and 1976-1980 data (all data except for pH expressed as mg/L)

Constituent	1968-1970[2]	1976-1980[1]	
		RM[3] 15.2	RM 40.2
pH	6.76	6.2-8.0	6.1-8.5
Alkalinity	21.80	25.5-28.7	35.3-35.9[4]
Suspended solids	32.00	29.5-56.1	27.4-87.5
Ammonia nitrogen	0.98	0.32-0.53	0.29-0.60
Nitrate nitrogen	1.43	0.70-1.03	0.83-1.24
Sulfate	125.00	89.4-99.9	82.1-90.4
Total iron	14.20	2.01-2.76	1.64-4.13
Manganese	5.20	0.36-0.51	0.36-0.57
Phenol	0.01	0.0047-0.0090	0.0052-0.0121

[1]Mean value reported in FES-CP Table 2.3 for RM 40.

[2]Range of mean values reported in ER-OL Table 2.4-10.

[3]RM = river mile; Beaver Valley is located at RM 34.7.

[4]Data reported for only 2 years out of 4.

Table 4.9 Ohio River fishes at the Beaver Valley site: comparison between the FES-CP and more recent data

Fish	FES-CP*	1980-83**
Minnow family (Cyprinidae)		
bluntnose minnow (*Pimephales notatus*)	X	X
carp (*Cyprinus carpio*)	X	X
common shiner (*Notropis cornutus*)		X
emerald shiner (*Notropis atherinoides*)	X	X
golden shiner (*Notemigonus crysoleucas*)		X
goldfish (*Carassius auratus*)		X
mimic shiner (*Notropis volucellus*)	X	X
sand shiner (*Notropis stramineus*)	X	X
spotfin shiner (*Notropis spilopterus*)	X	X
spottail shiner (*Notropis hudsonius*)		X
river chub (*Nocomis micropogon*)		X
Sucker family (Catostomidae)		
northern hog sucker (*Hypentelium nigricans*)		X
redhorse (*Moxostoma* spp.)	X	X
quillback (*Carpiodes cyprinus*)	X	X
river carpsucker (*Carpiodes carpio*)		X
white sucker (*Catostomus commersoni*)	X	X
Perch family (Percidae)		
johnny darter (*Etheostoma nigrum*)		X
log perch (*Percina caprodes*)		X
channel darter (*Percina copelandi*)		X
sauger (*Stizostedion canadense*)		X
walleye (*Stizostedion vitreum*)	X	X
yellow perch (*Perca flavescens*)	X	X
Silversides family (Atherinidae)		
brook silverside (*Labidesthes sicculus*)		X
Topminnow family (Cyprinodontidae)		
banded killifish (*Fundulus diaphanus*)		X
Herring family (Clupeidae)		
gizzard shad (*Dorosoma cepedianum*)	X	X
skipjack (or "river") herring (*Alosa chrysochloris*)	X	

Table 4.9 (continued)

Fish	FES-CP*	1980-83**
Sunfish family (Centrarchidae)		
bluegill (*Lepomis macrochirus*)	X	X
green sunfish (*Lepomis cyanellus*)	X	X
pumpkinseed (*Lepomis gibbosus*)	X	
rock bass (*Ambloplites rupestris*)	X	
smallmouth bass (*Micropterus dolomieui*)	X	X
largemouth bass (*Micropterus salmoides*)	X	X
spotted bass (*Micropterus punctulatus*)		X
white crappie (*Pomoxis annularis*)		X
black crappie (*Pomoxis nigromaculatus*)	X	X
Catfish family (Ictaluridae)		
black bullhead (*Ictalurus melas*)	X	
brown bullhead (*Ictalurus nebulosus*)	X	
channel catfish (*Ictalurus punctatus*)	X	X
flathead catfish (*Pylodictis olivaris*)		X
white catfish (*Ictalurus catus*)		X
yellow bullhead (*Ictalurus natalis*)	X	X
Pike family (Esocidae)		
muskellunge (*Esoc masquinongy*)		X
northern pike (*Esox lucius*)		X
tiger muskellunge (*Esox lucius* x *E. masquinongy* hybrid)		X
Trout-perch family (Percopsidae)		
trout-perch (*Percopsis omiscomaycus*)		X
Sea-bass family (Percichthyidae)		
white bass (*Morone chrysops*)		X
Drum family (Sciaenidae)		
freshwater drum (*Aplodinotus grunniens*)		X
Gar family (Lepisosteidae)		
longnose gar (*Lepisosteus osseus*)		X

*FES-CP Table 2.8 (applicant's preoperational gill net sampling, October 12-14, 1971) and Table 2.10 (data from EPA, September 19, 1968, based on rotenone sampling at Montgomery Lock and Dam, Beaver County, Pennsylvania).

**Duquesne (1981, 1982, 1983, 1984), Tables V-E-2, V-F-1, V-G-2, and V-H-1.

Table 4.10 Ichthyoplankton (fish eggs and larvae) density (number per 100 m^3) measured in the channel behind Phillis Island and in the main channel of the Ohio River

Date	Behind Phillis Island		Main channel of Ohio River	
	Surface	Bottom	Surface*	Bottom**
April 23, 1980	0.84	0	0	0-1.01
May 21, 1980	0.94	0	0-7.37	1.20-1.27
June 19, 1980	10.73	7.65	9.94-37.62	4.70-13.61
July 22, 1980	131.56	63.11	22.58-400.53	15.57-117.28
April 20, 1981	0.93	1.32	0	0
May 12, 1981	0	0	0-1.32	0-2.25
June 17, 1981	36.65	18.58	14.38-80.33	31.10-31.62
July 22, 1981	19.10	14.08	29.28-64.62	10.00-20.83
April 19, 1982	0	0	0	0
May 18, 1982	0.80	8.04	0-4.42	7.60-17.86
June 21, 1982	3.16	12.12	3.70-6.51	10.09-38.78
July 20, 1982	37.75	27.16	10.91-56.01	11.98-20.98
April 13, 1983	0	0	0-1.06	1.03-2.26
May 11, 1983	0	0	0	0-0.82
June 14, 1983	1.88	6.42	0-2.88	30.84-31.07
July 12, 1983	6.35	79.94	4.72-66.94	32.73-87.37

*Range from Stations 1, 3, and 5.

**Range from Stations 2 and 4.

Source: Duquesne (1981, 1982, 1983, 1984), Tables V-F-1 and V-H-1

5 ENVIRONMENTAL CONSEQUENCES AND MITIGATING ACTIONS

5.1 Résumé

This section evaluates changes in environmental impacts that have developed since the issuance of the FES-CP.

Section 5.2 discusses changes in impact to land use. The effects of both an increase in total site acreage and minor alterations to the transmission lines are addressed.

Section 5.3 includes changes in impacts to water use, and water quality, as well as other hydrologic impacts. The increase in free available chlorine concentration, and the changes in station water use are identified.

Air quality impacts resulting from nonradioactive atmospheric pollutants that were not addressed in the FES-CP are addressed in Section 5.4

Section 5.5 discusses changes in impacts to both terrestrial and aquatic ecology. Changes in terrestrial impacts are further defined by plant-specific data on cooling tower operation and additional information on ice formation as a result of cooling tower drift during ice storms. Changes in aquatic impacts include: variations in mortality of various fish species resulting from intake structure impingement; a decrease in the effects of thermal releases; the release of chemical discharge to Peggs Run (not anticipated in the FES-CP); and a decrease in the effects of thermal or chemical discharge on spawning.

Impacts to endangered and threatened species and to historic and archeological sites are discussed in Sections 5.6 and 5.7, respectively. However, no changes are noted in either section. Section 5.8 identifies only minimal socioeconomic impacts.

Information in Section 5.9 on radiological impacts has been revised to reflect knowledge gained since the FES-CP was issued. The material on plant accidents contains information that has been revised and updated, including actual experience with nuclear power plant accidents beyond design-basis accidents and the lessons learned from the accident at Three Mile Island Unit 2.

Impacts from the environmental effects from the uranium fuel cycle are discussed in Section 5.10, and those from decommissioning are discussed in Section 5.11. The noise impacts from the natural-draft cooling towers, transformers, and loud-speakers are discussed in Section 5.12, and Section 5.13 addresses emergency planning impacts. Environmental monitoring--including terrestrial, aquatic, atmospheric, and noise--is discussed in Section 5.14.

5.2 Land Use

5.2.1 Plant Site

The impacts of Unit 2 construction on land use at the site were evaluated in the FES-CP (Sections 4 and 5.1), and the conclusions remain valid, although

several changes have been made. The Unit 2 plant facilities will occupy 22.7 ha (56 acres) instead of the 4.1 ha (10 acres) to 5.3 ha (13 acres) estimated in the FES-CP. Most of the land for Unit 2 was graded during construction of Unit 1. Of the recently added acreage (Section 4.2.2), land use changes have occurred only on the 4.5-ha (11-acre) parcel. Before the Beaver Valley Training Center was constructed on this parcel, the vegetation was a combination of old fields and mixed mesophytic forest types mostly on Monongahela silt loam soil, which qualifies as farmland of statewide importance. After construction is completed, unoccupied site areas used for temporary facilities are to be graded and seeded. Trees will be planted to screen low buildings and parking, and the river bank will be planted to effect a natural setting (ER-OL Section 3.1).

Alterations in the floodplain have occurred since the FES-CP was issued, but these alterations will have no significant impact on Ohio River flooding because the river is highly regulated by reservoirs on its tributaries and numerous navigation locks and dams (ER-OL Section 2.1.3.1.4).

Operation of Unit 2 is not expected to affect the land use of the site or the vicinity. However, the size and operation of the natural draft cooling tower may affect the local environment. These potential impacts are evaluated in Section 5.5.

5.2.2 Transmission Lines

Effects of transmission lines on land use as a result of construction are minimal because the Beaver Valley-to-Crescent circuit will be strung mostly on existing towers. Construction of one new tower on the site to connect Beaver Valley with the existing Hanna-to-Mansfield circuit will disturb a small area of old field plant community (ER-OL Figure 3.9.1).

Minimal clearing of some mixed oak/sugar maple habitat on the site is required for the connecting circuits leaving the Beaver Valley switchyard (Figure 4.2). Existing land use in the offsite transmission corridor will be unchanged. Operation of the Unit 2 transmission circuit is not expected to affect the land use of the site or the right-of-way.

5.3 Water

5.3.1 Water Quality

The proposed chemical releases from the station have not changed significantly since the FES-CP was issued (Section 4.2.6). The water quality of the Ohio River has improved since the FES-CP was issued (Section 4.3.2), thus allowing a greater ability to dilute chemical discharges, in general. Nevertheless, for some water quality variables, there could be concentrations near the discharge that exceed Pennsylvania water quality criteria. For constituents that may already exceed criteria (e.g., phenolics, copper, iron, lead mercury, and zinc) (Section 4.3.2), the concentrating effect of the cooling system results in an effluent that, on a localized basis, will aggravate this problem. Even after complete mixing, the resulting concentrations would continue to be above the Pennsylvania criteria.

The applicant has estimated, for the four constituents whose concentration in the mixing zone will be raised above the Pennsylvania criteria by the operation of the station, the area and downstream distance for which the Pennsylvania criteria would be exceeded, under worst case conditions. The approximate area and downstream distance of exceedance at the 7-day, 10-year low flow are: for manganese, 42,000 m^2 (450,000 $feet^2$) and 660 m (2150 feet); for total dissolved solids (TDS), 880 m^2 (9500 $feet^2$) and 90 m (300 feet); for unionized ammonia, 36,000 m^2 (385,000 $feet^2$) and 570 m (1875 feet); and for nitrite nitrogen, 4000 m^2 (43,000 $feet^2$) and 180 m (600 feet) (ER-OL Table 5.3-4a). In these four cases, the maximum ambient (without effluent from Beaver Valley) concentrations range from 46% (TDS) to 88% (manganese) of the state criteria, and the maximum blowdown concentrations range from 111% (TDS) to 580% (ammonia) of the criteria (ER-OL Table 5.3-4). These exceedances are primarily a function of the concentrating effect of the evaporative cooling system, rather than of any chemical additions from the station. Note that the PDER has not chosen to issue discharge limitations for these four constituents (see NPDES permit, Appendix G).

Chlorine in the discharge will be regulated on the basis of free available chlorine (FAC), even though combined forms of chlorine, which are contributors to total residual chlorine (TRC), are also toxic (Mattice and Zittel, 1976). The applicant's study of Unit 1 operation shows TRC concentrations to be low, averaging about 0.2 mg/L. This was about 2.5 times the monitored FAC concentration, on average, but was proportionally lower whenever the FAC concentration reached or exceeded the NPDES-permitted value of 0.2 mg/L (Section 4.2.3). FAC concentrations never exceeded the maximum allowable value of 0.5 mg/L or the permitted average of 0.2 mg/L. Unit 2 operation is expected to result in similarly low values in the Unit 2 blowdown. Mixing with unchlorinated Unit 1 blowdown before it is discharged will result in a further reduction in TRC concentration in the station discharge by one-half. FES-CP Section 5.6.2.2 assumed a maximum FAC concentration of 0.1 mg/L. The applicant has appealed the FAC limit imposed in the NPDES permit (Appendix G) for two reasons: (1) the applicant would like to demonstrate that the NPDES limits do not allow for effective control of biofouling, and (2) the applicant contends that the NPDES limit is ambiguous in that it is not clear whether the 2-hour limit refers to the dosing period or the period of discharge to the river.

5.3.2 Water Use

Station water use is somewhat different than described in the FES-CP. Cooling water is still obtained from the Ohio River; however, a portion of the service water--31.8 m^3/min (8400 gpm)--will now be discharged to the emergency outfall structure instead of to the blowdown line as was anticipated at the CP stage. In addition, although FES-CP Section 3.7.1 stated that the Unit 1 sanitary treatment system would treat Unit 2 sanitary waste, now a separate treatment system will handle sanitary wastes from support buildings, as described in Section 4.2.6.1. Sewage from the main Unit 2 plant buildings will be discharged to the Unit 1 sewage plant for treatment. FES-CP Section 3.3 stated that groundwater would not be used during routine operation of the station; however, this is no longer the case. Domestic water for the support buildings will now be supplied by wells, rather than by the Unit 1 domestic water system, as was anticipated during the CP stage.

5.3.2.1 Surface Water

The cooling water systems consist of the main circulating water system (CWS) and the service water system (SWS). The CWS is a closed loop system that uses a natural draft cooling tower to dissipate heat to the atmosphere. The SWS takes water from the Ohio River through the intake structure. A portion of the service water is discharged to the circulating water lines and travels from there to the cooling tower. By this means, the SWS provides the makeup water necessary to replace water losses resulting from evaporation and drift and to maintain acceptable water quality in the CWS.

Under normal operating conditions, the SWS withdraws about 104.4 m^3/min (27,570 gpm or 61.4 cfs) from the New Cumberland Pool on the Ohio River. This water is pumped by two of three 50% capacity service water pumps located in the intake structure to cooling equipment in various buildings. A portion of the service water (72.6 m^3/min (19,170 gpm or 42.7 cfs)) is then discharged to the main circulating water lines to be used as makeup water to replace losses and blowdown from the cooling tower. The remaining 31.8 m^3/min (8400 gpm or 18.7 cfs) is discharged to the Ohio River via the emergency outfall structure to prevent silt buildup in the 76.2-cm (30-inch) service water discharge lines.

Beaver Valley Unit 2 will consume water primarily through evaporation from the cooling tower. Of the 104.4 m^3/min (27,570 gpm or 61.4 cfs) that will be withdrawn from the Ohio River, about 33.2 m^3/min (8775 gpm or 19.5 cfs) will be lost to evaporation. This is less than 0.4% of the estimated 7-day 10-year low flow of 8830 m^3/min (2.33×10^6 gpm or 5200 cfs) and less than 0.5% of the flow of the 1930 record drought of 6780 m^3/sec (1.79×10^6 gpm or 4000 cfs). For two-unit operation, the average consumptive water use will be about 69.2 m^3/min (18,275 gpm or 40.7 cfs). This is less than 0.8% of the 7-day 10-year low flow and 1.0% of the flow of the 1930 drought. When compared with the average flow in the Ohio River, the water consumed by both Units 1 and 2 will amount to only 0.11% of the estimated average flow of 1040 m^3/min (36,700 cfs). Because the water consumptively used by the station is a small amount of the flow of the Ohio River, the staff concludes that operation of Units 1 and 2 will not adversely affect existing and projected water users downstream.

5.3.2.2 Groundwater

Domestic water for support buildings will be supplied by two onsite wells; average use is estimated to be about 0.11 m^3/min (27.8 gpm or 0.06 cfs). Unit 2 main plant structures will receive their potable water from Unit 1.

As well pumpage in the onsite wells occurs, the groundwater level will be lowered and a cone of depression will result. Locally the groundwater gradient will be directed from the river to the aquifer because, as discussed in Section 4.3.1.2, groundwater in the terrace aquifer is hydraulically connected with the Ohio River. The pumped well water will thus be partly from the river and partly from the aquifer.

Intrusion of river water into the terrace aquifer caused by pumping at the site is not expected to affect other surface water users downstream because the amount of water that will intrude is a very small amount of water available

in the Ohio River. Use of groundwater at the site will not affect other groundwater users because there are no other users who draw on this terrace aquifer. Additionally, because the river recharges the aquifer and prevents excessive drawdown, it is not expected that the groundwater supply will be depleted by pumpage for Unit 2.

5.3.3 Other Hydrologic Impacts

The objective of Executive Order 11988, "Floodplain Management" (May 1977), is "...to avoid to the extent possible the long and short term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative...."

The elevation of the 100-year flood on the Ohio River adjacent to the site, as determined in March 1979 by the U.S. Army Corps of Engineers, is 211.8 m (695 feet) msl. As shown in Figure 5.1, structures related to Unit 1 and/or Unit 2 that are located in the floodplain include the impact basin, blowdown discharge structure, intake structure, and auxiliary intake structure. Of these, only the impact basin was constructed for exclusive use by Unit 2. The others are existing structures that were constructed for Unit 1 and will be shared by Unit 2.

Unit 1 was constructed and in operation before Executive Order 11988 was signed in May 1977. Therefore, the staff concludes that consideration of alternative locations for the blowdown discharge structure, the intake structure, and the auxiliary intake structure is neither required nor practicable. The plant itself is located above any conceivable flood on the Ohio River; thus the only plant-related structure in the floodplain constructed after the Executive Order was signed is the impact basin. However, this structure is a minor intrusion on the floodplain of the Ohio River that will have no measurable effect on the 100-year Ohio River flood level nor on the aerial extent of flooding. The staff therefore concludes that the objectives of Executive Order 11988 have been met.

5.4 Air Quality

5.4.1 Fog and Ice

The evaluation of the atmospheric impacts due to the operation of the natural draft cooling tower for Beaver Valley Unit 2 is unchanged from that in the FES-CP.

5.4.2 Other Emissions

Air quality impacts from nonradioactive atmospheric pollutants (particulates, sulfur dioxide, and nitrogen oxides) were not addressed in the FES-CP. Serving Units 1 and 2 are four oil-fired auxiliary boilers, three of which may be in use at any one time; four emergency diesel generators, one standby diesel generator; and a diesel fire pump. All of these will emit particulates, sulfur dioxide, carbon monoxide, hydrocarbons, and nitrogen oxides when they are in operation. On the bases of (1) the use of No. 2 fuel oil with a sulfur content of 0.5% by weight and (2) projected operating times, the applicant has estimated that emissions from the auxiliary boilers, diesel generators, and

diesel pump will be less than 250 tons per year for any pollutant governed by EPA criteria. These emissions are less than those stipulated by the EPA requirement for a prevention-of-significant-deterioration (PSD) analysis (40 CFR 52.21). Therefore, the staff concludes that operation of the auxiliary boilers, emergency diesel generators, and diesel fire pump at Beaver Valley should not have a significant impact on air quality in the vicinity of the plant.

5.5 Ecology

5.5.1 Terrestrial Ecology

The effects of operation of Unit 2 on the terrestrial resources are described in ER-OL Chapter 5 and FES-CP Section 5.6.1. The terrestrial ecological data (including aerial photographs) collected for Unit 1 serve as a preoperational data base for Unit 2. The estimated impacts of operation include minimal effects of cooling tower drift and loss of some birds as a result of collisions with the cooling tower and transmission poles and lines. No additional impacts to terrestrial resources of the transmission corridor are expected.

5.5.1.1 Cooling Tower Operation

Operation of natural draft cooling towers can result in impacts to terrestrial resources. These include deposition of salt drift on soil and vegetation, bird impaction, and weather modification. In FES-CP Section 5.3.3, the projected maximum drift from the Unit 2 cooling tower was based on generic information and was estimated as 90 kg/ha/year (80 lb/acre/year). The staff considered this estimate to be high. Subsequently, a model was developed for the combined drift from the Units 1 and 2 cooling towers based on (1) manufacturer's guarantees of the amount of drift leaving the towers, (2) the annual average total dissolved solids (TDS) concentration in the blowdown, and (3) onsite meteorological data for 1976 (ER-OL Appendix 3B). According to this model, the maximum salt deposition rate for the combined towers is predicted to be 11.1 kg/ha/year (9.9 lb/acre/year) 1448 m (4750 feet) east of the cooling towers (ER-OL Figure 3B-4). The maximum monthly salt deposition rate is predicted to be 3.6 kg/ha/month (3.22 lb/acre/month). The minimum deposition of salt drift known to injure sensitive species of natural vegetation (e.g., flowering dogwood) is about 5 kg/ha/month (4.5 lb/acre/month) (Davis, 1979). Thus, no adverse impacts to sensitive native vegetation are expected. In addition, most cropland in the Beaver Valley area is southwest of the site where the deposition is one-third of the maximum salt deposition or less; thus it is unlikely that even sensitive species (e.g., onions, carrots, and beans) would be affected by operation of the cooling towers. In looking at infrared aerial photographs taken from 1975 to 1983, the staff saw no injury to vegetation from cooling tower drift in the vicinity of Unit 1.

FES-CP Section 5.6.1 suggested that increased ice formation as a result of cooling tower drift during ice storms might result in additional limbfall in the forested upland. However, information in ER-OL Sections 5.1.4.1.2 and 5.1.4.2 shows that the maximum surface icing accumulation as a result of drift is insignficant, and no damage to local vegetation is expected.

Mixing the plumes from Units 1 and 2 with nearby industrial emissions, particularly those from the fossil-fueled Bruce Mansfield Plant, could result in increased local acid deposition. On the basis of modeling (ER-OL

Section 5.1.4.1.5), it is estimated that the visible plume from the Beaver Valley cooling tower and the plume from the Bruce Mansfield Plant stack will intersect for approximately 19 hours per year. Effects cannot be predicted accurately because acid formation and deposition are not well enough understood, but effects would be infrequent and of short duration, as indicated by the short total time estimated for interaction of the plumes.

Bird mortality as a result of collisions with the Unit 1 natural draft cooling tower has not been a problem. During 5 years of seasonal surveys, only 27 birds (26 passerines and 1 rail) were found at the base of the tower (ER-OL Section 5.1.4.2). Potentional increased losses as a result of the Unit 2 cooling tower are considered insignificant when compared to the number of birds that die from other hazards during migration.

Other possible effects of the operation of natural draft cooling towers--such as ground-level fogging and icing, increased precipitation or humidity, ground-level shading by the plume, and noise--have been shown to be inconsequential (Carson, 1976; Talbot, 1979; and Wilbur and Webb, 1983).

5.5.1.2 Transmission System Operation

Operation and maintenance of the Hanna-to-Mansfield and Beaver Valley-to-Crescent transmission circuits is not expected to result in ecological impacts because the lines will be mostly located on existing towers and poles in existing rights-of-way. Additional access roads are not anticipated. Maintenance of the transmission system right-of-way includes mechanical cutting of woody species and the use of EPA-approved herbicides applied by state-licensed operators every 8 to 10 years (ER-OL Section 5.5.1). The chemicals are applied by adjustable handguns from trucks. This equipment is similar to the type used in orchard spraying. Pellets are used in inaccessible areas. This treatment results in the death of most woody vegetation. Grasses (e.g., Agrostis stolonifera) and common blackberry (Rubus allegheniensis) are the predominant species found on the treated sections of the transmission corridor (NUS, 1976). Some wildlife populations on the right-of-way may fluctuate with the spraying cycles, but this type of spraying is used widely by utilities and should not have unexpected or serious impacts if appropriate precautions are used during application.

Other potential impacts to terrestrial biota from operation of the transmission lines may result from electric and magnetic fields, electrostatic induction, corona effects, and noise. These potential impacts are fully described in ER-OL Section 3.9.4-7. Most research (Lee et al., 1982) has shown that biological effects from these conditions are not expected from operation of transmission lines, even at 500 kV. The applicant has operated 345-kV transmission lines since 1970 with no problems that could not be corrected. Extensive experience with high voltage lines up to 765 kV and the overall results of numerous studies provide little evidence that transmission lines pose a long-term biological hazard.

5.5.2 Aquatic Resources

Potential effects on aquatic resources may be divided into (1) mortality of Ohio River biota as a result of withdrawal of cooling water at the intake structure and (2) effects of thermal and chemical discharges. These will be

discussed separately. The results of monitoring at the site during the operation of Unit 1 and the applicant's thermal and chemical models also are discussed.

5.5.2.1 Intake Effects

FES-CP Section 5.6.2.1 cited two features of the intake system that would tend to minimize mortality to the biota of the Ohio River: low approach velocity and installation of the intake structure flush with the shoreline (thus eliminating any embayment that would attract fish). The design and location of the intake structure, which is shared with Unit 1, have not changed since the FES-CP was issued. The maximum intake velocity is now anticipated to be 0.10 m/sec (0.34 fps), rather than the 0.07 m/sec (0.24 fps) considered earlier (Section 4.2.4); still, this maximum velocity is less than the 0.15 m/s (0.5 fps) recommended limit cited by Boreman (1977).

On the other hand, FES-CP Section 5.6.2.1 speculated that the "cave-like chambers" of the intake structure could attract fish. Impingement sampling from 1980-1982 demonstrated that certain species (e.g., channel catfish and bluegill) were impinged in numbers greater than expected, based on their abundance in the river, while for other species (e.g., carp and bluntnose minnow) the opposite was true (Duquesne, 1981, 1982, 1983, and 1984). It would appear that intake mortality should not have a significant effect on Ohio River fishes, based on the small numbers impinged. The mortality that will occur may affect some species more than others.

In FES-CP Section 5.6.2.1, the staff assumed that plankton would be drawn into the station approximately in proportion to the fraction of the river flow withdrawn. Densities of phytoplankton and zooplankton collected from the intake structure were similar to densities in the river channel from 1976 through early 1980 (when river sampling was discontinued) (Duquense, 1981). Thus, at the intake rate given in Section 4.2.3, the station may be assumed to destroy, at the 7-day, 10-year low flow of 147,000 L/s (5,200 cfs), approximately 1.2% of the plankton, which is identical to the estimate in FES-CP Section 5.6.2.1.

5.5.2.2 Thermal and Chemical Effects

FES-CP Section 5.6.2.3 stated that thermal releases from the station would have only minor effects on the biota of the Ohio River. Because of the limited extent of heated water in terms of area and depth, impacts on adult fish, drifting organisms, benthos, and spawning activities were all predicted to be minor.

The thermal effects evaluated in the FES-CP are, in fact, greater than those that are now expected. FES-CP Section 5.2 assumed that the heat contribution from the Shippingport plant would be added to the contribution from Beaver Valley Units 1 and 2. However, by the time the Unit 2 begins operation, there will be no heat contribution from the Shippingport station.* Because Shippingport would have accounted for most of the total thermal discharge of the combined plants (72% on an annual average, ranging from 60% in winter to 87% in summer) (ER-OL Section 5.1.2.1), the potential thermal effects on river biota should be even less than were anticipated in the FES-CP.

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*The Shippingport station is being decommissioned.

FES-CP Section 5.6.2.2 stated that effects of chemical releases on Ohio River biota would be slight, considering the dilution of the low-volume discharges by the river. Even though some river water quality constituents are at levels above the applicable criteria (Section 5.3.2), the discharge of these constituents at the concentration factor resulting from Unit 2 operation will not necessarily result in adverse effects on river biota. Comparison of the expected maximum discharge concentration, based on a not-necessarily coincident maximum river concentration of these constituents, with maximum concentrations known to be not harmful to aquatic biota indicates that mortality would not be expected. Additionally, biological surveys of the river in the station vicinity show that organisms are surviving the ambient water quality, even when it is in excess of applicable standards. Because the chemical releases from Unit 2 have not changed significantly since the FES-CP was issued (Section 4.2.6) and the water quality of the Ohio River has improved in recent years (Section 4.3.2), the assessment in the FES-CP remains valid.

The Ohio River concentrations of manganese, TDS, un-ionized ammonia, and nitrite nitrogen in the vicinity of the station discharge will be elevated to above state water quality criteria by the Unit 2 discharge (Section 5.3.2). Manganese will be discharged at a maximum concentration of 2.11 mg/L (ER-OL Table 5.3.4). According to EPA (1976), concentrations of 1.5 mg/L to over 1000 mg/L are tolerated by freshwater life, so the Ohio River would be expected to rapidly dilute even the maximum discharge concentration to a nontoxic level. TDS will be discharged at a maximum concentration of 832.8 m/L (ER-OL Table 5.3-4), whereas the lowest concentration of TDS reported toxic by EPA (1976) is 10,000 mg/L; thus, no significant toxicity would be expected. The maximum concentration of nitrite nitrogen to be discharged is 5.93 mg/L (ER-OL Table 5.3-4). According to EPA (1976), most warm water fish should not be adversely affected by concentrations below 5 mg/L. The maximum concentration of un-ionized ammonia to be discharged is 0.29 mg/L (ER-OL Table 5.3-4), which is in the range of toxic concentrations (0.2 to 2.0 mg/L) cited by EPA (1976). Dilution by the river will be necessary to reduce this discharged concentration to a nontoxic level.

One point of uncertainty concerns chlorine in the discharge. Concentrations of TRC in the Unit 2 blowdown are not expected to normally exceed about 0.45 mg/L, on the basis of a statistical evaluation of the Unit 1 operational study (Section 4.2.3). When the Unit 2 discharge is mixed with the unchlorinated blowdown from Unit 1, the TRC concentration of the station discharge would be reduced by a factor of 2 or more (Unit 1 blowdown is greater than Unit 2 blowdown). According to studies by Dickson et al. (1974) and Brooks and Seegart (1978), intermittent exposures of up to about 0.2 mg/L TRC for up to a total of 2 to 2.5 hours a day do not result in mortality to warm water fish such as common shiner, spotfin shiner, bluegill, carp, white bass, channel catfish, white sucker, sauger, and freshwater drum. Discharge concentrations of TRC could be expected to be at or below the cited safe concentration for two-unit operation. The duration of TRC presence in the combined discharge cannot be predicted for two-unit operation with the data available. Operational experience from Unit 1 indicates that detectable TRC presence in the discharge has occurred for longer than 2 hours 63% of the time (TRC concentrations were not specified for the persistence interval.) Mixing the discharge in the river will reduce TRC time/concentration exposures by dilution and chemical reaction. Because the cross-sectional area and volume of the river that is affected by the Beaver Valley discharge are predicted to be relatively small, adverse impacts (from either toxic effects or habitat reduction through avoidance reactions by resident biota)

are likely to be localized and minor. On the basis of Unit 1 experience, operation of Unit 2 alone potentially could be more severe in terms of toxic effects (although affecting a smaller area of the river). These effects are not expected to be significantly different than those experienced with Unit 1 operation.

The release of a chemical discharge to Peggs Run was not anticipated in the FES-CP. That stream is now expected to receive the treated effluent from the Unit 2 sewage plant (Section 4.2.6) and from the oil/water separator located at the fuel oil unloading facility. The design flow of the sewage plant constitutes more than 1% of the creek's mean flow (estimated by the applicant at 140 L/sec or 5 cfs (ER-OL Section 2.4.3). The discharge from the separator is low volume and intermittent. A discharge of no more than 1900 to 3800 L (500 to 1000 gallons) is expected weekly for about 6 weeks, approximately once every 18 months (during refueling outages, when the auxiliary boiler is in use). The discharge is expected to meet the limitations for the oil/water separator regulated as Outfall 303 by the NPDES permit (Appendix G), although, according to the applicant, the permit has not yet been revised to control this source. Because Peggs Run is already a highly degraded stream (Section 4.3.4.2), the potential effects of the sewage discharge (e.g., high oxygen demand and suspended solids) and separator discharge (e.g., oil/grease and suspended solids) on Peggs Run would be limited.

The possibility was raised in FES-CP Section 5.6.2.2 that the channel behind Phillis Island might be a particularly productive spawning area. If that were the case, then this might be an area where thermal or chemical discharges would affect sensitive life stages of fish (such as larvae), as the discharge will largely be confined to the channel. However, the applicant's monitoring data do not indicate that the channel is a particularly productive spawning area relative to the main channel of the Ohio River (Section 4.3.4.2).

Exposure of Ohio River fishes to the potential toxic effects of chemicals in the discharge could be affected by their attraction to or avoidance of the heated effluent. During August (when the mean river temperature is 26.4°C), for example, many of the species that are found at the site are expected to avoid waters more than 5C° to 9C° warmer than ambient (Table 5.1), a greater differential than the discharge ΔT.

For species such as bluegill, walleye, and largemouth bass, the avoidance temperature differential in January (when the mean river temperature is 2.5°C) is expected to be greater than the discharge ΔT. In these cases, avoidance of the effluent would not be expected; in fact, there may be some attraction of fish to the effluent (Goodyear et al., 1974). On the other hand, for species such as bluntnose minnow, channel catfish, white crappie, pumpkinseed, and spotfin shiner, the avoidance temperature differential at an acclimation temperature of 2.5°C is less than the discharge ΔT and avoidance behavior could reduce their exposure to maximum discharge concentrations of chemicals such as residual chlorine.

FES-CP Section 5.6.2.3 stated there was little likelihood for cold shock (thermal stress to fish acclimated to warmer discharge temperatures, in the event of an abrupt plant shutdown during winter months), because the operation of three units (Beaver Valley Units 1 and 2, Shippingport) would reduce the probability of a simultaneous shutdown of all the plants. Although Shippingport is no longer in operation, this event would still require the simultaneous

shutdown of both Beaver Valley units. In February 1983, following a shutdown of Unit 1, a number of dead fish at the site were reported. The observed dead fish were almost entirely gizzard shad. Their death has been attributed to their congregation in shallow, warmer water after the shutdown, in addition to any thermal stress (Duquesne, 1984). At the time of that shutdown, the Shippingport station was no longer operational, so Unit 1 was the only thermal source at the site. Unit 2 has two major features that, according to information presented by Coutant (1977), would tend to reduce the likelihood of cold shock: (1) because Unit 2 has a closed-cycle, rather than a once-through cooling system, the volume of heated water is relatively small, and (2) the discharge area is not confined (as in a discharge canal) and does not have restricted mixing (as in a cove).

5.5.2.3 Results of Unit 1 Monitoring

The discussions in Sections 5.5.2.1 and 5.5.2.2 suggest that effects of two-unit operation on aquatic biota should be minor and localized. Because of the similarity between Units 1 and 2, the results of ecological monitoring conducted by the applicant to evaluate changes caused by Unit 1 are applicable to Unit 2.

The applicant compared population densities of benthos, phytoplankton, zooplankton, and ichthyoplankton upstream and downstream of the Beaver Valley station. (This analysis would be conservative because changes that were a result of operation of the Shippingport station could not always be distinguished.) If the ratio of densities observed at the two transects exceeded the highest ratio observed at the two transects during preoperational studies, any effect on the population may be tentatively ascribed to Unit 1. The applicant also used a second test: whether the density in an operational sample differed significantly from the corresponding density in preoperational samples. However, in light of the known changes in water quality and fish populations in recent years (Sections 4.3.2 and 4.3.4), simultaneous exceedance of this second criterion is not required to indicate an effect of Unit 1. Table 5.2 summarizes these upstream-downstream comparisons. Of the 388 upstream-downstream comparisons made in 1977 through 1979 (Unit 1 began operation in 1976, and the sampling required for the comparisons was discontinued in early 1980), only 16 (or 4%) of the comparisons suggested a possible effect from operation of Unit 1; even this low percentage of upstream-downstream differences could be attributed to natural variability.

These data confirm that, at worst, Ohio River biota experienced minor and localized impacts from operation of Unit 1 and Shippingport. A similar range of effects would also be expected from the combined operation of Units 1 and 2, without Shippingport.

5.6 Endangered and Threatened Species

5.6.1 Terrestrial Species

No endangered or threatened species of plants or animals listed by the U.S. Fish and Wildlife Service or the State of Pensylvania are known to be present within the plant site or transmission corridor. Protected transient species potentially occurring in the region are discussed in Section 4.3.5.1 above. Because these species do not regularly occur on the site or along the ROW, no impacts are expected.

5.6.2 Aquatic Species

Because no threatened or endangered species have been collected at the site (Section 4.3.5), the station is not expected to affect any such species.

5.7 Historic and Archeological Impacts

As noted in Section 4.3.6 above, the operation and maintenance of the plant and associated facilities is not anticipated to have any effect on any sites or properties eligible for or listed in the National Register of Historic Places. See Appendix H for letters from Ohio, Pennsylvania, and West Virginia state historic preservation offices.

5.8 Socioeconomic Impacts

The socioeconomic impacts of the operation of Beaver Valley Unit 2 are discussed in ER-OL Section 8.1. It is estimated that 465 employees, which includes 25 contractor security workers, will be required for the operation of Unit 2. In addition, about 1000 contract workers will be required every 18 months for approximately 10 weeks for outage-related work. The residental locations of Unit 2 operating workers are likely to be similar to those of Unit 1 plant employees. Thus, about 51% of the workers are expected to reside in Beaver County, Pennsylvania; 37% in Allegheny County, Pennsylvania; 4% in Columbiana County, Ohio; 1% in Hancock County, West Virginia; and the rest in surrounding counties. Because of the relatively small number of workers required to operate Unit 2, the impacts on the communities in which they will reside and on traffic are expected to be minimal. The annual payroll for the operating workers is projected to be $18 million (in 1987 dollars). Local purchases of materials and supplies resulting from the operation of Beaver Valley Unit 2 for the first full year of operations are estimated to total about $11.6 million (in 1987 dollars). The local purchases are expected to be made in the Pittsburgh standard metropolitan statistical area, which includes Allegheny, Beaver, Washington, and Westmoreland Counties. Table 5.3 shows the estimated state taxes that will result from the plant. The projected dollar amounts are provided for the first five full years of operation.

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). The radiation protection standards of 10 CFR 20 specify limitations on whole body radiation doses to members of the general public in unrestricted areas at three levels: 500 millirems in any calendar year, 100 millirems in any 7 consecutive days, and 2 millirems in any 1 hour. These limits are consistent with national and international standards, in terms of protecting public health and safety.

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/year to the total body or 10 mrems/year to any organ from all pathways of exposure from liquid effluents; 10 mrads/year gamma radiation or 20 mrads/ year beta radiation air dose from gaseous effluents near ground level --and/or 5 mrems/ year to the total body or 15 mrems/year 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 that 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 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 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 all fuel-cycle facility contributions that may impact a specific individual in the public.

5.9.2 Operational Overview

During normal operations of Beaver Valley Unit 2, small quantities of radioactivity (fission, corrosion, and activation products) will be released to the environment. As required by NEPA, the staff has determined the estimated dose 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 facility-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. Radioactive-waste management systems are incorporated into the plant and are designed to remove most of the fission-product radioactivity that is assumed to leak from the fuel, as well as most of the activation and corrosion-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 areas outside the plant boundaries are to be recorded and published semiannually in the Radioactive Effluent Release Reports for the facility.

Airborne effluents will diffuse in the atmosphere in a fashion determined by the meteorological conditions existing at the time of release and are generally dispersed and diluted by the time they reach unrestricted areas that are open to the public. Similarly, waterborne effluents will be diluted with plant waste water and then further diluted as they mix with the Ohio River beyond the plant boundaries.

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, if this "maximally exposed" individual were 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 Beaver Valley Unit 2, 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 that, 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 Beaver Valley Unit 2.

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 20 years after the station begins operation. (Calculation for the 20th 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 Beaver Valley Unit 2 facility 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 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 miles). This limitation is based on several facts. Experience, as demonstrated by calculations, has shown that all individual dose commitments (>0.1 mrem/year) 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/year, 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 Pressurized Water Reactors (PWRs)

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 PWRs. Recently licensed 1000-MWe PWRs 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 RG 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 are reported in the staff's SERs. 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 270 PWR reactor years of operation is available for those plants operating between 1974 and 1981. (The year 1974 was chosen as a starting date because the dose data for years prior to 1974 are primarily from reactors with average rated capacities below 500 MWe.)

These data indicate that the average reactor annual collective dose at PWRs has been about 500 person-rems, although some plants have experienced annual collective doses averaging as high as about 1400 person-rems/year over their operating lifetime (NUREG-0713, Vol 3). These dose averages are based on widely varying yearly doses at PWRs. For example, for the period mentioned above, annual collective doses for PWRs have ranged from 18 to 3223 person-rems per reactor. However, the average annual dose per nuclear plant worker of about 0.8 rem (ibid) 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/year, or 1.25 rems/quarter if it is not.

The wide range of annual collective doses experienced at PWRs 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 Beaver Valley Unit 2 are based on the assumption that the facility will experience the annual average occupational dose for PWRs to date. Thus the staff has projected that the collective occupational doses at Beaver Valley Unit 2 will be 500 person-rems, but annual collective doses could average as much as 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 5.5 years, will be about 34 person-rems. This radiation exposure will result predominantly from radioactive components and gaseous effluents from Unit 1. Based on experience with other PWRs, 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 12.4-8 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 5.4 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 to 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, 1972 and BEIR III, 1980). 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 220 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 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 there may be biological mechanisms that can repair damage caused by radiation at low doses and/or dose rates. The number of potential nonfatal cancers would be approximately the same as the number of potential fatal cancers, according to the 1980 report of the National Academy of Sciences Committee on the Biological Effects of Ionizing Radiation (BEIR III).

Values for genetic risk estimators range from 60 to 1100 potential cases of all forms of genetic disorders per million person-rems (BEIR III). The value of 220 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, 1977), the National Council on Radiation Protection and Measurement (NCRP, 1975), the National Academy of Sciences (BEIR III), and the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR, 1982).

The risk of potential fatal cancers in the exposed work-force population at Beaver Valley Unit 2 is estimated as follows: multiplying the annual plant-worker-population dose (about 500 person-rems) by the somatic risk estimator, the staff estimates that about 0.06 cancer death may occur in the total exposed population. The value of 0.06 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 6 chances in 100. The risk of potential genetic disorders attributable to exposure of the work force is a risk borne by the progeny of the entire population and is thus properly considered as part of the risk to the general public.

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 wastes from the reactor to waste burial grounds is considered in 10 CFR 51.52. 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 51.52, reproduced herein as Table 5.5. The cumulative dose to the exposed population as summarized in Table S-4 is very small when compared to the annual collective dose of about 60,000 person-rems to this same population or 28,000,000 person-rems to the U.S. population from background radiation.

- Direct Radiation for PWRs

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. Direct radiation from sources within the plant are due primarily to nitrogen-16, a radionuclide produced in the reactor core.

Because the primary coolant of a PWR is contained in a heavily shielded area, dose rates in the vicinity of PWRs are generally undetectable (less than 5 mrems/year).

Low-level radioactivity storage containers outside the plant are estimated to make a dose contribution at the site boundary of less than 1% of that due to the direct radiation from the plant.

- Radioactive-Effluent Releases: Air and Water

Limited quantities of radioactive effluents will be released to the atmosphere and to the hydrosphere during normal operations. Plant-specific radioisotope-release rates were developed on the basis of estimates regarding fuel performance and descriptions of the operation of radwaste systems in the applicant's FSAR, and by using the calculative models and parameters described in NUREG-0017.

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 the radioactivated gas 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 strontium 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 to 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 and corrosion products, such as nuclides of sodium, iron, and cobalt; 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 rates 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 RG 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," and in Appendix B 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, and 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 below the Appendix I design objective values, 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. The staff also concludes that the combined site doses for both Units 1 and 2 satisfy the requirement of the RM-50-2 Annex to Appendix I, and, therefore, no cost-benefit analysis is required for additional radwaste processing equipment.

Operation of Beaver Valley Unit 2 will be governed by operating license Technical Specifications that will be based on the dose-design objectives of Appendix I, Annex RM-50-2, 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 to natural background doses ($\sim$100 mrems/year) or the dose limits (500 mrems/year, 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 Beaver Valley Unit 2.

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 staff's position as stated in NUREG-0543 is that as long as a nuclear plant site operates at a level below the relatively more conservative Appendix I dose-design objectives and reporting requirements, it is operating in compliance with 40 CFR 190. Therefore, the NRC staff concludes that under normal operations the Beaver Valley facility is capable of operating within these EPA 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 Beaver Valley Unit 2 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 miles) 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 to total cancer incidence from causes unrelated to the operation of Beaver Valley Unit 2.

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, 39 person-rems) by the preceding somatic risk estimator, the staff estimates that about 0.006 cancer death may occur in the

*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.

exposed population. The significance of this risk can be determined by comparing it to the total incidence of cancer death in the U.S. population. Multiplying the estimated U.S. population for the year 2010 (~280 million persons) by the current incidence of actual cancer fatalities (~20%), about 56 million cancer deaths are expected (American Cancer Society, 1978).

For purposes of evaluating the potential genetic risks, the progeny of workers are considered members of the general public. However, according to ICRP Publication 26 (1977), paragraph 80, it is assumed that only about one-third of the occupational radiation dose is received by workers who have offspring subsequent to the radiation exposure. Multiplying the sum of the U.S. population dose from exposure to radioactivity attributable to the normal annual operation of the plant (that is, 39 person-rems), and one-third of the estimated dose from occupational exposure (that is, one-third of 500 person-rems) by the preceding genetic risk estimator, the staff estimates that about 0.05 potential genetic disorder may occur in all future generations of the exposed population. Because BEIR III indicates that the mean persistence of the two major types of genetic disorders is about 5 generations and 10 generations, in the following analysis the risk of potential genetic disorders from the normal annual operation of the plant is conservatively compared with the risk of actual genetic ill health in the first 5 generations, rather than the first 10 generations. Multiplying the estimated population within 80 km of the plant (~4 million persons in the year 2010) by the current incidence of actual genetic ill health in each generation (~11%), about 2 million genetic abnormalities are expected in the first 5 generations of the 80-km population (BEIR III).

The risks to the general public from exposure to radioactive effluents and transportation of fuel and wastes from the annual operation of the facility are very small fractions of the estimated normal incidence of cancer fatalities and genetic abnormalities. On the basis of the preceding comparison, the staff concludes that the risk to the public health and safety from exposure to radioactivity associated with the normal operation of the 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, 1976), 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 that 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 generically in greater detail in RG 4.1, Revision 1, "Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants," and in the Radiological Assessment Branch Technical Position, Revision 1, November 1979, "An Acceptable Radiological Environmental Monitoring Program."*

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. ER-OL Section 6.1.5 states that the ongoing operational radiological monitoring program for Beaver Valley Unit 1 serves as the preoperational program for Beaver Valley Unit 2. The specifics of the current environmental radiological monitoring program for Unit 1 are described in Section 3, Table 3.01 of the Beaver Valley Unit 1, Offsite Dose Calculation Manual (ODCM) and are reproduced in this report in Table 5.6.

The applicant states that the preoperational program is documenting 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 2 when the operational radiological monitoring program will begin.

The staff has reviewed the preoperational environmental monitoring program of the applicant and finds that it is generally acceptable as presented. The staff review of this area will continue until the time of implementation of the operational 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.

5.9.3.4.2 Operational

The operational, offsite radiological-monitoring program is conducted to provide data on measurable 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 RG 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, with some periodic adjustment of sampling frequencies in expected critical exposure pathways--such as increasing milk sampling frequency and deletion of fruit, vegetable, soil, and gamma radiation survey samples. 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 staff, and the specifics of the required monitoring program will be incorporated into the operating license Radiological Technical Specifications.

5.9.4 Environmental Impacts 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 Beaver Valley plant site in accordance with the NRC's June 13, 1980 Statement of Interim Policy. The discussion below reflects the staff's considerations and conclusions.

Section 5.9.4.2 deals with general characteristics of nuclear power plant accidents, including a brief summary of safety measures incorporated into the design that tend to minimize the probability of their occurrence and to mitigate the consequences should accidents 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 societal impacts associated with actions to avoid such health effects as a result of air, water, and ground contamination from accidents are also identified.

Next, actual experience with nuclear power plant accidents and their observed health effects and other societal impacts are described. This is followed by a summary review of safety features of the Beaver Valley Unit 2 facilities 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 within the design basis are then given. Also described are the results of calculations for the Beaver Valley site using probabilistic methods to estimate the possible impacts and the risks associated with severe accident sequences of exceedingly low probability of occurrence.

5.9.4.2 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 the Commission's regulations in 10 CFR 20 and 10 CFR 50, Appendix I.

Several features combine to reduce the risk associated with accidents at nuclear power plants. Safety features in 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. A number of additional lines of defense are designed to mitigate the consequences of failures in the first line. Descriptions of these features for Beaver Valley Unit 2 are in the FSAR. The most important mitigative features are described in Section 5.9.4.4(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.

(1) Fission Product Characteristics

By far the largest inventory of radioactive material in a nuclear power plant is 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. Table 5.7 lists the inventories of radionuclides that could be expected in a Beaver Valley Unit 2 reactor core.

These radioactive materials exist in a variety of physical and chemical forms. Their potential for dispersion into the environment depends not only on mechanical forces that might physically transport them, but also on 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 on 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 low frequency but credible events (see Section 5.9.4.3). For this reason the safety analysis of each nuclear power plant incorporates a hypothetical design-basis accident that postulates the release of the entire contained inventory of radioactive

noble gases from the fuel into the containment structure. If these gases were 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 structure is designed to minimize this type of release.

Radioactive forms of iodine are produced in substantial quantities in the fuel by the fission process, and in some chemical forms they may be quite volatile. For these reasons, iodine has traditionally been regarded as having a relatively high potential for release from the fuel. If the radionuclides are 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, the potential for release of radioiodines 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 temperatures, so they have a strong tendency to condense (or "plate out") on 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 would act to mitigate the release from the containment structure, which has large internal surface areas and contains 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 (for example, 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 iodines, have 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 they are transported to a lower temperature region and/or dissolve in water when it is present. The former mechanism can result in production of 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 (fallout) or by precipitation (washout or rainout), 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. 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 renders the radioactive materials hazardous.

(2) Meteorological Considerations

Two separate analyses of accident sequences are performed by the staff. One analysis, the determination of the consequences of certain accidents (referred

to as design-basis accidents) is performed for the staff's safety evaluation report. This analysis is performed to assure that the doses to any individual at the exclusion area boundary (EAB) over a period of 2 hours, or at the outer boundary of the low population zone (LPZ) during the entire period of plume passage,* will not exceed the siting dose guidelines given in 10 CFR 100 of 25 rems to the whole body or 300 rems to the thyroid. This analysis is used to examine site suitability (10 CFR 100) and the mitigative capability of certain plant safety features (10 CFR 50). The atmospheric dispersion model for this evaluation, as described in Regulatory Guide 1.145, uses onsite meteorological data (typically, a multiyear period of record) considered representative of the site and vicinity to calculate relative concentrations (χ/Q) that will be exceeded no more than 0.5% of the time in any one sector (22½°) and no more than 5% of the time for all sectors (360°) at the EAB and LPZ.

The second analysis of accident consequences is addressed in this report and considers a spectrum of release categories (including severe accidents) and actual meteorological conditions from a representative 1-year period of record of onsite data. From this 1-year period (8670 consecutive hours) meteorological observations (wind speed, atmospheric stability, and precipitation), for each hour are averaged, and 91 time sequences are used to estimate the dispersion and deposition of radioactive material from each release category into each of 16 sectors corresponding to the 22½° sectors used to report wind direction. The sampling of meteorological data is performed in a way that (1) all hourly data appear at some time during at least one of the time sequences, and (2) favorable, unfavorable, and typical atmospheric dispersion conditions are considered. Using 91 time sequences for 16 directions produces 1456 sets of computed consequences for each release category. The probability associated with each set is the product of the probability of the release categories multiplied by the annual probability of the wind blowing into a given sector, divided by 91 to represent the equal likelihood of the meteorological samples. The diversity of meteorological conditions sampled is principally responsible for the general shape of the probability distributions given below (see Figures 5.4 through 5.9). Combinations of the worst severe accident release category and the most unfavorable meteorological conditions sampled are represented by the extreme of the distribution on the bottom right of each of the plots presented. A detailed description of the atmospheric dispersion model is in WASH-1400, Appendix VI (NUREG-75/014).

(3) Exposure Pathways

The radiation exposure (hazard) to individuals is determined by their proximity to the radioactive materials, the duration of exposure, and factors that act to shield the individual from the radiation. Pathways for radiation and the transport of 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 of radioactivity initially carried in the air onto

*Plume passage can be defined as the time period associated with the passage of the radioactive cloud created by the release of fission products following an accident.

open bodies of water or onto land and eventual runoff into open water bodies. 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 via groundwater. These pathways may lead to external exposure to radiation and to internal exposure if radioactive material is contacted, 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 accident consequences are very much dependent upon the weather conditions existing at the time.

(4) Health Effects

The cause-and-effect relationships between radiation exposure and adverse health effects are quite complex (CONAES, 1979; Land, 1980).

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 shortly thereafter. Doses about 10 to 20 times larger, 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 proximity of the plant if measures are not or cannot be taken to provide protection, such as by sheltering or evacuation.

Lower levels of exposures may also constitute a health risk, but the ability to define a cause-and-effect relationship between any given health effect and a known exposure to radiation 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 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 occurrence of cancer itself is not necessarily indicative of fatality. The somatic health consequences model used in this assessment is based on the 1972 BEIR Report of the National Academy of Sciences (NAS) (BEIR I).

Most authorities agree 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 NAS BEIR III Report (1980), 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, the model in BEIR III projects approximately 220 genetic changes per million person-rems over succeeding generations. This is the estimate currently used by the NRC staff. (This value was computed as the sum of the risk of specific genetic defects and risk of defects with complex etiology (causes)).

(5) Health Effects Avoidance

Radiation hazards in the environment tend to disappear by the natural process of radioactive decay. Where the decay process is slow, 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 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.

5.9.4.3 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 April 1984, there were 79 commercial nuclear power reactor units licensed for operation in the United States (at 52 sites) with power-generating capacities ranging from 50 to 1180 megawatts electric (MWe). (Beaver Valley Unit 2 is designed for an electric power output to 870 MWe (stretch power).) The combined experience with these operating units represents approximately 700 reactor-years of operation over an elapsed time of about 23 years. Accidents have occurred at several of these facilities (Bertini, 1980; NUREG-0651; Thompson and Beckerley, 1964). Some of these accidents 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 contamination of the environment. This experience base is not large enough to permit reliable statistical prediction of accident probabilities. It does, however, suggest that significant environmental impacts caused by accidents are very unlikely to occur over time periods of a few decades.

Melting or severe degradation of reactor fuel occurred during the accident at Three Mile Island Unit 2 (TMI-2) on March 28, 1979. It has been estimated that about 2.5 million curies of noble gases (about 0.9% of the core inventory) and 15 curies of radioiodine (about 0.00003% of the core inventory) were released to the environment at TMI-2 (NUREG/CR-1250). 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 millirems (Rogovin, 1980; President's Commission, 1979). The total population exposure has been estimated to be in the range from about 1000 to

5000 person-rems (this range is discussed on page 2 of NUREG-0558). This exposure could produce between zero and one additional fatal cancer over the lifetime of the 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, 1980; President's Commission, 1979), 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 affected.

Accidents at nuclear power plants in the United States 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) are a small fraction of the exposures experienced during normal routine operations; these exposures average about 440 to 1300 person-rems in a PWR and 740 to 1650 person-rems in a BWR per reactor-year.

Accidents have also occurred at other nuclear facilities in the United States and in other countries (Bertini, 1980; Thompson and Beckerley, 1964). Because 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 Enrico Fermi Atomic Power Plant Unit 1. Fermi Unit 1 was a sodium-cooled fast breeder demonstration reactor designed to generate 61 MWe. The damages were repaired and the reactor reached full power 4 years after the accident. It operated successfully and completed its mission in 1973. The Fermi 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 curies, to the environment (United Kingdom, 1957). 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 (characteristic of graphite-moderated reactor), the fuel overheated and radioiodine and noble gases were released directly to the atmosphere from a 123-m (405-foot) stack. Milk produced in a 518-km^2 (200-mi^2) area around the facility was impounded for up to 44 days. The United Kingdom National Radiological Protection Board (Crick, 1982) estimated that the releases may have caused as many as 260 cases of thyroid cancer, about 13 of them fatal, and as many as seven deaths from other cancers or hereditary diseases. This kind of accident cannot occur in a water-moderated-and-cooled reactor like Beaver Valley Unit 2, however.

5.9.4.4 Mitigation of Accident Consequences

Pursuant to the Atomic Energy Act of 1954, as amended, the staff is conducting a safety evaluation of the application to operate Beaver Valley Unit 2. Although the SER will contain more detailed information on plant design, the principal design features are presented in the following section.

(1) Design Features

Beaver Valley Unit 2 contains features designed to prevent accidental release of radioactive fission products from the fuel and to lessen the consequences should such a release occur. Many of the design and operating specifications of these features are derived from the analysis of postulated events known as design-basis accidents. These accident prevention and mitigation features are collectively referred to as engineered safety features (ESFs). The possibilities or probabilities of failure of these systems are incorporated in the assessments discussed in Section 5.9.4.5.

The steel-lined concrete containment building is a passive mitigating system that is designed to minimize accidental radioactivity releases to the environment by maintaining a subatmospheric pressure in the containment structure. Safety injection systems are incorporated to provide cooling water to the reactor core during an accident to prevent or minimize fuel damage. Cooling fans provide the capability to remove heat inside the containment following steam release in accidents and thus help to prevent containment failure as a result of overpressure. Similarly, the containment spray system is designed to spray cool water into the containment atmosphere. The spray water also contains an additive (sodium hydroxide) that will chemically react with any airborne radioiodine to help remove it from the containment atmosphere and minimize its release to the environment.

All the mechanical systems mentioned above are supplied with emergency power from onsite diesel generators if normal offsite station power is interrupted.

The fuel handling building also has accident-mitigating systems. The safety-grade ventilation system contains both charcoal and high efficiency particulate filters. This ventilation system is also designed to keep the area around the spent-fuel pool below the prevailing barometric pressure during fuel handling operations so there will be no leakage through building openings. If radioactivity were to be released into the building, it would be drawn through the ventilation system, and most of the radioactive iodine and particulate fission products would be removed from the flow stream before it is exhausted to the outdoor atmosphere.

There are features of the plant that are necessary for its power-generation function that can also play a role in mitigating certain accident consequences. For example, although the main condenser is not classified as an ESF, it can act to mitigate the consequences of accidents involving leakage from the primary to the secondary side of the steam generators (such as steam generator tube ruptures). If normal offsite power is maintained, the ability of the plant to send contaminated steam to the condenser instead of releasing it through the safety valves or atmospheric dump valves can significantly reduce the amount of water-soluble radionuclides released to the environment.

Much more extensive discussions of the safety features and characteristics of Beaver Valley Unit 2 are in the FSAR; the staff evaluation of these features is in the Beaver Valley Unit 2 SER.

In addition to the benefits to be gained from these features, Beaver Valley Unit 2 will benefit from the implementation of the lessons learned from the TMI-2 accident--in the form of improvements in design, procedures, and operator training. These lessons learned will significantly reduce the likelihood of a

degraded core accident that could result in large releases of fission products to the containment. Specifically, the applicant will be required to meet those TMI-2 related requirements clarified in NUREG-0737.

(2) Site Features

The NRC's reactor site criteria, 10 CFR 100, require that the site for every power reactor have certain characteristics that tend to reduce the risk and the potential impact of accidents. The discussion that follows briefly describes the Beaver Valley Unit 2 site characteristics and how they meet these requirements.

First, the site has an exclusion area, as required by 10 CFR 100. The total site area is about 206 ha (501 acres). The exclusion area, located within the site boundary, has a 609-m (2000-foot) radius centered on the Unit 1 containment building. There are no residents within the exclusion area. The applicant owns all surface and minerals rights in the exclusion area, and has the authority, as required by 10 CFR 100, to determine all activities in this area. One state road traverses the area, allowing access to the plant. The exclusion area is also traversed by a railroad line, which is controlled by the applicant, and the Ohio River, which is used for barge transportation.

Second, beyond and surrounding the exclusion area, there is a low population zone (LPZ), also required by 10 CFR 100. The LPZ for the Beaver Valley Unit 2 site is a circular area with a 5.8-km (3.6-mile) radius. Within this zone, the applicant must ensure that there is a reasonable probability that appropriate protective measures could be taken on behalf of the residents in the event of a serious accident. The applicant has indicated that 10,600 persons lived within the 5.8-km (3.6-mile) radius in 1980 and projects that the population will increase to 10,900 in the year 2010. The major sources of transients within the 5.8-km radius of the site are nearby industries, schools, and recreational areas. They comprise a total of approximately 4600 persons within the LPZ. 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 plant (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 should be at least one and one-third times the distance from the reactor to the outer boundary of the LPZ. This distance requirement provides protection against excessive doses to people in large centers. The city of McCandless, Pennsylvania, with a 1980 population of 26,250, which is about 27 km (17 miles) east of the site, is the nearest population center. The population center distance is at least one and one-third times the LPZ distance. The resident population density within a 48-km (30-mile) radius of the site was 214 people/km^2 (549 people/mi^2) in 1980 and is projected to increase to about 242 people/km^2 (619 people/mi^2) by the year 2010.

The safety evaluation of the Beaver Valley Unit 2 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. The review encompassed nearby industrial and transportation facilities that might create explosive, fire, missile, or toxic gas hazards. The risk to Beaver

Valley Unit 2 from such hazards has been found to be negligible. A more detailed discussion of the compliance with the NRC siting criteria and the consideration of external hazards is in the Beaver Valley Unit 2 Safety Evaluation Report.

(3) Emergency Preparedness

Emergency preparedness plans including protective action measures for Beaver Valley Unit 2 and environs are in an advanced, but not yet fully completed, stage. In accordance with 10 CFR 50.47, effective November 3, 1980, no operating license will be issued to the 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 miles) in radius and an ingestion exposure pathway EPZ of about 80 km (50 miles) 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 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 in NUREG-0654. After NRC and FEMA make the above determinations, 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 in the SER. Further, if those findings indicate that the risk to the public from severe accidents, discussed in the following sections, is significantly larger because of the details of the final plans, a supplement to the Final Environmental Statement will be issued. 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.

5.9.4.5 Accident Risk and Impact Assessment

(1) Design-Basis Accidents

As a means of ensuring that certain features of Beaver Valley Unit 2 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 off the site. 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.

Three categories of accidents have been considered, based on their probability of occurrence. These categories are (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 similar to the consequences from normal operation that are discussed in Section 5.9.3.

Some of the initiating events postulated in the second and third categories for Beaver Valley Unit 2 are shown in Table 5.8. To evaluate the potential environmental impacts inherent in the operation of Beaver Valley Unit 2, the applicant has analyzed a variety of accidents, in a more realistic manner, using the guidance of Regulatory Guide 4.2, Revision 2, "Preparation of Environmental Reports for Nuclear Power Plants." The types of accident analyzed in Table 5.8 are similar to some events evaluated in the staff's Safety Evaluation Report. The applicant's estimates of the radiation doses to individuals at the nearest boundary of the plant during the first 2 hours are also shown in Table 5.8.

The results shown in Table 5.8 reflect the expectation that certain engineered safety features designed to mitigate the consequences of the postulated accidents would function as intended. An important assumption in these evaluations is that the releases considered are limited to noble gases and radioiodines and that other radioactive meterials are not released in significant quantities.

The staff does not perform an independent assessment of the potential offsite consequences using realistic assumptions. Instead, the staff estimates potential upper bound exposures to individuals for the same types of accidents contained in Table 5.8 for the purpose of implementing the provisions of 10 CFR 50 and 10 CFR 100. For the staff evaluations, much more pessimistic assumptions are made as to the course taken by the accident and the prevailing plant conditions; the accidents are referred to as design-basis accidents. The assumptions used for the design-basis accidents include much larger amounts of radioactive material released, additional single failures in equipment, operation of ESFs in a degraded mode* and poor meterological dispersion conditions. Again, the results of the staff's evaluation are described in more detail in the SER.

For comparison with the dose values in Table 5.8, the results taken from the SER-CP show that the limiting whole body exposures are not expected to exceed 16 rems to any individual at the exclusion area boundary. They also show that radioiodine releases have the potential for offsite exposures ranging up to about 280 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 an exposure to the thyroid is the potential appearance of benign or malignant thyroid nodules in about 9 out of 100 cases, and the development of a fatal thyroid cancer in about 4 out of 1000 cases.

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

None of the calculations of the impacts of design-basis accidents described in this section takes into consideration possible reduction in individual or population exposure as a result of any protective actions.

(2) Probabilistic Assessment of Severe Accidents

This section and the following three sections provide a discussion of the probabilities and consequences of accidents of greater severity than the design-basis accidents discussed in the previous section. As a class, these accidents 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 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 structure to perform its intended function of limiting the release of radioactive materials to the environment.

The assessment methodology employed is that described in the RSS, which was published in 1975. A less comprehensive but more up-to-date treatment is in NUREG/CR-2300, which was published in 1983. A discussion of the uncertainties surrounding the RSS methodology is provided in Section 5.9.4.5(7).

However, the sets of accident sequences that were found in the RSS to be the dominant contributors to the risk in the prototype PWR (Westinghouse-designed Surry Unit 1) have recently been updated (rebaselined). The rebaselining has been done largely to incorporate peer group comments, as well as better data and analytical techniques resulting from research and development after the publication of the RSS (see NUREG-0773). Entailed in the rebaselining effort was the re-evaluation of the individual dominant accident sequences. The earlier technique of grouping a number of diverse accident sequences into encompassing "Release Categories," as was done in the RSS, has been largely (but not completely) eliminated.

Beaver Valley Unit 2 is a Westinghouse-designed PWR having similar design and operating characteristics to Surry. Therefore, the present assessment for Beaver Valley Unit 2 has used as its starting point the rebaselined accident sequences and release categories referred to above and more fully described in Appendix F. Characteristics of the sequences (and release categories) used (all of which involve partial to complete melting of the reactor core) are shown in Table 5.9.

Sequences initiated by external phenomena--such as tornadoes, floods, or seismic events--and those that could be initiated by humans, including deliberate acts of sabotage--are not included in the event sequences corresponding to the listed release categories. The only plants for which external events have been assessed in detail in a probabilistic sense are Zion, Indian Point, Limerick, and Millstone Unit 3. In these cases, no estimates of risk from sabotage were made, because these estimates are considered beyond the state of the art. The staff notes, however, that the consequences of large releases caused by sabotage should not be different in kind from the releases estimated for severe internally initiated accidents. For Zion and Limerick, the licensees submitted probabilistic risk assessments that indicate external events can be significant

contributors to risk. For Indian Point, the staff's evaluations also indicate significant* risks as a result of external events other than sabotage.

Although the staff made no numerical assessment of externally initiated accident risks for Beaver Valley Unit 2, the staff did draw on information from the Zion, Limerick, Millstone Unit 3, and Indian Point studies. Thus, the staff concludes the actual risks from internal and external causes (exclusive of sabotage) could be higher than those presented here, but are unlikely to exceed those determined from risk multipliers computed for Zion, Limerick, and Indian Point. These multipliers would not result in risks at Beaver Valley Unit 2 outside an uncertainty range of a factor of 100 times the risks from internal events, as discussed in Section 5.9.4.5(7).

Calculated probability per reactor-year associated with each accident sequence (or release category) used is shown in the second column in Table 5.9. 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. The probability of accident sequences from the Surry plant were used to give a perspective of societal and individual risk at Beaver Valley Unit 2 because, although the probabilities of particular accident sequences may be substantially different and even improved for Beaver Valley Unit 2, the overall effect of all sequences taken together is likely to be within the uncertainties (see Section 5.7.2.5(7) for a discussion of uncertainties in risk estimators).

The magnitudes (curies) of radioactivity postulated to be released for each release category are obtained by multiplying the release fractions shown in Table 5.9 by the amounts that would be present in the core at the time of the hypothetical accident. These are shown in Table 5.7 for Beaver Valley Unit 2 at a core thermal power level of 2766 MWt, the power level used in the safety evaluation. Of the hundreds of radionuclides present in the core, the 54 listed in the table were selected as significant contributors to the health and economic risks of severe accidents. The core radionuclides were selected on the basis of (1) half-life, (2) approximate relative offsite dose contribution, and (3) health effects of the radionuclides and their daughter products.

The potential radiological consequences of these releases have been calculated by the consequence model (NUREG/CR-2300) used in the RSS, adapted and modified as described below to apply to a specific site. The essential elements are shown in schematic form in Figure 5.3. Environmental parameters specific to the Beaver Valley site have been used and include the following:

- meteorological data for the site representing a full year of consecutive hourly measurements and seasonal variations
- projected population for the year 2010 extending to a 563-km (350-mile) radius from the plant

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*"Significant," as used herein, means that the best estimate of the additional risk from external events other than sabotage were calculated to be as much as a factor of 30 higher than the best estimate risks from internal events at Indian Point, but about 2 to 10 times the best estimate risk from internal events at Zion.

- the habitable land fraction within a 563-km (350-mile) radius
- land-use statistics, on a statewide basis, including farm land values, farm product values including dairy production, and growing season information for the State of Pennsylvania and each surrounding state within the 563-km (350-mile) region (land-use statistics for Canada were assumed to be the same as for adjacent states)

To obtain a probability distribution of consequences, the calculations are performed assuming the releases, as defined by the release categories, at each of 91 different start times throughout a 1-year period. Each calculation used (1) the site-specific hourly meteorological data, (2) the population projections for the year 2010 for a distance of 563 km (350 miles) around the Beaver Valley site, and (3) 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 from severe releases. The evacuation model used (see Appendix F) has been revised from that in the RSS for better site-specific application. The quantitative characteristics of the evacuation model used for the Beaver Valley site are estimates made by the staff. There normally would be some facilities near a plant, such as schools or hospitals, where special equipment or personnel may be required to effect evacuation, and there may be some people near a site who fail to evacuate. Therefore, actual evacuation effectiveness could be greater or less than that characterized, but it would not be expected to be very much less, because special consideration will be given in emergency planning for the unit to any unique aspects of dealing with special facilities.

The other protective actions include: (1) either complete denial of use, or limited use, or permitting use only at a sufficiently later time after appropriate decontamination of food stuffs 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 of severely contaminated land and property for varying periods of time until the contamination levels are reduced by radioactive decay and weathering to such values that 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.

Evacuation within and relocation of people from outside the plume exposure pathway zone 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 Beaver Valley Unit 2 include some 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 probabilities.

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.

(3) Dose and Health Impacts of Atmospheric Releases

The results of the atmospheric pathway calculations of dose and health impacts performed for the Beaver Valley facility and site are presented in the form of probability distributions in Figures 5.4 through 5.8* and are included in the impact summary table, Table 5.10. All of the release categories shown in Table 5.9 contribute to the results, and each is weighted by its associated probability.

Figure 5.4 shows the probability distribution for the number of persons who might receive bone marrow doses equal to or greater than 200 rems, whole body doses equal to or greater than 25 rems, and thyroid doses equal to or greater than 300 rems from early exposure,** all on a per-reactor-year basis. The 200-rem bone marrow dose figure corresponds approximately to a threshold value for which hospitalization would be indicated for the treatment of radition injury. The 25-rem whole-body dose and 300-rem thyroid dose figures correspond to the Commission's guideline values for reactor siting in 10 CFR 100.

Figure 5.4 shows in the left-hand portion that there are approximately 3 chances in 100,000 (2.5×10^{-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 the three curves initially run almost parallel in horizontal lines shows that if one person were to receive such doses, the chances are about the same that ten to hundreds would be so exposed. The chances of larger numbers of persons being exposed at those levels are seen to be consideraby smaller. For example, the chances are about 1 in 25,000,000 (4×10^{-8}) that 10,000 or more people might receive bone marrow doses of 200 rems or greater. Virtually all of the exposures reflected in this figure would occur within an 80-km (50-mile) radius.

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*Figures 5.4 through 5.8 are called complementary cumulative distribution functions (CCDF). They are intended to show the relationship between the probability of a particular type of consequence being equalled or exceeded and the magnitude of the consequence. Probability per reactor-year (r-y) is the chance that a given event will occur in 1 year of operation for one reactor. Because the different accident releases, atmospheric dispersion conditions, and changes of a health effect (for example, early fatalities) result in a wide range of calculated consequences, they are presented on a logarithmic plot in which numbers varying over a very large range can be conveniently illustrated by a grid indicated by powers of 10. For instance, 10^6 means one million or 1,000,000 (1 followed by 6 zeros). The cumulative probabilities of equalling or exceeding a given consequence are also calculated to vary over a large range (because of the varying probabilities of accidents and atmospheric dispersion conditions), so the probabilities are also plotted logarithmically. For instance, 10^{-6} means one millionth or 0.000001.

**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 cloud passage. Other pathways of exposure are excluded.

Figure 5.5 shows the probability distribution for the total population exposed in person-rems; that is, the probability per reactor-year that the total population exposure will equal or exceed the values given. Most of the population exposure up to 1,000,000 person-rems would be expected to occur within 80 km (50 miles), but the more severe releases (as in the first two release categories in Table 5.9) could result in exposure to persons beyond the 80-km range as shown.

For perspective, population doses shown in Figure 5.5 may be compared with the annual average dose to the population within 80 km of the Beaver Valley site resulting from background radiation of 420,000 person-rems, and to the anticipated annual population dose to the general public (total United States) from normal plant operation of 41 person-rems (excluding plant workers) (see Appendix D, Tables D-7 and D-8.)

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 28-km (18-mile) radius and the majority within an 8-km (5-mile) radius. The results of the calculations shown in Figure 5.5 and in Table 5.10 reflect the effect of evacuation within the 16-km (10-mile) plume exposure pathway zone.

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. These estimates may be compared to the cancer fatality risk per individual per year from all causes of 1.9×10^{-3} (American Cancer Society, 1981).

An additional potential pathway for doses resulting from atmospheric release is from fallout onto open bodies of water. This pathway was investigated in the NRC analysis of the Fermi Unit 2 plant, which is located adjacent to Lake Erie and for which appreciable fractions of radionuclides in the plume could be deposited in the Great Lakes (NUREG-0769). For the Fermi site, the indicated individual and societal doses from this pathway were on the same order of magnitude as the interdicted doses from other pathways. Further, the individual and societal liquid pathway doses could be substantially eliminated by the interdiction of the aquatic food pathway in a manner comparable to interdiction of the terrestrial food pathway in the present analysis.

Because Beaver Valley is not adjacent to a large surface water body, the fraction of radioactive material that could fall in nearby rivers, streams, or lakes would be correspondingly reduced.

The staff has also considered fallout onto and runoff and leaching into water bodies in connection with a study of severe accidents at the Indian Point reactors in southeastern New York (Codell, 1983). In this study, empirical models were developed based upon considerations of radionuclide data collected in the New York City water supply system as a result of fallout from atmospheric

weapons tests. As with the Fermi study, the Indian Point evaluation indicated that the uninterdicted risks from this pathway were fractions of the interdicted risks from other pathways. Further, if interdicted in a manner similar to interdiction assumed for other pathways, the liquid pathway risks from fallout would be a very small fraction of the risks from other pathways. Considering the regional meteorology and hydrology for the Beaver Valley Unit 2 site, the staff sees nothing to indicate that the liquid pathway contribution to the total accident risk at Beaver Valley Unit 2 would be significantly greater than found for Fermi 2 and Indian Point. This water pathway would be of small importance compared to the results presented here for fallout onto land.

(4) Additional Possible Releases to Groundwater

A pathway through the groundwater for radiation exposure to the public 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 Beaver Valley Unit 2. The principal contributors 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 bodies used for drinking water, aquatic food, and recreation. Releases of radioactivity to the groundwater underlying the site could also occur through the failed basemat through depressurization of the containment atmosphere, or the release of radioactive water from the emergency core cooling system.

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 compared the risk of accidents involving the liquid pathway (drinking water, irrigation, aquatic food, swimming, and shoreline usage) for five conventional, generic, land-based nuclear plant sites 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.

Doses to individuals and populations were calculated in the LPGS without consideration of interdiction methods such as isolating the contaminated groundwater, restricting aquatic food consumption, or prohibiting 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 present analysis considers only the case of "prompt" release of highly contaminated sump water released through a failed basemat, which was the PWR-7 scenario in the LPGS. This release was chosen because, of those studied in the LPGS that could contribute to the groundwater pathway, this release would result in the highest population dose. In the LPGS case, 25% of the Sr-90 and

100% of the Cs-134 and Cs-137 isotopes in the core inventory were conservatively considered to be released to the ground in the sump water. Transport in the groundwater was found to be relatively slow because of "retardation" caused by interaction of the radionuclides with the rock or soil. In addition, decay of many radionuclides was found to be appreciable. Only 87% of the Sr-90 and 31% of the Cs-137 were estimated to enter the river. Dose contributions from radionuclides other than Sr-90 and Cs-137 were considered negligible.

The discussion in the remainder of this section is a summary of an analysis performed to determine whether or not the liquid pathway consequences of a postulated accident at the Beaver Valley Unit 2 site would be unusual when compared with the generic "small river" land-based site considered in the LPGS.

The LPGS presented analyses for four-loop Westinghouse PWRs located at a number of land sites, one of which is similar to the Beaver Valley Unit 2 site. The LPGS "small river" site is on the Clinch River, about 34 km (21 miles) upstream of the Tennessee River. The balance of this river system consists of the Tennessee River (912 km, 567 miles), the Ohio River (74 km, 46 miles), and 1535 km (954 miles) of the Mississippi River. Beaver Valley Unit 2 is a three-loop Westinghouse PWR located adjacent to the Ohio River (as described in Section 4.3.1.1). The river system is similar to the LPGS site, consisting of 1522 km (946 miles) of the Ohio River and the same 1535 km (954 miles) of the Mississippi River.

Beaver Valley Unit 2 is located on a terrace of alluvial deposits on the south side of the Ohio River. In the general site region, the south bank of the river is characterized by bedrock bluffs that rise abruptly from the water's edge to elevations as much as several hundred feet above the river. About 3660 m (12,000 feet) upstream of the station, the bedrock bluff begins to deviate inland from the river bank. At its maximum point, the bluff is about 762 m (2500 feet) inland (south) of the river bank. At a point about 610 m (2000 feet) downstream of the station, the bedrock bluff again joins the river's edge. Thus, a saddle-like bedrock formation exists at the site. The bedrock underneath the containment building is about 107 m (350 feet) thick. The back (south side) and sides of the saddle are formed by upswings in the bedrock surface which reach elevations in excess of 234 m (800 feet) msl. The bedrock saddle is filled with alluvial deposits that form the terraces on which the unit is located. These terraces are comprised mainly of sand and gravel and have a hydraulic conductivity ranging between 1.7×10^{-3} to 6.1×10^{-3} m/sec (5.7×10^{-5} to 2.0×10^{-4} ft/sec). The alluvial soils make up the only significant aquifier in the site vicinity. However, there are no wells located in this aquifier between the reactor building and the river.

At the site, the surface of the alluvial soils is at elevation 223 m (730 feet) msl and the foundation mat of the containment building extends about 15 m (50 feet) below the surface to elevation 207 m (680 feet) msl. The normal groundwater level is 4.4 m (14.5 feet) lower than the foundation mat at elevation 202.8 m (665.5 feet) MSL and about 13.9 m (45.5 feet) higher than the top of the bedrock which is elevation 189 m (620 feet) msl.

In the event of a core-melt accident, there could be a release of radioactivity to the terrace alluvial aquifier beneath the reactor. Radionuclides that would enter the aquifer would be entrained in the natural groundwater flow to

the Ohio River. Using, for conservatism, the highest value of hydraulic conductivity (1.7×10^{-3} m/sec, 2.0×10^{-4} ft/sec) determined by the applicant, an effective porosity of 0.23, and a hydraulic gradient of 0.0013, the staff estimated that it would take about 22 years for contaminated groundwater to migrate to the river through the alluvium. The movement of most of the radioactivity dissolved in the groundwater would be much slower than the groundwater itself because of the process of sorption.

In the LPGS, it was demonstrated that for groundwater travel times on the order of years, the only significant contributors to population dose are Sr-90 and Cs-137. Retardation factors for these radionuclides are difficult to estimate; however, Parsons (1962) estimated distribution coefficients (Kds) of 13 to 43 mL/g for Sr and 100 mL/g for Cs for sands. Niemczyk (NUREG/CR-1596) used Kd's of 20 and 200 for Sr-90 and Cs-137, respectively. Isherwood (1977) suggested that Kd's for sand range from 1.7 to 43 for Sr and 22 to 314 for Cs. For Beaver Valley Unit 2 the staff conservatively estimated nuclide travel time using the distribution coefficients used in the LPGS: 2 mL/g for Sr and 20 mL/g for Cs. This resulted in retardation factors of 9.2 for Sr-90 and 83 for Cs-137, respectively. Using these values the travel time would be about 200 years for Sr-90 and 1800 years for Cs-137. When these times are compared to 5.7 years for Sr-90 and 51 years for Cs-137 in the LPGS case, the longer travel times at Beaver Valley Unit 2 would allow a smaller portion of the radioactivity to enter the Ohio River. In the LPGS, 87% of the Sr-90 and 31% of the Cs-137 entered the river. For Beaver Valley Unit 2, less than 1% of the Sr-90 would enter the river. Virtually all of the Cs-137 would have decayed before reaching the river.

In the case of the LPGS small river site, approximately 80% of the total population dose would be from Sr-90 and 20% from Cs-137. Because virtually all the Cs-137 would decay before reaching the Ohio River, essentially all of the population dose would be from Sr-90 alone. The percent of Sr-90 entering the Ohio River is more than 87 times smaller than that in the LPGS. The staff, therefore, concludes that the population dose for Beaver Valley Unit 2 would also be less than that for the LPGS case, and that the liquid pathway at Beaver Valley Unit 2 does not pose an unusual contribution to risk when compared to other land-based sites and is thus small in comparison to the risk posed by airborne pathways.

Finally, there are measures that could be taken to further minimize the impact of the liquid pathway. As described above, the staff estimated that the groundwater travel time from the reactor building to the Ohio River would be about 22 years and that the most significant nuclides would be retarded by sorption. This would allow ample time for engineering measures such as slurry walls and well point dewatering to isolate the radioactive contamination near the source and to establish a groundwater monitoring program that would ensure early detection if any contaminants should escape the isolated area. A comprehensive discussion of these and other mitigation methods potentially applicable to Beaver Valley Unit 2 is in Harris, Yang, Bynoc, and Warkentien (1982) and Harris, Winters, and Yang (1982).

(5) Economic and Societal Impacts

As noted in Section 5.9.4.2, the various measures for avoidance of adverse health effects, including those resulting from residual radioactive contamination in the environment, are possible consequential impacts of severe accidents.

Calculations of the probabilities and magnitudes of such impacts for Beaver Valley Unit 2 and its environs have also been made. Unlike the radiation exposure and 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 5.10. The factors contributing to these estimated costs include the following:

- evacuation costs
- value of milk contaminated and condemned
- cost of decontamination of property where practical
- indirect costs attributable to loss of use of property and income derived therefrom

The last-named 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 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 small (about one chance in one hundred thousand per reactor-year).

Additional economic impacts that can be monetized by the RSS consequence model include costs of decontamination of the facility itself. Another impact is the cost of replacement power. Probability distributions for these impacts have not been calculated, but they are included in the discussion of risk considerations in Section 5.9.4.5(6) below.

(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 also useful to combine them to obtain average measures of environmental risk. Such averages provide a useful perspective, and 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 the peoples' attitudes about risks, 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 shows average values of risk associated with population dose, early fatalities, latent fatalities, and costs for 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. Because the probabilities are on a per-reactor-year basis, the averages shown are also on a per-reactor-year basis.

The population exposures and latent cancer fatality risks may be compared with those for normal operation shown in Appendix D. The comparison (excluding exposure to the plant personnel) shows that the accident dose risks (expressed in person-rems per reactor-year) to the total population are similar to the anticipated doses from normal operation, but the accident dose risks within 80 km (50 miles) are about 10 times higher than the anticipated normal operation doses within 80 km.

The latent cancer fatality risks from potential accidents can also be compared to the cancer risk from all other sources. For accidents, this risk, averaged over those within 80 km (50 miles) of the Beaver Valley plant, is 1.7×10^{-8} per year per person, compared with the cancer fatality risk from all other sources of 1.9×10^{-3} per year.

There are no early fatality or economic risks associated with protective actions and decontamination for normal releases; therefore, these risks are unique for accidents. For perpective and understanding of the meaning of the early fatality risk of 2×10^{-3} per reactor-year, however, the staff notes that to a good approximation the population at risk is that within about 16 km (10 miles) of the plant, which is estimated to be about 166,200 persons in the year 2010. Accidental fatalities per year for a population of this size, based upon overall averages for the United States, are approximately 36 from motor vehicle accidents, 13 from falls, 5 from drowning, 5 from burns, and 2 from firearms. The average early fatality risk from reactor accidents is thus an extremely small fraction of the total risk embodied in the combined 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 downwind distance from the plant within the plume exposures pathway zone. The values are on a per-reactor-year basis, and all accident sequences and release categories in Table 5.11 contributed to the dose, weighted by their associated probabilities.

Evacuation and other protective actions can reduce the risks to an individual of such impacts as early fatality or of latent cancer fatality. Figure 5.10 shows lines of constant risk of early fatality per reactor-year to an individual living within the emergency planning zone of the Beaver Valley Unit 2 site, of early fatality as a function of location resulting from potential accidents in the reactor. Figure 5.11 shows similar curves of constant risk of latent cancer fatality. Directional variations in these plots 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 are the risks of fatality per year to an individual living in the United States (CONAES, page 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 evacuation and other protective actions could be compared with property damage costs associated with alternative energy generation technologies. The use of fossil fuels--coal or oil, for example--would cause substantial quantities of sulfur dioxide and nitrogen

oxides to be emitted into the atmosphere and, among other things, lead to environmental and ecological damage through the phenomenon of acid rain (CONAES pages 559-560). This effect has not, however, been sufficiently quantified for a useful comparison to be drawn at this time.

Other Economic Risks

There are other risks that can be monetized but that are not included in the cost calculation discussed above. These are accident impacts to the facility itself that result in added costs to the public. These costs would derive from decontamination and repair of the facility as well as from increased expenditures for replacement power while the unit is out of service. 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 operation of the Beaver Valley Unit 2 (beginning in 1986), the associated economic penalty is estimated to total approximately $1650 million (1986 dollars) for decontamination and repair of the facility. This estimate is based on a conservative (high cost) 10% annual escalation of the $950 million (1980 dollars) repair cost estimate for the Three Mile Island facility (Comptroller General, 1981). Although, insurance would cover $300 million or more of the repair costs, the insurance is not credited against this cost because the $300 million times the risk probability should theoretically balance the insurance premium.

In addition to repair costs, the staff estimates there will be additional annual production expenses of approximately $76 million (1986 dollars) for replacement power while the unit is out of service. This estimate assumes that energy that would have been generated by the unit (assuming a 70% average annual capacity factor, a conservatively high estimate) will be replaced primarily by coal-fueled generating facilities. Assuming the nuclear unit is out of service for an 8-year period, replacement power costs during restoration will total $608 million (constant 1986 dollars).

The probability of a core melt of severe reactor damage is assumed to be as high as 10^{-4} per reactor year (this accident probability is intended to account for all severe core damage accidents leading to large economic consequences for the owner, not just those leading to significant offsite consequences).

Multiplying the sum of the previously estimated repair and replacement power costs of approximately $2258 million for an accident to the unit during the initial year of its operation by the above 10^{-4} probability, results in an economic risk of approximately $225,800 during the first year (1986 dollars, or for the purpose of comparison with other costs presented in this section, $127,500 in 1980 dollars). This is also the approximate economic risk (in 1986 dollars) to Beaver Valley Unit 2 during each subsequent year of operation, although this amount will gradually decrease as the nuclear unit depreciates in value and operates at a reduced annual capacity factor.

Regional Industrial Impacts

A severe accident that requires the interdiction and/or decontamination of land areas will force numerous businesses to temporarily or permanently close. These closures would have additional economic effects beyond the contaminated areas through the disruption of regional markets and sources of supplies. This

section provides estimates of these impacts which were made using: (1) the RSS consequence model discussed elsewhere in this section, and (2) the Regional Input-Output Modeling System (RIMS II), developed by the Bureau of Economic Analysis (BEA) (NUREG/CR-2591).

The industrial impact model developed by BEA takes into account contamination levels of a physically affected area defined by the RSS consequence model. Contamination levels define an interdicted area immediately surrounding the plant, followed by an area of decontamination, an area of crop interdiction, and finally an area of milk interdiction. (The industry-specific impacts are estimated for the four accident sequences listed in Table 5.9.)

Assumptions used in the analysis include the following:

- In the interdicted area, all industries would lose total production for more than a year.

- In the decontamination zone, there would be a 3-month loss in nonagricultural output; a 1-year loss in all crop output, except there would be no loss in greenhouse, nursery, and forestry output; a 3-month loss in dairy output; and a 6-month loss in livestock and poultry output.

- In the crop interdicted area, there would be no loss in nonagricultural output; a 1-year loss in agricultural output, except no loss in greenhouse, nursery, and forestry output; no loss in livestock and poultry output; and a 2-month loss of dairy output.

- In the milk interdiction zone, there would be only a 2-month loss in dairy output.

The estimates of industrial impacts are made for an economic study area that consists of a physically affected area and a physically unaffected area. An accident that causes an adverse impact in the physically affected area (for example, the loss of agricultural output) could also adversely affect output in the physically unaffected area (for example, food processing). In addition to the direct impacts in the physically affected area, the following additional impacts would occur in the physically unaffected area:

- decreased demand (in the physically affected area) for output produced in the physically unaffected area

- decreased availability of production inputs purchased from the physically affected area

Only the impacts occurring during the first year following an accident are considered. The longer term consequences are not considered because they will vary widely, depending on the level and nature of efforts to mitigate the accident consequences and to decontaminate the physically affected areas. The estimates assume no compensating effects such as the use of unused capacity in the physically unaffected area to offset the initial lost production in the physically affected area, or income payments to individuals displaced from their jobs that would enable them to maintain their spending habits. These compensating effects would occur over a lengthy period. The estimates using no compensating effects are the best measures of first year economic impacts.

Table 5.12 presents the regional economic output and employment impacts and corresponding expected risks associated with the different release categories. The estimated overall risk value using output losses as the measure of accident consequences, expressed in a per-reactor-year basis, is $23,627. This number is composed of direct impacts of $19,902 in the nonagricultural sector and $1138 in the agricultural sector, and indirect impacts of $2587 from decreased export and supply constraints. The corresponding expected employment loss per reactor year is about 0.9 job. It should be noted that 34% of the expected losses, or $8073, results from releases occurring toward the east southeast. On an absolute basis, the impacts from the Event V and TMLB' releases to the east southeast are the greatest and would result in a loss of $7.1 billion and 264,000 jobs. Releases from the PWR 7 scenarios, on the other hand, contribute nothing to the total economic risk.

The staff has also considered the health care costs resulting from hypothetical accidents in a generic model developed by the Pacific Northwest Laboratory.

Based upon this generic model, the staff concludes that such costs may be a fraction of the offsite costs evaluated herein, but that the model is not sufficiently constituted for application to a specific reactor site (Nieves, 1983).

(7) Uncertainties

The probabilistic risk assessment discussed above has been based mostly upon the methodology presented in the RSS, which was published in 1975. Although substantial improvements have been made in various facets of the RSS methodology since the RSS was published, there are still large uncertainties in the results of the analysis presented in the preceeding sections, including uncertainties associated with the likelihoods of the accident sequences and containment failure modes leading to the release categories, the source terms for the release categories, and the estimates of environmental consequences. The relatively more important contributors to uncertainties in the results presented in this environmental statement are as follows:

- Probability of Occurrence of Accident

  If the probability of a release category would change by a certain factor, the probabilities of various types of consequences from that release category would also change by exactly the same factor. Thus, an order of magnitude uncertainty in the probability of a release category would result in an order of magnitude uncertainty in both societal and individual risks stemming from the release category. As in the RSS, there are substantial uncertainties in the probabilities of the release categories. This is due, in part, to difficulties associated with the quantification of the human error and to inadequacies in the data base on failure rates of individual plant components and in the data base on external events and their effects on plant systems components that are used to calculate the probabilities.

  Another related area of uncertainty involves risks from externally caused accidents (such as earthquakes, floods and events caused by people, including sabotage). Although such risks have not been evaluated for Beaver Valley Unit 2, some of these types of risks have been evaluated for Indian Point, Millstone Unit 3, Limerick, and Zion. In those evaluations, such

risks were found to be within a factor of less than 100 times greater than risks from internally initiated accidents at the corresponding plants. Such experiences in plant-specific probabilistic risk assessments cannot be extended directly to Beaver Valley Unit 2 because of site and plant design characteristics. However, the staff judges such risks to be within the uncertainty bounds discussed below.

- <u>Quantity and Chemical Form of Radioactivity Released</u>

  This relates to the quantity of each radionuclide species, and its chemical form, that would be released from a reactor unit during a particular accident sequence. Such releases would originate in the fuel and would be attenuated by physical and chemical processes in route to being released to the environment. Depending on the accident sequence, attenuation in the reactor vessel, the primary cooling system, the containment, and adjacent buildings would influence both the magnitude and chemical form of radioactive releases. The source terms used in the staff analysis were determined using the RSS methodology applied to a PWR of the same design as the Surry plant. Therefore, the RSS methodology may not have been fully appropriate for Beaver Valley Unit 2. Information available in NUREG-0772 indicates that best-estimate source terms cannot be much worse than the larger source terms used in the analysis, but could be substantially lower than the source terms used here for the same types of initiating accident sequences. The impact of smaller source terms would be lower estimates of health effects, particularly early fatalities and injuries.

- <u>Atmospheric Dispersion Modeling for the Radioactive Plume Transport, Including the Physical and Chemical Behavior of Radionuclides in Particulate Form in the Atmosphere</u>

  This uncertainty relates to the differences in modeling the atmospheric transport of radioactivity in gaseous and particulate states, and the actual transport, diffusion, and deposition or fallout that would occur during an accident (including the effects of condensation and precipitation). The phenomenon of plume rise as a result of the heat associated with the atmospheric release, the effects of precipitation on the plume, and fallout of particulate matter from the plume all have considerable impact on the magnitudes of early health consequences and on the distance from the reactor to which these consequences would occur. The staff judgment is that these factors can result in substantial overestimates or underestimates of both early and later effects (both health and economic).

Other areas that have substantial but relatively less effect on uncertainty than the preceding items are

- <u>Release Duration and Energy of Release, Warning Time, and Inplant Radionuclide Decay Time</u>

  These areas relate to the differences between assumed release duration, energy of release, and the warning and the inplant radioactivity decay times compared with those that would actually occur during a real accident.

  For an atmospheric release of a relatively long duration (greater than a half-hour), the actual cross-wind spread (the width) of the radioactive

plume that would develop would likely be larger than the width calculated by the dispersion model in the code used by the staff (CRAC). However, the effective width of the plume is calculated in the code using a plume expansion factor that is determined by the release duration. For a given quantity of radionuclides in a release, the plume and, therefore, the area that would come under its cover would become wider if the release duration were made longer. In effect, this would result in lower air and ground concentrations of radioactivity, but a greater area of contamination.

The thermal energy associated with the release affects the plume rise phenomenon, which results in relatively lower air and ground concentrations in the closer regions and relatively higher concentrations as a result of fallout in the more distant regions. Therefore, if a large thermal energy were associated with a release containing large fractions of the core-inventory of radionuclides, the distance from the reactor over which early health effects may occur could increase. If, on the other hand, the release behavior were dominated by the presence of large amounts of condensing steam, very much the reverse could occur, because of the close-in deposition of radionuclides induced by the falling water condensed from the steam.

The warning time before evacuation has considerable impact on the effectiveness of offsite emergency response. Longer warning times would improve the effectiveness of the response.

The time from reactor shutdown until the beginning of the release to the environment (atmosphere), known as the time of release, is used to calculate the depletion of radionuclides by radioactive decay within the plant before release. The depletion factor for each radionuclide (determined by the radioactive decay constant and the time of release) multiplied by the release fraction of the radionuclide and its core inventory determines the actual quantity of the radionuclide released to the environment. Later releases would result in the release of fewer curies to the environment for given values of release fractions.

The first three of the above parameters (duration and energy of release and warning time) can have significant impacts on accident consequences, particularly on early consequences. The staff judgment is that the early consequences and risks calculated for this review could be substantial underestimates or overestimates, because of uncertainties in the first three parameters.

- Meteorological Sampling Scheme Used

This relates to the possibility that the meteorological sequences used with the selected 91 start times (sampling) in the CRAC code may not adequately represent all meteorological variations during the year, or that the year of meteorological data may not represent all possible conditions. This factor is judged to produce greater uncertainties for early effects and less for latent effects.

- Emergency Response Effectiveness

  This relates to the differences between modeling assumptions regarding the emergency response of the people residing near the Beaver Valley site compared to what would happen during an actual severe reactor accident. Included in these considerations are such subjects as the effectiveness of evacuation under different circumstances, the effectiveness of possible sheltering, and the effectiveness of population relocation. The staff judgment is that the uncertainties associated with emergency response effectiveness could cause large uncertainties in early health consequences. The uncertainties in latent health consequences and costs are considered to be smaller than those for early health consequences.

- Dose Conversion Factors and Dose Response Relationships for Early Health Consequences, Including Benefits of Medical Treatment

  This relates to the uncertainties associated with estimates of dose and early health effects on individuals exposed to high levels of radiation. Included are the uncertainties associated with the conversion of contamination levels to doses, relationships of doses to health effects, and considerations of the availability of what was described in the RSS as supportive medical treatment (a specialized medical treatment program of limited availability that would minimize the early health effect consequences of high levels of radiation exposure following a severe reactor accident). Previous staff analysis indicates that uncertainty for this last source is less than a factor of 3.

- Dose-Conversion Factors and Dose-Response Relationships for Latent Health Consequences

  This relates to the uncertainties associated with dose estimates and latent (delayed and long-term) health effects on individuals exposed to lower levels of radiation and on their succeeding generations. Included are the uncertainties associated with conversion of contamination levels to doses and doses to health effects. The staff judgment is that this category has a large uncertainty. The uncertainty could result in relatively small underestimates of consequences, but also in substantial overestimates of consequences. (Note: radiobiological evidence on this subject could indicate zero consequences.)

- Chronic Exposure Pathways, Including Environmental Decontamination and the Fate of Deposited Radionuclides

  This relates to uncertainties associated with chronic exposure pathways to humans from long-term use of the contaminated environment. Uncertainty arises from the possibility of different protective action guide levels that may actually be used for interdiction or decontamination of the exposure pathways from those assumed in the staff analysis. Further, uncertainty arises because there is a lack of precise knowledge about the fate of the radionuclides in the environment as influenced by natural processes such as runoff, weathering, etc. The staff's qualitative judgment is that the uncertainty from these considerations is substantial.

• Economic Data and Modeling

This relates to uncertainties in the economic parameters and economic modeling, such as costs of evacuation, relocation, medical treatment, cost of decontamination of properties, and other costs of property damage.Uncertainty in this area could be substantial.

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 consistent with current data and methodology, there are large uncertainties associated with the results shown. It is the qualitative judgment of the staff that the uncertainty bounds could be well over a factor of 10, but not as large as a factor of 100. Within these uncertainty bounds, however, the uncertainties associated with the probability-integrated values consequences (the risks) are likely to be less (although still large) than uncertainties in the curves in the figures showing probability distribution of consequences because of the partial cancellation of uncertainties by integration.

When the accident at Three Mile Island occurred in March 1979, the accumulated record of experience with operating reactors was about 400 reactor-years. It is of interest to note that this implied accident frequency was within the range of frequencies estimated by the RSS for an accident of this severity (CONAES, page 553).

The Three Mile Island accident has resulted in a very comprehensive evaluation of reactor accidents by a significant number of investigative groups. 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 (1979), 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) contains 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 results in a gradually increasing improvement in safety as individual actions are completed. Beaver Valley Unit 2 is receiving and will receive the benefit of these actions.

(8) Comparison of Beaver Valley Unit 2 Risks with Other Plants

To provide a perspective as to how Beaver Valley Unit 2 compares in terms of risks from severe accidents with some of the other nuclear power plants that are either operating or that are being reviewed by the staff for possible issuance of a license to operate, the estimated risks from severe accidents for several nuclear power plants (including those for Beaver Valley Unit 2) are shown in Figures 5.12 through 5.20 for three important categories of risk. The values for individual plants are based upon three types of estimates: from the RSS (labeled WASH-1400 Average Plant), from independent staff reviews of contemporary probabilistic risk assessments (Indian Point 2 and 3, Zion, Limerick, and Millstone 3), and from generic applications of RSS methodology to reactor sites for environmental statements by the staff (for 27 nuclear power plants). Figure 5.12 indicates that the calculated risk of early fatality at the Beaver Valley site is higher than the median of the plants evaluated.

Figures 5.13 and 5.14 show that the calculated risk of latent cancer fatalities are slightly higher than the median of the plants evaluated. Figures 5.15 through 5.20 show the range of estimated uncertainties for the three measures of risk.

5.9.4.6 Conclusions

The foregoing sections consider the potential environmental impacts from accidents at Beaver Valley Unit 2, covering 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 core melt. The environmental impacts that have been considered include potential releases of radioactivity to the environment with resulting 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) the fact that, in order to obtain a license to operate the Beaver Valley facility, the applicant must comply with the applicable Commission regulations and requirements; and (3) the fact that a probabilistic assessment of the risk based upon the methodology developed in the RSS.

The overall assessment of environmental risk of accidents, assuming protective actions, shows that it is on the same order as the risks from normal operation, although accidents have a potential for early fatalities and economic costs that cannot arise from normal operations. The risks of early fatality from a potential accident at the site are small in comparison with risks of accidental deaths from other human activities. The risks of latent cancer fatalities from potential accidents at the site are small when compared with the background cancer risk (see Section 5.9.4.5(6))

On the basis of the above considerations, the staff concluded that there are no special or unique circumstances about the Beaver Valley site and environs that would warrant consideration of alternatives for Beaver Valley Unit 2.

5.10 Impacts from the Uranium Fuel Cycle

The uranium fuel cycle rule, 10 CFR 51.51 (49 FR 9388), 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 in 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 Table S-3 of the rule. 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* herein. 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 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 Beaver Valley Unit 2. 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 purposes of decommissioning are (1) to safely remove nuclear facilities from service and (2) to remove or isolate the associated radioactivity from the environment so that the part of the facility site that is not permanently committed can be released for other uses. Alternative methods of accomplishing these purposes 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.

Section 4.3 of NUREG-0586 presents estimates of radiation doses to members of the public and to plant workers for decommissioning of a reference pressurized water reactor.

Radiation doses to the public as a result of end-of-life decommissioning activities should be small; they will come primarily from the transportation of

*The U.S. Supreme Court has upheld the validity of the S-3 rule in Baltimore Gas & Electric Co., et al. v. Natural Resources Defense Council, Inc., No. 82-524, issued June 6, 1983, 51 U.S. Law Week, 4678.

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 rulemaking proceedings that will develop a more explicit overall policy for decommissioning commmercial nuclear facilities. Specific licensing requirements are being considered that include the development of decommissioning plans and financial arrangements for decommissioning nuclear facilities.

5.12 Noise Impacts

Sound pressure levels expected to occur from the operation of Beaver Valley Units 1 and 2 have been calculated for

(1) seven ambient noise survey positions (R1 to R7) in the vicinity of the site (see Figure 5.21), as chosen by the applicant

(2) the three nearest residences (RF1 to RF3) representative of the residential area just east of the site (see Figure 5.22).

Locations R1 to R7 were used in both 1977 and 1983 to measure octave band sound pressure levels and A-weighted sound pressure levels. The exact locations of R1 to R7 are given in Table 5.14. All are potential noise-sensitive locations in the community. During the 1977 survey, two units of the Bruce Mansfield Power Station were in operation and a third unit was under construction. During the 1983 survey, Beaver Valley Unit 1 and three units of the Bruce Mansfield Plant were in operation. Daytime and nighttime measurements were made in both the 1977 and the 1983 surveys.

Further details on these measurements are in ER-OL Section 2.7 and the responses to staff questions E290.5 through E290.9. These data provide the most representative information on ambient noise levels in the vicinity of the plant. For the purposes of its calculations, the staff assumed that the residual ambient at each receptor location R1 to R7 could be best represented by the lowest sound pressure level measured during the 1977 and 1983 surveys. A minimum sound pressure level was therefore chosen for each octave band from the four measured values: daytime 1977, nighttime 1977, daytime 1983, and nighttime 1983. Ambient noise data from R2 was assumed to be representative of receptors RF1 to RF3.

It should be noted that the ambient noise levels at the plant site vicinity is high in comparison to other nuclear plants located in rural communities. In fact, the noise-sensitive areas adjacent to the site reveal an average day/night sound level (L_{dn}) exceeding 55 dBA (ER-OL Table 5.6-1). The EPA (1974) has identified an L_{dn} of 55 dBA as the maximum level for residential areas above which interference with speech, sleep, relaxation, privacy, and other activities may occur.

The major noise sources at the site are

(1) the two natural draft cooling towers

(2) 10 transformers (Each unit has one main transformer (945 MVA), two unit station service transformers (32 MVA each), and two system station service transformers (32 MVA).)

The natural draft cooling towers emit noise of a broadband nature and the transformers emit noise of a tonal nature at the discrete frequencies 120, 240, 360, and 480 Hz.

Staff calculations were made based on a University of Illinois/Argonne National Laboratory (UI/ANL) computer model by Dunn et al. (1982). That model is based largely on the Edison Electric Institute (EEI) Environmental Noise Guide (Bolt, Beranek and Newman, 1978) and was used to predict the effect of the above plant noise sources on the 10 community receptors. Calculations were made using only the significant noise sources listed above. Other noise sources at the site lead to insignificant contributions to community noise levels because of their location inside buildings, the intermittent nature of some sources, or the low sound power level of other sources. The relatively large distances from these sources to the nearby sensitive areas is further responsible for the negligible contribution from those sources. The two natural draft cooling towers and 10 transformers were assumed to be in operation continuously and throughout the day and night. Standard day conditions (15°C ambient temperature and 70% relative humidity) were also assumed. Source data on natural draft cooling tower noise came from the EEI Noise Guide. Data on the noise level of the transformers came from Gordon et al. (1978).

Data on transformers of similar MVA rating were examined, and the staff chose the data that represented the strongest source of noise for each transformer. A conservative assumption was also made in neglecting attenuation as a result of intervening trees and barriers between the sources and receptors.

Model predictions were carried out in two steps. First, the increase in ambient noise at all 10 receptor points was computed on the bases to the two natural draft cooling towers alone. The community impact of the increased broadband noise was then determined (details are presented below).

The second step involved a rerun of the UI/ANL noise computer model employing the "new" ambient represented by the increased broadband noise in the community because of the cooling towers. In this second run, only the transformer core tones at 120, 240, 360, and 480 Hz were modeled. The cooling tower noise was found to increase the masking level of the ambient and thereby assisted in making the transformer tones inaudible. The results of step 2 showed that only the 120-Hz tone would be audible and then only at R2, RF1, RF2, and RF3. Even then, the tone sound level is less than 5 dB above masking level, the threshold for an expectation of individual complaints from transformer tonal noise (Ver and Anderson, 1977). Even the "old" ambient level at each receptor was high and provided significant masking. The increase in the ambient because of the cooling tower noise provided considerable incremental masking of the transformer tones at the core tone frequencies.

Tables 5.15 and 5.16 summarize the noise predictions from the two natural draft cooling towers (part of the first step, above).

Table 5.16 gives the expected community reaction at each of these receptor locations in terms of the modified composite noise rating (CNR) (Bolt, Beranek

and Newman, 1978). Tables 5.15 and 5.16 and Figure 5.23 show that the reactions at each receptor R1 to R7 and RF1 to RF3 range from "no reaction" to "widespread complaints." At RF1 to RF3 and R2 the increase in noise resulting from the cooling towers may, therefore, lead to complaints from persons at those residences.

The above calculations were made employing two important assumptions. First, the sound power levels for the cooling towers and transformers were taken from the literature, because no data were available from the manufacturer in each case. There is some uncertainty in that the noise levels for the natural draft cooling towers purchased by the applicant may differ from that provided for an "average" natural draft cooling tower in the EEI Noise Guide. If noise levels are made available from the manufacturer, they might provide the basis for more accurate noise predictions. The same applies to the transformer noise for which sound power data were taken from the literature from transformers of similar MVA rating and other transformer characteristics. A complete match could not be made, however, because of the limited quantity of manufacturer's data that have been published.

Second, noise attenuation from intervening trees, vegetation, and barriers between the residences and noise sources has been neglected. For instance, no offsite receptor is believed to have an unblocked direct line of sight to the two main transformers because of the intervening turbine buildings. This barrier effect has been neglected in the calculations. Some barrier effects are also present that may reduce cooling tower noise. Some of the conservatism built into the neglect of barrier effects may be counterbalanced in part by the uncertainty as to the true residual ambient since ambient measurements were made only over short periods of time (few days).

The issue of the impact of loudspeaker noise on the receptor points was also evaluated. Figure 5.24 shows the locations of the eight loudspeakers to be present during plant operation. Table 5.17 lists the loudspeaker locations, axial directions, and other pertinent data. The potential for loudspeaker annoyance in the community during plant operation was identified as a potential problem by a resident in the RF1 to RF3 area. This resident had been complaining of the noise resulting from a different and more extensive loudspeaker system present during plant construction. The sound power level of the loudspeakers were taken from the EEI Noise Guide. The directional effects of the loudspeaker noise were included in the staff's calculations. Because of the orientation of the axis of the loudspeakers away from the critical residences (R2, and RF1 to RF3), the increase in sound level at those residences is calculated to be less than 1 dB, a value not sufficient for audibility at those residences.

5.13 Emergency Planning Impacts

In connection with the promulgation of the Commission's upgraded emergency planning requirements, the NRC staff issued NUREG-0658, "Environmental Assessment for Effective Changes to 10 CFR Part 50 and Appendix E to 10 CFR Part 50; Emergency Planning Requirements for Nuclear Power Plants." The staff believes the only noteworthy potential source of impacts to the public from emergency planning would be associated with the testing of the early notification system.

The test requirements and noise levels will be consistent with those used for existing systems; therefore, the NRC staff concludes that the noise impacts from the system will be infrequent and insignificant.

5.14 Environmental Monitoring

5.14.1 Terrestrial Monitoring

Preoperational monitoring studies for Unit 2 are based primarily on the Unit 1 operational monitoring programs, which are described in the 1974 baseline study and the annual environmental reports (NUS, 1976; Duquesne, 1977, 1979, and 1981). These studies showed that there were no Unit 1 operational impacts on flora and that the number of birds killed at the cooling tower was insignificant. Thus, the only terrestrial monitoring planned for Unit 2 is continued infrared aerial photography every other year. The photographs will be compared with preoperational photographs of the Unit 2 area, and any signs of injury as a result of salt drift and other sources will be checked (ER-OL Section 6.2.4.3). The details of this program will be specified in the Environmental Protection Plan that will be included as Appendix B of the operating license. Monitoring the possible effects of power lines on terrestrial ecology is not considered necessary.

5.14.2 Aquatic Monitoring

Nonradiological aquatic monitoring of potential Unit 2 effects has been established by the state through the NPDES permit (see Appendix G). The NRC will rely on the Commonwealth of Pennsylvania, under the authority of the Clean Water Act, for the protection of water quality and aquatic biological resources, and for any associated monitoring that may be required during station operation.

5.14.3 Atmospheric Monitoring

The FES-CP did not describe the onsite meteorological measurements program. The present onsite meteorological measurements program was initiated in January 1976. Measurements are made on a tower extending 152 m (500 feet) above a grade of 223 m (730 feet) msl. The tower is about 1100 m northeast of the Beaver Valley Unit 1 reactor structure and about 800 m northeast of the natural draft cooling tower locations for both units.

The following meteorological measurements are made on the tower: wind speed and direction at the 10.7-m, 45.7-m and 152-m levels; vertical temperature gradient between the 45.7-m and 10.7-m levels and between the 152-m and 10.7-m levels; and temperature and dewpoint at the 10.7-m level. Precipitation is measured at an elevation of about 1 m above grade near the tower.

The joint data recovery for wind speed and wind direction at the 10.7-m level and atmospheric stability (defined by the vertical temperature difference between the 45.7-m and 10.7-m levels) for the 5-year period January 1976 to December 1980 presented in the FSAR was 90%, with yearly data recovery ranging from 85% to 93%. The joint data recovery for wind speed and wind direction at the 152-m level and atmospheric stability (defined by vertical temperature difference between the 152-m and 10.7-m levels) for the 5-year period was 88%, with yearly data recovery ranging from 79% to 93%.

The meteorological measurements systems complies with the accuracy specifications in Regulatory Guide 1.23, "Onsite Meteorological Programs." However, the ER-OL states that changes in the meteorological tower location in January 1976 produced a shift in the prevailing wind direction data and that this shift resulted from the channeling effect of the valley. Therefore, the staff asked the applicant to provide additional information to demonstrate that data from the current tower location was adequate for the determination of atmospheric dispersion. The applicant's response demonstrated that adequate estimates of dispersion could be made using these data.

Whether the onsite data for the 5-year period is representative of long-term conditions was determined by comparing data from the concurrent 5-year period for Pittsburgh with data from a 28-year period for Pittsburgh. These comparisons indicate that reasonable long-term estimates of atmospheric dispersion for accidental and routine releases of radioactive effluents can be made from the 5-year record of onsite data.

5.14.4 Noise Monitoring

Because of the uncertainty in the staff's assumptions regarding the exact cooling tower and transformer sound power levels and in the variation in background levels during the year, the staff will require that the applicant conduct a short-term noise monitoring program during the first year of plant operation. The purpose of this program is to quantify operational phase noise levels and the mitigative measures necessary, if any, to reduce adverse impacts on the vicinity of the Beaver Valley Station. An evaluation of noise impacts at R2 and in the area of RF1 to RF3 is to be made in terms of broadband and tonal noises and noise related complaints, including the effects of the nearest loudspeakers. Noise measurements are to be made on a one-third octave band basis along with A-weighted and statistical indicators L_{90}, L_{50}, L_{eq} (L_{90} is the sound level exceeded 90% of the time; L_{eq} is the energy-based sound level integrated over a specified time period).

Measurements are to be made twice a year (for 1 year), once in the wintertime and once in the summertime. Data are to be acquired during both daytime and nighttime (12 midnight to 4 a.m.) periods. A comparison of measured noise levels compared to the 1977 and 1983 ambients is to be made. The details of this short term monitoring program will be included in the Environmental Protection Plan (EPP) for the site. The measurement of one-third octave band spectra (rather than octave band) should provide sufficient data to isolate the transformer tones and enable a more precise assessment of their impacts (if any).

Community impacts are to be evaluated by the applicant from these measurements, in terms of incremental broadband and tonal noise and from any plant-noise-related complaints. The audibility of the loudspeaker system at offsite residential locations is also to be evaluated as an intermittent source during daytime and nighttime.

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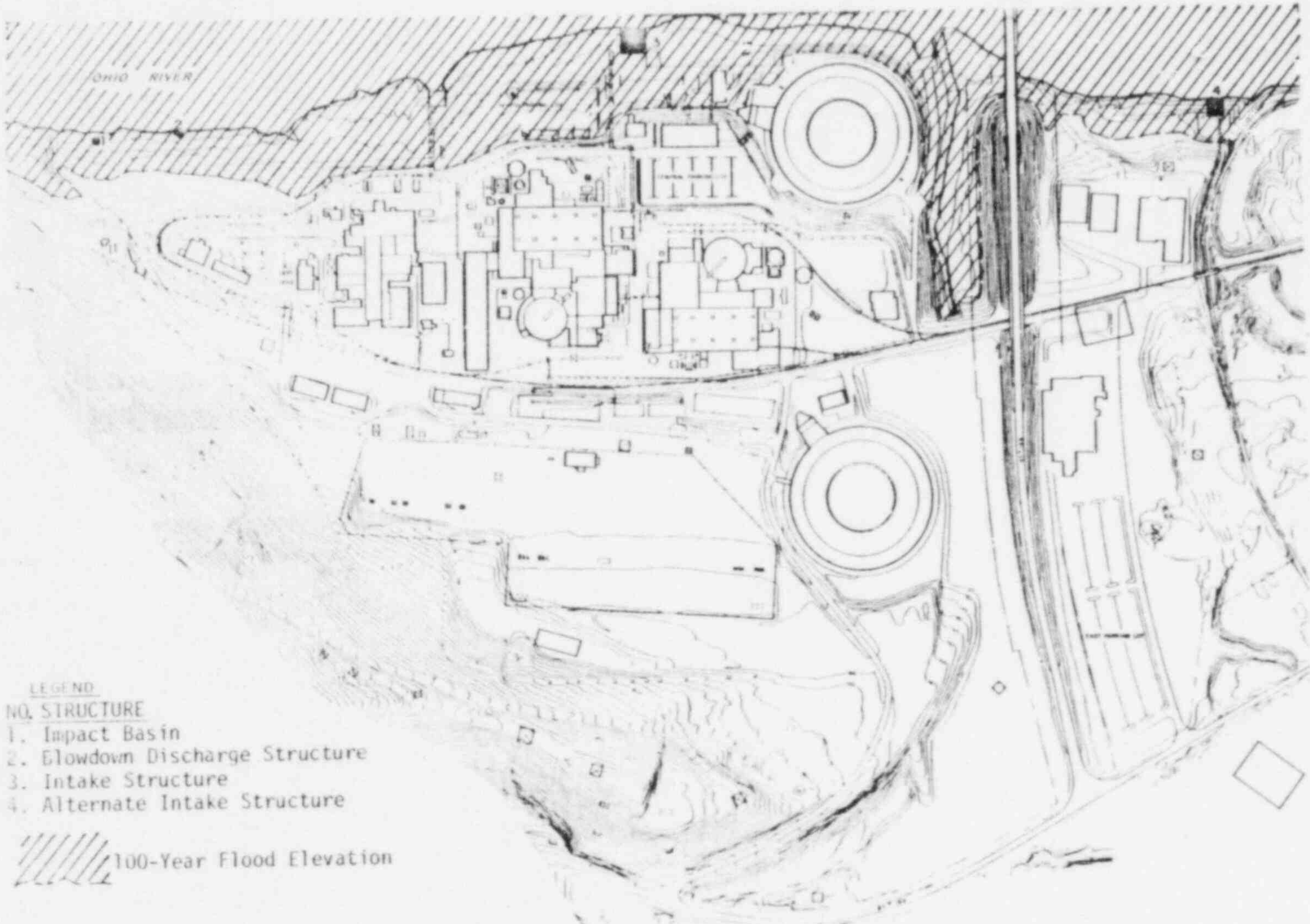

Figure 5.1 100-year floodplain

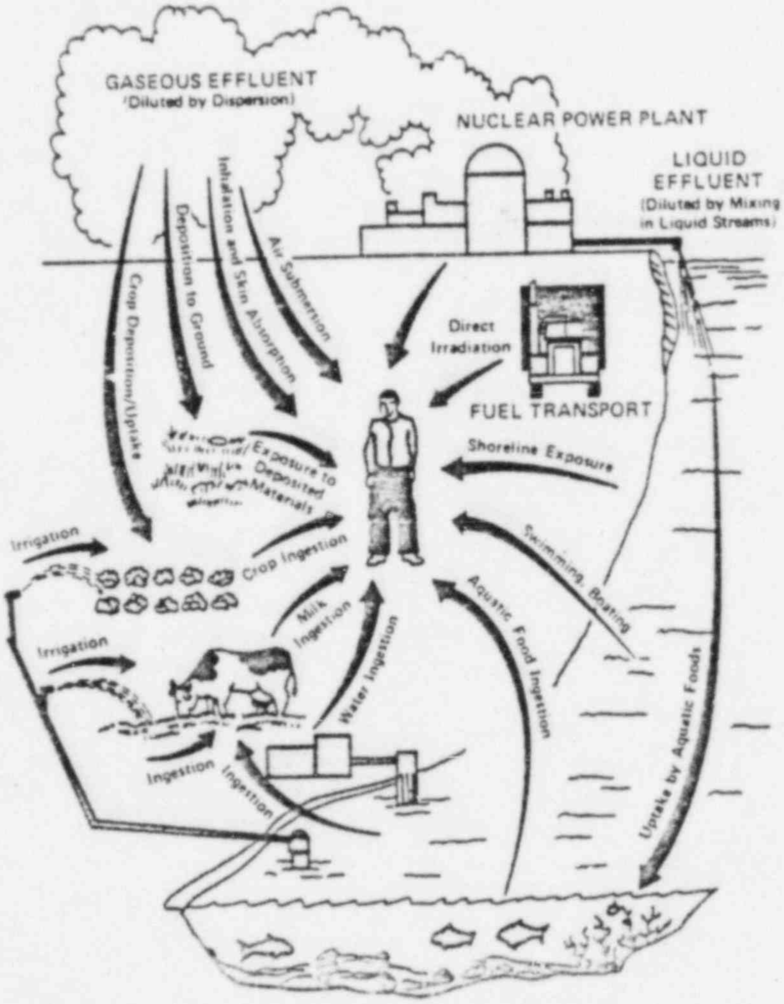

Figure 5.2 Potentially meaningful exposure pathways to individuals

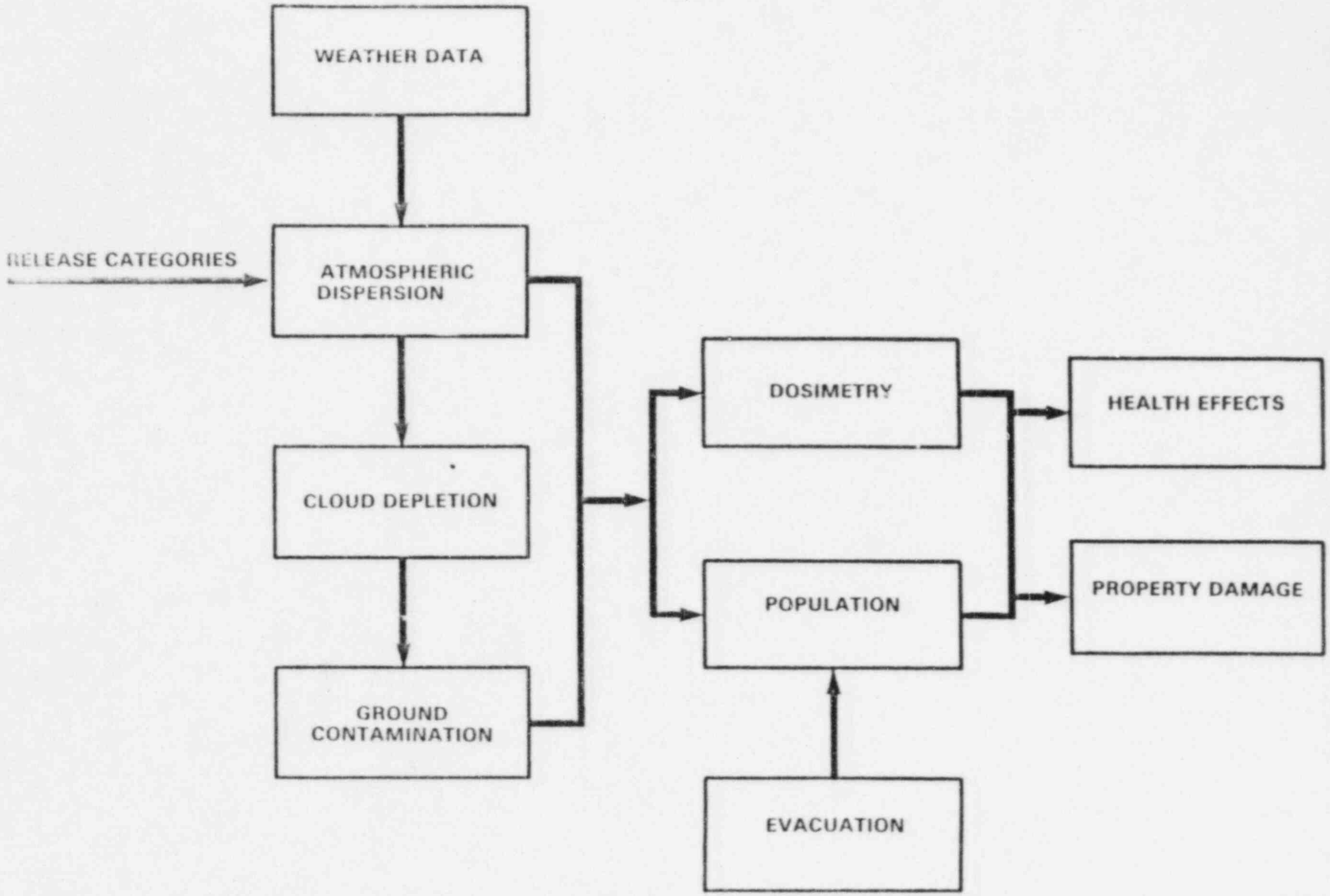

Figure 5.3 Schematic outline of consequence model

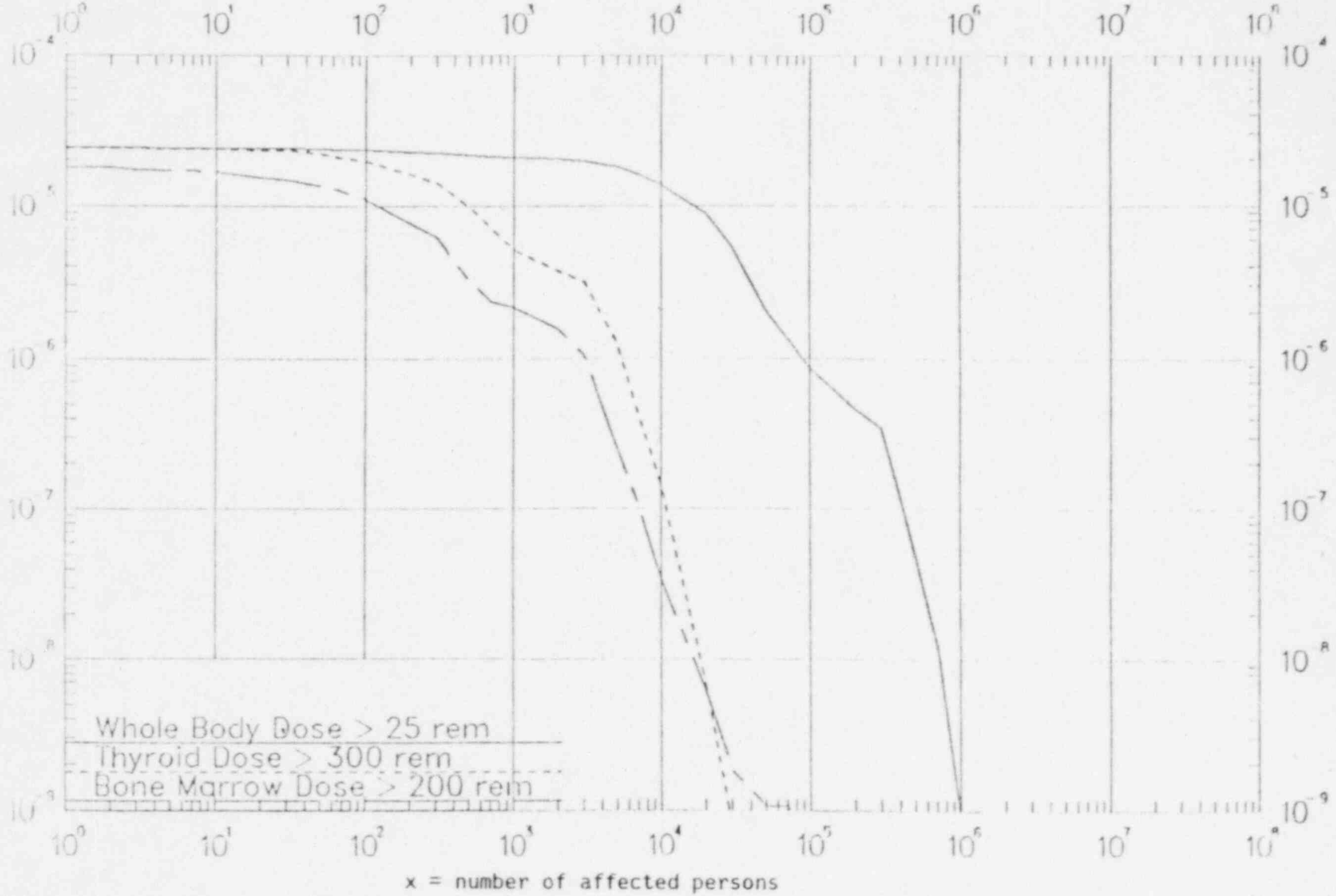

Figure 5.4 Probability distributions of individual dose impacts (see Section 5.9.4.5(7) for a discussion of uncertainties in risk estimates)

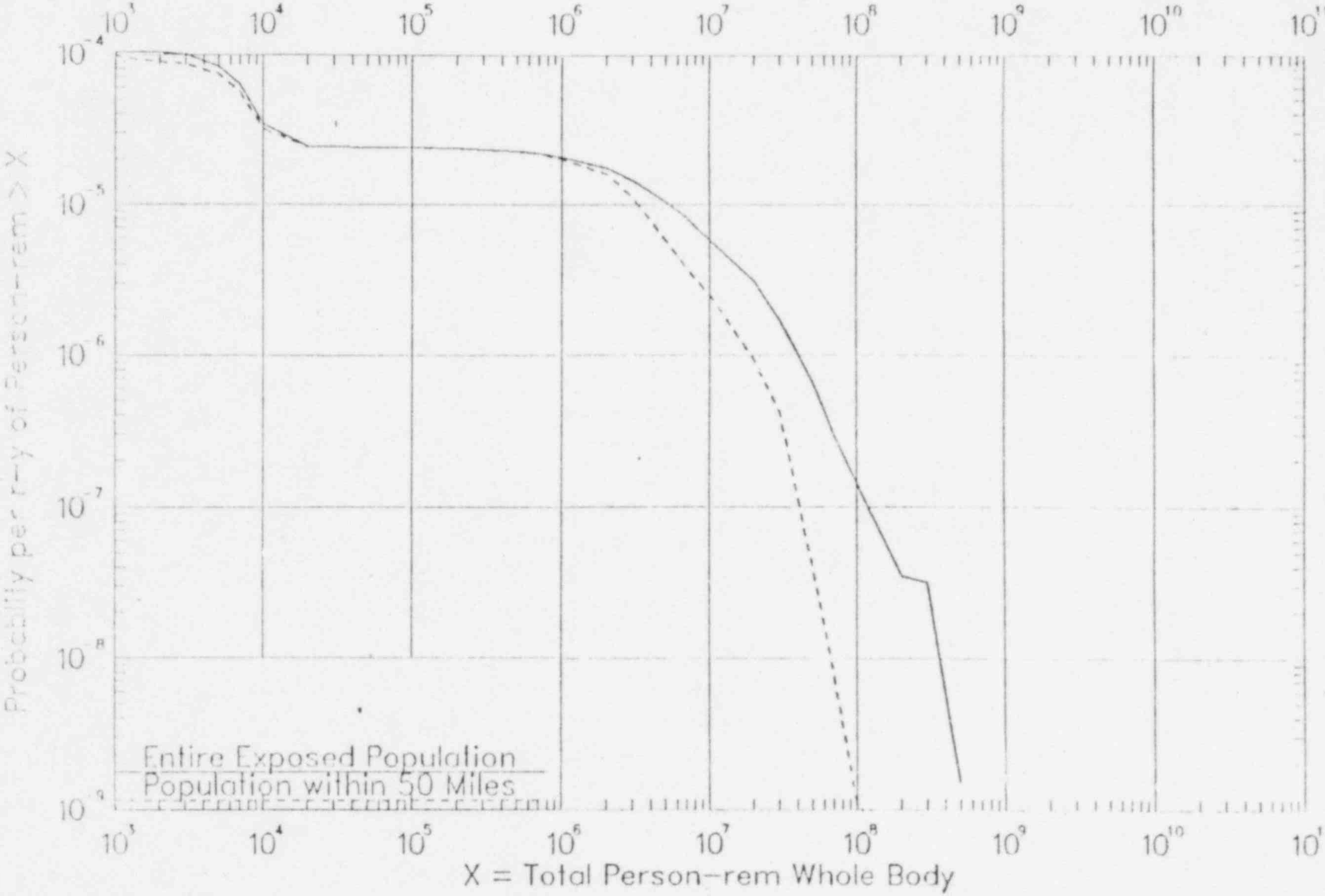

Figure 5.5 Probability distributions of population exposures (see Section 5.9.4.5(7) for a discussion of uncertainties in risk estimates) (50 mi = 80 km)

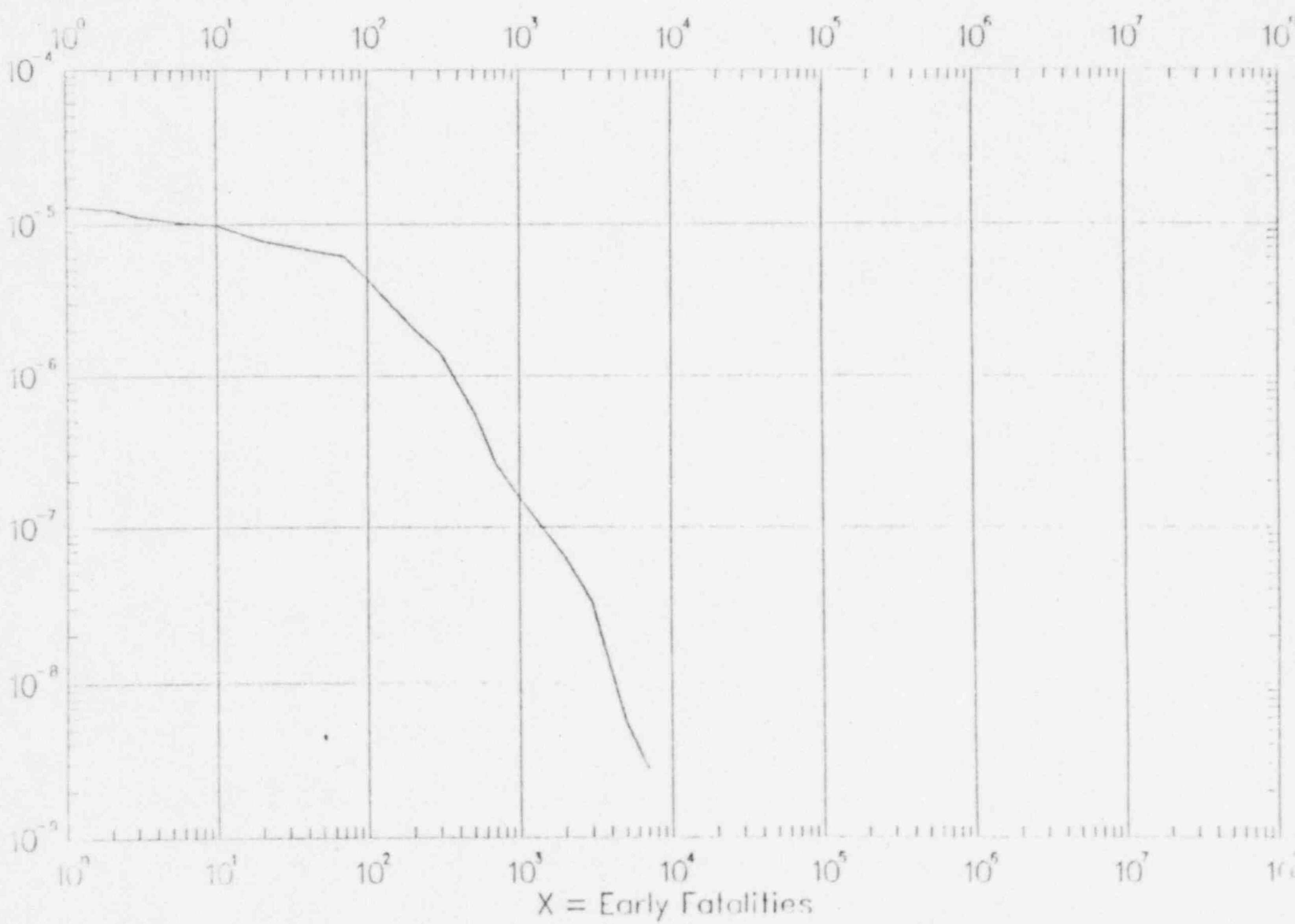

Figure 5.6 Probability distribution of early fatalities with supportive medical treatment (see Section 5.9.4.5(7) for a discussion of uncertainties in risk estimate)

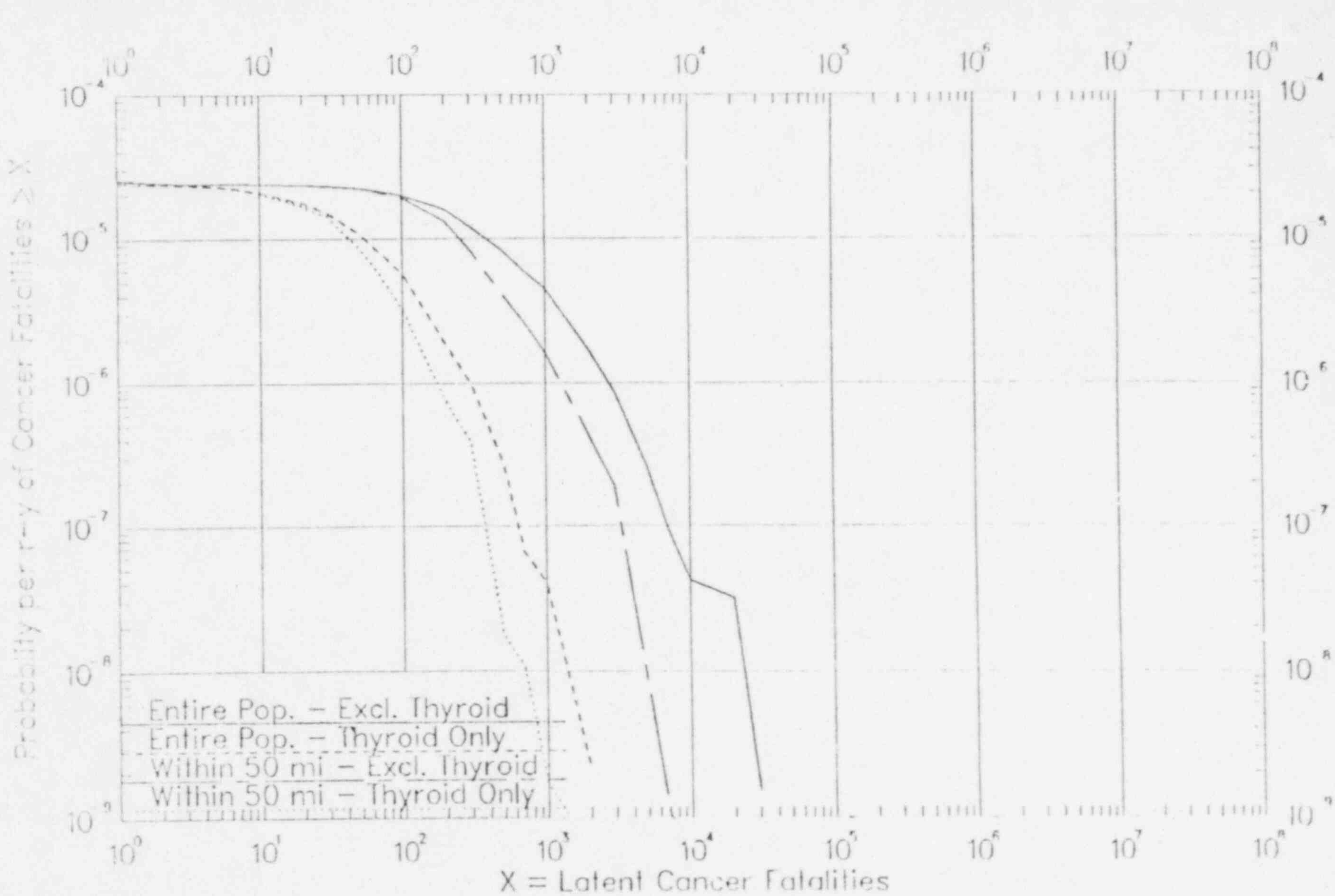

Figure 5.7 Probability distributions of cancer fatalities (see Section 5.9.4.5(7) for a discussion of uncertainties in risk estimate)

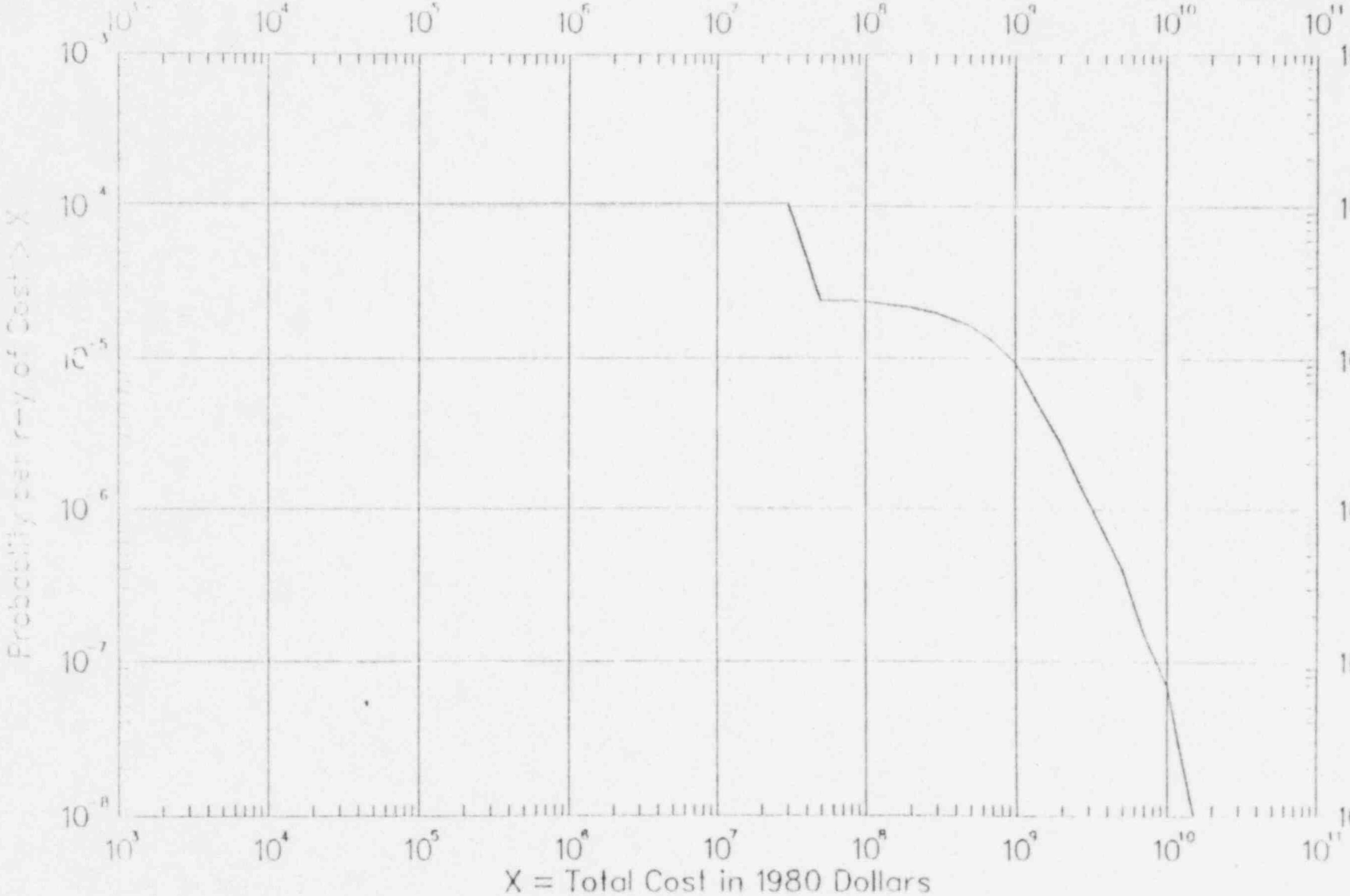

Figure 5.8 Probability distribution of mitigation measures cost (see Section 5.9.4.5(7) for a discussion of uncertainties in risk estimates)

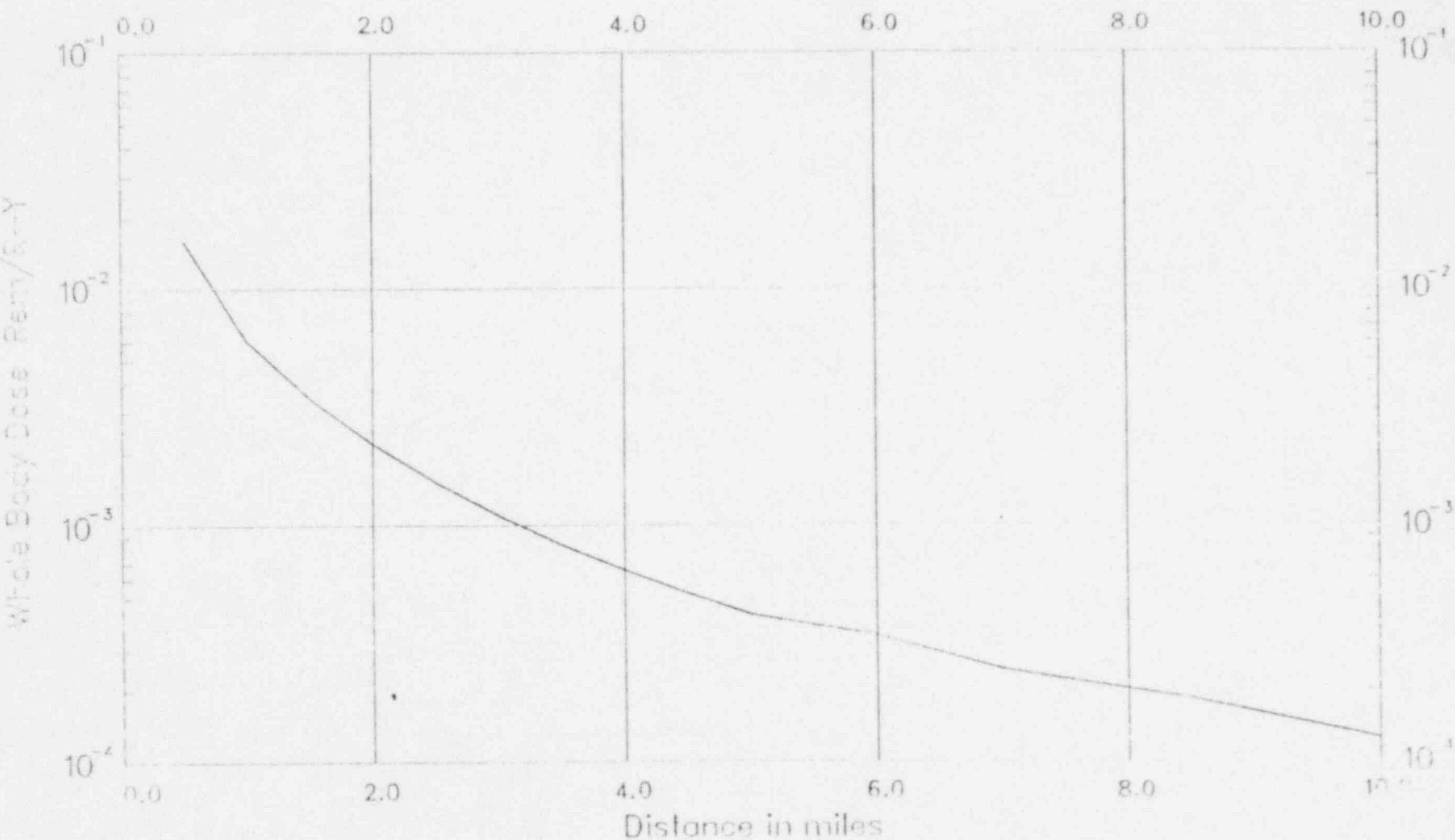

Figure 5.9 Individual risk of dose as a function of distance (see Section 5.9.4.5(7) for a discussion of uncertainties in risk estimates) (to convert mi to km multiply values shown by 1.6093)

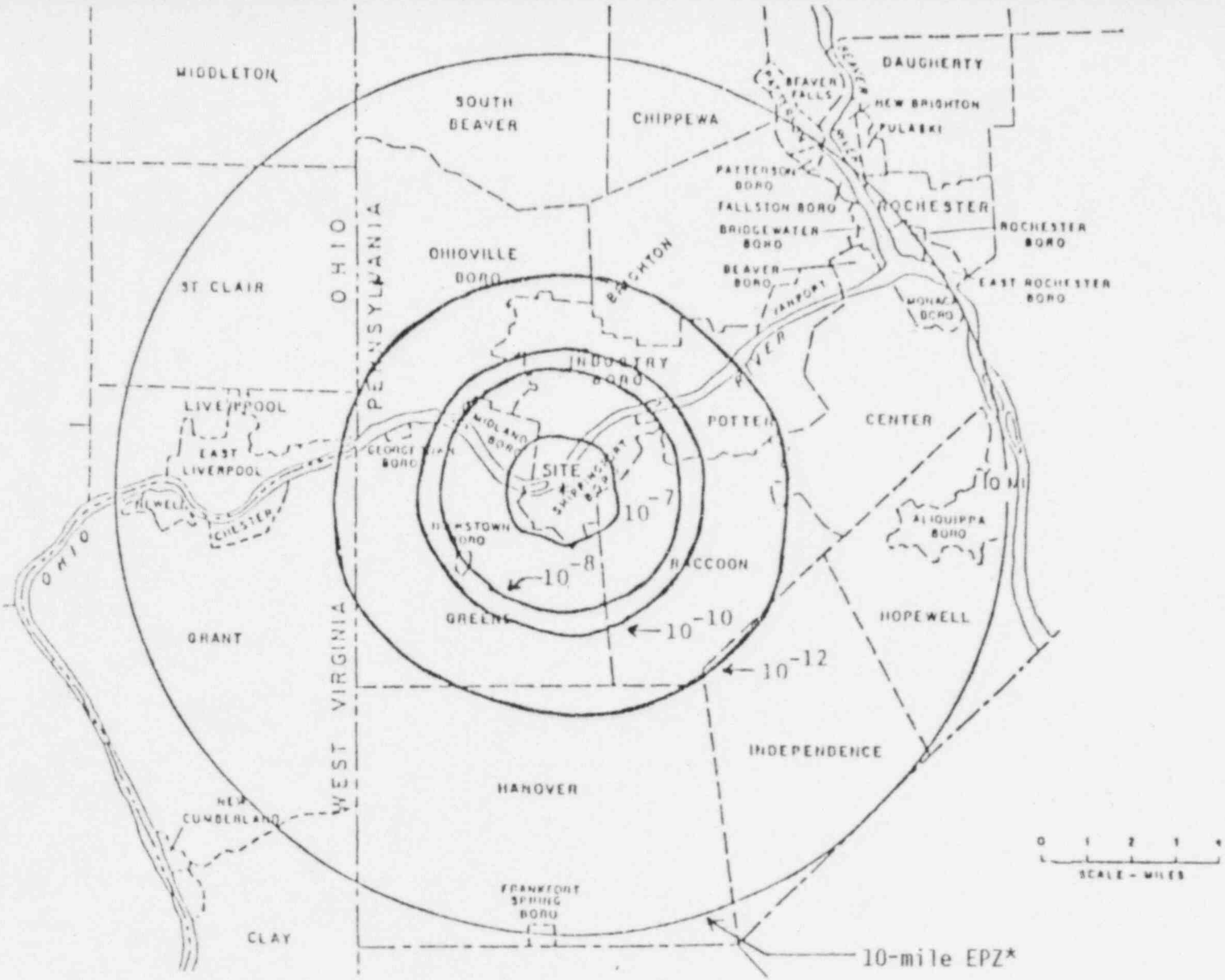

Figure 5.10 Isopleths of risk of early fatality per reactor-year to an individual (to convert mi to km, multiply values shown by 1.6093)

*Note: The actual EPZ boundary has a radius of about 10 miles, but is shown here as a circle for illustrative purposes only.

Figure 5.11 Isopleths of risk of latent cancer fatality per reactor-year to an individual (to convert mi to km, multiply values shown by 1.6093)

*Note: The actual EPZ boundary has a radius of about 10 miles, but is shown here as a circle for illustrative purposes only.

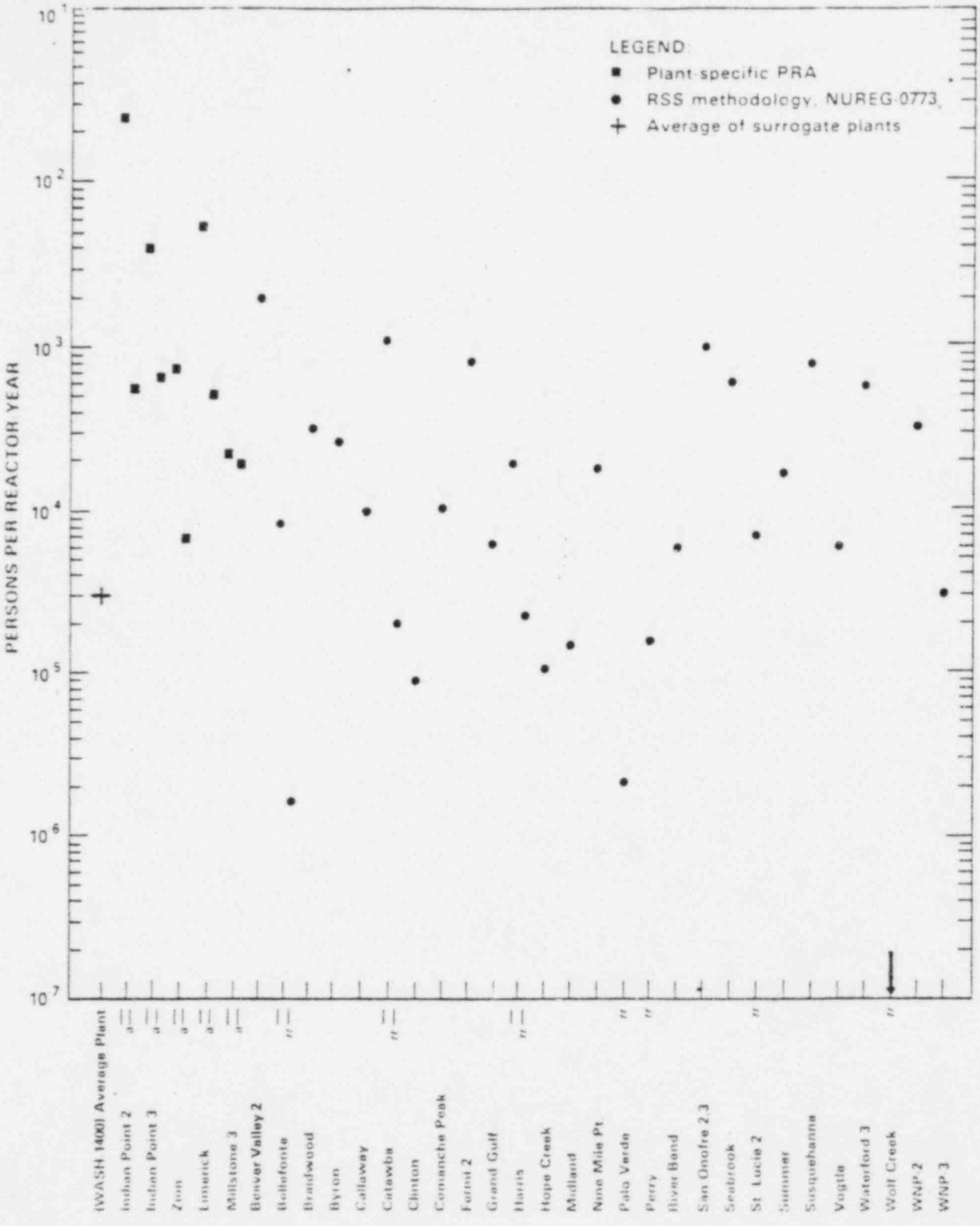

Figure 5.12 Estimated early fatality risk (persons), with supportive medical treatment, from severe reactor accidents, for several nuclear power plants either operating or receiving consideration for issuance of a license to operate. See footnotes following Figure 5.20.

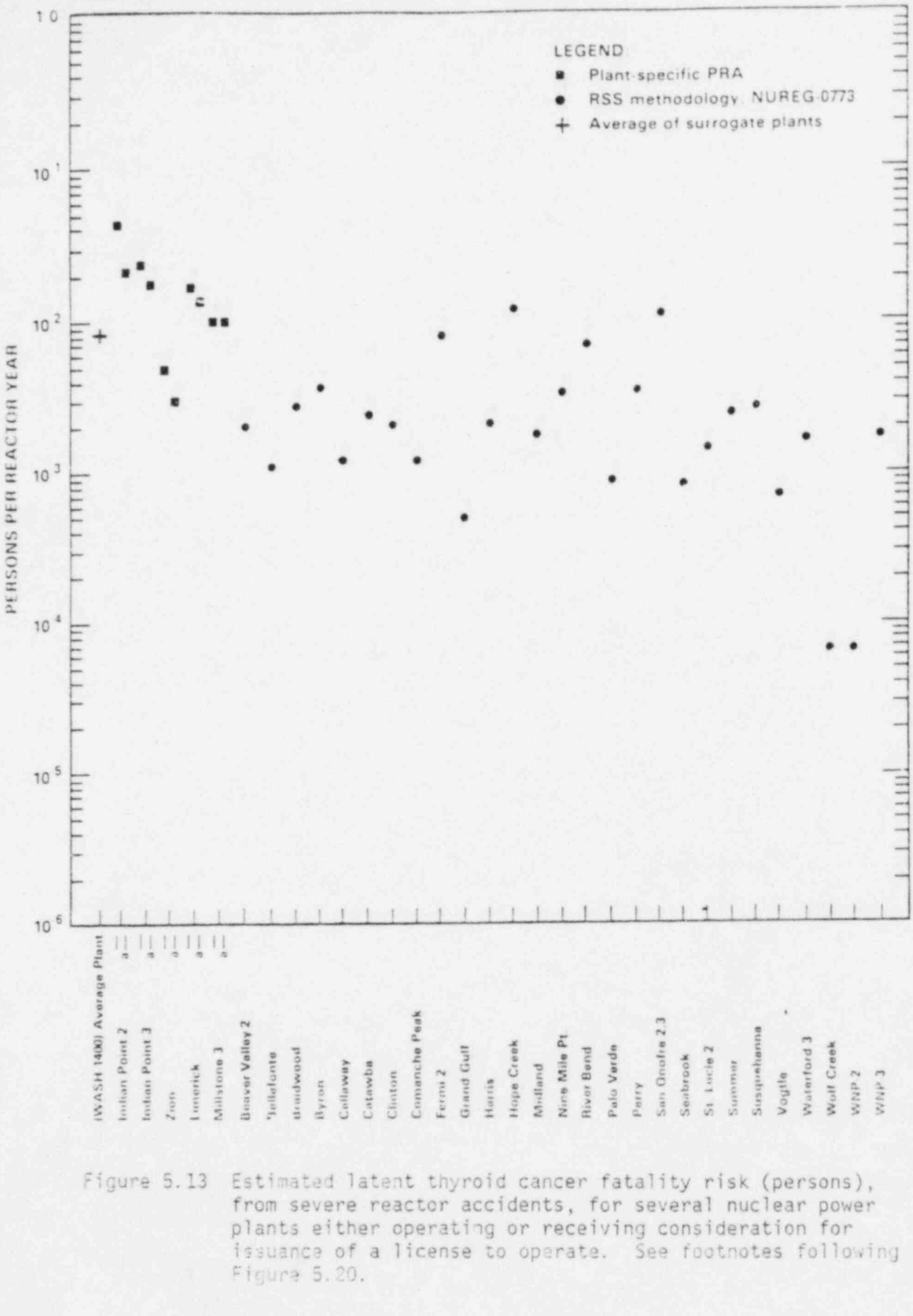

Figure 5.13 Estimated latent thyroid cancer fatality risk (persons), from severe reactor accidents, for several nuclear power plants either operating or receiving consideration for issuance of a license to operate. See footnotes following Figure 5.20.

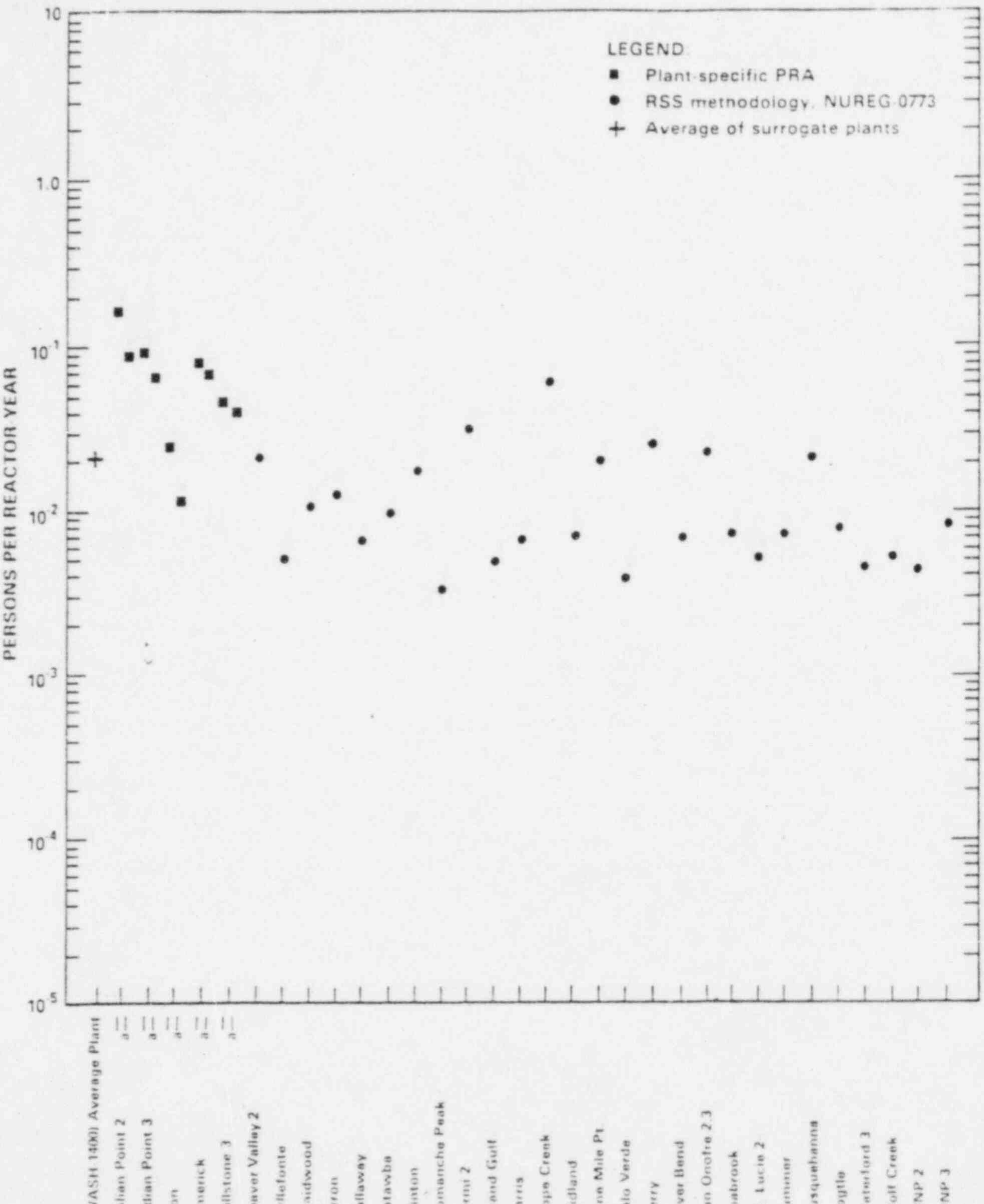

Figure 5.14 Estimated latent cancer fatality risk (persons), excluding thyroid, from severe reactor accidents, for several nuclear power plants either operating or receiving consideration for issuance of a license to operate. See footnotes following Figure 5.20.

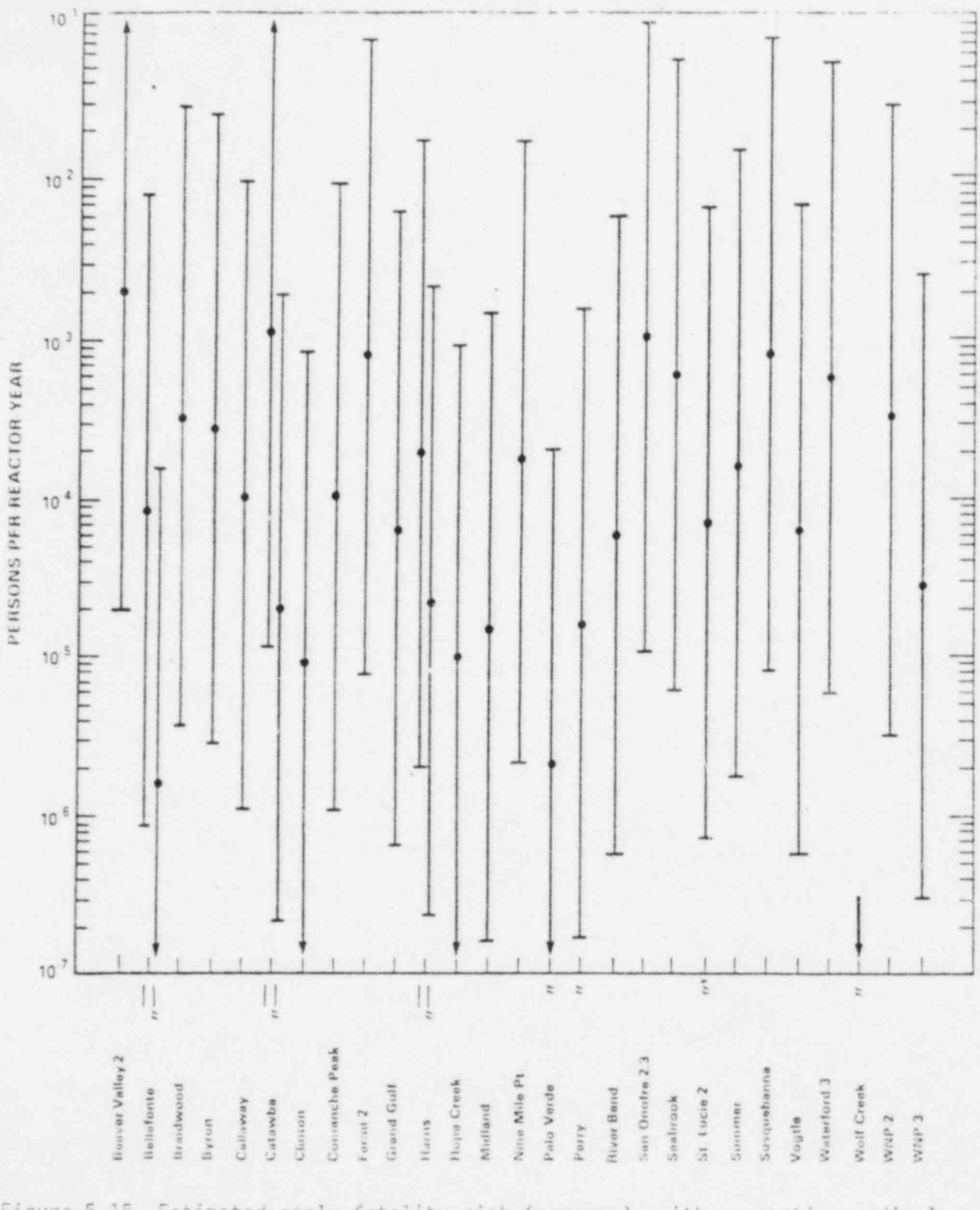

Figure 5.15 Estimated early fatality risk (persons), with supportive medical treatment, from severe reactor accidents, for several nuclear power plants either operating or receiving consideration for issuance of a license to operate, for which site-specific applications of NUREG-0773 accident releases have been used to calculate offsite consequences. Bars are drawn to illustrate effect of uncertainty range discussed in text. See footnotes following Figure 5.20.

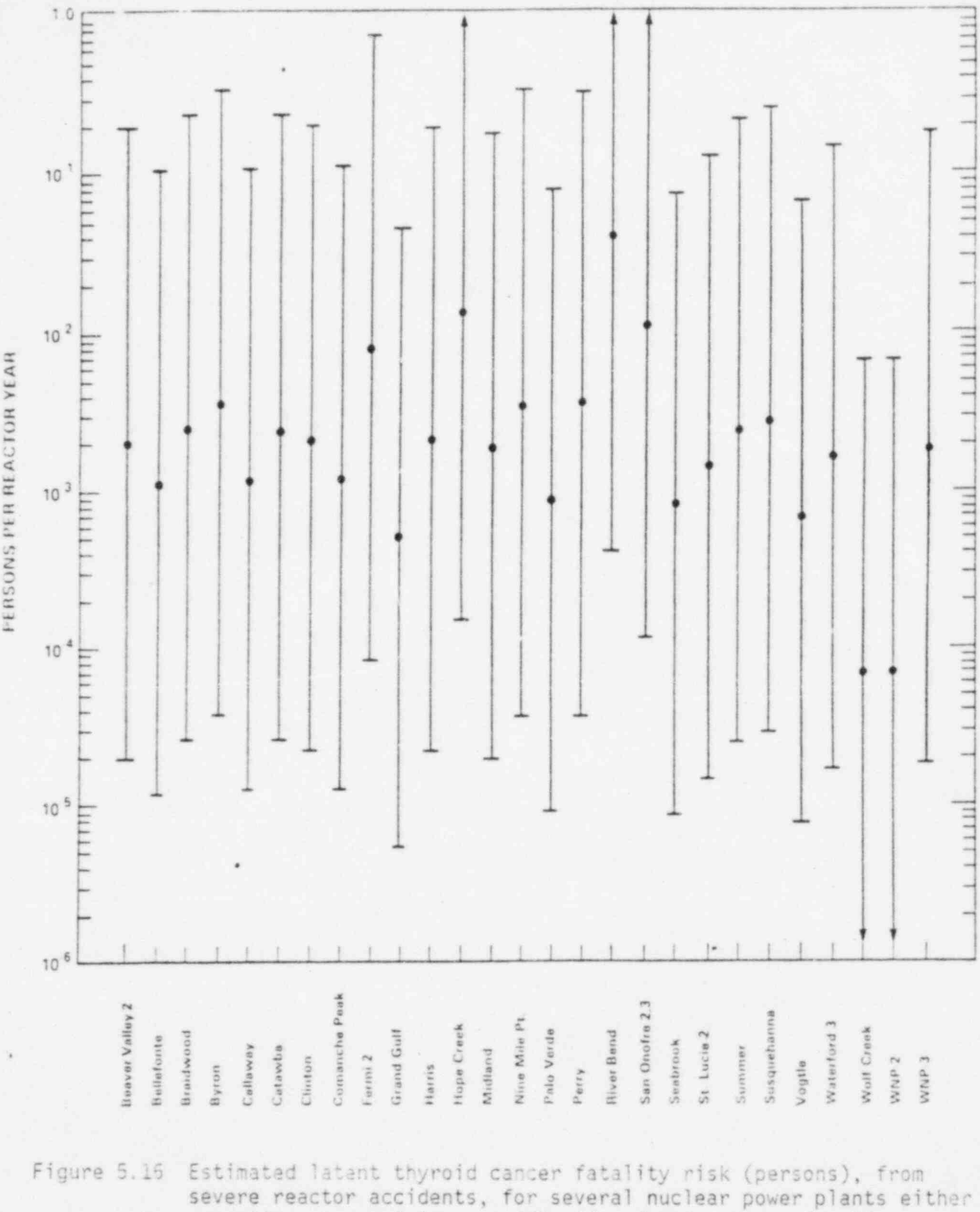

Figure 5.16 Estimated latent thyroid cancer fatality risk (persons), from severe reactor accidents, for several nuclear power plants either operating or receiving consideration for issuance of a license to operate, for which site-specific applications of NUREG-0773 accident releases have been used to calculate offsite consequences. Bars are drawn to illustrate effect of uncertainty range discussed in text. See footnotes following Figure 5.20.

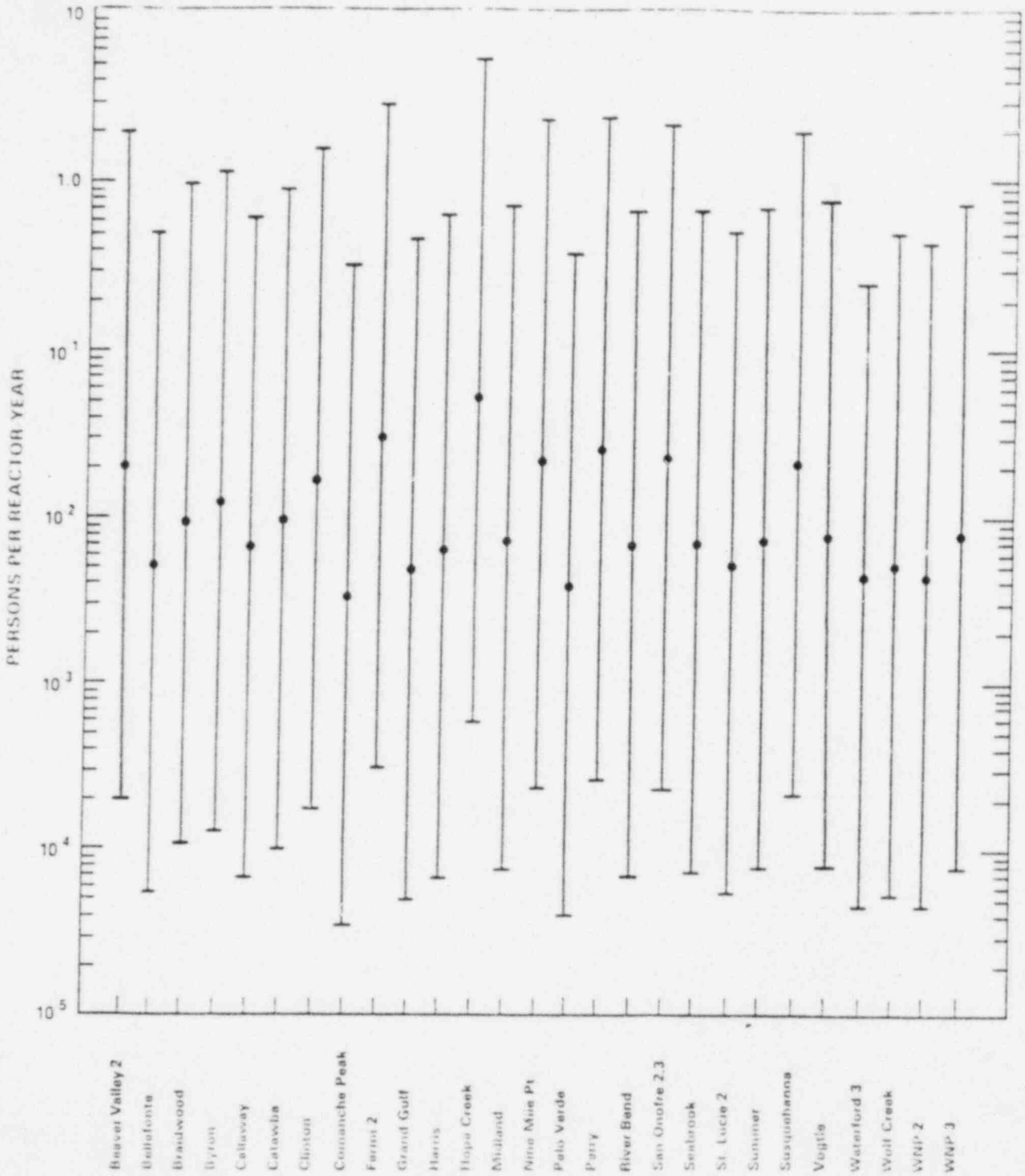

Figure 5.17 Estimated latent cancer fatality risk, excluding thyroid (persons), from severe reactor accidents, for several nuclear power plants either operating or receiving consideration for issuance of a license to operate, for which site-specific applications of NUREG-0773 accident releases have been used to calculate offsite consequences. Bars are drawn to illustrate effect of uncertainty range discussed in text. See footnotes following Figure 5.20.

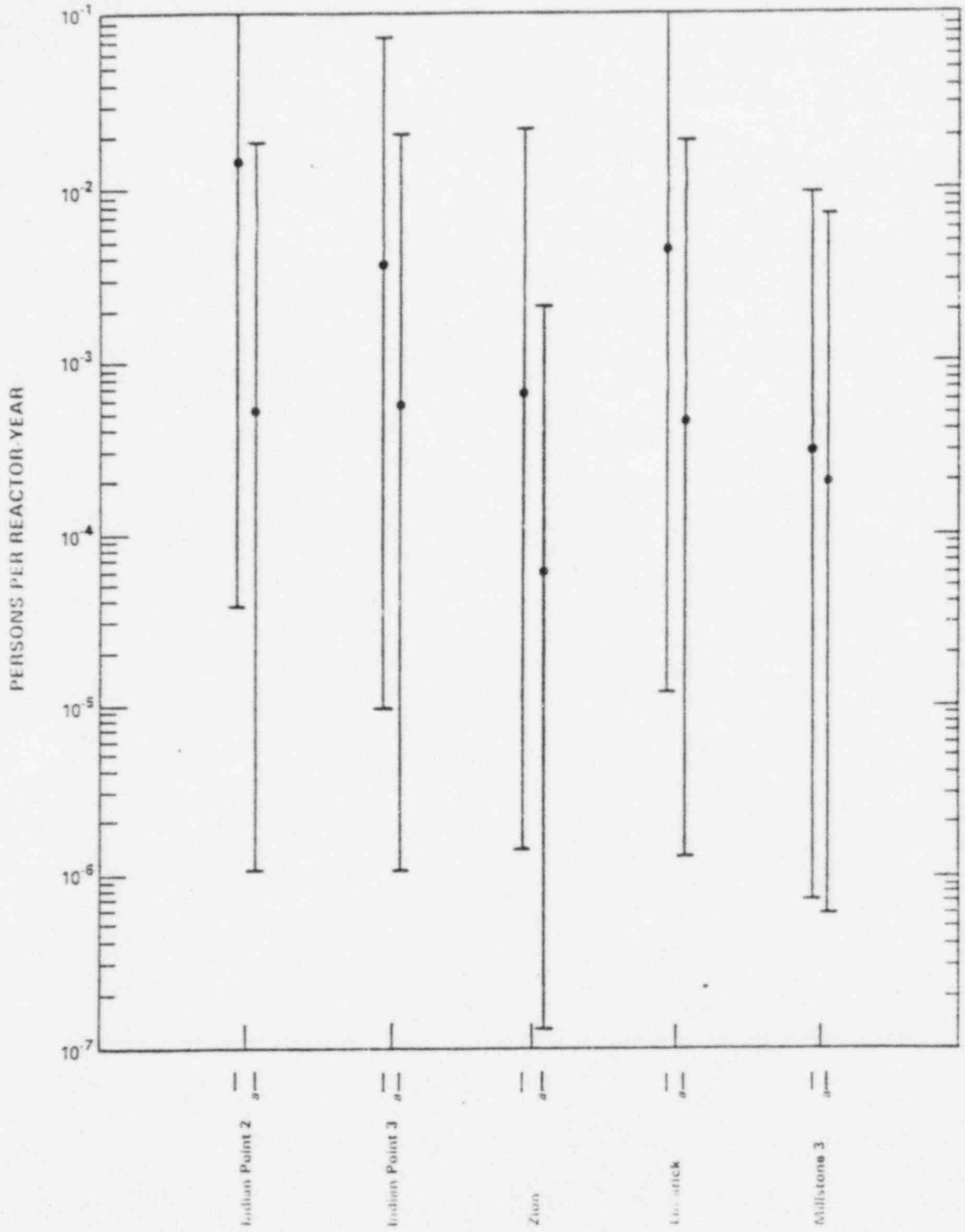

Figure 5.18 Estimated early fatality risk, with supportive medical treatment (persons), from severe reactor accidents, for nuclear power plants having plant-specific PRAs, showing estimated range of uncertainties. See footnotes following Figure 5.20.

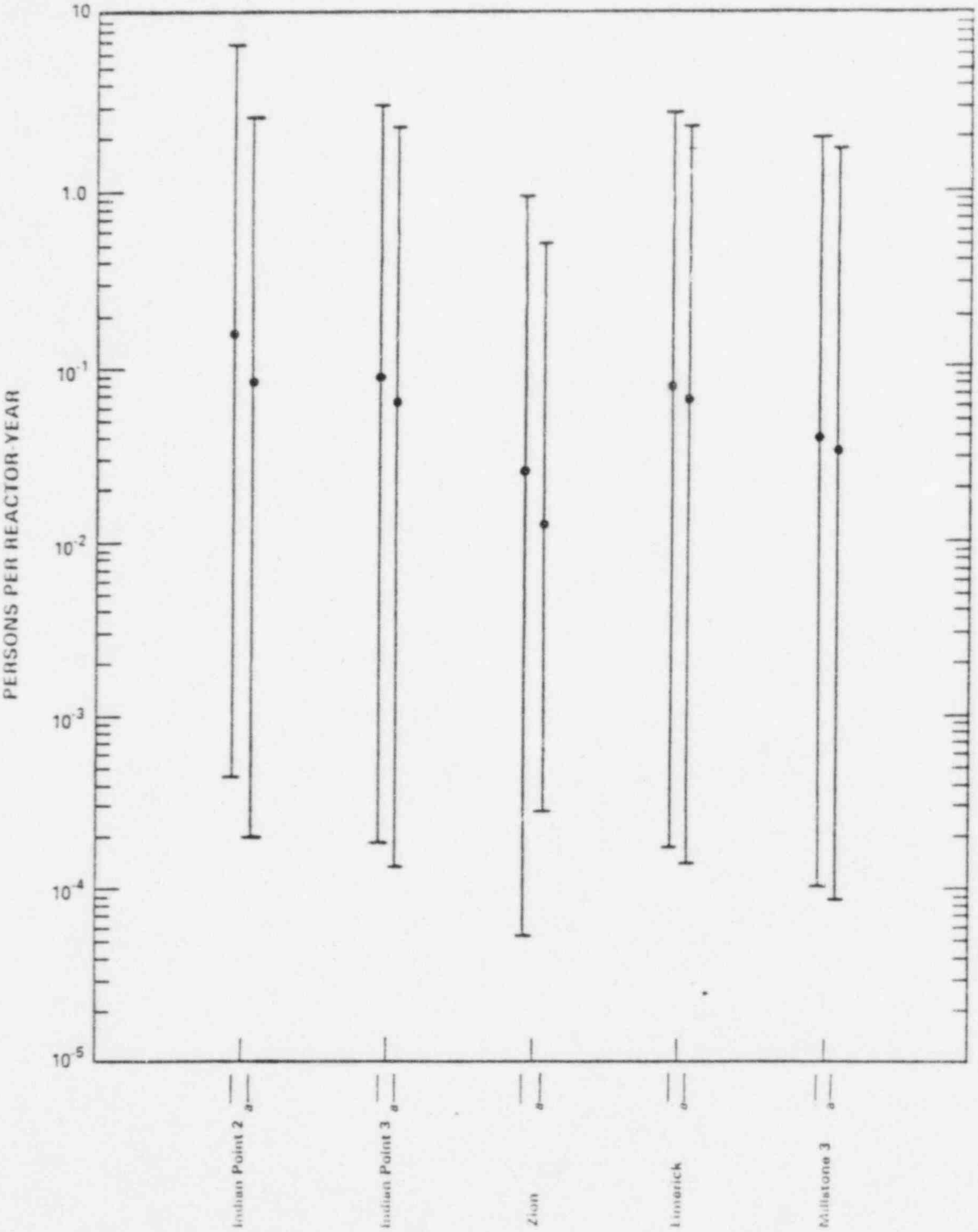

Figure 5.19 Estimated latent cancer fatality risk, excluding thyroid (persons), from severe reactor accidents, for nuclear power plants having plant-specific PRAs, showing estimated range of uncertainties. See footnotes following Figure 5.20.

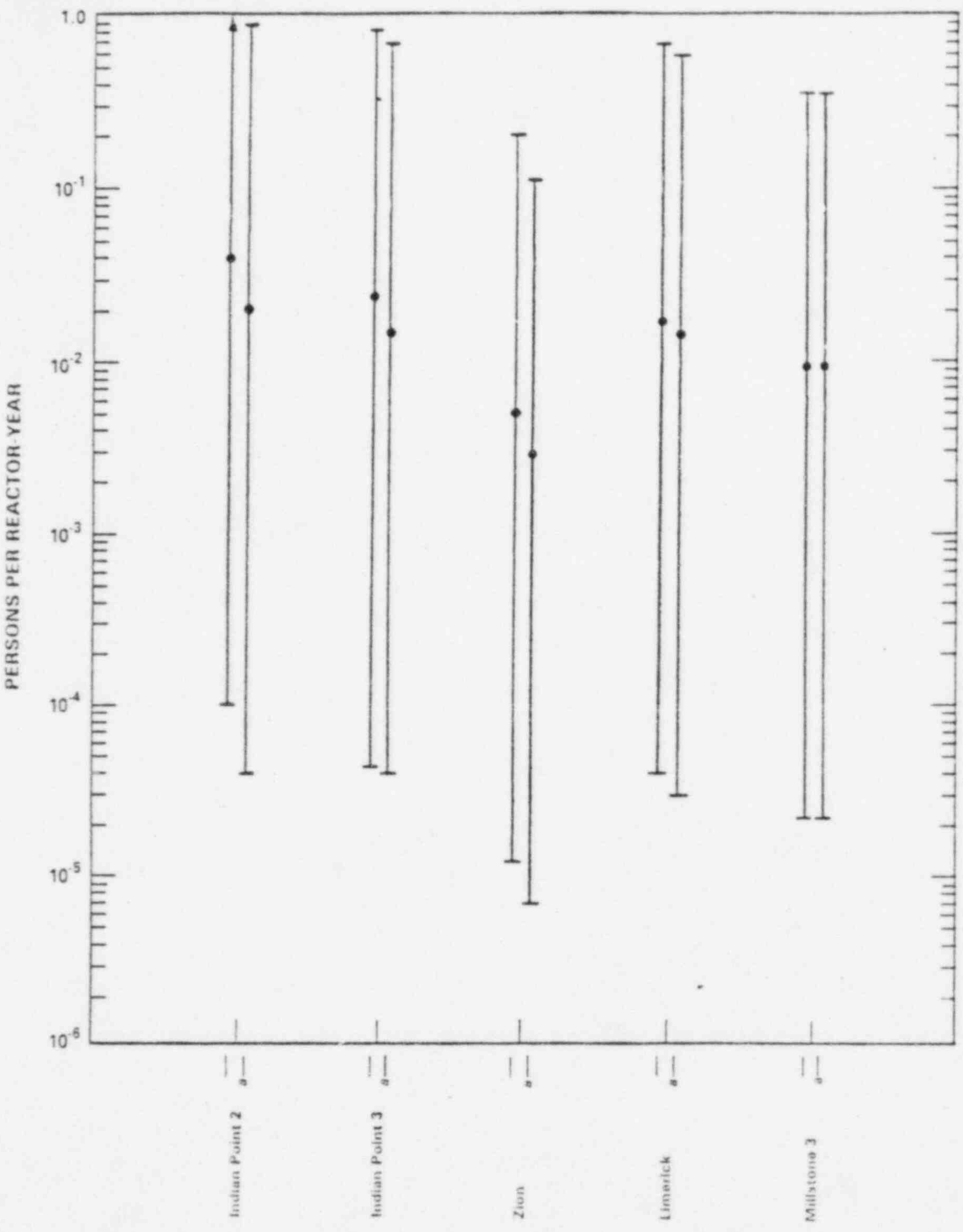

Figure 5.20 Estimated latent thyroid cancer fatality risk (persons) from severe reactor accidents for nuclear power plants having plant-specific PRAs, showing estimated range of uncertainties. See footnotes following this figure.

Notes for Figures 5.12 through 5.20

* Except for Indian Point, Zion, Limerick, Braidwood, Hope Creek, NMP-2, and WNP-3, risk analyses for other plants in these figures are based on WASH-1400 generic source terms and probabilities for severe accidents and do not include external event analyses. The staff and the applicants extensively reviewed Indian Point 2 and 3, Zion, Limerick, and Millstone 3, including externally initiated accidents. The staff briefly reviewed Braidwood, Hope Creek, NMP-2, and WNP-3 to determine the plant-specific release category probabilities considering internal events only. On the basis of these reviews, the staff concludes that any or all of the values could be under- or over-estimates of the true risks.

* 1-01 = 1×10^{-1}

††With evacuation within 16 km (10 miles) and relocation from 16 to 40 km (10 to 25 miles).

[a]Excluding severe earthquakes and hurricanes.

NOTE: Please see section 5.9.4.5(7) for discussion of uncertainties.

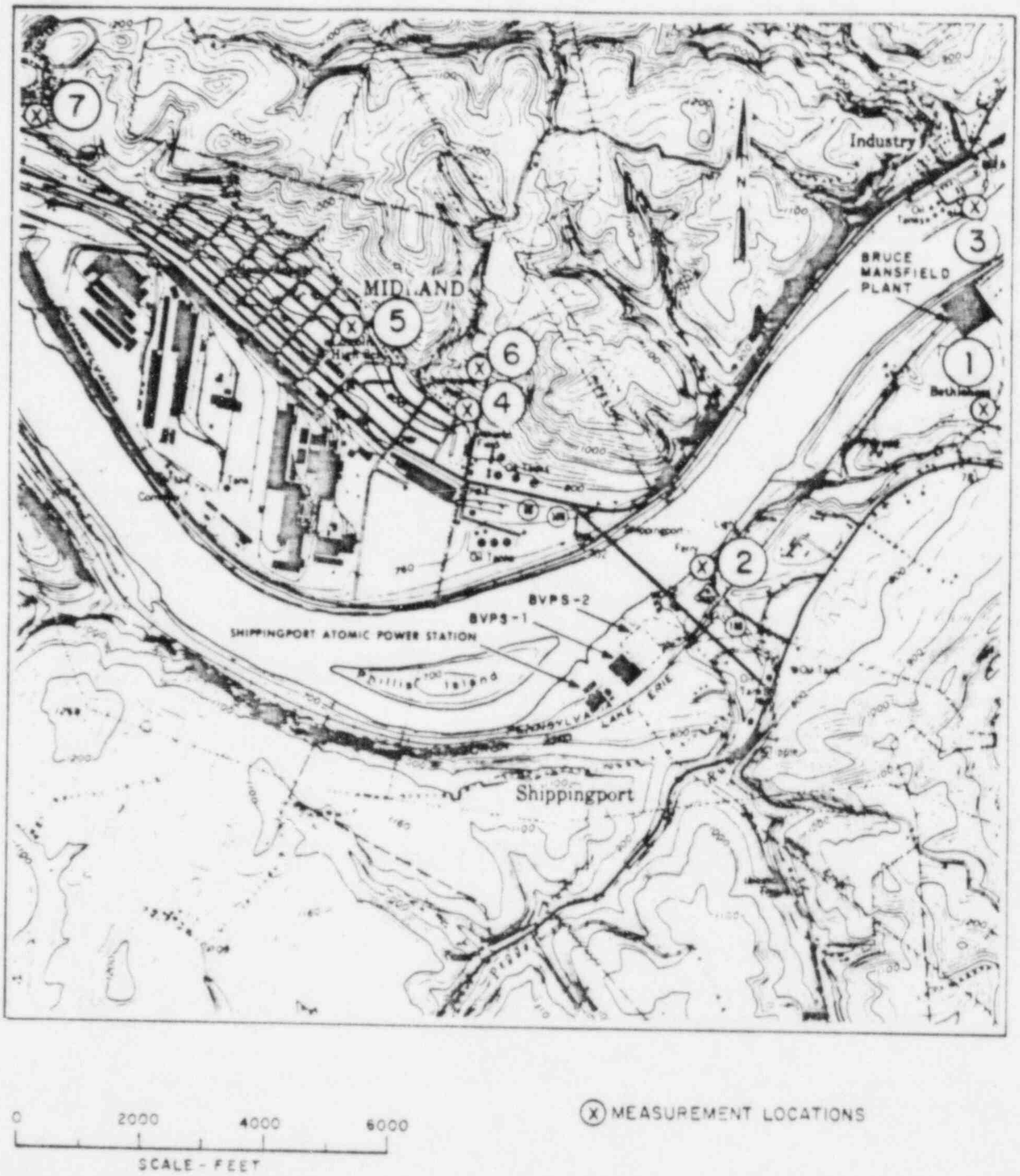

Figure 5.21 Seven ambient measurement positions representing sensitive noise areas (to convert ft to m, multiply by 0.3048)

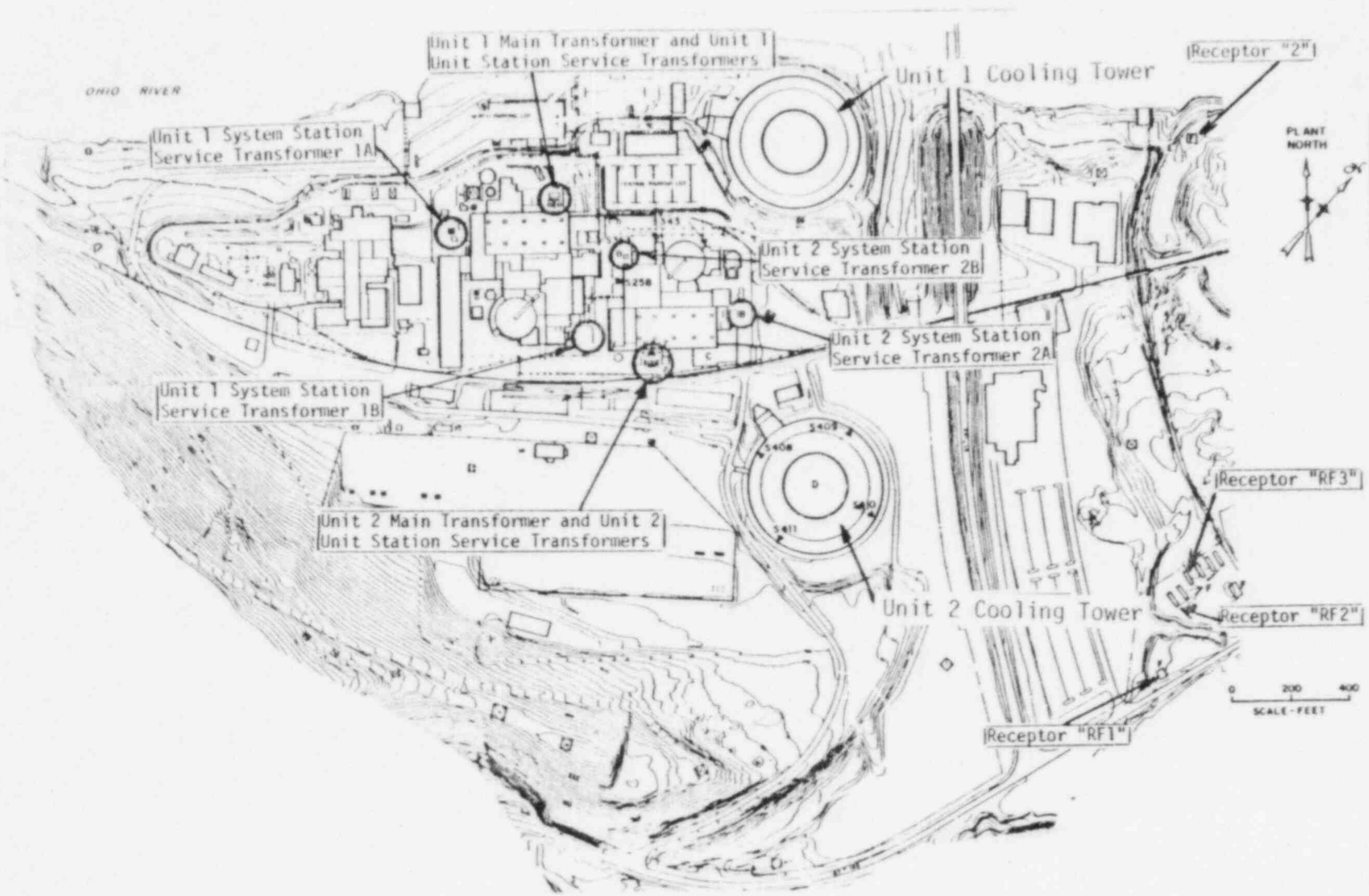

Figure 5.22 Key noise sources (to change ft to m, multiply by 0.3048)

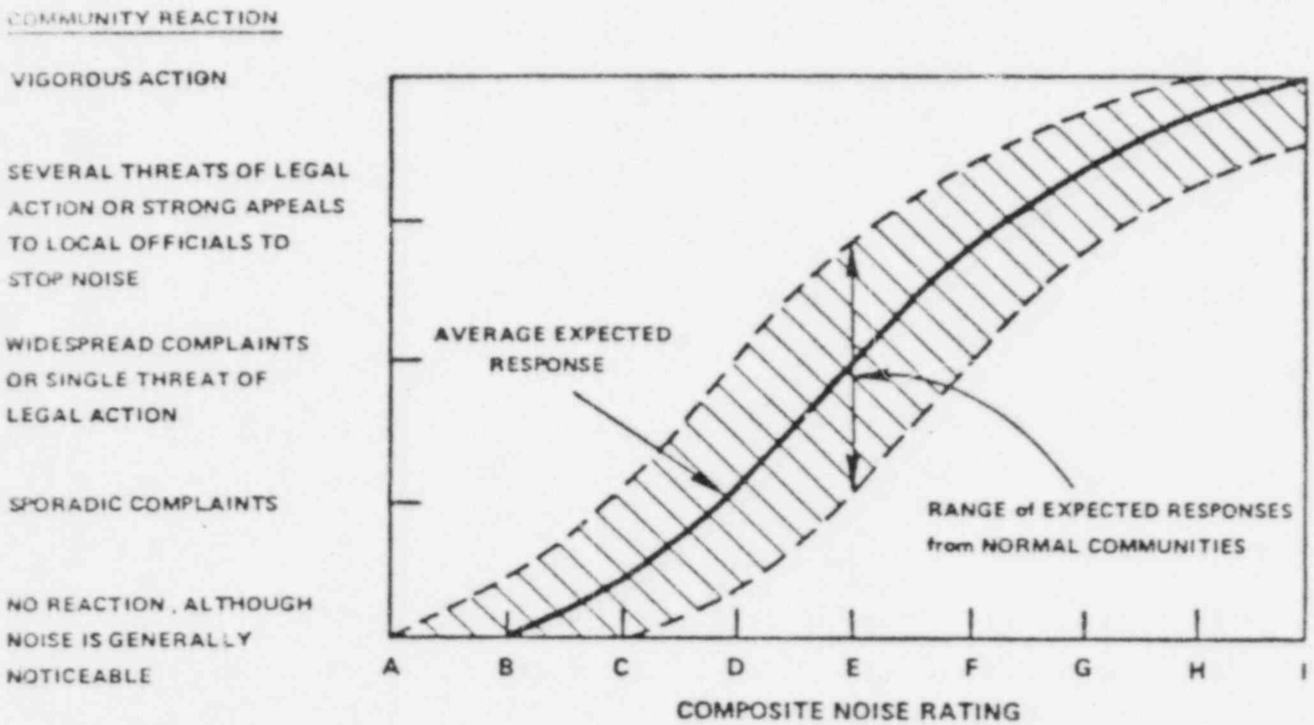

Figure 5.23 Estimated community response versus composite noise rating

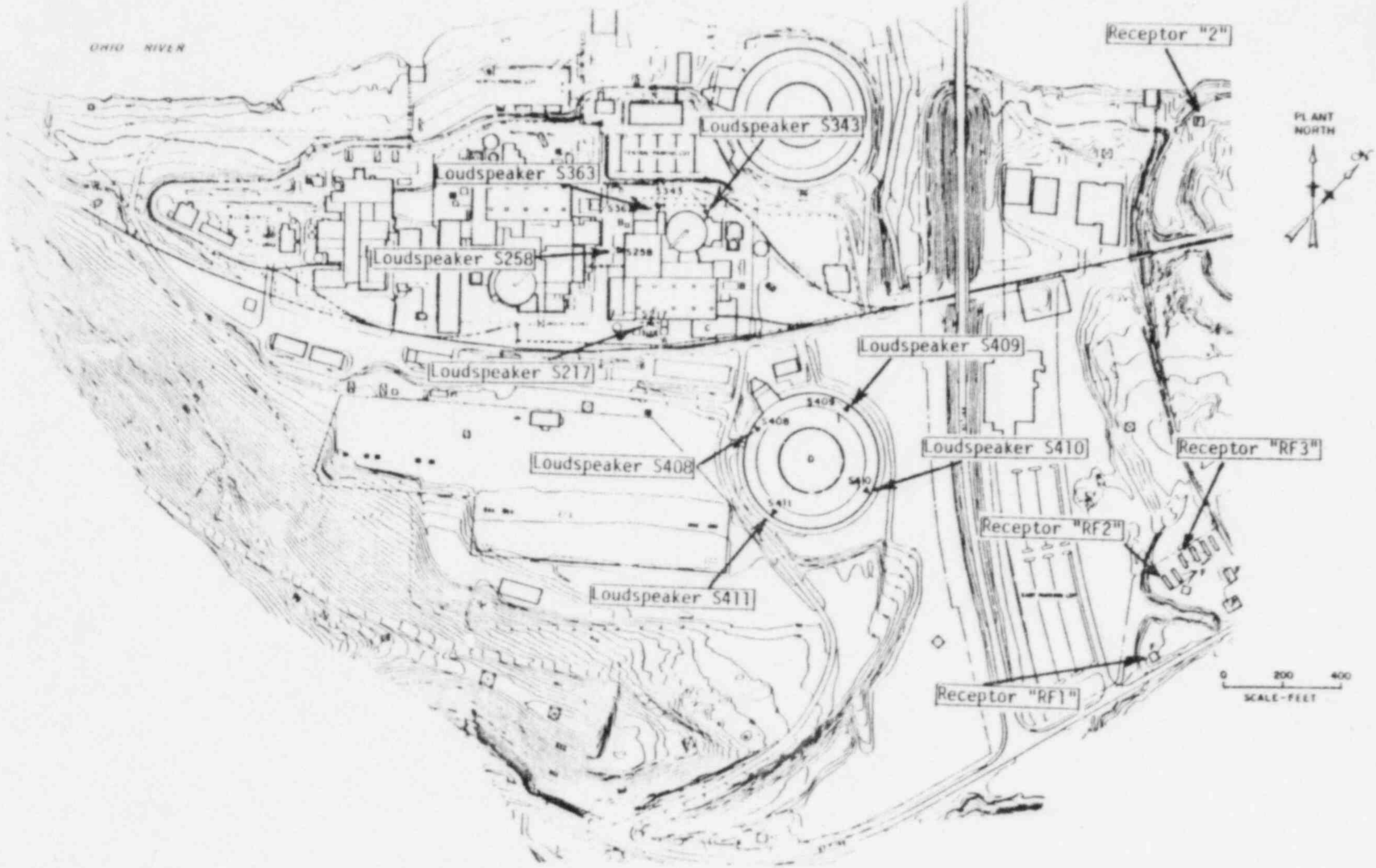

Figure 5.24 Location of eight loudspeakers planned for plant operation (to change ft to m, multiply by 0.3048)

Table 5.1 Expected avoidance temperatures of selected fishes at the Beaver Valley site, °C

Species	Avoidance Temperature†	
Spottail shiner	*	31.7
Spotfin shiner	16.3	31.1
Bluntnose minnow**	16.9	-*,**
Bluntnose minnow***	14.1	32.5
Brown bullhead	*	33.3
Channel catfish	16.2	33.8
Pumpkinseed	18.1	35.1
Bluegill	24.7	33.8
Smallmouth bass	*	33.6
Largemouth bass	19.2	34.1
White crappie	16.8	31.6
Walleye	21.6	31.7
Yellow perch	*	32.1
RANGE OF AVOIDANCE ΔT	11.6 to 22.2	4.7 to 8.7

†The values in the left hand column represent avoidance in temperatures starting from a typical winter acclimation temperature of 2.5°C. The values in the right hand column represent avoidance temperatures starting from a typical summer acclimation temperature of 26.4°C.

*Acclimation temperature outside range of acclimation temperatures tested.

**For rising ambient temperatures.

***For falling ambient temperatures.

Source: Regression coefficients for avoidance temperature and acclimation temperature reported in Mathur et al. (1983), Table 1.

Table 5.2 Upstream-downstream comparison of population densities of organisms at the Beaver Valley site, 1977-1979*

Organisms	Year 1977	1978	1979
Benthos			
Oligochaetes	0/4	0/4	0/4
Chironomids	0/4	0/4	0/4
Mollusks	0/4	0/4	0/2
Total	0/4	0/4	0/4
Phytoplankton			
Chlorophytes	0/12	1/12	1/12
Chrysophytes	0/12	0/12	0/12
Cyanophytes	0/12	0/12	0/12
Cryptophytes	0/12	1/12	2/12
Microflagellates	0/12	0/12	0/12
Total	0/12	0/12	0/12
Zooplankton			
Protozoans	0/12	1/12	0/12
Rotifers	3/12	0/12	4/12
Total	0/12	0/12	1/12
Ichthyoplankton			
Larvae	1/6	0/6	0/6

*The first number in each column represents the number of comparisons in which the upstream-downstream difference exceeded the criterion, based on preoperational variability; the second represents the total number of comparisons in the year.

Source: Duquesne, 1978, 1979, and 1980, Tables III-2, -3, -4, and -5

Table 5.3 Estimated state taxe[illegible] t[illegible] paid on Beaver Valley Unit 2 ($ thousands)*

	Pennsylvania			Ohio
Year	Public utility realty	Gross receipts	Corporate income	Public utility excise
1987	18,487	2,401	9,118	12,911
1988	18,025	1,939	9,765	9,876
1989	17,533	2,651	10,603	13,844
1990	17,041	2,280	9,749	11,500
1991	16,549	2,393	8,870	12,082

*Dollars are valued in year stated.

Source: ER-OL Table E310.6

Table 5.4 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 industry-wide average radiation dose of 0.8 rem is about 11 potential premature deaths per 105 person-years due to cancer, based on the risk estimators described in the following text. The average non-radiation-related risk for seven U.S. electrical utilities over the period 1970-1979 is about 12 actual premature deaths per 105 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.)

Table 5.5 (Summary Table S-4) Environment… impact of transportation of fuel and waste to and from o… light-water-cooled nuclear power reactor[1]

NORMAL CONDITIONS OF TRANSPORT

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

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

ACCIDENTS IN TRANSPORT

	Environmental risk
Radiological effects	Small[4].
Common (nonradiological) causes	1 fatal injury in …0 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 Surv… of Transportation of Radioactive Materials to and from Nuclear Power Plants," WASH-1238, December 1972, and Supp. I, …REG-75/038 April 1975. Both documents are available for inspection and copying at the Commission's Public Document R… n, 1717 H St. NW., Washington, D.C., and may be obtained from National Technical Information Service, Springfield, Va. 22… 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.… (microfiche, $2.25).

[2] The Federal Radiation Council has recommended that the radiation doses fr… all sources of radiation other than natural background and medical exposures should be limited to 5,000 millirem per ye… for individuals as a result of occupational exposure and should be limited to 500 millirem per year for individuals in the ge… al 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 indiv… is 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 millire… 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 ma… m.

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

Table 5.6 Preoperational radiological environmental monitoring program for Beaver Valley Unit 2

Exposure Pathway and/or Sample	DLC Site No.	Sector[1]	Miles[2]	Sample Point Description[3]	Sampling and Collection Frequency	Type and Frequency of Analyses
1. AIRBORNE						
Radioiodine and Particulates	13.0	11	1.6	Hookstown (Meyer's Farm)	Continuous sampler operation with collection at least weekly.	Radioiodine Cartridge: I-131 analysis weekly. Particulate Sampler: Gross beta analysis following filter change;[5] Gamma isotopic analysis on composite (by location) quarterly.
	30.0	4	0.6	Shippingport (Cooke's Ferry Substation)		
	32.0	15	0.8	Midland (Midland Substation)		
	46.1	6	2.0	Industry (Tire Company)		
	48.0	10	16.5	Weirton, WV[4] (Weirton Water Storage Tank)		
2. DIRECT RADIATION	10.0	4	0.8	Shippingport Boro (Post Office)	Continuous measurement with quarterly collection.	Gamma dose quarterly.
	13.0	11	1.6	Meyer's Farm		
	14.0	11	2.6	Hookstown		
	15.0	14	3.3	Georgetown		
	27.0	7	6.2	Brunton's Farm		
	28.0	1	8.7	Sherman's Farm		
	29B	3	8.1	Beaver County Hospital		
	30.0	4	0.6	Shippingport Boro (Cooke's Ferry)		
	32.0	15	0.8	Midland Boro (Midland Substation)		
	45.0	5	2.2	Raccoon Township (Mt. Pleasant Church)		
	45.1	6	2.0	Raccoon Township (Kennedy's Corner)		
	46.0	3	2.5	Industry (Church)		
	46.1	3	2.1	Industry (Tire Company)		
	47.0	14	4.8	East Liverpool, OH (Water Company)		
	48.0	10	16.5	Weirton, WV (Water Company)		
	51.0	5	8.0	Aliquippa		
	59.0	7	1.1	Iron's Farm		
	60.0	13	3.7	Haney's Farm		

*Adapted from Beaver Valley Unit 1 Dose Calculation Manual.

Table 5.6 (continued)

Exposure Pathway and/or Sample	DLC Site No.	Sector[1]	Miles[2]	Sample Point Description[3]	Sampling and Collection Frequency	Type and Frequency of Analyses
2. DIRECT RADIATION (Continued)	70.0	1	3.0	Western Beaver High School	Continuous measurement with quarterly collection.	Gamma dose quarterly.
	71.0	2	5.6	Brighton Township School		
	72.0	3	3.2	Logan School		
	73.0	4	2.2	Potter Township School		
	74.0	4	6.8	Center Township (Community College)		
	75.0	5	4.3	Raccoon Township (Holt Road)		
	76.0	6	3.8	Raccoon Township School		
	77.0	6	5.8	Raccoon Township (Green Garden Road)		
	78.0	7	2.3	Raccoon Township Municipal Building		
	79.0	8	4.6	Raccoon Township (Routes 18 & 151)		
	80.0	9	8.4	Raccoon Park		
	81.0	9	3.9	Southside School		
	82.0	9	7.1	Hanover Township Municipal Building		
	83.0	10	4.5	Greene Township (Mill Creek Road)		
	84.0	11	8.5	Hancock County, WV (Children's Home)		
	85.0	12	5.8	Hancock County, WV (Routes 8 & 30)		
	86.0	13	6.5	East Liverpool, OH (Cahill's)		
	87.0	14	7.0	Calcutta, OH		
	88.0	15	3.1	Midland Heights		
	89.0	15	4.7	Ohioville		
	90.0	16	5.2	Fairview School		
	91.0	2	3.7	Brighton Township (Pine Grove & Doyle Roads)		
	92.0	12	3.0	Greene Township (Georgetown Road)		
	93.0	16	1.3	Midland (Sunset Hills)		
	94.0	8	2.4	Raccoon Township (McCleary Road)		
	95.0	10	2.4	Greene Township (McCleary Road)		

Table 5.6 (continued)

Exposure Pathway and/or Sample	DLC Site No.	Sector[1]	Miles[2]	Sample Point Description[3]	Sampling and Collection Frequency	Type and Frequency of Analyses
3. WATERBORNE						
a. Surface (River)	49.1	4	5.0	Upstream - in vicinity of Montgomery Dam[4] (ARCO Chemical Company, formerly ARCO Polymers)	Composite sample with sample collection at least monthly.[6]	Gamma isotopic analysis monthly; tritium analysis on composite (by location) quarterly.
	2.1	14	1.3	Downstream - Midland		
b. Drinking Water	4.0	14	1.3	Midland (Midland Water Treatment Plant)	Composite sample with sample collection at least bi-weekly.[6]	I-131 analysis bi-weekly; gamma isotopic analysis on composite (by location) monthly; tritium analysis on composite (by location) quarterly.
	5.0	14	4.8	East Liverpool, OH (East Liverpool Water Treatment Plant)		
c. Ground Water				None required[7]		
d. Shoreline Sediment	2A	13	0.2	Vicinity of BVPS Discharge Structure	Semi-annually.	Gamma isotopic analysis semi-annually.
4. INGESTION						
a. Milk	25.0	10	2.1	Searight's Dairy	At least bi-weekly when animals are on pasture; at least monthly at other times.	Gamma isotopic and I-131 analysis on each sample.
	55.0[8]	-	-			
	56.0[8]	-	-			
	57.0[8]	-	-			
	96.0	10	10.3	Windshimer's Dairy[4]		

Table 5.6 (continued)

Exposure Pathway and/or Sample	DLC Site No.	Sector[1]	Miles[2]	Sample Point Description[3]	Sampling and Collection Frequency	Type and Frequency of Analyses
4. INGESTION (Continued)						
b. Fish	2A	13	0.2	Downstream - in vicinity of BVPS Discharge Structure	Semi-annually	Gamma isotopic analysis on edible portion
	49.0	3	4.7	Upstream - in vicinity of Montgomery Dam		
c. Food Products (Leafy Vegetables)	10.0	4	0.8	Three (3) locations within 5 miles of BVPS	Annually at harvest time	Gamma isotopic and I-131 analysis on edible portion
	15.0	14	3.3			
	46.0	3	2.5			
	48.0	10	16.5	One (1) location[4] (Weirton, WV area)		

[1]Sector numbers 1-16 correspond to the 16 compass direction sectors N - NNW.

[2]Distance (in miles) is as measured from the BVPS Containment Building.

[3]All Sample Points, unless otherwise noted, are in the Commonwealth of Pennsylvania. Maps showing the approximate locations of the Sample Points are provided as Figures 3.0-1 through 3.0-9.

[4]This is a Control Station and is presumed to be outside the influence of BVPS effluents.

[5]A gamma isotopic analysis is to be performed on each sample when the gross beta activity is found to be greater than 10 times the mean of the Control Station sample.

[6]Composite samples are obtained by collecting an aliquot at intervals not exceeding 2 hours.

[7]Collection of Ground Water samples is not required as the hydraulic gradient or recharge properties are directed toward the river because of the high terrain in the river valley at the BVPS; thus, station effluents do not affect local wells and ground water sources in the area.

[8]These Sample Points will vary and are chosen based upon calculated annual deposition factors (highest).

Table 5.7 Activity of radionuclides in a Beaver Valley Unit 2 reactor core at 2766 MWt

Group/radionuclide	Radioactive inventory, millions of curies	Half-life, days
A. <u>NOBLE GASES</u>		
Krypton-85	0.48	,950
Krypton-85m	21	.183
Krypton-87	40	.0528
Krypton-88	59	.117
Xenon-133	147	.28
Xenon-135	30	.384
B. <u>IODINES</u>		
Iodine-131	74	.05
Iodine-132	101	.0958
Iodine-133	147	.875
Iodine-134	163	.0366
Iodine-135	132	.280
C. <u>ALKALI METALS</u>		
Rubidium-86	0.023	3.7
Cesium-134	6.5	50
Cesium-136	2.6	3.0
Cesium-137	4.0	1,000
D. <u>TELLURIUM-ANTIMONY</u>		
Tellurium-127	5.1	.391
Tellurium-127m	0.9	39
Tellurium-129	27	.048
Tellurium-129m	4.6	4.0
Tellurium-131m	10.9	.25
Tellurium-132	101	.25
Antimony-127	5.3	.88
Antimony-129	29	.179
E. <u>ALKALINE EARTHS</u>		
Strontium-89	78	2.1
Strontium-90	3.2	1,030
Strontium-91	93	.403
Barium-140	140	2.8
F. <u>COBALT AND NOBLE METALS</u>		
Cobalt-58	0.68	1.0
Cobalt-60	0.25	,920
Molybdenum-99	140	.8
Technetium-99m	124	.25
Ruthenium-103	93	9.5
Ruthenium-105	62	.185
Ruthenium-106	22	66
Rhodium-105	43	.50

Table 5.7 (continued)

Group/radionuclide	Radioactive inventory, millions of curies	Half-life, days
G. RARE EARTHS, REFRACTORY OXIDES AND TRANSURANICS		
Yttrium-90	3.3	2.67
Yttrium-91	101	59.0
Zirconium-95	132	65.2
Zirconium-97	132	0.71
Niobium-95	132	35.0
Lanthanum-140	140	1.67
Cerium-141	132	32.3
Cerium-143	109	1.38
Cerium-144	74	284
Praseodynium-143	109	13.7
Neodymium-147	52	11.1
Neptunium-239	1397	2.35
Plutonium-238	0.049	32,500
Plutonium-239	0.018	8.9 x 106
Plutonium-240	0.018	2.4 x 106
Plutonium-241	2.9	5,350
Americium-241	0.0015	1.5 x 105
Curium-242	0.43	163
Curium-244	0.02	6,630

Note: The above grouping of radionuclides corresponds t that in Table 5.9.

Table 5.8 Approximate 2-hour radiation doses from design-basis accidents at the exclusion area boundary using realistic assumptions

	Dose (rems) at 547 meters*	
	Thyroid	Whole body
Infrequent Accident		
Steam generator tube rupture**	0.0046	0.021
Fuel handling accident	0.0007	0.0097
Limiting Faults		
Control rod ejection	0.12	0.0064
Large-break LOCA	1.2	0.064

*Plant exclusion area boundary distance.

**See NUREG-0651 for descriptions of three steam generator tube rupture accidents that have occurred in the United States.

Source: ER-OL Table 7.1-1 (modified by updated meteorology)

Table 5.9 Summary of atmospheric releases in hypothetical accident sequences in an RSS PWR (rebaselined)*

Accident sequence**	Probability per r-y	Time, hr	Duration, hr	Fraction of core inventory released						
				Xe-Kr	I	Cs-Rb	Te-Sb	Ba-Sr	Ru***	La†
1. Event V	1×10^{-6}	1.0	1.0	1.0	0.6	0.8	0.4	0.1	0.04	.006
2. TMLB'-σ	2×10^{-5}	2.5	0.5	1.0	0.3	0.4	0.2	0.04	0.02	2×10^{-3}
3. PWR-3	3×10^{-6}	5.0	1.5	0.8	0.2	0.2	0.3	0.02	0.03	3×10^{-3}
4. PWR-7	8×10^{-5}††	10.0	10.0	6×10^{-3}	2×10^{-5}	1×10^{-5}	2×10^{-5}	1×10^{-6}	1×10^{-6}	2×10^{-7}

*Background on the isotope groups and release mechanisms is in NUREG-0773.

**See Appendix F for a description of the accident sequences and release categories.

***Includes Ru, Rh, Co, Mo, Tc.

†Includes Y, La, Zr, Nb, Ce, Pr, Nd, Np, Pu, Am, Cm.

††Probability value is the sum of core melt probabilities for basemat melt through and for core melt accidents in which the containment does not fail. Core melt with no containment failure sequences are expected to be about 5×10^{-5} per reactor year.

Note: See Section 5.9.4.5(7) for a discussion of uncertainties in risk estimates.

Table 5.10 Environmental impacts and probabilities

Probability of impact per r-y	Persons exposed over 200 rems	Persons exposed over 25 rems	Early fatal-ities	Population exposure, millions of person-rems, 80 km/total	Latent cancer fatalities 80 km/ total	Offsite mitigating actions cost, $ millions
10^{-4}	0	0	0	0/0.003	0/0	0
10^{-5}	130	18,000	7	3/5	310/470	940
5×10^{-6}	380	32,000	88	6/13	540/1000	1,700
10^{-6}	3,100	92,000	400	20/43	1700/3100	3,400
10^{-7}	7,300	470,000	1,600	47/140	4500/7700	8,900
10^{-8}	19,000	760,000	4,700	69/440	5700/29,000	19,000
Related figure	5.4	5.4	5.6	5.5	5.7	5.8

Table 5.11 Average values of environmental risks due to accidents, per reactor-year

Environmental risk	Average value
Population exposure	
Person-rems within 80 km	110
Total persons-rems	230
Early fatalities	0.002
Early injuries	0.0005
Latent cancer fatalities	
All organs excluding tyroid	0.02
Thyroid only	0.002
Cost of protective actions and decontamination	$29,000*

*1980 $.

Table 5.12 Regional economic impacts, output and employment

Release specification	Wind direction	Direct losses: Nonagricultural	Direct losses: Agricultural	Indirect losses	Total losses	Loss in employment (annualized jobs)	Expected loss in output per r-y**
Event V	ESE	6236*	56*	774*	7066*	264000	383
TMLB'	ESE	6236*	56*	774*	7066*	264000	7660
PWR 3	SW	313*	10*	40*	363*	13000	63
PWR 7	NW	16*	0*	2*	18*	1000	0
Minimum losses							
Event V	S	39*	6*	5*	50*	1000	2
TMLB'	S	39*	6*	5*	50*	1000	41
PWR 3	S	11*	0*	1*	12*	1000	1
PWR 7	10 directions	0*	0*	0*	0*	0	0
Expected losses per reactor year, 1980							
Event V	ALL	933**	51**	121**	1105**	1	***
TMLB'	ALL	18655**	1016**	2419**	22090**	1	
PWR3	ALL	314**	71**	47**	432**	1	
PWR7	ALL	0**	0**	0**	0**	0	
ALL	ALL	19902	1138	2587	23627	0.9	

*millions of 1980$.

**1980$.

***Not applicable, because the expected loss is already expressed in the "Total" column for this portion of the table.

Source: Bureau of Economic Analysis, U.S. Department of Commerce with assumptions supplied by the U.S. Nuclear Regulatory Commission

Table 5.13 (Summary Table S-3) Uranium-fuel-cycle environmental data[2]

[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[a]	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):[b]		
SO_x	4,400	
NO_x[c]	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 (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.

[3] 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.

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

[5] 1.2 percent from natural gas use and process.

Table 5.14 Noise measurement locations

Location	Description	Distance, direction from site, ft
R1	Bethelem Church parking lot	7,000 NE*
R2	Adjacent to Ferry Road	2,000 NE
R3	Town of Industry adjacent to river	9,000 NE
R4	Virginia and 13th Streets, Midland	4,500 NW
R5	Ohio Street and Park Place, Midland	7,000 NW
R6	Hillcrest Manor Apartments	5,000 NW
R7	Midland Heights houses (used only in 1971 survey)	13,000 NW
RF1-RF3	Additional receptors just east of plant site in cluster of private houses	

Note: To change feet to meters, multiply the values shown by 0.3048.

Source: ER-OL Table 2.7-1

Table 5.15 Residual ambient noise levels assumed for receptors R1-R7 and RF1-RF3

Receptors	Sound pressure level, dB									A-weighted sound pressure level, dBA
	31	63	125	250	500	1000	2000	4000	8000	
R1	-	75	74	61	59	58	54	44	35	64
R2	-	50	45	42	37	30	27	13	13	39
R3	-	60	58	51	46	43	38	31	18	49
R4	-	48	46	40	32	31	31	28	21	38
R5	-	52	53	49	46	38	33	26	17	47
R6	-	52	52	48	43	40	32	13	13	45
R7	-	52	53	49	46	38	33	26	17	47
RF1	-	50	45	42	37	30	27	13	13	39
RF2	-	50	45	42	37	30	27	13	13	39
RF3	-	50	45	42	37	30	27	13	13	39

Table 5.16 Sound pressure levels predicted for R1-R7 and RF1-RF3 as a result of the cooling towers and transformers

Receptors	Sound pressure levels, dB[1]									A-weighted level[3]	120-Hz tone, dB above masking level	Modified CNR rating[2]
	31	63	125	250	500	1000	2000	4000	8000			
R	-	+0	+0	+0	+0	+0	+0	+0	+0	64(+0)	0	A
R2	-	+0	+4	+5	+10	+17	+18	+27	+11	51(+12)	3	F
R3	-	+0	+0	+0	+0	+0	+0	+0	+0	49(+0)	0	A
R4	-	+0	+0	+0	+2	+1	+0	+0	+0	39(+1)	1	B
R5	-	+0	+0	+0	+0	+0	+0	+0	+0	47(+0)	0	A
R6	-	+0	+0	+0	+0	+0	+0	+0	+0	45(+0)	0	A
R7	-	+0	+0	+0	+0	+0	+0	+0	+0	47(+0)	0	A
RF1	-	+0	+4	+5	+10	+17	+18	+27	+11	51(+12)	2	F
RF2	-	+0	+4	+5	+10	+17	+18	+27	+11	51(+12)	2	F
RF3	-	+0	+4	+5	+10	+17	+18	+27	+11	51(+12)	2	F

[1]Values in parentheses represent the increase in decibels over the assumed ambient values given in Table 5.15.

[2]CNR = composite noise rating; for estimated community response, see Figure 5.24.

[3]Values represent predicted operational phase overall A-weighted level with increases over assumed ambient values shown in parentheses.

Table 5.17 Loudspeaker characteristics and locations

Speaker number	Plant coordinates	Elevation	Watts	Direction of aim	Location
5217	N3612 E8005	740'-3"	29	south	Turbine bldg
5258	N3830 E7875	745'-3"	29	west	Auxiliary bldg
5343	N3974 E8167	777'-7"	29	north	Reactor bldg
5363	N3978 E8028	745'-3"	29	north	Decontamination bldg
5408	N3258 E8370	809'-4"	29	east-southeast	Inside cooling tower
5409	N3339 E8642	809'-4"	29	south-southwest	Inside cooling tower
5410	N3042 E8730	809'-4"	29	west-northwest	Inside cooling tower
5411	N2961 E8458	809'-4"	29	north-northeast	Inside cooling tower

Note: Loudspeaker sound power level taken from EEI Noise Guide (p. 4-36 and 4-37) (Bolt, Beranek and Newman).

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 operation of Beaver Valley Unit 2. These impacts are summarized in Table 6.1.

The applicant is required to adhere to the following conditions for the protection of the environment:

(1) Before engaging in any additional construction or operational activities that may result in any significant adverse environmental impact that was not evaluated or that is significantly greater than that evaluated in this statement, the applicant will provide written notification of such activities to the Director of the Office of Nuclear Reactor Regulation and will receive written approval from that office before proceeding with such activities.

(2) The applicant will carry out the environmental monitoring programs outlined in Section 5 of this statement, as modified and approved by the staff and implemented in the Environmental Protection Plan and Technical Specifications that will be incorporated in the operating license.

(3) If an adverse environmental effect or evidence of irreversible environmental damage is detected during the operating life of the plant, the applicant will provide the staff with an analysis of the problem and a proposed course of action to alleviate it.

6.2 Irreversible and Irretrievable Commitments of Resources

There has been no change in the staff's assessment of this impact since the earlier review except that the continuing escalation of costs has increased the dollar values of the materials used for constructing and fueling the plant.

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

There have been no significant changes in the staff's evaluation for Beaver Valley Unit 2 since the CP stage environmental review.

6.4 Benefit-Cost Summary

6.4.1 Summary

A major benefit to be derived from Beaver Valley Unit 2 is the lower production cost for approximately 4.0 billion kWh of baseload electrical energy that will be produced annually. (This projection assumes, conservatively, that the unit will operate at an annual average capacity factor of 55%.) Production

costs avoided on 4.0 billion kWh of electrical energy will be approximately 26 mills/kWh, resulting in a total annual cost avoided on existing generation of $102 million (constant 1986 dollars).

The addition of each unit will also improve the applicant's ability to supply system load requirements by contributing 833 MW of capacity (maximum dependable capacity, net) to the applicant's bulk power supply system.

6.4.2 Economic Costs

The economic costs associated with station operation include fuel costs and operation and maintenance (O&M) costs, which are expected to average approximately 10.6 mills per kWh and 7.4 mills per kWh, respectively (1986 dollars). This cost estimate for fuel is derived from applicant's response to staff question 320.1. The estimate of O&M cost is based on a 5% annual escalation of the 1982 average cost for nuclear plants in the east-north-central region of the U.S. (DOE, 1983).

The applicant estimates decommissioning costs will range from $36 million to $48 million (1982 dollars).

6.4.3 Socioeconomic Costs

No significant socioeconomic costs are expected from either the operation of Beaver Valley Unit 2 or from the number of station personnel and their families living in the area. The socioeconomic impacts of a severe accident could be large; however, the possibility of such an accident is small.

6.5 Reference

U.S. Department of Energy, "DOE Update, April-June 1983: Nuclear Power Plant Program Information and Data," DOE/NE0048/3, August 1983.

Table 6.1 Benefit-cost summary

Primary impact and effect on population or resources	Quantity	Impacts*
BENEFITS		
Capacity		
.Additional generating capacity	833 MWe	Large
Economic		
Reduction in existing system production costs	4.0 billion kWh/yr @ 26.0 mills/kWh or $102 million/yr	Moderate
COSTS		
Economic		
Fuel	10.6 mills/kWh**	Small
Operation and maintenance	7.4 mills/kWh**	Moderate
Total	$72 million/yr	Small
Decommissioning	$36-48 million (1982 dollars)	Small
Environmental		
Damages suffered by other water users		
Surface water consumption	(Section 5.3.2)	Small
Surface water contamination	(Section 5.3.1)	Small
Groundwater consumption	(Section 5.3.2)	Small
Damage to aquatic resources		
Impingement and entrainment	(Section 5.5.2)	Small
Thermal effects	(Section 5.5.2)	Small
Chemical discharges	(Section 5.5.2)	Small
Damage to terrestrial resources		
Station operations	(Section 5.5.1)	Small
Transmission line maintenance	(Section 5.5.1)	Small
Adverse socioeconomic effects		
Loss of hisotric or archeological resources	(Section 5.7)	None
Increased demands on public facilities and services	(Section 5.8)	Small
Increased demands on private facilities and services	(Section 5.8)	Small
Noise	(Section 5.12)	Small-Moderate

Footnote on next page.

Table 6.1 (Continued)

Primary impact and effect on population or resources	Quantity	Impacts*
Adverse nonradiological health effects		
Water quality changes	(Section 5.3.1)	None
Air quality changes	(Section 5.4)	None
Adverse radiological health effects		
Routine operation	(Section 5.9.3)	Small
Postulated accidents	(Section 5.9.4)	Small
Uranium fuel cycle	(Section 5.10)	Small

*A subjective measure of costs and benefits is assigned by a reviewer where quantification is not possible: "Small" = impacts that, in the reviewer's judgment, are of such minor nature, based on currently available information, they do not warrant detailed investigation or consideration of mitigative actions; "Moderate" = impacts that, in the reviewer's judgment, are likely to be clearly evident (mitigation alternatives are usually considered for moderate impacts); "Large" = impacts, that, in the reviewer's judgment, represent either a severe penalty or a major benefit. Acceptance requires that large negative impacts be more than offset by other overriding project considerations.

**1986 dollars. The net reduced generating cost is the difference between $102 million/yr and $72 million/yr, or $30 million/yr.

7 CONTRIBUTORS

The following personnel of the Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, participated in the preparation of this document:

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8 AGENCIES, ORGANIZATIONS, AND PERSONS TO WHOM COPIES OF THE DRAFT ENVIRONMENTAL STATEMENT WERE SENT

Advisory Council on Historic Preservation

Federal Emergency Management Agency

U.S. Department of Agriculture

U.S. Department of Army Corps of Engineers

U.S. Department of Commerce

U.S. Department of Energy

U.S. Department of Health and Human Services

U.S. Department of Housing and Urban Development

U.S. Department of the Interior

U.S. Department of Transportation

U.S. Environmental Protection Agency

Mayor of the Borough of Shippingport, Pennsylvania

Pennsylvania Department of Environmental Resources

Pennsylvania State Clearinghouse

Southwestern Pennsylvania Regional Planning Commission

9 STAFF RESPONSES TO COMMENTS ON THE DRAFT ENVIRONMENTAL STATEMENT

Pursuant to 10 CFR 50, the "Draft Environmental Statement Related to the Operation of Beaver Valley Power Station, Unit 2" (DES), was transmitted, with a request for comments, to the agencies and organizations listed in Section 8. In addition, the NRC requested comments on the DES from interested persons by a notice published in the Federal Register on January 18, 1985.

The organizations and individuals who responded to the requests for comments are listed below in chronological order, according to the dates on the comment letters. The comment letters are reproduced in the same order in Appendix A. In parentheses after the name of each commentor are the initials used to identify the commentor later in this section and the page in Appendix A on which the comment letter begins. The commentors were

U.S. Department of Agriculture, Soil Conservation Service (USDA, 1)
U.S. Department of the Army, Corps of Engineers (COE, 2)
Pennsylvania Intergovernmental Council (PIC, 3)
Duquesne Light (the applicant) (DLC, 4)
U.S. Department of the Interior (DOI, 10)
John F. Doherty (JFD, 12)
U.S. Department of Housing and Urban Development (HUD, 13)
U.S. Department of the Interior (DOI, 10)
U.S. Environmental Protection Agency (EPA, 14)

The letters from USDA, COE, PIC, and HUD did not require a staff response, because those commentors had no comments at this time. The remaining comment letters did require a staff response.

The staff's consideration of these comments and the disposition of the issues involved are reflected, in part, by text revisions in the pertinent sections of this FES (and indicated by lines in the margin next to the revised lines of text) and, in part, by the discussion in the subsections below. (In cases where commentors merely noted minor typographical or editorial errors, the corrections have been made but the comments are not addressed in this section.) The section numbers in this section correspond to the section numbers in the FES and DES except that each is preceded by the digit "9". The comments are referenced by the use of the abbreviations indicated above and by the individual comment numbers noted in the margins of the comment letters in Appendix A. Comments on appendices are in Section 9.10, and references cited in Section 9 are listed in Section 9.11.

Table 9.1 is a cross-reference list of comments and the section(s) of this report in which they are addressed.

9.1. <u>Abstract, Summary and Conclusions, Table of Contents, Foreword, and Introduction</u>

9.1.2 Permits and Licenses

DLC-1

The applicant states that the NPDES permit was issued on November 26, 1984, and was submitted to the staff in March 1985.

· Staff Response

A copy of the effective NPDES permit received in March 1985 is provided as Appendix G of this FES.

9.4 Project Description and Affected Environment

9.4.1 Résumé

DLC-2

The applicant states that the maximum water velocity has increased across the bar racks in the main intake structure, as discussed in Section 4.2.4.

· Staff Response

Section 4.1 has been revised to agree with Section 4.2.4.

9.4.2 Facility Description

9.4.2.2 Land Use

DLC-3

The applicant states that the exclusion area boundary (EAB) for Unit 2 has been changed to a 2000-foot radius centered on the Unit 1 containment building. This change is docketed in letter no. 2 NRC-5-015, dated February 1, 1985.

· Staff Response

After receiving the applicant's February 1, 1985 letter (from E.J. Woolever to G.W. Knighton), the staff determined that the approximate nearest EAB distance is 547 m (1794 feet). The second paragraph of Section 4.2.2 has been revised to reflect this change.

DLC-13

The applicant notes that Figure 4.2 should be revised to reflect the EAB change addressed in DLC-3.

· Staff Response

Figure 4.2 has been revised to reflect this comment. The text in Section 4.2.2 also has been restated to be consistent with the FSAR.

9.4.2.3 Water Use and Treatment

9.4.2.3.2 Water Treatment

DLC-4

The applicant states that the free available chlorine (FAC) concentration "at the condenser outlet" should be changed to "at the discharge to the river," in accordance with the final NPDES permit (outfall 001).

- Staff Response

Section 4.2.3.2.2 has been revised to reflect this change in the point of effluent discharge.

DLC-5

The applicant states that the proprietary substance Calgon CL-4000 used to treat the secondary component cooling water and cooling tower water has been changed to Betz DUQ.01.

- Staff Response

Section 4.2.3.2.2 has been revised to indicate the applicant's planned use of Betz DUQ.01 rather then Calgon CL-4000.

9.4.2.4 Cooling System

DLC-6

The applicant states that the service water system provides once-through cooling of primary and secondary heat exchangers, control room refrigerant cooling units, safeguards area air conditioners, main steam valve area cooling coils, auxiliary building motor control center cooling units, and charging pump coolers. The control room air conditioners are cooled by the chilled water system.

- Staff Response

Section 4.2.4 has been revised to indicate the corrected list of components cooled by the service water system.

DOI-1

DOI notes that the DES indicates, on page 4-5, that there would be an increase in the discharge water temperature during the operation of both Units 1 and 2. The discharge temperature differential above ambient of 1.3°C to 15.9°C and maximum change of 22°C would seasonally exceed the Pennsylvania State Water Quality Standards for water temperature of discharges into warm water fishery areas. This standard was set to protect indigenous fishes and aquatic resources against thermal shock. The final statement should discuss the alternatives that were considered to reduce the temperature differential in the heated discharge and present the rationale for choosing the selected method of discharge.

· Staff Response

At the CP stage, a maximum temperature differential of 22°C (40°F) was discussed. The maximum expected temperature differential has been revised downward, to 15.9°C (in January). As discussed in Section 5.5.2.2, the thermal effects now expected are less than those evaluated in the FES-CP. The question of cold shock is also addressed in Section 5.5.2.2.

9.4.2.6 Nonradioactive Waste Management Systems

9.4.2.6.1 Liquid Effluents

DLC-7

The applicant notes that a separate sewage treatment facility has been built to handle the increased sanitary load of the support builings for Units 1 and 2 (the emergency response facility, training building south office shops, primary access facility).

· Staff Response

Section 4.2.6.1 has been revised to reflect this comment.

DLC-8

The applicant states that Section 4.2.6.1 should be revised to note that all discharges are to the Ohio River, except the sanitary wastes and the discharge from the oil/water separator serving the fuel oil unloading facility (which are released to Peggs Run, a tributary of the Chio River).

· Staff Response

The text in Section 4.2.6.1 has been revised to include a description of the oil/water separator serving the fuel oil unloading facility.

DLC-14

The applicant states that Tables 4.4 (Current effluent limitations for Unit 1) and 4.5 (Anticipated effluent limitations for Unit 2) should be revised in accordance with the final NPDES permit for Units 1 and 2 issued on November 26, 1984.

· Staff Response

Tables 4.4 and 4.5 have been deleted. The final NPDES permit is reproduced as Appendix G to this FES.

DLC-15

The applicant states that Table 4.6 should be revised in accordance with the final NPDES permit. The Pennsylvania DES Permit Number noted at the bottom of the table should specify the permit that applies to each specific sewage treatment plant: for example, 0479403 (Unit 1), 0482404 (Unit 2).

• Staff Response

Table 4.6 has been deleted. A copy of the final NPDES permit has been included in Appendix G.

9.4.2.6.2 Gaseous Effluents

DLC-9

The applicant states that Section 4.2.6.2 should be revised to note that the emergency diesel generators are tested once a month for an hour.

• Staff Response

Section 4.2.6.2 has been revised to reflect this comment.

9.4.3 Project-Related Environmental Descriptions

9.4.3.2 Water Quality

EPA-1

EPA states that although it finds most of the information presented in the DES adequate, EPA has reservations regarding the effluent water quality. The water quality description on pages 4-10 and following indicates that improvement in water quality has been made since 1974, appearing to indicate an upward trend. The text on pages 5-3 and 5-9, on the other hand, details loadings of criteria pollutants that will add to the pollution load levels already existing in the receiving waters. Even though the DES states that these loadings and levels will "...not necessarily result in adverse effects...," EPA feels that using mortality and survival as the measures of water quality begs the issue of maintaining and improving water quality. EPA suggests that the applicant should make an effort to lower or eliminate these pollutant levels through treatment so that water quality in the receiving waters may continue its current upward trend in quality.

It is EPA policy to adhere to the antidegradation clause of the Clean Water Act. EPA expresses concern that the practice of incremental addition of these and other pollutants at this plant appears to set an unwise precedent that may be repeated elsewhere. Moreover, EPA is concerned that such incremental additions can result in long-term cumulative effects throughout receiving streams, which appears to be contrary to the principles of the Clean Water Act.

• Staff Response

The concentrations of several constituents will exceed criteria in the discharge area, mostly because of the concentrating effect of the evaporative cooling system, rather than as a result of chemical additions from the station, as pointed out in the revision to Section 5.3.1. The pollution load itself is primarily a result of other sources in the Ohio River basin. The Pennsylvania DER has chosen to not impose discharge limitations for manganese, ammonia, total dissolved solids, and nitrite, the four constituents discussed on pages 5-3 and 5-9. A copy of the NPDES permit appears in Appendix G of this FES.

9.4.3.3 Meteorology

DLC-10

The applicant states that no "hurricanes" have been recorded for the Beaver Valley site area (FSAR 2.3.1.2.1). Any hurricanes that have approached the region have been downgraded before they have reached the site.

· Staff Response

The staff agrees with the comment that hurricanes that have approached the region have been downgraded before they have reached the site. However, remnants of tropical storms and hurricanes, which can be classified as severe weather phenomena, do affect the region in which the site is located.

9.4.3.4 Terrestrial and Aquatic Resources

9.4.3.4.2 Aquatic

DLC-11

The applicant states that it is overly conservative to indicate that there is any significant commercial fish harvest for the Ohio River near the Beaver Valley site.

· Staff Response

The text suggests that the staff is generally in agreement with the applicant's comments regarding the present status of the commercial fishery resource. The harvest estimates may represent overly optimistic values, but not overly conservative values for the purpose stated in the text.

DLC-12

The applicant noted that the SER has not yet been published.

· Staff Response

The text has been changed to indicate that the SER will be published in late 1985.

9.4.3.5 Endangered and Threatened Species

9.4.3.5.2 Aquatic

DOI-2

The applicant states that biologists of the State College, Pennsylvania, Field Office of the Fish and Wildlife Service have collected two skipjack herrings upstream from the Beaver Valley plant site. Up until this time, the skipjack herring was thought to have been extirpated from the area. Therefore, the final statement should be revised to reflect the occurrence of the skipjack herring within the proposed project area.

· Staff Response

Section 4.3.5.2 has been revised to note the recent collection of skipjack herring upstream from the site.

9.5 Environmental Consequences and Mitigating Actions

9.5.3 Water

9.5.3.1 Water Quality

DLC-16

The applicant states that text should be revised to state that, after a review of Ohio River water quality and discharge from Units 1 and 2, the Pennsylvania DER elected not to impose any water quality-based limits in the NPDES permit.

· Staff Response

The text has been revised to note that the state-issued NPDES permit will not regulate discharges of the four constitutents discussed in Section 5.3.1.

DLC-17

The applicant states that Section 5.3.1 should be revised to note that the applicant has appealed the FAC limits on the cooling tower blowdown from Units 1 and 2. The appeal is based on the fact that, because of severe condenser tube corrosion on Unit 1, the Unit 1 condenser was completely re-tubed in 1984.

The applicant is proposing to conduct a chlorine minimization study to allow for either increased FAC discharge times (greater than 2 hours per day per unit) and/or higher FAC effluent limitations. The applicant has also appealed the NPDES permit FAC chlorination limits on the grounds that they are ambiguous as to whether they apply to the dosing period, or to the period of discharge into the river.

· Staff Response

The text in Section 5.3.1 has been revised to note the applicant's appeal of the NPDES permit limit on chlorination.

EPA-1

See comment EPA-1 in Section 9.4.3.2 above.

· Staff Response

The text has been revised to reflect this comment.

9.5.3.2 Water Use

DLC-18

The applicant states that the sewage from the main plant buildings of Unit 2 is discharged to the Unit 1 sewage plant. The Unit 2 sewage plant is used only for support buildings (emergency response facility, training building, etc.).

· Staff Response

Section 5.3.2 has been revised to note that the Unit 2 sewage plant is used for support buildings only.

9.5.3.2.2 Groundwater

DLC-19

The applicant states that the main plant structures of Unit 2 receive their potable water from Unit 1; only the support buildings use well water.

· Staff Response

The text has been revised to reflect this comment.

9.5.4 Air Quality

9.5.4.2 Other Emissions

EPA-2

EPA states that Section 5.4.2 presumes that, because the total annual emission does not exceed 250 tons and no air pollution standard will be violated, no further analyses are needed. However, EPA states that this presumption is not necessarily correct because (1) 250 tons a year is a cutoff below which no prevention of significant deterioration permit is required and (2) the fact that emissions will be below the cutoff does not ensure that the ambient standards will be met. EPA comments that the DES air quality analyses are deficient because no calculations of expected air quality have been performed, nor are emission estimates stated.

· Staff Response

As required by the Pennsylvania Bureau of Air Quality Control, the applicant will obtain operating permits for the auxiliary boilers and the diesel generators. Acquisition of these permits requires that the applicant first demonstrate that ambient air quality standards have not been exceeded. There are no requirements imposed by the NRC, provided the annual emission does not exceed 250 tons.

9.5.5 Ecology

9.5.5.1 Terrestrial Ecology

9.5.5.1.2 Transmission System Operation

DLC-20

The applicant states that the word "serious" should be deleted from the text in Section 5.5.1.2 because the applicant has never had any "serious" problems with 345-Kv lines.

- Staff Response

The suggested change has been made.

9.5.5.2 Aquatic Resources

9.5.5.2.2 Thermal and Chemical Effects

DLC-21

The applicant states that the text (paragraph 6, Section 5.5.2.2) should be revised to state that Peggs Run now is expected to receive the treated effluents from the Unit 2 sewage treatment plant and from the oil/water separator located at the fuel oil unloading facility.

The design flow of the sewage treatment plant constitutes more than 1% of the creek's mean flow (estimated by the applicant at 140 L/sec or 5 cfs, ER-OL Section 2.4.3). The discharge from the oil/water separator is low in volume and intermittent. Because Pegg's Run is already a highly degraded stream (Section 4.3.3.2), the potential effects of the sewage discharge (e.g., high oxygen demand and suspended solids) and oil/water separator discharge (e.g., oil/grease and suspended solids) on Pegg's Run would be limited.

- Staff Response

The text has been revised to include a discussion of the discharge from the oil/water separator at the fuel oil unloading facility.

9.5.8 Socioeconomic Impacts

DLC-22

The applicant notes that socioeconomic impacts are discussed in ER-OL Section 8.1.

- Staff Response

The text has been changed to reflect this comment.

9.5.9 Radiological Impacts

9.5.9.3 Radiological Impacts from Routine Operations

9.5.9.3.2 Radiological Impacts on Humans

DLC-23

The applicant states that Beaver Valley Units 1 and 2 will be operated in accordance with the dose design objectives of Appendix I to 10 CFR 50, as described in NUREG-0133, and the most current version of the "Standard Radiological Effluent Technical Specifications for Pressurized Water Reactors" (NUREG-0472).

· Staff Response

The comment has been noted; no text changes are necessary.

EPA-4

EPA states that the discussion on radiation protection standards "leaves EPA and the public with inadequate assurances that the standards of 40 CFR 190 will be met."

· Staff Response

EPA does not offer any specific basis to support this assertion. Site-specific dose estimates are given in Appendix D, as well as in Section 5.9.3.2. The estimated doses in Appendix D are below the NRC dose design objectives in Appendix I to 10 CFR 50. These objectives, in turn, are more stringent than the EPA 40 CFR 190 standards for radiation protection. Therefore, these estimated doses are far below the EPA 40 CFR 190 standards.

The NRC staff is aware that the standards in 40 CFR 190 apply to the entire uranium fuel cycle, not just to normal operation. However, because of the remoteness of the other operations of the uranium fuel cycle from the area surrounding the Unit 2 site, the contribution from these other fuel cycle operations to the public radiation doses near Unit 2 will be small. Additional information on this topic is in NUREG-0543.

9.5.9.4 Environmental Impacts of Postulated Accidents

9.5.9.4.1 Plant Accidents

EPA-3

EPA expresses concern about the "continuum of NRC documentation of small component failures."

· Staff Response

The small component failure data of the Reactor Safety Study (NUREG-75/014) were used to generate accident sequence probabilities (per reactor-year) for

the accident consequence/risk calculations performed for the DES/FES. The staff maintains failure data on a continuous basis, also. The staff feels that, although the major accident sequence probabilities may change somewhat as a function of small component failure/unavailability, these changes are not likely to lead to changes in risks exceeding fractions of factors of 10 to 100.

9.5.9.4.4 Mitigation of Accident Consequences

(2) Site Features

DLC-24

The applicant notes that the Unit 2 EAB has a 2000-foot radius centered on the Unit 1 containment building.

- Staff Response

As discussed in the response to DLC-3 (Section 9.4.2.2 above), the EAB has been changed. The EAB description has been revised to be consistent with the FSAR.

9.5.9.4.5 Accident Risk and Impact Assessment

(1) Design-Basis Accidents

DLC-28

The applicant states that the EAB distance for the values given in Table 5.8 is 547 m northwest (ER-OL Table 7.1-1). The χ/Q values associated with this distance are being revised and will be included in Table 2.3-38A in the next FSAR amendment. The applicant states that the values may change slightly.

- Staff Response

The doses given in DES Table 5.8 correspond to χ/Q values for an EAB distance of 457 m (1500 feet). The table and doses herein have been revised to correspond to an EAB of 547 m (1794 feet).

(4) Additional Possible Releases to Groundwater

DOI-3

DOI states that Note 7 of Table 5.6 indicates that there will be no radiological monitoring of groundwater on the site, because the current hydraulic gradient is northwest toward the river. DOI suggests that during operation, pumping from the onsite wells will cause changes in the gradient direction that would make radiological monitoring as well as chemical and biological monitoring advisable at the site. DOI adds that application of aquifer characteristics given in the DES on pages 5-41 and 5-42 indicates that the reversal of gradient will be appreciable and groundwater travel within the cone of depression will be accelerated. DOI suggests that this issue be reevaluated.

• Staff Response

The two wells that will supply domestic water to the support buildings are located about 427 m (1400 feet) east of the plant. The actual location is east of the highway 168 approach, adjacent to the emergency response facilities building (ERFB). Figure 4.11 shows the location of the ERFB.

The applicant conducted pumping tests on the two wells to determine drawdown. Both wells were pumped for 48 hours; then the drawdowns were measured. For well No. 1 the drawdown was 2.1 m (6.9 feet), for a pumpage rate of 0.79 m^3/min (210 gpm). For well No. 2, the drawdown was about 3.4 m (11 feet), for a pumpage rate of 0.44 m^3/sec (115 gpm). The applicant notes that because groundwater pumpage rate during operation will be less than the rates used during the pumping tests, the corresponding drawdown will also be less. As stated in Section 5.3.2.2, groundwater requirements for Unit 2 will average about 0.11 m^3/sec (27.8 gpm or 0.06 cfs).

When a well is pumped, the groundwater level is lowered for some radial distance away from the well. This lowering, or cone of depression as it is called, is greatest at the well and decreases with increasing distance from the pumped well. At some distance from the well, pumpage will have no effect on the groundwater level. The distance from the well to the point at which the groundwater table is not affected is commonly referred to as the radius of influence.

The staff estimated the radius of influence for both wells using the drawdown values provided by the applicant and a conservative value of 6.1×10^{-3} cm/sec (2.0×10^{-4} ft/sec) for the hydraulic conductivity of the aquifer material. The staff's drawdown estimates were 48.8 m (160 feet) for well No. 1 and 79.3 m (260 feet) for well No. 2. Because the wells are located 427 m (1400 feet) from the plant, the staff concludes that the cone of depression formed by pumping groundwater from two onsite wells will not affect the direction of groundwater flow beneath the plant. Therefore, radiological monitoring of the groundwater is not required.

The onsite wells are routinely monitored for chemical and biological contaminants.

(6) Risk Considerations

DLC-27

The applicant notes that although a "10-mile EPZ" is used, the actual EPZ boundary follows various natural and political boundaries located approximately 10 miles from the site. The Beaver Valley Emergency Preparedness Plan contains detailed information on the EPZ.

• Staff Response

The staff acknowledges the actual EPZ boundaries. The 10-mile circular EPZ boundaries shown on Figures 5.10 and 5.11 are for illustrative purposes. They are intended to allow the reader a better visualization of the risk isopleths for early fatality and latent cancer fatality, as indicated by the footnotes on revised Figures 5.10 and 5.11.

(7) Uncertainties

DLC-25

The applicant states that although uncertainties associated with emergency response do exist, the Beaver Valley Emergency Preparedness Plan and associated equipment and facilities, combined with an extensive training program for local residents, have attempted to minimize these uncertainties. The applicant has (1) conducted extensive evacuation studies, (2) used state-of-the-art equipment to aid in making the evacuation-versus-shelter decision, (3) held training programs for EPZ residents, and (4) cooperated and coordinated actions with state and local agencies. These efforts, the applicant states, have resulted in "exceptional emergency drills which, in turn, reflect the adequacy of the Emergency Plan and the minimization of the uncertainties in early health consequences."

· Staff Response

The staff agrees that the applicant's efforts in the area of emergency preparedness have generally been thorough and complete. The intended thrust of the staff's statement regarding emergency response effectiveness was directed toward the differences between emergency response modeling assumptions in the CRAC computer code and the actual emergency response activities during reactor accidents at the site. The staff acknowledges that these differences constitute a source of uncertainty in the staff's early health consequence analyses.

9.5.11 Decommissioning

EPA-6

EPA comments that the DES is not self contained regarding radiation dose estimates for the different decommissioning alternatives. EPA also mentions that NRC is developing information on decommissioning that is more explicit than that currently available and suggests that the FES include information more detailed than that in the DES.

· Staff Response

It is the staff's position that it is not necessary to include detailed information on dose estimates for the decommissioning alternatives in the DES/FES. Moreover, it would make the DES/FES too voluminous. Detailed dose estimates for the decommissioning alternatives are on pages 4-3 to 13 of Section 4.3 of NUREG-0586.

9.5.14 Environmental Monitoring

9.5.14.2 Aquatic Monitoring

DLC-26

The applicant notes that the NPDES permit was issued on November 26, 1984.

• Staff Response

The text has been revised to reflect the issuance of the NPDES permit.

9.6 Evaluation of the Proposed Action

9.6.1 Unavoidable Adverse Impacts

DLC-30

The applicant states that the noise impact for the operation of Unit 2 listed in Table 6.1 should be "small".

• Staff Response

This determination is somewhat subjective. Because of (1) the high ambient sound levels and existing concern over noise in the site environs and (2) uncertainties in the analyses, the staff concluded that the ultimate evaluation of the significance of noise would be made during station operation (see Section 5.14.4).

9.6.4 Benefit-Cost Summary

9.6.4.1 Summary

DLC-29

The applicant states that production costs should be 28 mills/kWhr, resulting in a total annual cost avoided of $112 million. In addition, based on recent experience at Unit 1, the applicant states that the 55% average capacity figure is conservative and that the higher capacity figures would result in even greater savings.

• Staff Response

In performing the analysis at issue, the staff intended to determine the potential impact of operation of the Beaver Valley facility on the applicant's annual production (operating) costs. The analysis indicates that substantial savings will accrue as a result of the plant's operation. These savings were derived even though the staff employed considerable conservatism in its assumptions regarding capacity factor and sources of replacment energy. Although the staff agrees with the applicant that the estimate provided in the DES may be low, the staff considers that the applicant's calculation of savings is in error. The applicant's analysis fails to include, as part of the operating cost for the Beaver Valley unit, the total operating and maintenance (O&M) cost.

Recent information indicates that more than 90% of the O&M cost for a nuclear facility is fixed; that is, this cost will be incurred regardless of the amount of energy generated. However, these fixed costs will be incurred only after an operating license is granted. If the unit is not licensed (the issue under consideration), neither fixed or variable O&M cost will result. To exclude O&M costs in performing a comparative analysis of this type develops extremely biased results. This is particularly true in light of the recent trend in the rate of increase of O&M costs for commercial nuclear facilities.

In summary, the staff feels that although the estimate of savings provided in the DES is conservative, it also is reasonable and serves to illustrate that there will be considerable economic benefit from the operation of the plant.

9.10 Appendices

9.10.3 Appendix C

JFD comments that Appendix C does not mention other serious cancer and infant mortality impacts on people from tailings piles that must be created to provide the fuel for the plant.

· Staff Response

Appendix C contains estimates of the population dose commitments due to the release of radon-222 from stabilized-tailings piles at uranium mills for each year of operation of the model 1000-MWe light water reactor (LWR) and the estimated risk of cancer deaths to humans as a result of exposure. The basis for the health risk estimates is given in Section 5 of Appendix C. This section, in turn, refers to DES/FES Section 5.9.3.1, which describes in more detail the health effects models and risk estimators used by the staff, which consider nonfatal, genetic, and fatal health effects for all age groups, including infants.

EPA-5

EPA expresses concern about the evaluation of potential radiation doses and health effects that may result from the exposure to background levels of radon-222. EPA notes that the estimated dose of 450 milliems to the bronchial epithelium from exposure to radon-222 from natural sources has been reevaluated in a more recent report by the National Council on Radiation Protection and Measurement (NCRP).

· Staff Response

The staff is aware of the NCRP report cited by EPA ("Exposure from the Uranium Series with Emphasis on Radon and its Daughters," NCRP No. 77), as well as NCRP Report No. 78, "Evaluation of Occupational and Environmental Exposures to Radon and Radon Daughters in the United States." According to NCRP No. 77, the annual dose to the bronchial epithelium from exposure to inhaled radon-222 and its short-lived daughters in indoor air is estimated to be about 3000 mrems/yr. As noted in NCRP No. 77, the estimated dose is based on the median value of radon daughter concentrations measured in 26 dwellings in New York and New Jersey over a 2-year period. The concentrations vary considerably, depending on type of building and location in building, as well as on other factors. Because it is difficult to predict indoor radon daughter concentrations far into the future, the staff has relied on comparisons with background radon daughter concentrations in outdoor air, rather than indoor air. In summary, the use of data in NCRP Reports Nos. 77 and 78 in the comparison in Appendix C of this report does not change the staff's conclusion 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.

Minor changes to the text in Appendix C have been made accordingly.

9.10.4 Appendix D

JFD comments that the staff's discussion of radiation dose calculations in Appendix D should indicate whether radiation exposures of rapidly multiplying breast tissue cells of females at puberty and women in the early stages of pregnancy are accounted for in the calculations.

· Staff Response

The staff interpreted this comment as being basically concerned with the increased sensitivity of the female breast tissues to radiation-induced cancers if irradiation occurs when breast tissue cells are multiplying rapidly.

The staff is aware of the evidence from human studies that suggest that female breast tissue may be more sensitive to radiation carcinogenesis if irradiation occurs at times of breast tissue proliferation (Boice and Stone, 1978; McGregor et al., 1977). As stated in Section 5.9.3.2, the staff has concluded that the risks to the general public from exposure to radioactive effluents and transportation of fuel and wastes from the annual operation of the Beaver Valley facility are very small fractions of the estimated normal incidence of cancer fatalities and genetic abnormalities from causes unrelated to the operation of the Beaver Valley facility in the year 2010 population.

On the basis of the preceding comparison, the NRC staff concludes that the risk to the public health and safety from exposure to radioactivity associated with the normal operation of the Beaver Valley facility will be very small.

DLC-31

The applicant states that the dilutions factors given in Table D.5 do not agree with the ER Table 5C-3 (Amendment 6). The applicant believes that the staff's dilution factors are overly conservative, especially for Chester, West Virginia.

· Staff Response

The footnotes to Table D.5 state that dilution factors were assumed for purposes of an upper limit estimate. Thus the staff agrees that the dilution factors given in Table D.5 are conservative. The rationale for using conservative dilution factors is described more fully in Chapter 4 of NUREG-0133.

The staff's initial evaluation of the drinking water exposure pathway at Chester estimated the annual dose commitment using the conservative dilution factor presented in Table D.5. The resultant dose, shown in Table D.6, turned out to be below the design objectives of 10 CFR 50, Appendix I. Because this initial evaluation, performed using a conservative dilution factor, showed that the dose would be below the NRC dose design objectives, there was no reason for the staff to perform a more rigorous dose assessment using a more realistic dilution factor.

9.11 References

Boice, J.D. Jr. and B.J. Stone, "Interaction between Radiation and Other Breast Cancer Risk Factors," in Late Biological Effects of Ionizing Radiation, Vol 1, International Atomic Energy, 1978.

McGregor, D.H., et al., "Breast Cancer Incidence Among Atomic Bomb Survivors, Hiroshima and Nagasaki, 1950-69," in Journal of the National Cancer Institute, Vol 59, 1977.

National Council on Radiation Protection (NCRP), "Exposure from the Uranium Series with Emphasis on Radon and its Daughters," NCRP No. 77, March 1984.

---, "Evaluation of Occupational and Environmental Exposures to Radon and Radon Daughters in the United States," NCRP No. 78, May 1984.

U.S. Nuclear Regulatory Commission, NUREG-75/014, "Reactor Safety Study," 1975 (formerly published by the U.S. Atomic Energy Commission as WASH-1400).

---, NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants," 1978.

---, NUREG-0543, "Methods for Demonstrating LWR Compliance with the EPA Uranium Fuel Cycle Standard (40 CFR Part 190)," February 1980.

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

Table 9.1 Comments on the DES and sections of this report where each comment is addressed

Comment	Section	Comment	Section
USDA	no response needed	DLC 21	9.5.5.2.2
		22	9.5.8
		23	9.5.9.3.2
COE	no response needed	24	9.5.9.4.4(2)
		25	9.5.9.4.5(7)
		26	9.5.1.4.2
PIC	no response needed	27	9.5.9.4.5(6)
		28	9.5.9.4.5(1)
		29	9.6.4.1
DLC 1	9.1.2	30	9.6.1
2	9.4.1	31	9.10.4
3	9.4.2.2		
4	9.4.2.3.2	DOI 1	9.4.2.4
5	9.4.2.3.2	2	9.4.3.5.2
6	9.4.2.4	3	9.5.9.4.5(4)
7	9.4.2.6.1		
8	9.4.2.6.1	JFD 1	9.10.4
9	9.4.2.6.2	2	9.10.3
10	9.4.3.3		
11	9.4.3.4.2	HUD	no response needed
12	9.4.3.4.2		
13	9.4.2.2		
14	9.4.6.1	EPA 1	9.4.3.2, 9.5.3.1
15	9.4.6.1	2	9.5.4.2
16	9.5.3.1	3	9.5.9.4.1
17	9.5.3.1	4	9.5.9.3.2
18	9.5.3.2	5	9.10.3
19	9.5.3.2.2	6	9.5.11
20	9.5.5.1.2		

APPENDIX A

COMMENTS ON THE DRAFT ENVIRONMENTAL STATEMENT

United States Department of Agriculture

Soil Conservation Service

228 Walnut Street, Room 850
Box 985 Federal Square Station
Harrisburg, Pennsylvania 17108-0985

February 13, 1985

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

Dear Sir:

Our agency has received a copy of the Draft Environmental Statement related to the proposed operation of the Beaver Valley Power Station, Unit 2.

This document has been reviewed and we have no comments on the operational impacts detailed in this assessment. Our primary concerns on this project related to the construction permit phase and were previously evaluated in the Final Environmental Statement prepared in October 1973.

Sincerely,

John J. Mank
Assistant State Conservationist
for Natural Resource Projects

cc:
Thomas N. Shiflet, Director of Ecological Sciences, SCS, Washington, DC

8502200286 850213
PDR ADOCK 05000412
D PDR

COE

DEPARTMENT OF THE ARMY
PITTSBURGH DISTRICT, CORPS OF ENGINEERS
WILLIAM S. MOORHEAD FEDERAL BUILDING
1000 LIBERTY AVENUE, PITTSBURGH, PA 15222-4186

February 19, 1985

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

Dear Sir:

We have reviewed the Draft Environmental Statement for the operation of the Beaver Valley Power Station, Unit 2, and have no comments to offer relative to our mission responsibility.

Sincerely,

George Zingle, Jr., P.E.
Chief, Planning Division

Pennsylvania Intergovernmental Council
P. O. BOX 11880 · HARRISBURG, PA. 17108-1880 · (717) 783-3700

February 27, 1985

U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Attention: Director, Division of Licensing

Dear Sir or Madam:

Subject: Draft Environmental Statement - Beaver Valley Power Station, Unit 2

Pennsylvania's Single Point of Contact under Executive Order 12372 (Intergovernmental Review of Federal Programs) has received copies of the Draft Environmental Statement for the Beaver Valley Power Station, Unit 2. We distributed copies to several of our reviewing agencies; these agencies do not wish to comment on the Statement.

We appreciate the opportunity to review this document.

Sincerely,

Barbara J. Gontz
Project Coordinator
Intergovernmental Review Process

BJG/slk

DLC

Duquesne Light

Nuclear Construction Division
Robinson Plaza, Building 2, Suite 210
Pittsburgh, PA 15205

2NRC-5-034
(412) 787-5141
(412) 923-1960
Telecopy (412) 787-2629

March 1, 1985

United States Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Ms. Marilyn Ley
Divison of Licensing

SUBJECT: Beaver Valley Power Station - Unit No. 2
Docket No. 50-412
BVPS-2 Draft Enviromental Statement Comments

Gentlemen:

Please find enclosed DLC comments on the BV-2 Draft Environmental Statement. These comments are divided into two parts: the editorial (Attachment 1) and those that are substantial in nature (Attachment 2).

If there are any questions, please contact T. J. Zoglmann at (412) 787-5141.

DUQUESNE LIGHT COMPANY

By E. J. Woolever
Vice President

TJZ/wjs
Attachment

cc: Mr. B. K. Singh, Project Manager (w/a)
Mr. G. Walton, NRC Resident Inspector (w/a)

ATTACHMENT 1

Editorial Comments on BV-2 DES

Pg. No.	Section	Line No.	
V	Item 3	9	FES CP is dated July 1973
3-1	3	2	Spelling: "ongoing"
4-5	4.2.4	9, 34	Figure 4-3 should be 4-9
4-5	4.2.4	36	(11,365 gpm) should be (10,463 gpm)
4-5	4.2.4	43	(3.4°F) should be (2.4°F)
4-7	4.2.6.1	28	87065 L/M should be 87065 L/d
		34	Spelling: "contactor"
4-8	4.2.7	9	"three" should be "two"
		11	Spelling: "Hanna"
		12	"three" should be "two"
4-18	4.3.7	15	Spelling: "declined"
4-21	F4.1	Title	Spelling: "values"
4-29	Fig. 4-9		not found in ER-OL-FSAR or FES-CP
4-30	Fig. 4-10		not found in ER-OL-FSAR or FES-CP although similar to EROL Fig. 2.4-1
4-32	T4.1	19	percent of site should be "< or less than 0.1" for oil tank
4-33	T4-2	1	Spelling: "qualify"
		45B2	Wellston silt loam
		45C2	Wellston silt loam
		MS-CD	8-25
		MA-AB	Urban & Fill land
		d	Spelling: "qualify"
4-38	T4.6	Source	ER-OL Table 5.4-1
4-39	T4.7	Title	delete second "line"
		Area Co. 1	"miles" should be "Acres"
	T4.8		1968-1970 data is not in ER-OL Table 2.4-10
4-42	T4.10	June 14, 1983	1.28 is 1.88
		July 12, 1983	79.44 is 79.94; 27.37 is 87.37
5-3	5.3.1	13	ER-OL Table 5.3.4
5-6	5.5.1	3.	Spelling: "preoperational"
5-6	5.5.1.1	18	Spelling: "Valley"
5-7	5.5.1.2	1	Spelling: "Crescent"
		2	Spelling: "expected"
		4	Spelling: "anticipated"
5-9	5.5.2.2	24	change 1.59 mg/1 to 5.93 mg/L
5-27	5.9.4.2	16, 21, 32	Spelling: "meteorology"
5-32	5.9.4.4	21	(3.6 mile)
5-34	5.9.4.5	42	Spelling: "concentration"
5-39	5.9.4.5	5, 6, 7	delete lines 5, 6, and 7
5-39	5.9.4.5	45	Indian "Point"
5-56	5.12	35	Spelling: "loudspeaker"
5-86	Fig. 5-22		North Cooling Tower is BV-1 Cooling Tower South Cooling Tower is BV-2 Cooling Tower
5-89	T5.1		species name missing from first line of table
5-90	T5.3	Title	($Thousands)
		1989	change 18533 to 17,533
5-91	T5.4	heading & ***	shouldn't 105 person years be 10^5 person years?
D-5	TD-2		Nearest milk goat is 21Km (FSAR-T-2.3-41)
D-6	TD-3		Nearest milk goat is 21Km (FSAR-T-2.3-41)

ATTACHMENT 2

Comments on BV-2 DES

	Pg. No.	Section	Line No.	
		All Sections: General comment on the Draft Environmental Statement: Although the staff's assumptions are generally more conservative than the applicants, the overall conclusions arrived at in the DES indicates that the benefits associated with the operation of BVPS-2 far outweigh the environmental costs.		
DLC-1	1-2	1.2	13	The NPDES permit for BVPS was issued on November 26, 1984, and will be submitted as information to the staff in March, 1985.
DLC-2	4-1	4.1	90	The maximum water velocity has increased across the bar racks in the main intake structure as discussed in Section 4.2.4.
DLC-3	4-2	4.2.2	19	The BVPS-2 EAB has been changed to a 2,000 ft. radius centered on the BVPS-1 containment building. This change has been discussed with the staff and is docketed under letter No. 2NRC-5-015 on February 1, 1985.
DLC-4	4-3	4.2.3.2	8	The free available chlorine (FAC) concentration "at the condenser outlet" should be changed to "at the discharge to the river" per the BVPS NPDES permit (outfall 001).
DLC-5	4-4	4.2.3.2	37, 38	The proprietary substance Calgon CL-4000 used to treat the secondary component cooling water and cooling tower water has been changed to Betz DUQ.01.
DLC-6	4-5	4.2.4	16	The service water system provides once-through cooling of primary and secondary heat exchangers, control room refrigerant condensing units, safeguards area air conditioners, main steam valve area cooling coils, auxiliary building motor control center cooling units, and charging pump coolers. The control room air conditioners are cooled by the chilled water system.
DLC-7	4-7	4.2.6.1	1	The separate sewage treatment facility was built to handle the increased sanitary load of the BVPS-1 & -2 support buildings (ERF, Training Bldg.,South Office Shops, Primary Access Facility).
DLC-8	4-7	4.2.6.1	13	Revise the line as follows: All of these discharges are to the Ohio River except the sanitary wastes and the discharge from the oil water seperator serving the Fuel Oil Unloading Facility (released to Peggs Run, a tributary of the Ohio River)...
DLC-9	4-8	4.2.6.2	10	Change the sentence to read: The emergency diesel generators are tested once a month for one hour; ...
DLC-10	4-11	4.3.3	5	DLC does not know of any "hurricanes" being recorded for the Beaver Valley site area (FSAR 2.3.1.2.1). Any hurricanes that have approached the region have been downgraded before they have reached the site.

Comments on BV-2 DES (page 2)

Pg. No.	Section	Line No.		
4-14	4.3.4.2		DLC believes that it is overly conservative to indicate any significant commercial fish harvest for the Ohio River near the BV site.	DLC-11
4-16	4.3.4.2	15	The BVPS-2 SER has not been published, it is anticipated that the SER will be issued by March 30, 1985.	DLC-12
4-22	Fig. 4-2		The EAB has been changed to a 2,000 ft. radius centered on the BV-1 containment building as discussed in letter No. 2NRC-5-015, dated February 1, 1985.	DLC-13
4-36 and 4-37	T4.4 T4.5		Table 4.4 (Current Effluent Limitations for Unit 1) and Table 4.5 (Anticipated Effluent Limitations for Unit 2) should be revised in accordance with the NPDES permit for BV-1 and BV-2 issued on November 26, 1984, since the permit is final.	DLC-14
4-38	T4.6		Table 4.6 should be revised in accordance with the NPDES permit issued on November 26, 1984. The Pennsylvania DES Permit Number noted at the bottom of the table should specify the permit that applies to each specific sewage treatment plant, i.e., 0479403 (Unit 1) and 0482404 (Unit 2).	DLC-15
5-3	5.3.1	13	Add: The DER after reviewing the Ohio River water quality and discharges from the BV-1 and BV-2 power stations elected not to impose any water quality based limits in the NPDES permits.	DLC-16
5-3	5.3.1	26	Add: The NPDES permit has been appealed with respect to FAC limits imposed on the Unit 1 and Unit 2 cooling tower blowdown due to severe condenser tube corrosion on Unit 1 resulting in the complete retubing of the Unit 1 condenser in 1984. In this regard, DLC is proposing to conduct a chlorine minimization study to allow for either increased FAC discharge times (greater than 2 hours per day per unit) and/or higher FAC effluent limitations. The permittee has also appealed the FAC chlorination limits imposed in the NPDES permit, in that, they are ambiguous as to whether they apply to the dosing period or to the period of discharge into the river.	DLC-17
5-3	5.3.2	6	The main BV-2 plant buildings sewage is discharged to the BVPS-1 sewage plant. The BV-2 sewage plant is used only for support buildings (ERF, Training Building, etc.)...	DLC-18
5-4	5.3.2.2	3	BV-2 main plant structures receives its potable water from BV-1, only the support buildings use well water.	DLC-19
5-7	5.5.1.2	22	DLC has never had any "serious" problems with its 345 Kv lines. Therefore, delete the word "serious."	DLC-20

Comments on BV-2 DES (page 3)

	Pg. No.	Section	Line No.	
DLC-21	5-10	5.5.2.2		The second through fourth sentences should be amended as follows: The stream is now expected to receive the treated effluents from the Unit 2 Sewage Treatment Plant (Section 4.2.6) and from the Oil Water Separator located at the Fuel Oil Unloading Facility. The design flow of the sewage treatment plant constitutes more than 1% of the creek's mean flow (estimated by the applicant at 140 L/sec or 5cfs ER-OL Section 2.4.3). The discharge from the oil water separator is low volume in nature and intermittent. Because Pegg's Run is already a highly degraded stream (Section 4.3.3.2), the potential effects of the sewage discharge (e.g., high oxygen demand and suspended solids) and oil water separator discharge (e.g., oil/grease and suspended solids) on Pegg's Run would be limited.
DLC-22	5-12	5.8	2	The socioeconomic impacts are discussed in ER-OL Section 8.1.
DLC-23	5-20	5.9.3.2		Although BVPS-2 meets RM-50-2 criteria, the applicant will follow Appendix I operational criteria per NUREG 0133 and Standard Radiological Tech. Specs.
DLC-24	5-32	5.9.4.4(2)	8	The BV-2 EAB is a 2,000 ft. radius centered on the BV-1 containment building.
DLC-25	5-50	Para. 1		Emergency Response Effectiveness: Although uncertainties associated with emergency response do exist, the BV-Emergency Preparedness Plan and associated equipment and facilities combined with an extensive training program for local residents, has attempted to minimize the impact of these uncertainties. The applicant has performed a number of actions to address these uncertainties: a) extensive evacuation studies; b) state of the art equipment to aid in the evacuation vs. shelter decision; c) complete training programs for residents within the EPZ; d) complete cooperation and coordination with State and Local agencies. The above efforts have realized exceptional emergency drills which in turn reflect the adequacy of the Emergency Plan and the minimization of the uncertainties in early health consequences.
DLC-26	5-57	5.14.2		The NPDES permit was issued on November 26, 1984.
DLC-27	5-73 and 5-74	Fig. 5-10 Fig. 5-11		Although BVPS uses a "10 mile EPZ," the actual EPZ boundary follows various natural and political boundaries located approximately 10 miles from the site. The BVPS Emergency Preparedness Plan contains the detailed information on the EPZ.

Comments on BV-2 DES (page 4)

Pg. No.	Section	Line No.		
5-99	T5.8		The EAB distance for these values is 547 meters N.W. The source is ER-OL Table 7.1-1. The x/q values associated with this distance are being revised and will be included in the next FSAR amendment (FSAR Table 2.3-38A). The values may change slightly.	DLC-28
6-1 and 6-2	6.4.1 6.4.1		Production costs should be 28 mills/kwhr resulting in a total annual cost avoided of $112 million; ER-OL responses to question 320.01. Also based on recent BV-1 capacity factors (1983-64.9%; 1984-67.4%), the applicant believes that the 55% average capacity factor is conservative and that the higher capacity factors would result in even greater savings.	DLC-29
6-3	T6.1	Noise	The applicant believes that the noise impact for the operation of BV-2 should be "small".	DLC-30
D-7	TD-5		The dilution factors do not agree with ER Table 5C-3 Amendment 6. The applicant believes that the staff's dilution factors are overly conservative, especially for Chester, WV.	DLC-31

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

ER 85/139

MAR 1 1985

George W. Knighton, Chief
Licensing Branch No. 3
Division of Licensing
Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Knighton:

Thank you for your letter of January 11, 1985, transmitting copies of the draft environmental impact statement (OLS) for Beaver Valley Power Station, Unit 2, Beaver County, Pennsylvania. Our comments are presented according to the format of the statement or by subject.

Cooling System

DOI-1 The draft statement indicates on page 4-5 that there would be an increase in the discharge water temperature during the operation of both Units 1 and 2. The discharge temperature differential above ambient of 1.3°C to 15.9°C and maximum change of 22°C would seasonally exceed the Pennsylvania State Water Quality Standards for water temperature of discharges into warmwater fishery areas. This standard was set to protect indigenous fishes and aquatic resources against thermal shock. The final statement should discuss the alternatives that were considered to reduce the temperature differential in the heated discharge and present the rationale for choosing the selected method of discharge.

Aquatic

DOI-2 Biologists of the State College, Pennsylvania, Field Office of the Fish and Wildlife Service have collected two skipjack herrings upstream from the Beaver Valley plant site. Up until this time, the skipjack herring was thought to have been extirpated from the area. Therefore, the final statement should be revised to reflect the occurrence of the skipjack herring within the proposed project area.

Groundwater Monitoring

DOI-3 Note 7 of Table 5.6, Preoperational Radiological Monitoring Program for Beaver Valley, Unit 2, indicates that there will be no radiological monitoring of ground water on the site, because the current hydraulic gradient is northwest toward the river. We suggest that during operation, pumping from the onsite wells will cause changes in the gradient direction that would make radiological monitoring as well as chemical and biological monitoring advisable at the site. Application of the aquifer characteristics given in the

statement on pages 5-41 and 5-42 indicates that the reversal of gradient will be appreciable and ground-water travel within the cone of depression will be accelerated. This issue should be reevaluated.

We hope these comments will be helpful to you.

Sincerely,

Bruce Blanchard, Director
Environmental Project Review

JFD

March 4, 1985

318 Summit Ave. #3
Brighton, Mass. 02135

Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington D. C. 20555

RE: COMMENTS ON THE DRAFT ENVIRONMENTAL STATEMENT RELATED TO THE OPERATION OF THE BEAVER VALLEY POWER STATION, UNIT 2 (NUREG-1094) (Docket 50-412)

John F. Doherty, address above, comments as below on the DEIS of the Commission with regard to the Beaver Valley plant.

Comment 1

JFD-1 Page D-1 of the DES states, "For younger persons, changes in organ mass and metabolic parameters with age after the initial uptake of radioactivity are accounted for." This would seem to indicate an accounting for the age, but not the sex of the individual. While there are certainly changes with age in adolescense for both sexes, the DES should indicate if its assessment of dose takes into account exposure to radiation from the plant for females at puberty and women in the early stages of pregnancy when there is rapid proliferation of breast tissue cells with increased risk of one of the forms of breast cancer.

Comment 2

JFD-2 The DES fails to mention other serious cancer and infant mortality impacts on human beings from tailings piles which must be created to provide the fuel for the Beaver Valley - 2 plant. Thus, at pages 4 and 5 of Appendix C, in the section titled "Radon-222" the DES should mention both non-fatal cancers and deaths to infants due to radiation induced birth defects.

Thank you for this opportunity.

Respectfully,

John F. Doherty, J.D.

John F. Doherty

c.c. Ms. Marilyn Ley, Project Manager

U.S. Department of Housing and Urban Development
Philadelphia Regional Office, Region III
Liberty Square Building
105 South Seventh Street
Philadelphia, Pennsylvania 19106-3392

MAR 8 1985

Director
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Sir:

We have completed our review of the Draft Environmental Statement for the Beaver Valley Power Station, Unit 2, and have no comments to offer.

Thank you for the opportunity to review this document.

Sincerely,

Francis X. Healy

Kenneth J. Finlayson
Regional Administrator

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
841 Chestnut Building
Philadelphia, Pennsylvania 19107

Mr. George W. Knighton, Chief
Licensing Branch No.3
Division of Licensing
Nuclear Regulatory Commission
Washington, D.C. 20555

MAR 11 1985

Dear Mr. Knighton:

Region III of EPA has completed its review of the Draft EIS related to the operation of the Beaver Valley Nuclear Power Station. Our comments presented below center around the issues of water quality, air quality, radiation, and decommissioning. These concerns have led us to the conclusion that the Draft EIS deserves a rating of EC-2, meaning that we have environmental concerns relating to the issues above, and that the the document includes insufficient information for these areas of concern. Our technical comments are presented here for your consideration in preparing the Final EIS.

Water Issues:

EPA-1 Although most of the information presented in the Draft EIS is adequate, we have reservations regarding the effluent water quality. The water quality description on pages 4-10 and following indicates that improvement in water quality has been made since 1974, appearing to indicate an upward trend. The text on pages 5-3 and 5-9, on the other hand, detail loadings of criteria pollutants that will add to the pollution load levels already existing in the receiving waters. Even though it is stated that these loadings and levels will "... not necessarily result in adverse effects...", we feel that using mortality and survival as the measures of water quality begs the issue of maintaining and improving water quality. The operator should make an effort to lower or eliminate these pollutant levels through treatment so that water quality in the receiving waters may continue its current upward trend in quality.

It is EPA's policy to adhere to the antidegradation clause of the Clean Water Act. The practice of incremental addition of these and other pollutants at this plant appears to set an unwise precedent that may be repeated elsewhere. Such incremental additions can result in the long term cumulative effects throughout receiving streams that appears to be contrary to the principles of the Clean Water Act.

Air Issues:

EPA-2 The description of airborne releases on page 5-5 presumes that, since the total annual emission does not exceed 250 tons and no air pollution standard will be violated, no further analyses are needed. This presumption is not necessarily correct. The 250 tons per year is a cutoff below which no PSD (prevention of significant deterioration) permit is required. The fact that plant's emissions will be below the cutoff does not assure that the ambient standards will be met. The document is deficient in the area of air quality analyses since no calculation of the expected air quality is performed, nor are the emission estimates stated. This is a

serious deficiency and should be cleared up prior to publication of the Final EIS so that it is assured that air quality standards will not be exceeded.

Radiation Issues:

It is acknowledged that most of the airborne radiological releases are a result of normal operation and it is our opinion that this issue is adequately treated in the document. It is also our opinion that accidental releases are probably adequately treated, we are concerned with the the continuum of NRC documention of small component failures. The likelihood of a major accident is probably not misrepresented, however. EPA-3

In another matter, EPA has set standards for radiation releases from the uranium fuel cycle. Page 5-21 states that Unit 2 will be in compliance with the standard, using the statement, "the NRC staff concludes that under normal operations the Beaver Valley facility is capable of operating within these EPA standards." The identical statement has appeared in previous EIS's and leaves EPA and the public with inadequate assurances that the standards of 40 CFR 190 will be met. These standards apply to the entire uranium fuel cycle, not just operation of the power plant. EPA-4

Furthermore, page 6 of Appendix C quotes a 1975 NCRP (National Council on Radiation Protection) report regarding impacts of radon 222 dose to bronchial epithelium. The national average yielding a dose of 450 millirems has been revised to 3000 by NCRP, representing a substantial increase. Since mining and milling contribute substantially to the dose from the uranium cycle the use of obsolete information is improper in this document. The Final EIS and other future NRC and applicant documents should reflect the revised limits. EPA-5

Decommissioning:

Page 5-53 and following presents too little information regarding dose estimates and reviewers had to look elsewhere in NRC documents. In addition, one reviewer was informed that NRC is developing more explicit information than is currently available on decommissioning. The Final EIS should include more detailed information than is detailed in this document. EPA-6

Conclusion:

Improved analytical work and updated information is important to your Final EIS. In addition, further work on the possibilities of treating the effluent from the various water-using operations should be carried out. If you have any questions on any of these issues please call Bob Davis on (215) 597-8327 (Comm. and FTS).

Sincerely,

John R. Pomponio

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 miles) of Beaver Valley Unit 2 employing the same dose calculation models used for individual doses (see RG 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 RG 1.111, Revision 1, is used in conjunction with the dose models in RG 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 Beaver Valley Unit 2.

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 RG 1.111, Revision 1, and the dose models described in RG 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 world-wide-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 U.S. toward the northeastern corner of the U.S. The model for the world-wide-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/s.

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) World-Wide Dispersion

For estimating the dose commitment to the U.S. population after the first-pass, world-wide 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 world-wide-dispersion model estimates the activity of each nuclide at the end of a 20-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, carbon-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 20 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 due to effluents in the receiving water within 80 km of the facility are calculated as described in RG 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, NUREG-0597, K. F. Eckerman, et al., "User's Guide to GASPAR Code," June 1980.

---, RG 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.

---, RG 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Reactors," Revision 1, July 1977.

APPENDIX C

IMPACTS OF THE URANIUM FUEL CYCLE

APPENDIX C

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 of Title 10 of the Code of Federal Regulations, Part 50 (10 CFR 50) (see Section 5.10 of the main body of this report) and the NRC staff's estimates of radon-222 and technetium-99 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 Beaver Valley Power Station, Unit 2.

1. Land Use

The total annual land requirement for the fuel cycle supporting a model 1000-MWe LWR is about 460,000 m² (113 acres). Approximately 53,000 m² (13 acres) per year are permanently committed land, and 405,000 m² (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 abandoment 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 m² per year of temporarily committed land, 320,000 m² are undisturbed and 90,000 m² 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 m³ (11.4×10^9 gal), about 42×10^6 m³ 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 0.6×10^6 m³ (16×10^7 gal) per year and water discharged to the ground (for example, mine drainage) of about 0.5×10^6 m³ 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

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*A coal-fired plant of 1000-MWe capacity using strip-mined coal requires the disturbance of about 810,000 m² (200 acres) per year for fuel alone.

consumptive water use of 0.6×10^6 m^3 per year is about 2% of that from the 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 (CEQ, 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-enchrichment, -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 U.S. 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 environmental dose commitment* to the U.S population from the LWR-supporting fuel cycle. Dose commitments are provided in this section for exposure to four categories of radioactive releases: (1) airborne effluents that are quantified in Table S-3 (that is, all radionuclides except radon-222 and technetium-99); (2) liquid effluents that are quantified in Table S-3 (that is, all radionuclides except technetium-99); (3) the staff's estimates of radon-222 releases; and (4) the staff's estimate of technetium-99 releases. Dose commitments from the first two categories are also described in a proposed explanatory narrative for Table S-3, which was published in the Federal Register on March 4, 1981 (46 FR 15154-15175).

Airborne Effluents

Population dose estimates for exposure to airborne effluents are based on the annual releases listed in Table S-3, using an environmental dose commitment (EDC) time of 100 years.** The computational code used for these estimates is the RABGAD code originally developed for use in the "Generic Environmental Impact Statement on the Use of Mixed Oxide Fuel in Light-Water-Cooled Nuclear Power Plants," GESMO (NUREG-0002, Chapter IV, Section J, Appendix A). Two generic sites are postulated for the points of release of the airborne effluents: (1) a site in the midwestern United States for releases from a fuel reprocessing plant and other facilities, and (2) a site in the western United States for releases from milling and a geological repository.

The following environmental pathways were considered in estimating doses: (1) inhalation and submersion in the plume during its initial passage; (2) ingestion of food; (3) external exposure from radionuclides desposited on soil; and (4) atmospheric resuspension of radionuclides deposited on soil. Radionuclides released to the atmosphere from the midwestern site are assumed to be transported with a mean wind speed of 2 m/sec over a 2413-km (1500-mile)** pathway from the midwestern United States to the northeast corner of the United States, and deposited on vegetation (deposition velocity of 1.0 cm/sec) with subsequent uptake by milk- and meat-producing animals. No removal mechanisms are assumed during the first 100 years, except normal weathering from crops to soil (weathering half-life of 13 days). Dose from exposure to carbon-14 were estimated using the GESMO model to estimate the dose to the population of the United States from the initial passage of carbon-14 before it mixed in the world's carbon pool. The model developed by Killough (1977) was used to estimate doses from exposure to carbon-14 after it mixed in the world's carbon pool.

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*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.

**Here and elsewhere in this narrative insignificant digits are retained for purposes of internal consistency in the model.

In a similar manner, radionuclides released from the western site were assumed to be transported over a 3218-km (2000-mile) pathway to the northeast corner of the United States. The agricultural characteristics that were used in computing doses from exposure to airborne effluents from the two generic sites are described in GESMO (NUREG-0002, page IV J(A)-19). To allow for an increase in population, the population densities used in this analysis were 50% greater than the values used in GESMO (NUREG-0002, page IV J(A)-19).

Liquid Effluents

Population dose estimates for exposure to liquid effluents are based on the annual releases listed in Table S-3 and the hydrological model described in GESMO (NUREG-0002, pages IV J(A)-20, -21, and -22). The following environmental pathways were considered in estimating doses: (1) ingestion of water and fish; (2) ingestion of food (vegetation, milk, and beef) that had been produced though irrigation; and (3) exposure from shoreline, swimming, and boating activites.

It is estimated from these calculations that the overall total body dose commitment to the U.S. population from exposure to gaseous releases from the fuel cycle (excluding reactor releases and the dose commitment due to radon-222 and technetium-99) would be approximately 450 person-rems to the total body for each year of operation of the model 1000-MWe LWR (reference reactor year, or RRY). Based on Table S-3 values, the additional 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 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 550 person-rems to the total body (whole body) per RRY.

Because there are higher dose commitments to certain organs (for example, lung, bone, and thyroid) than to the total body, the total risk of radiogenic cancer is not addressed by the total body dose commitment alone. Using risk estimators of 135, 6.9, 22, and 13.4 cancer deaths per million person-rems for total body, bone, lung, and thyroid exposures, respectively, it is possible to estimate the total body risk equivalent dose for certain organs (NUREG-0002, Chapter IV, Section J, Appendix B). The sum of the total body risk equivalent dose from those organs is estimated to be about 100 person-rems. When added to the above value, the total 100-year environmental dose commitment would be about 650 person-rems (total body risk equivalent dose) per RRY. (Section 5.9.3.1.1 describes the health effects models in more detail.)

Radon-222

At this time the quantities of radon-222 and technetium-99 releases are not listed in Table S-3. Principal randon 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 (Chapter IV, Section J, Appendix A). The results of these calculations for mining and milling activities prior to tailings stabilization are listed in Table C-2.

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 stablized 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 (Department of Energy, 1978), 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 34 Ci per year per RRY.

Based on a value of 37 Ci per year per RRY for long-term releases from unreclaimed open-pit mines, 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 environmental 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 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, 1978). 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 (that is, Table C-2) is about 0.11 cancer fatality per RRY. When the risks from radon-222 emissions from stabilized tailings and from reclaimed and unreclaimed open-pit mines are added to the value of 0.11 cancer fatality, the overall risks of radon-induced cancer fatalities per RRY are as follows:

0.19 fatality for a 100-year period
2.0 fatalities for a 1000-year period

These doses and predicted health effects have been compared with those that can be expected from natural-background emissions of radon-222. The National Council on Radiation Protection and Measurement (NCRP, 1975) estimates that the average outdoor radon-222 concentration in air in the contiguous United States is about 150 pCi/m^3, and that exposures to this concentration 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 from outdoor inhalation exposure to radon-222 and its daughter products. 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 outdoor 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.

Current NRC regulations (10 CFR 40, Appendix A) require that an earth cover not less than 3 meters in depth be placed over tailings to reduce the Rn-222 emanation from the disposed tailings to less than 2 pCi/m^2-sec, on a calculated basis, above background. In October 1983, the U.S. Environmental Protection Agency (EPA) published environmental standards for the disposal of uranium and thorium mill tailings at licensed commercial processing sites (EPA, 1983). The EPA regulations (40 CFR 192) require that disposal be designed to limit Rn-222 emanation to less than 20 pCi/m^2-sec, averaged over the surface of the disposed tailings. The NRC Office of Nuclear Material Safety and Safeguards is reviewing its regulations for tailings disposal to ensure that they conform with the EPA regulations. Although a few of the dose estimates in this appendix would change if NRC adopts EPA's higher Rn-222 flux limit for disposal of tailings, the basic conclusion of this appendix should still be valid. That conclusion is: "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."

Technetium-99

The staff has calculated the potential 100-year environmental dose commitment to the U.S. population from the release of technetium-99. 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) and are described in more detail in the staff's testimony at the operating license hearing for the Susquehanna Station (Branagan and Struckmeyer, 1981). The gastrointestinal tract and the kidney are the body organs that receive the highest doses from exposure to technetium-99. The total body dose is estimated at less than 1 person-rem per RRY and the total body risk equivalent dose is estimated at less than 10 person-rems per RRY.

Summary of Impacts

The potential radiological impacts of the supporting fuel cycle are summarized in Table C-5 for an environmental dose commitment time of 100 years. For an environmental dose commitment time of 100 years, the total body dose to the U.S. population is about 790 person-rems per RRY, and the corresponding total body risk equivalent dose is about 2000 person-rems per RRY. In a similar manner, the total body dose to the U.S. population is about 3000 person-rems per RRY, and the corresponding total body risk equivalent dose is about 15,000 person-rems per RRY using a 1000-year environmental dose commitment time.

Multiplying the total body risk equivalent dose of 2000 person-rems per RRY by the preceding risk estimator of 135 potential cancer deaths per million person-rems, the staff estimates that about 0.27 cancer death per RRY may occur in the

U.S. population as a result of exposure to effluents from the fuel cycle. Multiplying the total body dose of 790 person-rems per RRY by the genetic risk estimator of 220 potential cases of all forms of genetic disorders per million person-rems, the staff estimates that about 0.17 potential genetic disorder per RRY may occur in all future generations of the population exposed during the 100-year environmental dose commitment time. In a similar manner, the staff estimates that about 2 potential cancer deaths per RRY and about 0.8 potential genetic disorder per RRY may occur using a 1000-year environmental dose commitment time.

Some perspective can be gained by comparing the preceding estimates 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 and about 770,000 and 7,700,000 genetic disorders, 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 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 waste values in Table S-3 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.

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 the 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

Branagan, E., and R. Struckmeyer, testimony from "In the Matter of Pennsylvania Power & Light Company, Allegheny Electric Cooperatives, Inc. (Susquehanna Steam Electric Station, Units 1 and 2)," U.S. Nuclear Regulatory Commission, Docket Nos. 50-387 and 50-388, presented on October 14, 1981, in the transcript following page 1894.

Council on Environmental Quality, "The Seventh Annual Report of the Council on Environmental Quality," Figures 11-27 and 11-28, pages 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.

Killough, G.G., "A Diffusion-Type Model of the Global Carbon Cycle for the Estimation of Dose to the World Population from Releases of Carbon-14 to the Atmosphere," Oak Ridge National Laboratory, ORNL-5269, May 1977.

National Council on Radiation Protection and Measurements (NCRP), "Natural Background Radiation in the United States," NCRP Report No. 45, November 1975.

U.S. Environmental Protection Agency (EPA), "Environmental Standards for Uranium and Thorium Mill Tailings at Licensed Commercial Processing Sites (40 CFR 192)," Federal Register, Vol 48, No. 196, pp. 45926-45947, October 7, 1983.

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 Recycled 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.

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 3 days of hearings before the Atomic Safety and Licensing Appeal Board (ASLB) 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 heath 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.

Table C-2 Estimated 100-year environmental dose commitments per year of operation of the model 1000-MWe LWR

Radon source	Radon-222 releases (Ci)	Environmental dose commitments: Total body (person-rems)	Environmental dose commitments: Bone (person-rems)	Environmental dose commitments: Lung (bronchial epithelium) (person-rems)	Total body risk equivalent dose (person-rems)
Mining	4100	110	2800	2300	630
Milling and active tailings	1100	29	750	620	170
Total	5200	140	3600	2900	800

Table C-3 Estimated 100-year environmental 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)	Environmental dose commitments: Total body (person-rems)	Environmental dose commitments: Bone (person-rems)	Environmental dose commitments: Lung (bronchial epithelium) (person-rems)	Total body risk equivalent dose (person-rems)
100	3,700	96	2,500	2,000	550
500	19,000	480	13,000	11,000	3,000
1,000	37,000	960	25,000	20,000	5,500

Table C-4 Estimated 100-year environmental dose commitments from stabilized-tailings piles for each year of operation of the model 1000-MWe LWR

Time span (years)	Radon-222 releases (Ci)	Environmental dose commitments: Total body (person-rems)	Bone (person-rems)	Lung (bronchial epithelium) (person-rems)	Total body risk equivalent dose (person-rems)
100	100	2.6	68	56	15
500	4,090	110	2,800	2,300	630
1,000	53,800	1,400	37,000	30,000	8,200

Table C-5 Summary of 100-year environmental dose commitments per year of operation of the model 1000-MWe light-water reactor

Source	Total body (person-rems)	Total body risk equivalent (person-rems)
All nuclides in Table S-3 except radon-222 and technetium-99	550	650
Radon-222		
Mining, milling, and active tailings, 5200 Ci	140	800
Unreclaimed open-pit mines, 3700 Ci	96	550
Stabilized tailings, 100 Ci	3	15
Technetium-99, 1.3 Ci*	<1	<10
TOTAL	790	2000

*Dose commitments are based on the "prompt" release of 1.3 Ci/RRY. Additional releases of technetium-99 are estimated to occur at a rate of 0.0039 Ci/yr/RRY after 2000 years of placing wastes in a high-level-waste repository.

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, the quantities of radioactive material that may be released annually from Beaver Valley Power Station Unit 2 are estimated on the basis of the description of the design and operation of the radwaste systems as contained in the applicant's FSAR and by using the calculative models and parameters described in 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 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-mile) radius of the plant as a result of plant operations are discussed in detail in RG 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 is 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 2010. 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 20 years after the station begins operation (that is, the mid-point 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 average relative concentration (χ/Q) and relative deposition (D/Q) values were calculated using the straight-line Gaussian atmospheric dispersion model described in RG 1.111, modified to reflect potential spatial and temporal variations in airflow, using site-specific correction factors developed by the applicant. Releases through the process vent (at the top of the cooling tower)

were assumed to be elevated, and releases from the turbine building were assumed to be at ground level, with mixing in the turbulent wake of plant structures. Releases through the containment vent were assumed to be partially elevated, except for the transport directions (affected sectors) of north-northeast, northeast, east-southeast, and southeast. Dispersion in these transport directions is affected by the large natural draft cooling towers, and, for these transport directions, releases from the containment vent were assumed to be at ground level with mixing in the turbulent wake of plant structures. Intermittent releases through the containment vent were evaluated using the methodology in NUREG/CR-2919.

A 5-year period of record (January 1977-December 1981) of onsite meterological data was used for this evaluation. For releases from the containment and turbine building vents, wind speed and direction data were based on measurements made at the 10.7-m (35-foot) level, and atmospheric stability was defined by the vertical temperature difference between the 45.7-m (150-foot) and 10.7-m levels. For releases through the process vent at the top of the cooling tower, wind speed and direction data were based on measurements made at the 152-m (499-foot) level, and atmospheric stability was defined by the vertical temperature difference between the 152-m and 10.7-m levels.

In addition, 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 also 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 RG 1.109.

(b) Cumulative Dose Commitments to the General Population

Annual radiation dose commitments from airborne and waterborne radioactive releases from Beaver Valley Power Station Unit 2 are estimated for two populations in the year 2010: (1) all members of the general public within 80 km (50 miles) 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

U.S. Nuclear Regulatory Commission, NUREG-0017, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Pressurized Water Reactors (PWR-GALE Code)," April 1976.

---, NUREG/CR-2919, "User's Guide for χOQDOQ: Evaluating Routine Effluent Releases at Commmercial Nuclear Power Stations," J.F. Sagendorf, S.T. Goll, and W.F. Sandusky, September 1982.

---, RG 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.

---, RG 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water Reactors," Revision 1, 1977.

Table D-1 Calculated releases of radioactive materials in gaseous effluents from Beaver Valley Power Station Unit 2 (Ci/yr per reactor)

Nuclides	Sum of reactor containment vacuum, waste gas processing, and air ejector exhausts* (Cont)†	Auxiliary building (Cont)†	Reactor building stack*** (Interm't)†	Turbine building vent**** (Cont)†	Total
Ar-41	a	a	a	a	a
Kr-83m	a	a	a	a	a
Kr-85m	1	2	a	1	3
Kr-85	200	a	b	a	201
Kr-87	a	1	a	a	1
Kr-88	2	4	a	a	6
Kr-89	a	a	a	a	a
Xe-131m	36	a	a	a	36
Xe-133m	2	4	1	a	7
Xe-133	520	34	140	a	694
Xe-135m	a	a	a	a	a
Xe-135	5	4	a	a	9
Xe-137	a	a	a	a	a
Xe-138	a	a	a	a	a
		Total Noble Gases			960
Mn-54	0.000045	0.00018	0.0011	b	0.0011
Fe-59	0.000015	0.000060	0.00037	b	0.00039
Co-58	0.00015	0.00060	0.0037	b	0.0039
Co-60	0.000070	0.00027	0.0017	b	0.0020
Sr-89	0.0000033	0.000013	0.000085	b	0.00010
Sr-90	0.00000070	0.0000024	0.000015	b	0.000018
Cs-134	0.000045	0.00018	0.0011	b	0.0013
Cs-137	0.000075	0.00030	0.0019	b	0.0023
		Total Particulates			0.011
I-131	0.038*	0.0043	a	0.00052	0.043
I-133	0.013*	0.0062	a	0.00069	0.020
H-3	-	770	-	-	770
C-14	8	a	a	a	8

*Continuous, elevated release through cooling tower of Unit 1. The I-131 and I-133 release values consist of I-131 and I-133 release values of 0.035 Ci/yr and 0.009 Ci/yr, respectively, from the present containment vacuum exhaust system, which is not modified to properly filter 90% of the effluent iodine.

**Continuous mixed mode release, the staff assumes that the exhaust fans will be operated continuously during normal plant operations.

***Intermittent release, one 400-hr mixed-mode release per year from the reactor building (containment).

****Continuous, ground level release.

†Interm't = intermittent; cont = continuous.

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 Beaver Valley Unit 2

Location*	Source**	χ/Q (sec/m^3)	Relative deposition (m^{-2})
Nearest effluent-control boundary (0.34 km NE of Unit 2)	A	3.8×10^{-10}	1.1×10^{-9}
	B	1.3×10^{-5}	8.0×10^{-8}
	C	2.9×10^{-5}	1.8×10^{-7}
	D	1.4×10^{-5}	8.0×10^{-8}
Nearest residence and garden (0.61 km NE of Unit 2)	A	6.2×10^{-9}	1.5×10^{-9}
	B	5.1×10^{-6}	3.3×10^{-8}
	C	1.2×10^{-5}	7.7×10^{-8}
	D	5.7×10^{-6}	3.3×10^{-8}
Nearest milk cow (4.4 km WNW of Unit 2)	A	2.2×10^{-8}	1.7×10^{-10}
	B	1.1×10^{-6}	1.7×10^{-10}
	C	2.4×10^{-6}	3.6×10^{-10}
	D	4.8×10^{-6}	1.8×10^{-9}
Nearest milk goat (2.8 km ESE of Unit 2)	A	3.3×10^{-8}	8.3×10^{-10}
	B	3.1×10^{-7}	1.5×10^{-9}
	C	9.4×10^{-7}	4.5×10^{-9}
	D	3.2×10^{-7}	1.5×10^{-9}
Nearest meat animal (4.5 km NW of Unit 2)	A	1.8×10^{-8}	1.5×10^{-10}
	B	1.3×10^{-6}	1.8×10^{-10}
	C	2.6×10^{-6}	3.7×10^{-10}
	D	4.8×10^{-6}	1.8×10^{-9}

*"Nearest" refers to that type of location where the highest radiation dose is expected to occur from all appropriate pathways.

**Sources:

A - Reactor containment vacuum exhaust, waste gas processing or air ejector exhaust, Unit 2, continuous and elevated release.

B - Auxiliary building Unit 2, continuous and mixed mode release; the staff assumes that the exhaust fans will be operated continuously during normal plant operation.

C - Reactor containment purge Unit 2, intermittent and mixed release, 400 hours per year.

D - Turbine building ventilation exhaust, Unit 2, continuous, ground level release.

Table D-3 Nearest pathway locations used for maximally exposed individual dose commitments for Beaver Valley Unit 2

Location	Sector	Distance (km)
Nearest effluent-control boundary*	NE of Unit 2	0.34
Residence and garden**	NE	0.61
Milk cow	WNW	4.4
Milk goat	ESE	2.8
Meat animal	NW	4.5

*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 location includes vegetable consumption doses.

Table D-4 Calculated release of radioactive materials in liquid effluents from Beaver Valley Unit 2

Nuclide	Ci/yr per reactor*	Nuclide	Ci/yr per reactor
Corrosion and Activation Products		Fission Products (cont'd)	
Cr-51	0.000080	Te-127	0.000020
Mn-54	0.0010	Te-129m	0.000060
FE-55	0.000080	Te-129	0.000040
Fe-59	0.000050	I-130	0.00028
Co-58	0.0047	I-131	0.14
Co-60	0.0088	Te-131m	0.000060
Te-131m	0.00006	I-132	0.0038
Te-131	0.00001	I-133	0.076
Np-239	0.000040	I-134	0.000020
		Te-131	0.000010
Fission Products			
Br-83	0.000050	Cs-134	0.015
		I-135	0.013
Sr-89	0.00002	Cs-136	0.00069
Zr-95	0.0014	Cs-137	0.025
Nb-95	0.0020	Ba-137m	0.0012
Mo-99	0.0029		
		Ce-144	0.0052
Tc-99m	0.0025		
Ru-103	0.00014	All Others	0.000050
Ru-106	0.0024	Total(except H-3)	0.31
Ag-110m	0.00044		
Te-127m	0.00001	H-3	340

*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 Beaver Valley Unit 2*

Location	Transit time (hours)	Dilution factor
<u>ALARA dose calculations</u>**		
Nearest drinking-water intake (Chester, WV)	7.7	250
Nearest sport-fishing location (discharge area)	0.1	20
Nearest shoreline (bank of Ohio River near discharge area)	0.1	20
Nearest residential river bank well (Georgetown and Glasgow Boroughs and Green Township)	4.4	823
<u>Population Dose Calculations</u>***		
Sport and commercial fishing, shoreline use, swimming, and boating along the following segments of the Ohio River downstream from the Beaver Valley Unit 2 discharge area:		
0-18 km	6	489
18-35 km	18	515
35-53 km	30	550
53-70 km	42	550
70-88 km	54	550
Drinking water intakes from Ohio River within 80 km radius of the plant at the following distances (km) downstream from the plant:		
2.1, Midland, PA	1.4	623
8.4, East Liverpool, OH	5.7	623
11.4, Chester, WV**	7.7	250
38.8, Toronto, OH	26.2	550
43.4, Wierton, WV	29.3	550
48.6, Steubenville, OH	32.8	550
57.9, Mingo Junction, OH	39.1	550
83.4, Wheeling, WV	56.3	550
86.2, Martin's Ferry, OH	58.2	550
94.9, Bellaire, OH	64.1	550

*See RG 1.113, "Estimating Aquatic Dispersion of Effluent from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I."

**Assumed for an upper limit estimate; detailed information not available.

***The dilution factors are NRC staff estimates based on downstream distances and transit times given in ER-OL Amendment 6, Table 5C-3.

Table D-6 Annual dose commitments to a maximally exposed individual near Beaver Valley Unit 2

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 (0.34 km NE)	Direct radiation from plume	a	0.12	a		0.17	
		Iodine and particulates in gaseous effluents**					
		Total body		Organ			
Nearest*** site boundary (0.34 km NE)	Ground deposition	0.46	(T)	0.46	(C)	(thyroid)	
	Inhalation	0.40	(T)	0.50	(C)	(thyroid)	
Nearest residence and garden (0.61 km NE)	Ground deposition	0.19	(C)	0.19	(C)	(thyroid)	
	Inhalation	0.14	(C)	0.19	(C)	(thyroid)	
	Vegetable consumption	2.4	(C)	2.4	(C)	(thyroid)	
Nearest milk cow (4.4 km WNW)	Ground deposition	a	(C)	a	(I)	(thyroid)	
	Inhalation	a	(C)	a	(I)	(thyroid)	
	Vegetable consumption	0.49	(C)	0.49	(C)	(thyroid)**	
	Cow milk consumption	0.20	(C)	0.23	(C)	(thyroid)	
Nearest milk goat (2.8 km ESE)	Ground deposition	a	(I)	a	(I)	(thyroid)	
	Inhalation	a	(I)	a	(I)	(thyroid)	
	Goat milk consumption	0.19	(C)	0.73	(I)	(thyroid)	
Nearest meat animal (4.5 km NW)	Meat consumption	a	(A)	a	(A)	(thyroid)	
		Liquid effluents**					
		Total body		Organ			
Nearest drinking water Chester, WV	Water ingestion	a	(I)	0.13	(I)	(thyroid)	
Nearest fish at plant-discharge area	Fish consumption	0.37	(A)	0.51	(A)	(liver)	
Nearest shore access near plant-discharge area	Shoreline recreation	a	(A)	a	(A)	(liver)	

a=Less than 0.1 mrem/year.

*"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 Beaver Valley Unit 2

	Annual dose per reactor unit	
	Individual	
	Appendix I design objectives*	Calculated doses**
Liquid effluents		
Dose to total body from all pathways	3 mrems	0.37 mrem
Dose to any organ from all pathways	10 mrems	0.51 mrem (liver)
Noble-gas effluents (at site boundary)		
Gamma dose in air	10 mrads	a
Beta dose in air	20 mrads	0.17 mrad
Dose to total body of an individual	5 mrems	b
Dose to skin of an individual	15 mrems	0.12 mrem
Radioiodines and particulates***		
Dose to any organ from all pathways	15 mrems	2.8 mrems (child thyroid)
	Population dose within 80 km, person-rems	
	Total body	Thyroid
Natural-background radiation.	420,000	
Liquid effluents	0.91	2.6
Noble-gas effluents	0.12	0.12
Radioiodine and particulates	14	17

*Design objectives from Sections II.A, II.B, II.C, and II.D of Appendix I, 10 CFR Part 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 Pennsylvania, Ohio, and West Virginia of 106 mrems/yr, and year 2010 projected population of 3,950,000.

a=Less than 0.1 mrad/year.

b=Less than 0.1 mrem/year.

Table D-8 Calculated RM-50-2 dose commitments to a maximally exposed individual from operation of the Beaver Valley nuclear facility*

	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	1.0 mrem
Activity-release estimate, excluding tritium (Ci)	10	0.62
Noble-gas effluents (at site boundary)		
Gamma dose in air	10 mrads	0.17 mrad
Beta dose in air	20 mrads	0.34 mrad
Dose to total body of an individual	5 mrems	0.1 mrem
Dose to skin of an individual	15 mrems	0.24 mrem
Radioiodines and particulates***		
Dose to any organ from all pathways	15 mrems	5.6 mrems (child thyroid)
I-131 activity release (Ci)	2	0.1

*An optional method of demonstrating compliance with the cost-benefit Section (II.D) of Appendix I to 10 CFR Part 50.

**Annex to Appendix I to 10 CFR Part 50.

***Carbon-14 and tritium have been added to this category.

Table D-9 Annual total-body population dose commitments year 2010

Category	U.S. population dose commitment, person-rems/yr
Natural background radiation*	28,000,000*
Beaver Valley Unit 2 operation	
Plant workers	500
General public	
Liquid effluents**	0.91
Gaseous effluents	35
Transportation of fuel and waste	3

*Using the average U.S. background dose (100 mrems/yr) and year 2010 projected U.S. population from "Projections of the Population of the U.S. 1982-2050," Advance Report, U.S. Bureau of the Census, Department of Commerce, "Current Population Reports," Series P-25, No. 922, October 1982.

**80-km (50-mile) population dose

APPENDIX E

REBASELINING OF THE RSS RESULTS FOR PWRs

APPENDIX E

REBASELINING OF THE RSS RESULTS FOR PWRs

The results of the Reactor Safety Study (RSS) (WASH-1400, NUREG-75/014) have been updated. The update was done largely to incorporate results of research and development conducted since the October 1975 publication of the RSS and to provide a baseline against which the risk associated with various light-water reactors (LWRs) could be consistently compared.

Primarily, the rebaselined RSS results reflect use of advanced modeling of the processes involved in meltdown accidents; i.e., the MARCH computer code modeling for sequences initiated by transients and loss-of-coolant accidents (LOCAs) and the CORRAL code used for calculating the magnitudes of release accompanying various accident sequences. These codes* have led to a capability to predict the transient- and small LOCA-initiated sequences that is considerably advanced beyond that which existed at the time the RSS was completed. The MARCH and CORRAL advanced accident process models resulted in some changes in the staff's estimates of the release magnitudes from various accident sequences in WASH-1400. 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, although 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 grouping of large numbers of accident sequences into encompassing release categories, as was done in WASH-1400). The rebaselining of the RSS also eliminated the "smoothing technique" used in WASH-1400 that was criticized by the Risk Assessment Review Group (NUREG/CR-0400; sometimes known as the Lewis Report).

In both the RSS designs (pressurized water reactors (PWRs) and boiling-water reactors (BWRs)), the likelihood of an accident sequence leading to a steam explosion (α) in the reactor vessel was decreased. Results of both experiments and calculations to date have shown that, given certain accident sequences, small steam explosions are likely, but it is very unlikely that an explosion of as much energy as was postulated in WASH-1400 would occur. This large amount of energy would be necessary to cause a massive breach of containment as described for the BWR 1 release category of WASH-1400.

For rebaselining of the RSS PWR design, the release magnitudes for the risk-dominating sequences (Event V, TMLB'-δ, γ, and S_2C-δ, described below) were explicitly calculated and used in the consequence modelling, rather than being lumped into release categories as was done in WASH-1400. The rebaselining led

*It should be noted that the MARCH code was used for a number of scenarios in connection with the recovery efforts at Three-Mile Island Unit 2 (TMI-2) and for post-TMI-2 investigations to explore possible alternative scenarios that TMI-2 could have experienced.

to a small decrease in the predicted risk to an individual of early fatality or latent cancer fatality as compared to the original RSS PWR predictions. This result is believed to be largely attributable to the decreased likelihood of occurrence for sequences involving severe steam explosions (α) that breached containment. (In WASH-1400, the sequences involving severe steam explosions (α) were artifically elevated in their risk significance (i.e., made more likely) by use of the "smoothing technique.")

In summary, the rebaselining of the RSS results led to small overall differences from the predictions in WASH-1400. However, it should be recognized that these small differences as a result of the rebaselining efforts are likely to be far outweighed by the uncertainties associated with such analyses.

The accident sequences that are expected to dominate risk from the RSS PWR design are described below. Accident sequences are designated by strings of identification characters in the same manner as in the RSS (Table E.1 lists these symbols). Each of the characters represents a failure in one or more of the important plant systems or features that ultimately would result in melting of the reactor core and a significant release of radioactive materials from containment.*

Event V (Interfacing System LOCA)

During the RSS, a potentially large risk contributor was identified that was the result of the configuration of the multiple check valve barriers used to separate the high pressure reactor coolant system from the low design pressure portions of the emergency core cooling system (ECCS). (This was the low pressure injection subsystem, LPIS.) If these valve barriers were to fail in various modes (such as leak-rupture or rupture-rupture) and suddenly exposed the LPIS to high overpressures and dynamic loadings, the RSS judged that a high probability of LPIS rupture would exist. Because the LPIS is located largely outside the containment, the Event V scenario would be a LOCA that bypassed the containment and those mitigating features (e.g., sprays) within the containment. The RSS assumed that if the rupture of LPIS did not cause the complete failure of the LPIS makeup function (which would ultimately be needed to prevent core damage), the LOCA environment (flooding, steam) would. Predictions of the release magnitude and consequences associated with Event V have indicated that this scenario represents one of the largest risk contributors from the RSS PWR design. The NRC has recognized this RSS finding, and has taken steps to reduce the probability of occurrence of Event V scenarios in both existing and future LWR designs by requiring periodic surveillance testing of the interfacing valves to ensure that these valves are properly functioning as pressure boundary isolation barriers during plant operations.

TMLB'-δ, γ

This sequence essentially considers the loss and nonrestoration of all ac power sources available to the plant, along with an independent failure of the steam-turbine-driven auxiliary feedwater train (which would be required to operate to remove shutdown heat from the reactor core). This transient is initiated by loss of offsite ac power sources, which would result in plant trip (scram) and

*For additional information detail, see Appendix V of WASH-1400.

the loss of the normal way that the plant removes heat from the reactor core (via the power conversion system, which consists of the turbine, condenser, the condenser cooling system, and the main feedwater and condensate delivery system that supplies water to the steam generators). This initiating event would then demand operation of the standby onsite emergency ac power supplies (two diesel generators) and the standby auxiliary feedwater system, two trains of which are electrically driven by either onsite or offsite ac power. With failure and non-restoration of ac power and the failure of the steam-turbine-driven auxiliary feedwater train to remove shutdown heat, the core would ultimately uncover and melt. If restoration of ac power was not successful during (or following) melt, the containment heat removal and fission product mitigating systems would not be operational to prevent the ultimate overpressure (δ, γ) failure of containment and a rather large, energetic release of activity from the containment. Next to the Event V sequence, TMLB'-δ, γ is predicted to dominate the overall accident risks in the RSS PWR design.

S_2C-δ (PWR 3)

In the RSS, the S_2C-δ sequence was placed in PWR release category 3, and it actually dominated all other sequences in Category 3 in terms of probability and release magnitudes. The rebaselining entailed explicit calculations of the consequences from S_2C-δ, and the results indicated that it was next in overall risk importance after Event V and TMLB'-δ, γ.

The S_2C-δ sequence included a rather complex series of dependencies and interactions that are believed to be somewhat unique to the containment systems (subatmospheric) employed in the RSS PWR design.

In essence, the S_2C-δ sequence included a small LOCA in a specific region of the plant (reactor vessel cavity); failure of the recirculating containment heat removal systems (CSRS-F) because of a dependence on water draining to the recirculation sump from the LOCA; and a resulting dependence imposed on the quench spray injection system (CSIS-C) to provide water to the sump. The failure of the CSIS-C resulted in eventual overpressure failure of containment (δ) as a result of the the loss of CSRS-F. Given the overpressure failure of containment, the RSS assumed that the ECCS functions would be lost, because of either the cavitation of ECCS pumps or the rather severe mechanical loads that could result from the overpressure failure of containment. The core was then assumed to melt in a breached containment, which would lead to a significant release of radioactive materials.

Most of the release would occur over a period of about 1.5 hours. The release of radioactive material from containment would be caused by the sweeping action of gases generated by the reaction of the molten fuel with concrete. Because these gases would be heated initially by contact with the melt, the rate of sensible energy release to the atmosphere would be moderately high.

PWR 7

This is the same as the PWR release category 7 of the original RSS, which was made up of several sequences such as S_2D-ε (the dominant contributor to the risk in this category), S_1D-ε, S_2H-ε, S_1H-ε, AD-ε, AH-ε, TML-ε, and TKQ-ε. All of these sequences involved a containment base mat melt-through as the containment failure mode. With exception of TML-ε and TKQ-ε, all involve the potential

failure of the ECCS after a LOCA, with the containment engineered safety features (ESFs) continuing to operate as designed until the base mat was penetrated. Containment sprays would operate to reduce the containment temperature and pressure as well as the amount of airborne radioactivity. The containment barrier would retain its integrity until the molten core proceeded to melt through the concrete containment base mat. The radioactive materials would be released into the ground. Most of the release would occur continuously over a period of about 10 hours. Because leakage from containment to the atmosphere would be low and gases escaping through the ground would be cooled by contact with the soil, the energy release rate would be very low.

Reference

U.S. Nuclear Regulatory Commission, NUREG-75/014, "Reactor Safety Study," October 1975 (formerly WASH-1400).

Table E.1 Key to PWR accident sequence symbols

Sequence designator	Definition
A	Intermediate to large LOCA
B	Failure of electric power to ESFs
B´	Failure to recover either onsite or offsite electric power within about 1 to 3 hours following an initiating transient that is a loss of offsite AC power
C	Failure of the containment spray injection system
D	Failure of the emergency core cooling injection system
F	Failure of the containment spray recirculation system
G	Failure of the containment heat removal system
H	Failure of the emergency core cooling recirculation system
K	Failure of the reactor protection system
L	Failure of the secondary system relief valves and the auxiliary feedwater system
M	Failure of the secondary system steam relief valves and the power conversion system
Q	Failure of the primary system safety relief valves to reclose after opening
R	Massive rupture of the reactor vessel
S_1	A small LOCA with an equivalent diameter of about 2 to 6 inches
S_2	A small LOCA with an equivalent diameter of about 1/2 to 2 inches
T	Transient event
V	LPIS check valve failure
α	Containment rupture as a result of a reactor vessel steam explosion
β	Containment failure resulting from inadequate isolation of containment openings and penetrations
γ	Containment failure as a result of hydrogen burning
δ	Containment failure as a result of overpressure
ε	Containment vessel melt-through

APPENDIX F

CONSEQUENCE MODELING CONSIDERATIONS

APPENDIX F

CONSEQUENCE MODELING CONSIDERATIONS

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 post-accident response to reduce exposure from long-term ground contamination after plume passage. The Reactor Safety Study (RSS) (NUREG-75/014, WASH-1400) consequence model contains provision for incorporating the radiological consequence reduction benefits of public evacuation. The benefits of a properly planned and expeditiously carried out public evacuation would be a reduction of early health effects associated with early exposure; namely, in the number of cases of early fatality and acute radiation sickness that would require hospitalization. The evacuation model originally used in the RSS consequence model is described in WASH-1400 as well as in NUREG-0340 and NUREG/CR-2300. The evacuation model which has been used herein is a modified version of the RSS model and is, to a certain extent, site emergency planning oriented (Sandia, 1978). The modified version is briefly outlined below.

The model utilizes a circular area with a specified radius (the 16-km (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 one 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 downwind direction as its median (that is, 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; the time required by the authorities to interpret the data, decide to evacuate, and direct the people to evacuate; and the time required for the people to mobilize and get under way.

*Assumed to be of a constant value, 2 hours, that would be the same for all evacuees.

The model assumes that each evacuee would move radially outward* from the reactor 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. This distance is selected to be 24 km (15 miles) (which is 8 km or 5 miles more than the 16-km (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 that would be determined by the product of the duration over which the atmospheric release would take place and the average wind speed during the release. It is assumed that the front and the back of the cloud would move with an equal speed, which would be the same as the prevailing wind speed; 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, all evacuees would have a head start; that is, 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 (1) an evacuee will still have a head start, or (2) the cloud would be already overhead when an evacuee starts to leave, or (3) 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 one or more times before the evacuee would reach his/her destination. In the model, the radial position of an evacuating person, either stationary or in transit, is compared to 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 both 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: (1) 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; (2) exposed to one-half the calculated concentration when anywhere under the cloud; and (3) not exposed when they are in front of the cloud. Different values of the shielding protection factors for exposures from airborne radioactivity and ground contamination have been used.

Results shown in Section 5.9.4.5 of the main body of this environmental statement for accidents involving significant release of radioactivity to the atmosphere were based upon the assumption that all people within the 16-km (10-mile) plume exposure pathway EPZ would evacuate according to the evacuation scenario described above. Because sheltering can be a mitigative feature, it is not

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*In the RSS consequence model, the radioactive cloud is assumed to travel radially outward only, spreading out as it moves away.

**Assumed to be a constant value, 4 km (2.5 miles) per hour, that would be the same for all evacuees.

expected that detailed inclusion of any facility (see Section 5.9.4.5(2)) near a specific plant site, where not all persons would be quickly evacuated, would significantly alter the conclusions. For the delay time before evacuation, a value of 2 hours was used. The staff believes that such a value appropriately reflects the Commission's emergency planning requirements. The applicant has provided estimates of the time required to clear the 16-km (10-mile) zone.

From these estimates, the staff has conservatively estimated the effective evacuation speed to be 1.12 m per second (2.5 mph). It is realistic to expect that the authorities would aid and encourage evacuation at distances from the site where exposures above the threshold for causing early fatalities could be reached regardless of the EPZ distance. As an additional emergency measure for the Beaver Valley site, it was also assumed that all people beyond the evacuation distance who would be exposed to the contaminated ground would be relocated 12 hours after passage of the plume.

A modification of the RSS consequence model was used that incorporates the assumption that, if the calculated ground dose to the total bone marrow over a 7-day period were to exceed 200 rems, this high dose rate would be detected by actual field measurements following plume passage, and people from these regions would be relocated immediately. For this situation, the model limits the period of ground dose calculation to 12 hours; otherwise, for calculation of early dose, the period of ground exposure is limited to 7 days.

The model has the same provision for calculation of the economic cost associated with implementation of evacuation as does the original RSS model. For this purpose, the model assumes that for atmospheric releases of durations 3 hours or less, all people living within a circular area of 8-km (5-mile) radius centered at the reactor plus all people within a 90° angular sector within the plume exposure pathway EPZ and centered on the downwind direction will be evacuated and temporarily relocated. However, if the duration of release would exceed 3 hours, the cost of evacuation is based on the assumption that all people within the entire plume exposure pathway EPZ would be evacuated and temporarily relocated. For either of these situations, the cost of evacuation and relocation is assumed to be $225 (1980 dollars) per person, which includes cost of food and temporary sheltering for a period of 1 week.

Early Health Effects Model

The medical advisors to the Reactor Safety Study (Section 9.2.2 of Appendix IV, and Appendix F) proposed three alternative dose-mortality relationships that can be used to estimate the number of early fatalities in an exposed population. These alternatives characterize different degrees of post-exposure medical treatment from "minimal," to supportive," to "heroic"; they are more fully described in NUREG-0340. There is uncertainty associated with the mortality relationships (NUREG/CR-3185), and the availability and effectiveness of different classes of medical treatment (Andrulis, 1982).

The calculated estimates of the early fatality risks presented in Section 5.9.4.5(3) of the main body of this report used the dose-mortality relationship that is based upon the supportive treatment alternative. This implies the availability of medical care facilities and services that are designed for radiation victims exposed in excess of about 170 rems, the approximate level above which the medical advisors to the Reactor Safety Study recommended more

than minimal medical care to reduce early fatality risks. At the extreme low probability end of the spectrum (at the level of three chances in one hundred million per reactor-year), the number of persons involved might exceed the capacity of facilities that provide the best such services; in this case, the number of early fatalities might have been underestimated. However, this number may not have been greatly underestimated because hospitals now in the United States are likely to be able to supply considerably better care to radiation victims than the medical care upon which the assumed minimal medical treatment relationship is based. Further, a major reactor accident at Beaver Valley Unit 2 would certainly cause a mobilization of the best available medical services with a high national priority to save the lives of radiation victims. Therefore, the staff expect that the mortality risks would be less than those indicated by the RSS description of minimal treatment (and much less, of course, for those who will be given the type of treatment defined as "supportive"). For these reasons, the staff has concluded that the early fatality risk estimates are bounded by the range of uncertainties discussed in Section 5.9.4.5(7).

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APPENDIX G

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United States Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Mr. George W. Knighton, Chief
Licensing Branch 3
Office of Nuclear Reactor Regulation

SUBJECT: Beaver Valley Power Station - Unit No. 2
Docket No. 50-412
NPDES Permit

Gentlemen:

As indicated in ER-OL Appendix 5A, please find enclosed a copy of the BVPS-2 National Pollutant Discharge Elimination System (NPDES) Permit PA 0025615 issued on November 26, 1984. Also enclosed is a notice of appeal dated December 28, 1984.

It is the intention of Duquesne Light Company that the ER-OL will not be amended to include the NPDES Permit. If you have any questions, please contact T. J. Zoglmann at (412) 787-5141.

DUQUESNE LIGHT COMPANY

By [signature]
E. J. Woolever
Vice President

TZJ/wjs
Enclosure

cc: Mr. B. K. Singh, Project Manager (w/e)
Mr. G. Walton, NRC Resident Inspector (w/e)

SUBSCRIBED AND SWORN TO BEFORE ME THIS 4th DAY OF March, 1985.

Anita Elaine Reiter
Notary Public

ANITA ELAINE REITER, NOTARY PUBLIC
ROBINSON TOWNSHIP, ALLEGHENY COUNTY
MY COMMISSION EXPIRES OCTOBER 20, 1986

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA)
) SS:
COUNTY OF ALLEGHENY)

The Vice President, Nuclear Group, J. J. Carey, being first duly sworn, deposes, and says: that he is Vice President, Nuclear Group, of Duquesne Light Company; with legal authority to sign official correspondence on behalf of the Vice President - Nuclear Construction Division, Earl J. Woolever, in relation to licensing for Beaver Valley Power Station, Unit 2 and therefore authorized to submit the foregoing on behalf of the applicant.

3-4-85
Date

J. J. Carey
Vice President, Nuclear Group

Sworn and subscribed before me,
this 4th day of March, 1985.

Anita Elaine Reiter
Notary Public

ANITA ELAINE REITER, NOTARY PUBLIC
ROBINSON TOWNSHIP, ALLEGHENY COUNTY
MY COMMISSION EXPIRES OCTOBER 20, 1986

Received 11/29

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
BUREAU OF WATER QUALITY MANAGEMENT
Highland Building
121 South Highland Avenue
Pittsburgh, Pennsylvania 15206-3988 (412) 665-2900

Duquesne Light Company
One Oxford Centre
301 Grant Street
Pittsburgh, PA 15279

NOV 2 ~ 1984

RE: NPDES Permit PA0025615
Duquesne Light Company
Beaver Valley Power Station
Shippingport Borough
Beaver County

Gentlemen:

Your NPDES permit is enclosed. Please note that we have made several modifications to the draft permit sent to you via letter of April 20, 1984. These changes are in response to your comment letters of June 4, 1984 and October 30, 1984.

The most significant modifications were in response to your comments that:

1. A continuous chlorine monitor currently exists and is being used at the discharge weir (Outfall 001) and not at the unit #1 condenser outlet as previously supposed and

2. That you are now proposing to route several sources:

   009-unit #2 cooling tower blowdown and treated rad waste
   110 - the auxiliary boiler blowdown and
   210 - the chemical feed area drains

   to Outfall 001.

Based on those comments, the following changes have been made:

A. Those sources labeled as 110 (auxiliary boiler blowdown) and 210 (chemical feed area drains) by the draft permit, will now be labeled 301 and 401 respectively. Identical effluent limitations as the draft permit apply, with those exceptions as explained below.

B. Outfall 009 has been deleted from the permit. Monitoring and limitations for free available chlorine on the Unit #2 cooling tower blowdown are now specified at the discharge weir for Outfall 001.

That being stated, the following comments address your comments in the order presented in your letter:

Part A, Outfall 101, Page 2(a) of 14

The sample type for total suspended solids has been changed from a 24-hour composite to a 2-hour composite.

Part A, Outfall 201, Page 2(b) of 14

The sample point for free available chlorine has been changed from the discharge of the condenser to the discharge weir (Outfall 001) as requested. All limitations, monitoring requirements, and prohibition initially placed on 201 have been imposed on Outfall 001 and I.M.P. 201 has been eliminated.

Part A, Outfall 301, Page 2(c) of 14

The pH monitoring requirement has been deleted. As above I.M.P. 201 has been eliminated, I.M.P. 301 is now relabeled as 201.

Part A, Outfall 001, Page 2(d) of 14

See response to comments (B), and above Outfall 201.

Part A, Outfall 103, Page 2(g) of 14

The 24-hour composite sample type for total suspended solids has been maintained. However, as requested in your letter of 10/30/84, the sample type has been changed from "measured" to "estimated."

Part A, Outfall 007, Page 2(m) of 14

The pH moitoring and reporting requirement has been deleted as requested.

The permit already contains wording which requires monitoring for chlorine only during discharges from the reactor plant river water system.

Part A, Outfall 009, Page 2(n) of 14

As stated previously, Unit #2 cooling tower blowdown and treated rad waste is now controlled by the effluent limitations and monitoring requirements at 001; Outfall 009 has been eliminated.

Part A, Outfall 110, Page 2(p) of 14

As explained previously, I.M.P. 110 is redesignated as 301 as this source is now tributary to Outfall 001.

The pH limit has been deleted.

Part A, Outfall 210, Page 2(g) of 14

As explained previously, I.M.P. 210 is redesignated as 401 as this source is now tributary to Outfall 001.

The upper pH limit has been deleted.

Part A, Outfall 010, Page 2(r) of 14

The monitoring requirements for free available chlorine have been changed from continuous/recorded to a grab sample once per week.

The pH monitoring requirement has been deleted.

Part C, Requirement h, Page 14(b) of 14

As you are aware, requirement (h) is a standard condition taken from the Federal Guidelines and reads as follows: "Neither free available chlorine nor total residual chlorine may be discharged from any unit for more than two hours in any one day....unless the utility can demonstrate to the Regional Administrator or State, if the State has NPDES issuing authority, that the unit(s) in a particular location cannot operate at or below this level of chlorination."

What you seem to have concluded from your 1977 study was that during your normal power operations, the discharge of free available chlorine occurs beyond the 2-hour limit 36% of the time and further, that the discharge of total residual chlorine exceeded the 2-hour limit 63% of the time (page 1 of 3). You also appear to be saying that this discharge of chlorine over the 2-hour limit is a result of a "trail-out" effect, that is, that the discharge of chlorine occurs long after the dosing period has been completed. However, the study does not say what the dosing period is, and therefore does not really demonstrate a "trail-out" effect since the duration of chlorine discharge may correspond to the dosing period.

Assuming however, that the dosing period was and is limited to two hours (as you say it will be in your letter) and that a trail-out effect does occur, my feeling is that this situation is not what EPA intended to allow for when considering the granting of exclusions from the 2-hour discharge requirement. Indeed, I do not believe based on my review of past development documents and guidelines, that EPA ever considered the possibility of a trail-out effect. Rather, the exclusion appears to be specific to only a very few plants with unusual needs for crustacean control.

> It is my opinion that the 2-hour limit was and is intended to be a limit of "dosing time" rather than trail-out time. See EPA 1974 Development Document, page 409 - "free available chlorine discharges in both recirculating and non-recirculating cooling water systems are to be limited to average quantities reflecting concentrations of 0.2 mg/l during a maximum of two hours a day (aggregate)..." and "generally chlorination is not required at higher chlorine levels or for more than two hours each day for each unit."

None of the information I have indicates that this particular station has an excessive need for chlorine. Therefore because this has not been demonstrated, I have not deleted the 2-hour requirement. Furthermore, I would suggest that rather than being a site specific problem, this may be an industry wide problem and should be addressed at the Federal Effluent Guidelines division level of EPA.

You also noted in your letter that the revised flow diagrams reflecting the current situation would be following. Please see that these are submitted as soon as possible so that we may have a complete copy of this application for our files.

Finally because the permit or amendment authorizes a sewage discharge, it does not become operative until it is recorded in the office of the Recorder of Deeds in the county where the sewage discharge is located. Please take the enclosed permit or amendment plus the enclosed notary form and certificate to the Recorder. After the Recorder fills out the certificate, please return the certificate only to our Harrisburg office in the enclosed envelope.

Please study your permit carefully, and if you have any questions, please contact me.

Sincerely,

Deborah L. McDonald

Deborah L. McDonald
Sanitary Engineer

DLM/ld: c r t

Enclosure

cc: EPA
Operations Section
ORSANCO

3-WQ-15

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
BUREAU OF WATER QUALITY MANAGEMENT

AUTHORIZATION TO DISCHARGE UNDER THE
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
PERMIT PA0025615

n compliance with the provisions of the Clean Water Act, 33 U.S.C. Section 1251 et seq. the "Act") and Pennsylvania's Clean Streams Law, as amended, 35 P.S. Section 691.1 et seq.,

Duquesne Light Company
One Oxford Centre
301 Grant Street
Pittsburgh, PA 15279

s authorized to discharge from a facility located at

Beaver Valley Power Station
Shippingport Borough
Beaver County

o receiving waters named

Ohio River and Peggs Run

n accordance with effluent limitations, monitoring requirements and other conditions set forth n Parts A, B, and C of this permit.

his permit and the authorization to discharge shall expire at midnight NOV 26 1989.

he authority granted by this permit is subject to the following further qualifications:

. If there is a conflict between the application, its supporting documents and/or amendments and the terms and conditions of this permit, the terms and conditions shall apply.

2. Failure to comply with any of the terms or conditions of this permit is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of permit renewal.

3. If this permit authorizes a sewage discharge, the permit will not become operative until it is recorded in the office of the Recorder of Deeds in the county where the sewage discharge is located.

4. Application for renewal of this permit, or notification of intent to cease discharging by the expiration date, must be submitted to the Department at least 180 days prior to the expiration date (unless permission has been granted by the Department for submission at a later date), using the appropriate NPDES permit application form. In the event that a timely and complete application for renewal has been submitted and the Department is unable, through no fault of the permittee, to reissue the permit before the expiration date, the terms and conditions of this permit will be automatically continued and will remain fully effective and enforceable pending the grant or denial of permit renewal.

5. This permit does not constitute authorization to construct or make modifications to wastewater treatment facilities necessary to meet the terms and conditions of this perm

PERMIT ISSUED NOV 2 3 1984
DATE

BY
Hugh H. Archer, Ph.D., P.E.
Regional Water Quality Manager

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR OUTFALL 101 WHICH RECEIVES WASTE FROM:
chemical waste treatment system (demineralizer regenerants, lab sink drainage, Unit #1 auxiliary boiler blowdown)

a. The permittee is authorized to discharge during the period from issued date through expiration date.

b. Based on the production data and/or anticipated wastewater characteristics and flows described in the permit application and its supporting documents and/or amendments, the following effluent limitations and monitoring requirements apply. Total (dissolved plus suspended fraction) is implied for each parameter unless otherwise indicated.

	DISCHARGE LIMITATIONS (gross unless otherwise indicated)							MONITORING REQUIREMENTS		
	Mass Units (lb/day except flow)			Concentrations (mg/l unless otherwise indicated)						
scharge Parameter	Average Monthly	Average Weekly	Max. Daily	Average Monthly	Average Weekly	Max. Daily	Instant. Max.	Measurement Frequency	Sample Type	24-Hour Report Under A.3.c.
ow (mgd)								2/month	estimated	
spended Solids				30		100		2/month	2-hr. comp.	
l & Grease				15		20		2/month	grab	
	not less than 6.0 nor greater than 9.0 standard units							2/month	grab	

ere shall be no discharge of floating solids or visible foam in other than trace amounts.

mples taken in compliance with the monitoring requirements specified above shall be taken at the following location:
e discharge from the chemical waste sump prior to mixing with any other water

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR OUTFALL 201 WHICH RECEIVES WASTE FROM:
softener regenerants (formerly 103)

a. The permittee is authorized to discharge during the period from issued date through expiration date.

b. Based on the production data and/or anticipated wastewater characteristics and flows described in the permit application and its supporting documents and/or amendments, the following effluent limitations and monitoring requirements apply. Total (dissolved plus suspended fraction) is implied for each parameter unless otherwise indicated.

	DISCHARGE LIMITATIONS (gross unless otherwise indicated)							MONITORING REQUIREMENTS		
	Mass Units (lb/day except flow)			Concentrations (mg/l unless otherwise indicated)						
scharge Parameter	Average Monthly	Average Weekly	Max. Daily	Average Monthly	Average Weekly	Max. Daily	Instant. Max.	Measurement Frequency	Sample Type	24-Hour Report Under A.3.c.
ow (mgd)								2/month	estimated	
ispended Solids				30		100		2/month	grab	
l & Grease				15		20		2/month	grab	

ere shall be no discharge of floating solids or visible foam in other than trace amounts.

mples taken in compliance with the monitoring requirements specified above shall be taken at the following location:
stewater from the softener unit prior to mixing with any other water

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR OUTFALL 301 WHICH RECEIVES WASTE FROM:
Unit #2 auxiliary boiler blowdown

a. The permittee is authorized to discharge during the period from issued date through expiration date.

b. Based on the production data and/or anticipated wastewater characteristics and flows described in the permit application and its supporting documents and/or amendments, the following effluent limitations and monitoring requirements apply. Total (dissolved plus suspended fraction) is implied for each parameter unless otherwise indicated.

	DISCHARGE LIMITATIONS (gross unless otherwise indicated)							MONITORING REQUIREMENTS		
	Mass Units (lb/day except flow)			Concentrations (mg/l unless otherwise indicated)						24-Hour Report Under A.3.c.
;charge Parameter	Average Monthly	Average Weekly	Max. Daily	Average Monthly	Average Weekly	Max. Daily	Instant. Max.	Measurement Frequency	Sample Type	
›w (mgd)								2/month	estimated	*
;pended Solids				30		100		2/month	grab	
l & Grease				15		20		2/month	grab	

ere shall be no discharge of floating solids or visible foam in other than trace amounts.

mples taken in compliance with the monitoring requirements specified above shall be taken at the following location:
e discharge of boiler blowdown prior to mixing with any other water

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR OUTFALL 401 WHICH RECEIVES WASTE FROM:
drains from the chemical feed area of the auxiliary boilers for Unit #2

a. The permittee is authorized to discharge during the period from issued date through expiration date.

b. Based on the production data and/or anticipated wastewater characteristics and flows described in the permit application and its supporting documents and/or amendments, the following effluent limitations and monitoring requirements apply. Total (dissolved plus suspended fraction) is implied for each parameter unless otherwise indicated.

	DISCHARGE LIMITATIONS (gross unless otherwise indicated)							MONITORING REQUIREMENTS		
	Mass Units (lb/day except flow)			Concentrations (mg/l unless otherwise indicated)						24-Hour Report
scharge Parameter	Average Monthly	Average Weekly	Max. Daily	Average Monthly	Average Weekly	Max. Daily	Instant. Max.	Measurement Frequency	Sample Type	Under A.3.c.
ow (mgd)								2/month	estimated	
spended Solids				30		100		2/month	grab	
l & Grease				15		20		2/month	grab	
l	not less than 6.0							2/month	grab	

ere shall be no discharge of floating solids or visible foam in other than trace amounts.

mples taken in compliance with the monitoring requirements specified above shall be taken at the following location:
emical feed area drains prior to mixing with any other water

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR OUTFALL 001 WHICH RECEIVES WASTE FROM:
Unit #1 and Unit #2 cooling tower blowdown, sources previously monitored at 101, 201, 301 and 401, treated rad waste, and occasional clarified water overflow.

a. The permittee is authorized to discharge during the period from issued date through expiration date.

b. Based on the production data and/or anticipated wastewater characteristics and flows described in the permit application and its supporting documents and/or amendments, the following effluent limitations and monitoring requirements apply. Total (dissolved plus suspended fraction) is implied for each parameter unless otherwise indicated.

	DISCHARGE LIMITATIONS (gross unless otherwise indicated)							MONITORING REQUIREMENTS		
	Mass Units (lb/day except flow)			Concentrations (mg/l unless otherwise indicated)						24-Hour Report
charge Parameter	Average Monthly	Average Weekly	Max. Daily	Average Monthly	Average Weekly	Max. Daily	Instant. Max.	Measurement Frequency	Sample Type	Under A.3.c.
w (mgd)								continuous	recorded	
e Available Chlorine						0.2	0.5	continuous	recorded	
omium										
c										

It is the Department's understanding that the permittee does not add chromium or zinc compounds to the cooling water. Therefore, no limitation or monitoring requirement has been placed on chromium or zinc, and the permittee is prohibited from adding chromium or zinc compounds to the cooling water unless the permittee obtains an amendment to this permit. Refer to Part C for restrictions on the discharge of the 126 priority pollutants, free available and total residual chlorine, and the net addition of pollutants to non-contact cooling water.

re shall be no discharge of floating solids or visible foam in other than trace amounts.

mples taken in compliance with the monitoring requirements specified above shall be taken at the following location:
Outfall 001.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR OUTFALL 102 WHICH RECEIVES WASTE FROM:
intake screenhouse (pump bearing cooling water leakage) formerly 201

a. The permittee is authorized to discharge during the period from issued date through expiration date.

b. Based on the production data and/or anticipated wastewater characteristics and flows described in the permit application and its supporting documents and/or amendments, the following effluent limitations and monitoring requirements apply. Total (dissolved plus suspended fraction) is implied for each parameter unless otherwise indicated.

	DISCHARGE LIMITATIONS (gross unless otherwise indicated)							MONITORING REQUIREMENTS		
	Mass Units (Lb/day except flow)			Concentrations (mg/l unless otherwise indicated)						
...charge Parameter	Average Monthly	Average Weekly	Max. Daily	Average Monthly	Average Weekly	Max. Daily	Instant. Max.	Measurement Frequency	Sample Type	24-Hour Report Under A.3.c.
...w (mgd)								2/month	estimated	
...pended Solids				30		100		2/month	grab	
... & Grease				15		20		2/month	grab	
	not less than 6.0 nor greater than 9.0 standard units							2/month	grab	

...re shall be no discharge of floating solids or visible foam in other than trace amounts.

...ples taken in compliance with the monitoring requirements specified above shall be taken at the following location:
... discharge of collected pump bearing leakage prior to combination with any other water

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR OUTFALL 002 WHICH RECEIVES WASTE FROM:
intake screen backwash, asnd pump bearing leakage from 102

a. The permittee is authorized to discharge during the period from issued date through expiration date.

b. Based on the production data and/or anticipated wastewater characteristics and flows described in the permit application and its supporting documents and/or amendments, the following effluent limitations and monitoring requirements apply. Total (dissolved plus suspended fraction) is implied for each parameter unless otherwise indicated.

	DISCHARGE LIMITATIONS (gross unless otherwise indicated)							MONITORING REQUIREMENTS		
	Mass Units (lb/day except flow)			Concentrations (mg/l unless otherwise indicated)						24-Hour Report Under A.3.c.
scharge Parameter	Average Monthly	Average Weekly	Max. Daily	Average Monthly	Avarage Weekly	Max. Daily	Instant. Max.	Measurement Frequency	Sample Type	
	Debris collected on the intake trash racks shall not be returned to the waterway.									

re shall be no discharge of floating solids or visible foam in other than trace amounts.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR OUTFALL 103 WHICH RECEIVES WASTE FROM:
settling basin handling sludge from the intake clarifier (formerly 301)

a. The permittee is authorized to discharge during the period from issued date through expiration date.

b. Based on the production data and/or anticipated wastewater characteristics and flows described in the permit application and its supporting documents and/or amendments, the following effluent limitations and monitoring requirements apply. Total (dissolved plus suspended fraction) is implied for each parameter unless otherwise indicated.

	DISCHARGE LIMITATIONS (gross unless otherwise indicated)							MONITORING REQUIREMENTS		
	Mass Units (lb/day except flow)			Concentrations (mg/l unless otherwise indicated)						24-Hour Report
scharge Parameter	Average Monthly	Average Weekly	Max. Daily	Average Monthly	Average Weekly	Max. Daily	Instant. Max.	Measurement Frequency	Sample Type	Under A.3.c.
ow (mgd)								2/month	estimated	
spended Solids				30		100		2/month	24-hr. comp.	
	not less than 6.0 nor greater than 9.0 standard units							2/month	grab	

ere shall be no discharge of floating solids or visible foam in other than trace amounts.

mples taken in compliance with the monitoring requirements specified above shall be taken at the following location:
erflow from the basin prior to mixing with any other water

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR OUTFALL 203 WHICH RECEIVES WASTE FROM:
sewage treatment system at the main plant (formerly 302)

a. The permittee is authorized to discharge during the period from issued date through expiration date.

b. Based on the production data and/or anticipated wastewater characteristics and flows described in the permit application and its supporting documents and/or amendments, the following effluent limitations and monitoring requirements apply. Total (dissolved plus suspended fraction) is implied for each parameter unless otherwise indicated.

	DISCHARGE LIMITATIONS (gross unless otherwise indicated)							MONITORING REQUIREMENTS		
	Mass Units (lb/day except flow)			Concentrations (mg/l unless otherwise indicated)						
scharge Parameter	Average Monthly	Average Weekly	Max. Daily	Average Monthly	Average Weekly	Max. Daily	Instant. Max.	Measurement Frequency	Sample Type	24-Hour Report Under A.3.c.
ow (mgd)	0.023							2/month	measured	
)D-5 Day				30			60	2/month	grab	
ispended Solids				30			60	2/month	grab	
Removal (BOD-5 Day & SS)	refer to Part C									
cal Coliform Organisms	refer to Part C for effective disinfection							2/month	grab	
ı	not less than 6.0 nor greater than 9.0 standard units							2/month	grab	

ıere shall be no discharge of floating solids or visible foam in other than trace amounts.

ımples taken in compliance with the monitoring requirements specified above shall be taken at the following location:
verflow from the chlorine contact tank prior to mixing with any other water

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR OUTFALL 303 WHICH RECEIVES WASTE FROM:
oil/water separator handling Unit #1 turbine room floor drainage

a. The permittee is authorized to discharge during the period from issued date through expiration date.

b. Based on the production data and/or anticipated wastewater characteristics and flows described in the permit application and its supporting documents and/or amendments, the following effluent limitations and monitoring requirements apply. Total (dissolved plus suspended fraction) is implied for each parameter unless otherwise indicated.

	DISCHARGE LIMITATIONS (gross unless otherwise indicated)							MONITORING REQUIREMENTS		
	Mass Units (lb/day except flow)			Concentrations (mg/l unless otherwise indicated)						24-Hour Report Under A.3.c.
ischarge Parameter	Average Monthly	Average Weekly	Max. Daily	Average Monthly	Average Weekly	Max. Daily	Instant. Max.	Measurement Frequency	Sample Type	
low (mgd)								2/month	estimated	
uspended Solids				30		100		2/month	grab	
il & Grease				15		20		2/month	grab	
H	not less than 6.0 nor greater than 9.0 standard units							2/month	grab	

here shall be no discharge of floating solids or visible foam in other than trace amounts.

amples taken in compliance with the monitoring requirements specified above shall be taken at the following location:
verflow from the oil separator prior to mixing with any other water

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR OUTFALL 003 WHICH RECEIVES WASTE FROM:
see below

a. The permittee is authorized to discharge during the period from issued date through expiration date.

b. Based on the production data and/or anticipated wastewater characteristics and flows described in the permit application and its supporting documents and/or amendments, the following effluent limitations and monitoring requirements apply. Total (dissolved plus suspended fraction) is implied for each parameter unless otherwise indicated.

	DISCHARGE LIMITATIONS (gross unless otherwise indicated)							MONITORING REQUIREMENTS		
	Mass Units (lb/day except flow)			Concentrations (mg/l unless otherwise indicated)						
scharge Parameter	Average Monthly	Average Weekly	Max. Daily	Average Monthly	Average Weekly	Max. Daily	Instant. Max.	Measurement Frequency	Sample Type	24-Hour Report Under A.3.c.
ow 'mgd)										

This discharge shall consist solely of uncontaminated yard stormwater runoff and those sources monitored at 103, 203, and 303.

ere shall be no discharge of floating solids or visible foam in other than trace amounts.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR OUTFALL 004 WHICH RECEIVES WASTE FROM:
Unit #1 cooling tower overflow

a. The permittee is authorized to discharge during the period from issued date through expiration date.

b. Based on the production data and/or anticipated wastewater characteristics and flows described in the permit application and its supporting documents and/or amendments, the following effluent limitations and monitoring requirements apply. Total (dissolved plus suspended fraction) is implied for each parameter unless otherwise indicated.

	DISCHARGE LIMITATIONS (gross unless otherwise indicated)							MONITORING REQUIREMENTS		
	Mass Units (lb/day except flow)			Concentrations (mg/l unless otherwise indicated)						24-Hour Report
is harge Parameter	Average Monthly	Average Weekly	Max. Daily	Average Monthly	Average Weekly	Max. Daily	Instant. Max.	Measurement Frequency	Sample Type	Under A.3.c.
low (mqd)								1/week	estimated	
ree Available Chlorine						0.2	0.5			
hromium										
inc										

This overflow at Outfall 004 normally takes place during the months July thru October when the water level in the cooling tower basin is raised to increase pumping efficiency. The blowdown at Outfall 201 comes from the same basin, and the limitations and restrictions placed on 201 apply also to this 004. The only monitoring requirement at 004 is flow; monitoring results for other parameters at 201 will be considered applicable to 004 and must be shown on the DMR for 004 whenever there is a discharge at 004.

H not less than 6.0 nor greater than 9.0 standard units

here shall be no discharge of floating solids or visible foam in other than trace amounts.

amples taken in compliance with the monitoring requirements specified above shall be taken at the following location:
t the discharge pipe

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR OUTFALL 006 WHICH RECEIVES WASTE FROM:
auxiliary intake screen backwash

a. The permittee is authorized to discharge during the period from issued date through expiration date.

b. Based on the production data and/or anticipated wastewater characteristics and flows described in the permit application and its supporting documents and/or amendments, the following effluent limitations and monitoring requirements apply. Total (dissolved plus suspended fraction) is implied for each parameter unless otherwise indicated.

	DISCHARGE LIMITATIONS (gross unless otherwise indicated)							MONITORING REQUIREMENTS		
	Mass Units (lb/day except flow)			Concentrations (mg/l unless otherwise indicated)						
charge Parameter	Average Monthly	Average Weekly	Max. Daily	Average Monthly	Average Weekly	Max. Daily	Instant. Max.	Measurement Frequency	Sample Type	24-Hour Report Under A.5.c.

Debris collected on the intake trash racks shall not be returned to the waterways.

re shall be no discharge of floating solids or visible foam in other than trace amounts.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR OUTFALL 007 WHICH RECEIVES WASTE FROM:
auxiliary intake system testing water and periodic discharge from the reactor plant river water system

a. The permittee is authorized to discharge during the period from issued date through expiration date.

b. Based on the production data and/or anticipated wastewater characteristics and flows described in the permit application and its supporting documents and/or amendments, the following effluent limitations and monitoring requirements apply. Total (dissolved plus suspended fraction) is implied for each parameter unless otherwise indicated.

	DISCHARGE LIMITATIONS (gross unless otherwise indicated)							MONITORING REQUIREMENTS		
	Mass Units (lb/day except flow)			Concentrations (mg/l unless otherwise indicated)						
scharge Parameter	Average Monthly	Average Weekly	Max. Daily	Average Monthly	Average Weekly	Max. Daily	Instant. Max.	Measurement Frequency	Sample Type	24-Hour Report Under A.3.c.
ow (mgd)								1/week	estimated	
ee Available Chlorine						0.2	0.5	1/week	grab	

Monitoring for flow and free available chlorine are required only during those periods of discharge from the alternate flow path of the reactor plant river water system. Also refer to Part C for additional restrictions on free available and total residual chlorine, and the net addition of pollutants to non-contact cooling water.

ere shall be no discharge of floating solids or visible foam in other than trace amounts.

mples taken in compliance with the monitoring requirements specified above shall be taken at the following location:
the discharge pipe

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR OUTFALL 008 WHICH RECEIVES WASTE FROM:
Unit #1 cooling tower pumphouse (pump seal leakage, strainer backwash, roof rainfall) formerly 401

a. The permittee is authorized to discharge during the period from issued date through expiration date.

b. Based on the production data and/or anticipated wastewater characteristics and flows described in the permit application and its supporting documents and/or amendments, the following effluent limitations and monitoring requirements apply. Total (dissolved plus suspended fraction) is implied for each parameter unless otherwise indicated.

	DISCHARGE LIMITATIONS (gross unless otherwise indicated)							MONITORING REQUIREMENTS		
	Mass Units (lb/day except flow)			Concentrations (mg/l unless otherwise indicated)						24-Hour Report Under
ischarge Parameter	Average Monthly	Average Weekly	Max. Daily	Average Monthly	Average Weekly	Max. Daily	Instant. Max.	Measurement Frequency	Sample Type	A.3.c.
ow (mgd)								2/month	estimated	
spended Solids				30		100		2/month	grab	
l & Grease				15		20	30	2/month	grab	
	not less than 6.0 nor greater than 9.0 standard units							2/month	grab	

ere shall be no discharge of floating solids or visible foam in other than trace amounts.

mples taken in compliance with the monitoring requirements specified above shall be taken at the following location:
e discharge pipe and monitored so as to exclude stormwater

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR OUTFALL 010 WHICH RECEIVES WASTE FROM:
once-thru cooling water from Unit #2 heat exchangers, and sources monitored at 110 and 210

a. The permittee is authorized to discharge during the period from issued date through expiration date.

b. Based on the production data and/or anticipated wastewater characteristics and flows described in the permit application and its supporting documents and/or amendments, the following effluent limitations and monitoring requirements apply. Total (dissolved plus suspended fraction) is implied for each parameter unless otherwise indicated.

	DISCHARGE LIMITATIONS (gross unless otherwise indicated)							MONITORING REQUIREMENTS		
	Mass Units (lb/day except flow)			Concentrations (mg/l unless otherwise indicated)						24-Hour Report Under A.3.c.
ischarge Parameter	Average Monthly	Average Weekly	Max. Daily	Average Monthly	Average Weekly	Max. Daily	Instant. Max.	Measurement Frequency	Sample Type	
low (mgd)								1/week	estimated	
ee Available Chlorine						0.2	0.5	1/week	grab during chlorination	

Refer to Part C for additional restrictions on free available and total residual chlorine, and the net addition of pollutants to non-contact cooling water.

ere shall be no discharge of floating solids or visible foam in other than trace amounts.

mples taken in compliance with the monitoring requirements specified above shall be taken at the following location:
t the emergency overflow structure

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR OUTFALL 011 WHICH RECEIVES WASTE FROM:
three oil/water separators serving the Unit #2 turbine building and diesel generator building

a. The permittee is authorized to discharge during the period from issued date through expiration date.

b. Based on the production data and/or anticipated wastewater characteristics and flows described in the permit application and its supporting documents and/or amendments, the following effluent limitations and monitoring requirements apply. Total (dissolved plus suspended fraction) is implied for each parameter unless otherwise indicated.

	DISCHARGE LIMITATIONS (gross unless otherwise indicated)							MONITORING REQUIREMENTS		
	Mass Units (lb/day except flow)			Concentrations (mg/l unless otherwise indicated)						
ischarge Parameter	Average M thly	Average Weekly	Max. Daily	Average Monthly	Average Weekly	Max. Daily	Instant. Max.	Measurement Frequency	Sample Type	24-Hour Report Under A.3.c.
low (mgd)								2/month	estimated	
uspended Solids				30		100		2/month	grab	
il & Grease				15		20	30	2/month	grab	
H	not less than 6.0 nor greater than 9.0 standard units							2/month	grab	

The three oil/water separators discharge into a common pipe, and the pipe also handles yard drainage. The overflow from each oil/water separator must meet the limitations shown on this page, but at this time the Department is requiring the permittee to only monitor the combined flow of the separators.

nere shall be no discharge of floating solids or visible foam in other than trace amounts.

amples taken in compliance with the monitoring requirements specified above shall be taken at the following location:
t the discharge pipe and monitored so as to exclude stormwater

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR OUTFALL 012 WHICH RECEIVES WASTE FROM:
blowdown from the HVAC cooling tower serving the emergency response facility and stormwater runoff

a. The permittee is authorized to discharge during the period from issued date through expiration date.

b. Based on the production data and/or anticipated wastewater characteristics and flows described in the permit application and its supporting documents and/or amendments, the following effluent limitations and monitoring requirements apply. Total (dissolved plus suspended fraction) is implied for each parameter unless otherwise indicated.

	DISCHARGE LIMITATIONS (gross unless otherwise indicated)							MONITORING REQUIREMENTS		
	Mass Units (lb/day except flow)			Concentrations (mg/l unless otherwise indicated)						24-Hour Report Under A.5.c.
scharge Parameter	Average Monthly	Average Weekly	Max. Daily	Average Monthly	Average Weekly	Max. Daily	Instant. Max.	Measurement Frequency	Sample Type	
ow (mgd)								1/month	estimated	
ee Available Chlorine romium nc	It is the Department's understanding that the permittee does not add chlorine or chromium and zinc compounds to the cooling water. Therefore, no limitation or monitoring requirement has been placed on chlorine, chromium, or zinc, and the permittee is prohibited from adding chlorine, or chromium and zinc compounds to the cooling water unless the permittee obtains an amendment to this permit. Refer to Part C for restrictions on the discharge of the 126 priority pollutants, and the net addition of pollutants to non-contact cooling water.									
i				not less than 6.0 nor greater than 9.0 standard units				1/month	grab	

iere shall be no discharge of floating solids or visible foam in other than trace amounts.

mples taken in compliance with the monitoring requirements specified above shall be taken at the following location:
the discharge pipe

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR OUTFALL 113 WHICH RECEIVES WASTE FROM:
sewage treatment system serving Unit #2 and handling sanitary wastes and softener regeneration wastes

a. The permittee is authorized to discharge during the period from issued date through expiration date.

b. Based on the production data and/or anticipated wastewater characteristics and flows described in the permit application and its supporting documents and/or amendments, the following effluent limitations and monitoring requirements apply. Total (dissolved plus suspended fraction) is implied for each parameter unless otherwise indicated.

	DISCHARGE LIMITATIONS (gross unless otherwise indicated)							MONITORING REQUIREMENTS		
	Mass Units (lb/day except flow)			Concentrations (mg/l unless otherwise indicated)						24-Hour Report Under A.3.c.
ischarge Parameter	Average Monthly	Average Weekly	Max. Daily	Average Monthly	Average Weekly	Max. Daily	Instant. Max.	Measurement Frequency	Sample Type	
ow (mgd)	0.043							2/month	measured	
)-5 Day				30			60	2/month	grab	
spended Solids				30			60	2/month	grab	
emoval (BOD-5 Day & SS)	refer to Part C									
al Coliform Organisms	refer to Part C for effective disinfection							2/month	grab	
	not less than 6.0 nor greater than 9.0 standard units							2/month	grab	

re shall be no discharge of floating solids or visible foam in other than trace amounts.

nples taken in compliance with the monitoring requirements specified above shall be taken at the following location:
erflow from the chlorine contact tank and prior to mixing with any other water

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR OUTFALL 213 WHICH RECEIVES WASTE FROM:
Unit #2 cooling tower pumphouse floor and equipment drains

a. The permittee is authorized to discharge during the period from issued date through expiration date.

b. Based on the production data and/or anticipated wastewater characteristics and flows described in the permit application and its supporting documents and/or amendments, the following effluent limitations and monitoring requirements apply. Total (dissolved plus suspended fraction) is implied for each parameter unless otherwise indicated.

	DISCHARGE LIMITATIONS (gross unless otherwise indicated)							MONITORING REQUIREMENTS		
	Mass Units (lb/day except flow)			Concentrations (mg/l unless otherwise indicated)						24-Hour Report
charge Parameter	Average Monthly	Average Weekly	Max. Daily	Average Monthly	Average Weekly	Max. Daily	Instant. Max.	Measurement Frequency	Sample Type	Under A.3.c.
w (mgd)								2/month	estimated	
pended Solids				30		100		2/month	grab	
& Grease				15		20		2/month	grab	
	not less than 6.0 nor greater than 9.0 standard units							2/months	grab	

re shall be no discharge of floating solids or visible foam in other than trace amounts.

ples taken in compliance with the monitoring requirements specified above shall be taken at the following location:
charge from the pumphouse prior to mixing with any other water

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR OUTFALL 013 WHICH RECEIVES WASTE FROM:
see below

a. The permittee is authorized to discharge during the period from issued date through expiration date.

b. Based on the production data and/or anticipated wastewater characteristics and flows described in the permit application and its supporting documents and/or amendments, the following effluent limitations and monitoring requirements apply. Total (dissolved plus suspended fraction) is implied for each parameter unless otherwise indicated.

	DISCHARGE LIMITATIONS (gross unless otherwise indicated)							MONITORING REQUIREMENTS		
	Mass Units (lb/day except flow)			Concentrations (mg/l unless otherwise indicated)						24-Hour Report Under A.3.c.
scharge Parameter	Average Monthly	Average Weekly	Max. Daily	Average Monthly	Average Weekly	Max. Daily	Instant. Max.	Measurement Frequency	Sample Type	

This discharge shall consist solely of uncontaminated stormwater runoff and the soueces monitored at 113 and 213.

ere shall be no discharge of floating solids or visible foam in other than trace amounts.

2. DEFINITIONS

a. The "average monthly" mass discharge means the total discharge by weight during a calendar month divided by the number of days in the month that the production or commercial facility or sewage facility was operating. Where less than daily sampling is required by this permit, the average monthly mass discharge shall be determined by the summation of all the measured daily discharges by weight divided by the number of days during the calendar month when the measurements were made.

b. The "average weekly" mass discharge means the total discharge by weight during a calendar week divided by the number of days in the week that the facility was operating. Where less than daily sampling is required by this permit, the average weekly mass discharge shall be determined by the summation of all the measured daily discharges by weight divided by the number of days during the calendar week when the measurements were made.

c. The "maximum daily" mass discharge means the total discharge by weight during any calendar day.

d. The "average monthly" concentration means the arithmetic average of all the daily determinations of concentration made during a calendar month.

e. The "average weekly" concentration means the arithmetic average of all the daily determinations of concentration made during a calendar week.

f. The "maximum daily" concentration means the daily determination of concentration for any calendar day.

g. The "daily determination of concentration" means either the concentration of a composite sample taken during a calendar day or the arithmetic average of all grab samples taken during a calendar day.

h. The "instantaneous maximum" concentration means the concentration not to be exceeded at any time in any grab sample.

i. The term "composite sample" means a combination of individual samples obtained at regular intervals over a time period. Either the volume of each individual sample is proportional to discharge flow rates, or the sampling interval (for constant volume samples) is proportional to the flow rates over the time period used to produce the composite. The maximum time period between individual samples shall not exceed 2 hours except that for wastes of a uniform nature the samples may be collected on a frequency of at least twice per working shift and shall be equally-spaced over a 24-hour period (or over the operating day if flows are of a shorter duration).

j. The term "grab sample" means an individual sample collected in less than 15 minutes.

k. The "average monthly flow" means the arithmetic mean of daily flow measurements taken during a calendar month.

l. The term "measured flow" means any method of liquid volume measurement the accuracy of which has been previously demonstrated in engineering practice or for which a relationship to absolute volume has been obtained.

m. The term "estimated flow" means any method of liquid volume measurement based on a technical evaluation of the sources contributing to the discharge including, but not limited to, pump capabilities, water meters, and batch discharge volumes.

n. The "average monthly" temperature means the arithmetic mean of temperature measurement made on an hourly basis, or the mean value plot of the record of a continuous automated temperature recording instrument, either during a calendar month or during the operating month if flows are of a shorter duration.

o. The "maximum daily" temperature means the highest arithmetic mean of the hourly temperatures observed for any 2 consecutive hours during a 24-hour day or during the operating day if flows are of a shorter duration.

p. The term "I-s" means immersion stabilization in which a calibrated device is immersed in the effluent stream until the reading is stabilized.

q. The term "non-contact cooling water" shall mean water which is used in a cooling system designed so as to maintain constant separation of the cooling medium from all contact with process chemicals but which may on occasion, as a result of corrosion, cooling system leakage or similar cooling system failures, contain small amounts of process chemicals: provided that all reasonable measures have been taken to prevent, reduce, eliminate and control to the maximum extent feasible such contamination: and provided further, that all reasonable measures have been taken that will mitigate the effects of such contamination once it has occurred.

r. The term "at outfall XXX" means a sampling location in outfall line XXX downstream from the last point at which wastes are added to outfall line XXX or otherwise specified.

s. The term "bypass" means the intentional diversion of wastes from any portion of a treatment facility.

t. The term "severe property damage" means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or subtantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

u. The term "industrial user" means an establishment which discharges or introduces industrial wastes into a publicly owned treatment works (POTW).

v. The term "publicly owned treatment works" or "POTW" means a facility as defined by Section 212 of the Clean Water Act which is owned by a state or municipality, as defined by Section 502(4) of the Clean Water Act, including any sewers that convey wastewater to such a treatment works, but not including pipes, sewers or other conveyances not connected to a facility providing treatment. The term also means the municipality as defined in Section 502(4) of the Clean Water Act which has jurisdiction over the indirect discharges to and the discharges from such a treatment works.

3. SELF-MONITORING, REPORTING, AND RECORDS KEEPING

a. Representative Sampling

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge.

b. Reporting of Monitoring Results

(1) Monitoring results obtained during each month shall be summarized for that month and reported on a discharge monitoring report (DMR) postmarked no later than the 28th day of the following month. Signed copies of these and all other reports required herein, shall be submitted to the Department and the EPA Regional Office at the addresses listed in Part C of this permit.

(2) If the permittee monitors any pollutant using analytical methods described in Part A.3.e below more frequently than the permit requires, the results of this monitoring shall be incorporated as appropriate into the calculations used to report self-monitoring data on the DMR.

c. Non-Compliance Reporting

(1) 24-Hour Reporting - The permittee shall orally report to the Department within 24 hours of becoming aware of the following:

(a) Actual or anticipated non-compliance with any term or condition of this permit which may endanger health or the environment.

(b) Actual or anticipated non-compliance with any "maximum daily" discharge limitation which is identified in Part A.1 of this permit as being:

(i) A toxic pollutant effluent standard established by EPA pursuant to Section 307(a) of the Clean Water Act, or

(ii) For a toxic or hazardous pollutant which, if not adequately treated, could constitute a threat to human health, welfare, or the environment, or

(iii) Any pollutant identified as the method to control a toxic pollutant or hazardous substance (i.e. indicator pollutant).

(c) Any unanticipated bypass which exceeds any effluent limitations in the permit.

(d) Where the permittee orally reports this information within the above mentioned 24-hour time period, a written submission outlining the above information must be submitted to the Department within 5 days of becoming aware of such a condition unless this requirement is waived by the Department upon receipt of the oral report.

(2) Other Non-Compliance Reporting

(a) The permittee shall give advance notice to the Department of any planned changes to the permitted activity or facility which may result in non-compliance with permit requirements.

(b) Where the permittee knows in advance of the need for a bypass which will exceed effluent limitations, it shall submit prior notice to the Department at least 10 days, if possible, before the date of the bypass.

(c) The permittee shall report all instances of non-compliance which are not reported above at the time of DMR submission.

(3) The reports and notifications required above shall contain the following information:

(a) A description of the discharge and cause of non-compliance;

(b) The period of non-compliance, including exact dates and times and/or the anticipated time when the discharge will return to compliance; and

(c) Steps being taken to reduce, eliminate, and prevent recurrence of the non-complying discharge.

d. Specific Toxic Substance Notification Levels - Where the permittee is a manufacturing, commercial, mining, or silvicultural discharger, the permittee shall notify the Department as soon as it knows or has reason to believe the following:

(1) That any activity has occurred or will occur which would result in the discharge of any toxic pollutant which is not limited in the permit if that discharge will exceed the highest of the following "notification levels":

(a) One hundred micrograms per liter

(b) Two hundred micrograms per liter for acrolein and acrylonitrile

(c) Five hundred micrograms per liter for 2,4-dinitrophenol and 2-methyl-4,6-dinitrophenol

(d) One milligram per liter for antimony

(e) Five times the maximum concentration value reported for that pollutant in the permit application

(f) Any other notification level established by the Department

(2) That it has begun, or expects to begin, to use or manufacture as an intermediate or final product or byproduct any toxic pollutant which was not reported in the permit application.

e. Test Procedures

Unless otherwise specified in this permit, the test procedures for the analysis of pollutants shall be those contained in 40 CFR Part 136, or alternate test procedures approved pursuant to that part.

f. Recording of Results

For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information:

(1) The exact place, date, and time of sampling or measurements;

(2) The persons who performed the sampling or measurements;

(3) The dates the analyses were performed;

(4) The persons who performed the analyses;

(5) The analytical techniques or methods used; and

(6) The results of such analyses.

g. Records Retention

All records of monitoring activities and results (including all original strip chart recordings for continuous monitoring instrumentation and calibration and maintenance records), copies of all reports required by this permit, and records of all data used to complete the application for this permit shall be retained by the permittee for 3 years. The 3-year period shall be extended as requested by the Department or the EPA Regional Administrator.

4. SCHEDULE OF COMPLIANCE

a. If Part C of this permit contains a schedule of compliance, the permittee shall achieve compliance with the effluent limitations specified for discharges in accordance with that schedule.

b. No later than 14 calendar days following a date identified in the schedule of compliance, the permittee shall submit to the Department a written notice of compliance or non-compliance with the specific schedule requirement. In the case of non-compliance, the notice shall include the cause of non-compliance, any remedial actions taken, the estimated date when compliance with the elapsed date shall occur, and the probability of meeting the next scheduled requirement.

1. MANAGEMENT REQUIREMENTS

a. Permit Modification, Termination, or Revocation and Reissuance

(1) This permit may be modified, terminated, or revoked and reissued during its term for any of the causes specified in 25 Pa. Code, Chapter 92.

(2) The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated non-compliance, does not stay any permit condition.

(3) Toxic Pollutants - Notwithstanding the above, if a toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is established under Section 307(a) of the Clean Water Act for a toxic pollutant which is present in the discharge, and such standard or prohibition is more stringent than any limitation for such pollutant in this permit, then this permit shall be modified or revoked and reissued by the Department to conform with the toxic effluent standard or prohibition and the permittee so notified. In the absence of a Departmental action to modify or to revoke and reissue this permit, any toxic effluent standard or prohibition established under Section 307(a) of the Clean Water Act is considered to be effective and enforceable against the permittee.

b. Duty to Provide Information

(1) The permittee shall furnish to the Department within a reasonable time any information which the Department may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit.

(2) The permittee shall furnish to the Department, upon request, copies of records required to be kept by this permit.

(3) Other Information - Where the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Department, it shall promptly submit such facts or information to the Department.

(4) The permittee shall give advance notice to the Department of any planned physical alterations or additions to the permitted facility.

c. <u>Where the Permittee is a Publicly Owned Treatment Works (POTW)</u>

(1) The permittee shall provide adequate notice as discussed in subparagraph c(2) below to the Department of the following:

(a) Any new introduction of pollutants into the POTW from an industrial user which would be subject to Sections 301 and 306 of the Clean Water Act if it were otherwise discharging directly into waters of the United States.

(b) Any substantial change in the volume or character of pollutants being introduced into the POTW by an industrial user which was discharging into the POTW at the time of issuance of this permit.

(c) Any change in the quality and quantity of effluent introduced into the POTW.

(d) The identity of significant industrial users served by the POTW which are subject to pretreatment standards adopted under Section 307(b) of the Clean Water Act; the POTW shall also identify the character and volume of pollutants discharged into the POTW by the industrial user.

(2) The submission of the above information in the POTW's annual Wasteload Management Report, required under the provisions of 25 Pa. Code, Chapter 94, will normally be considered as providing adequate notice to the Department. However, if the above changes in industrial pollutant loadings to the POTW are significant enough to warrant either modification or revocation and reissuance of this permit, then the permittee is required to meet the provisions of Part B.1.a above.

(3) The POTW shall require all industrial users to comply with the reporting requirements of Sections 204(b), 307, and 308 of the Clean Water Act and any regulations adopted thereunder, and the Clean Streams Law and any regulations adopted thereunder.

(4) This permit shall be modified, or alternatively, revoked and reissued, to incorporate an approved POTW pretreatment program or a compliance schedule for the development of such program as required under Section 402(b)(8) of the Clean Water Act and regulations adopted thereunder or under the Department's approved pretreatment program.

d. Bypassing

(1) Bypassing not Exceeding Permit Limitations - The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if the bypass is for essential maintenance to assure efficient operation. This type of bypassing is not subject to the reporting and notification requirements of Part A.3.c above.

(2) Other Bypassing - In all other situations bypassing is prohibited unless the following conditions are met:

(a) A bypass is unavoidable to prevent loss of life, personal injury or "severe property damage";

(b) There are no feasible alternatives to a bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment down-time. (This condition is not satisfied if the permittee could have installed adequate backup equipment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance); and

(c) The permittee submitted the necessary reports required under Part A.3.c above.

(3) The Department may approve an anticipated bypass, after considering its adverse effects, if the Department determines that it will meet the 3 conditions listed above.

e. Adverse Impact

The permittee shall take all reasonable steps to minimize or correct any adverse impact on the environment resulting from non-compliance with this permit.

f. Facilities Operation

The permittee shall at all times maintain in good working order and properly operate all facilities and systems (and related appurtenances) for collection and treatment which are installed or used by the permittee for water pollution control and abatement to achieve compliance with the terms and conditions of this permit. Proper operation and maintenance includes but is not limited to effective performance based on designed facility removals, adequate funding, effective management, adequate operator staffing and training, and adequate laboratory and processing controls including appropriate quality assurance procedures. This provision includes the operation and backup of auxiliary facilities or similar systems when necessary to achieve compliance with this permit.

g. Reduction, Loss, or Failure of the Treatment Facilities

Where the permittee is a manufacturing, commercial, mining, or silvicultural discharger, then upon reduction, loss, or failure of the treatment facilities, and in order to maintain compliance with its permit, the permittee shall control production and all discharges until either the facility is restored or an alternative method of treatment is provided. This requirement applies in the situation where, among other things, the primary source of power of the treatment facility is reduced, lost, or fails.

h. Removed Substances

Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall be disposed of in a manner such as to prevent any pollutant from such materials from adversely affecting the environment.

2. RESPONSIBILITIES

a. Right of Entry

Pursuant to Sections 5(b) and 305 of the Clean Streams Law and 25 Pa. Code, Chapter 92, the permittee shall allow the head of the Department, the EPA Regional Administrator, and/or their authorized representatives, upon the presentation of credentials and other documents as may be required by law:

(1) To enter upon the permittee's premises where an effluent source is located or in which any records are required to be kept under the terms and conditions of this permit; and

(2) At reasonable times to have access to and copy any records required to be kept under the terms and conditions of this permit; to inspect any monitoring equipment or monitoring method required in this permit; to inspect any collection, treatment, pollution management, or discharge facilities required under this permit; and to sample any substances or parameters at any location.

b. Transfer of Ownership or Control

(1) No permit may be transferred unless approved by the Department.

(2) In the event of any pending change in control or ownership of facilities from which the authorized discharges emanate, the permittee shall notify the Department by letter of such pending change at least 30 days prior to the change in ownership or control.

(3) The letter shall be accompanied by the appropriate Department forms for transfer of this permit and a written agreement between the existing permittee and the new owner or controller stating that the existing permittee shall be liable for violations of this permit up to and until the date of permit transfer and that the new owner or controller shall be liable for permit violations from that date on.

(4) After receipt of the documentation required above, the Department shall notify the existing permittee and the new owner or controller of its decision concerning approval of the transfer. In approving the transfer the Department may modify or revoke and reissue this permit.

(5) In the event the Department does not approve transfer of this permit, the new owner or controller must submit a new permit application.

c. Confidentiality of Reports

Except for data determined to be confidential under 25 Pa. Code, Chapter 92, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Department and the EPA Regional Administrator. Effluent data shall not be considered confidential.

d. Penalties and Liability

(1) Nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for non-compliance pursuant to Section 309 of the Clean Water Act or Sections 602 or 605 of the Clean Streams Law.

(2) Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Clean Water Act.

e. Property Rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges; nor does it authorize any injury to private property or any invasion of personal rights.

f. Other Laws

Nothing herein contained shall be construed to be an intent on the part of the Department to approve any act made or to be made by the permittee inconsistent with the permittee's lawful powers or with existing laws of the Commonwealth regulating industrial and sewage wastes and the practice of professional engineering, nor shall this permit be construed to sanction any act otherwise forbidden by federal or state law or regulations, or by local ordinance. Nor does it pre-empt any duty to obtain state or local assent required by law for the discharges.

g. Severability

The provisions of this permit are severable, and if any provision of this permit or the application of any provision of this permit to any circumstances is held invalid, the application of such provision to other circumstances and the remainder of this permit shall not be affected thereby.

OTHER REQUIREMENTS

a. In accordance with Part A.3.b of this permit, the permittee shall submit a copy of the reports to each of the following:

Department of Environmental Resources
Bureau of Water Quality Management
600 Highland Building
121 South Highland Avenue
Pittsburgh, Pennsylvania 15206-3988

U.S. Environmental Protection Agency
Region III, Pennsylvania Section (3WM52)
Water Permits Branch
Water Management Division
Sixth and Walnut Streets
Philadelphia, Pennsylvania 19106

b. For outfall 203, effective disinfection to control disease producing organisms shall be the production of an effluent which will contain a concentration of fecal coliform organisms not greater than

1. 200/100 ml as a monthly geometric mean, nor exceed 400/100 ml in more than ten percent of the samples examined during any month from May through October inclusive.

2. 1000/100 ml as a monthly geometric mean, nor exceed 2000/100 ml in more than ten percent of the samples examined during any month from November through April inclusive.

c. For Outfall 113, effective disinfection to control disease producing organisms shall be the production of an effluent which will contain a concentration of fecal coliform organisms not greater than

1. 200/100 ml as a monthly geometric mean, nor greater than 1000/100 ml in more than ten percent of the samples examined during any month from May through September inclusive.

2. 2000/100 ml as a monthly geometric mean based on five consecutive samples collected on different days during any month from October through April inclusive.

d. In no case shall the arithmetic means of the effluent values of the biochemical oxygen demand (BOD-5 Day) and suspended solids discharged during a period of 30 consecutive days exc ed 15 percent of respective arithmetic means of the influent values for those parameters during the same time period except as specifically authorized by the Department.

e. There shall be no net addition of pollutants to non-contact cooling water over intake values except for heat, water conditioners (when used in accordance with the requirements of the Federal Insecticide, Fungicide, and Rodenticide Act), and as provided in Part A.2.q of this permit.

f. There shall be no discharge of polychlorinated byphenyl (PCB) compounds such as those commonly used for transformer fluid.

g. In cooling tower blowdown there shall be no detectable amount of the 126 priority pollutants from chemicals added for cooling tower maintenance. The 126 priority pollutants are listed at 40 CFR 423 - Appendix A, and "no detectable amount" means that the pollutants are not detectable by the analytical methods at 40 CFR 136.

h. Neither free available chlorine nor total residual chlorine may be discharged from any unit for more than two hours in any one day and not more than one unit in any plant may discharge free available or total residual chlorine at any one time unless the permittee can demonstrate to the Department that the units in a particular location cannot operate at or below this level of chlorination.

i. Waterborne releases of radioactive material to unrestricted areas shall conform to criteria set forth in Title 10 Code of Federal Regulations part 50 Appendix I - Numerical Guides for Design Objectives and Limiting Conditions For Operation To Meet The Criterion 'As Low As Is Reasonably Achievable' For Radioactive Material In Light-Water-Cooled Nuclear Reactor Effluents, as implemented through the Environmental Technical Specifications for the Facility. The facility operator shall provide the Department with copies of reports specifying the quantities of radioactive materials released to unrestricted areas in liquid/gaseous effluents. The facility operator shall provide the Department with copies of reports of the results of environmental surveillance activities and other such reports as necessary for the estimation of the dose consequential to facility operation. The above reports are to be forwarded to the following address:

Pennsylvania Department of Environmental Resources
Bureau of Radiation Protection and Toxicology
P.O. Box 2063
Harrisburg, Pennsylvania 17120

EHB-1 Rev 3/84

COMMONWEALTH OF PENNSYLVANIA

ENVIRONMENTAL HEARING BOARD

221 North Second Street
Third Floor
Harrisburg, Pennsylvania 17101
(717) 787-3483

NOTICE OF APPEAL

Any party desiring to appeal any action of the Department of Environmental Resources must file its Appeal *with this Board at the above address* within 30 days from date of receipt of notification of the Action.

1. Complete Name, Address and Telephone Number of Appellant:

DUQUESNE LIGHT COMPANY
One Oxford Centre
301 Grant Street
Pittsburgh, PA 15279
412/393-6055

2. (a) Specify the action for which review is sought, the Department officials who took said actions, and the location of the proposed project including the municipality and county. Also, attach a copy of the letter, order or notification from which you are appealing. (b) Specify the date when the order or notice of the action appealed was received.

(a) NPDES Permit PA0025615 (copy attached as Exhibit A) issued by Hugh V. Archer, Regional Water Quality Manager. Said Permit applies to the Beaver Valley Power Station, a nuclear power plant located in Shippingport Borough, Beaver County.
(b) Permit received on November 29, 1984.

3. We appeal for the following reasons: (Specify objections to the action of the Department. Objections not raised herein may be deemed waived pursuant to Rule 21.51(c). If the objections are not sufficiently specific, the appellee may move for a more specific pleading pursuant to Rule 21.84 or Appellant may be required to file the first pre-hearing memorandum. (Attach additional sheets as may be required.)

See attached sheets.

4. We hereby certify that we have served or mailed a copy of this appeal to
(X) (a) the Bureau of Litigation, P.O. Box 2357, 514 Executive House, 101 South Second Street, Harrisburg, PA 17120.
(X) (b) the Officer of the Department of Environmental Resources responsible for the action appealed, and
( ) (c) if the appeal is from the grant of a permit, license, approval or certification, a copy to the recipient thereof.

The information submitted is true and correct to the best of my information and belief:

SIGNATURE Walter T. Wardzinski - Vice President
Legal and Corporate Communications

*Signature of Appellant or Agent or Officer of Appellant if Appellant is not an individual. If you have authorized an attorney to represent you in this proceeding before the Board, please supply the following information:

Gene C. Bertsch, Esq. & Gerard F. Hickel, Esq.
(NAME) (Type or Print)
DUQUESNE LIGHT COMPANY
One Oxford Centre - 301 Grant Street
Pittsburgh, PA 15279
412/393-6055
(AREA CODE) PHONE NO.

NOTICE: FAILURE TO SUPPLY ANY OF THE ABOVE INFORMATION MAY RESULT IN THE DISMISSAL OF YOUR APPEAL.

ATTACHMENT - NOTICE OF APPEAL

3(a). Part C, requirement (h), of said Permit provides that:

"Neither free available chlorine nor total residual chlorine may be discharged from any unit for more than two hours in any one day and not more than one unit in any plant may discharge free available or total residual chlorine at any one time unless the permittee can demonstrate to the Department that the units in a particular location cannot operate at or below this level of chlorination.

(b). Appellant objects to Part C, requirement (h) in that it imposes an immediately-effective standard upon Appellant's facility. Appellant has recently become aware that the chlorination limits specified by requirement (h) are inadequate to control biofouling at its unit. Appellant cannot operate its unit at or below the prescribed level of chlorination and desires to make a demonstration of this fact to the Department, as permitted by requirement (h). Promptly upon discovery of the inadequacy of the prescribed chlorination limits, Appellant advised the Department thereof by letter of December 24, 1984) copy attached as Exhibit B), and also advised the Department of its desire to perform the demonstration authorized by requirement (h). In order to conduct such a demonstration, levels of chlorination exceeding those levels specified by requirement (h) will be necessary. If requirement (h) remains in force during the demonstration period, Appellant will be subject to

sanctions for exceedances of the chlorination level specified by requirement (h), thereby effectively denying Appellant the right to make its demonstration to the Department. Therefore, Appellant requests that the effectiveness of the chlorination limits specified by requirement (h) be suspended until Appellant has conducted its demonstration and the Department's ruling thereon has become final.

(c). Appellant further objects to requirement (h) in that the chlorination limits prescribed therein are ambiguous as to whether they apply to the dosing period or to the period of discharge into the river. The Department has by permit transmittal letter of November 26, 1984 (copy attached as Exhibit C) stated that it agrees with Appellant that the chlorination limits apply only to the dosing period, but such interpretation has not been reflected in the Permit, thereby exposing Appellant to possible actions by third parties, or by the Department, arising from a contrary interpretation of requirement (h). Therefore, Appellant requests that requirement (h) be amended by adding the following provision at the end thereof: "This limitation shall apply to the dosing period only."

(d). Part A, pages 2e and 21 of said Permit establish the following effluent limitations for free available chlorine:

"Maximum Daily Concentration -- 0.2 mg/l"

"Instantaneous Maximum Concentration -- 0.5 mg/l"

These numerical limitations were taken by the Department from United Stated Environmental Protection

2

Agency standards published at 40 CFR 125 and 423. The Environmental Protection Agency standards, however, clearly apply to daily average concentrations and to daily maximum concentrations, respectively, while the limitations of the Permit are ambiguous. The Department has verbally agreed with Appellant that the proper interpretation of the "maximum daily" limitation specified in the Permit is to apply the same to average daily discharge concentrations, in accordance with Environmental Protection Agency standards. This interpretation, however, is not reflected in the Permit, thereby exposing Appellant to possible actions arising from a contrary interpretation of the limitations. Therefore, Appellant requests that the free available chlorine effluent limitations specified at pages 2e and 21 of the Permit be amended to read as follows:

"Daily Average -- 0.2 mg/l"

"Daily Maximum -- 0.5 mg/l"

APPENDIX H

CORRESPONDENCE REGARDING
HISTORIC AND ARCHEOLOGICAL SITES

Duquesne Light
Nuclear Construction Division
Robinson Plaza, Building 2, Suite 210
Pittsburgh, PA 15205

2NRC-4-009
(412) 787-5141
(412) 923-1960
Telecopy (412) 787-2629
February 9, 1984

Mr. Harold R. Denton
Office of Nuclear Reactor Regulation
United States Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Mr. George Knighton

SUBJECT: Beaver Valley Power Station - Unit No. 2
Docket No. 50-412
ER Acceptance Review Questions - Additional Information

Gentlemen:

Please find enclosed copies of the information discussed below that were requested in Enclosures 1 and 2 to Mr. G. W. Knighton's letter to Mr. E. J. Woolever dated October 20, 1983, titled "Beaver Valley Unit 2 Environmental Review Requests for Additional Information." The enclosed information is as follows:

E310.10 Pennsylvania Historical and Museum Commission 1983. Signed concurrence by Ms. Brenda Barrett, Director, November 14, 1983, on letter from E. G. Nelson, SWEC, dated October 25, 1983.

- Ohio Historic Society 1983. Signed concurrence by W. Ray Luce, State Historic Preservation Officer, September 12, 1983, on letter from E. G. Nelson, SWEC, dated August 30, 1983.

- West Virginia Department of Culture and History 1983. Letter from Rodney S. Collins, Director, Historic Preservation Unit, dated August 23, 1983.

E451.6 One complete year (1979) of consecutive hourly meteorological data on one 9-track computer tape in NRC format collected at the BVPS site. The data on the tape consists of low-level (35 ft.) wind speed and wind direction, and precipitation for use by the NRC in their CRAC code.

DUQUESNE LIGHT COMPANY

By [signature]
E. J. Woolever
Vice President

TJZ/nml
Attachments

SUBSCRIBED AND SWORN TO BEFORE ME THIS 9th DAY OF February, 1984.

[signature]
Notary Public

ANITA ELAINE REITER, NOTARY PUBLIC
ROBINSON TOWNSHIP, ALLEGHENY COUNTY
MY COMMISSION EXPIRES OCTOBER 20, 1983

COMMONWEALTH OF PENNSYLVANIA)
) SS:
COUNTY OF ALLEGHENY)

On this 9th day of February, 1984, before me, a Notary Public in and for said Commonwealth and County, personally appeared E. J. Woolever, who being duly sworn, deposed and said that (1) he is Vice President of Duquesne Light, (2) he is duly authorized to execute and file the foregoing Submittal on behalf of said Company, and (3) the statements set forth in the Submittal are true and correct to the best of his knowledge.

Notary Public

ANITA [illegible], NOTARY PUBLIC
ROBINSON TOWNSHIP, ALLEGHENY COUNTY
MY COMMISSION EXPIRES OCTOBER 20, 1986

ETE/nml
Attachments

bcc: G. L. Beatty (w/o attachments)
R. D. Beck "
C. R. Bishop "
J. J. Carey "
E. T. Eilmann "
C. E. Ewing "
H. G. Frus "
K. M. Holcomb "
T. D. Jones "
E. F. Kurtz, Jr. "
J. Lee, Esq. "
T. J. Lex "
W. G. Logan "
R. E. Martin "
NCD File "
S. L. Pernick, Jr. "
J. A. Rocco "
H. M. Siegel "
R. J. Swiderski "
E. J. Woolever "
J. F. Zagorski "
T. J. Zoglmann "
D. R. Davidson (CEI) "
D. H. Hauser (CEI) "
L. Lazo (NRC) "
G. Walton (NRC) "
B. M. Miller (2) (OEC) "
P. RaySircar (3) "
J. Sutton (S&W) "
J. Silberg (SPPT) "
P. M. Smart (2) (TEC) "

STONE & WEBSTER ENGINEERING CORPORATION

245 SUMMER STREET, BOSTON, MASSACHUSETTS

ADDRESS ALL CORRESPONDENCE TO P.O. BOX 2325, BOSTON, MASS. 02107

W. U. TELEX: 94-0001
94-0977

BOSTON
NEW YORK
CHERRY HILL, N.J.
DENVER
CHICAGO
HOUSTON
PORTLAND, OREGON
WASHINGTON, D.C.

DESIGN
CONSTRUCTION
REPORTS
EXAMINATIONS
CONSULTING
ENGINEERING

Dr. Larry E. Tise
Executive Director
Pennsylvania Historical & Museum Commission
P.O.Box 1026
Harrisburg, PA 17120

October 25, 1983

J.O.No. 12241.09

Attn: Donna Williams:

HISTORIC AND ARCHAEOLOGICAL RESOURCES
DUQUESNE LIGHT COMPANY
BEAVER VALLEY POWER STATION, UNIT NO. 2

Stone & Webster Engineering Corporation (SWEC) is preparing amendments to the Operating License Environmental Report (OLER) for Beaver Valley Power Station, Unit No. 2 (BVPS-2). The OLER requires an identification of the historic and archaeological features within the 10 mile area around BVPS-2 and the effects, if any, of the operation of BVPS-2 on these features.

Given the location of BVPS-2 in Shippingport, Pennsylvania and the fact that no new off-site power transmission lines from the station extend into Beaver County, it is expected that the operation and maintenance of BVPS-2 and the associated transmission lines will have no adverse effect on cultural resources that are on or eligible to be on, the National Register in that portion of Pennsylvania within the 10 mile area around BVPS-2.

With reference to the two attached letters dated August 14, 1978 and September 29, 1983 between NUS Corporation and Stone & Webster Engineering Corporation and your office, respectively, I would like to request your concurrence with the above statement.

If you concur with the assessment that the operation and maintenance of BVPS-2 and its associated transmission lines will have no effect on these historic sites, please sign and date this letter in the space provided below and return it to me. If you disagree with this assessment please so indicate below by specifying the differences.

Thank you for your attention in this matter. Please contact Mr. Joel Brown at 617-589-2674 if you have any questions.

E G Nelson

EGNelson
Lead-Environmental Engineer

EGN:KR

I have reviewed the information and concur with the assessment above.

Name: [illegible] Date: [illegible]

Title: Director Representing: [illegible]

SEP 2 1983

STONE & WEBSTER ENGINEERING CORPORATION

245 SUMMER STREET, BOSTON, MASSACHUSETTS

ADDRESS ALL CORRESPONDENCE TO P.O. BOX 2325, BOSTON, MASS. 02107

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CHICAGO
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PORTLAND, OREGON
WASHINGTON, D.C.

DESIGN
CONSTRUCTION
REPORTS
EXAMINATIONS
CONSULTING
ENGINEERING

Mr. W. Ray Luce
State Historic Preservation Officer
The Ohio Historic Society
Interstate 71 at 17th Avenue
Columbus, OH 43211

August 30, 1983

J.O. No. 12241.09

Attn: Catherine Stroup:

HISTORIC AND ARCHAEOLOGICAL RESOURCES
DUQUESNE LIGHT COMPANY
BEAVER VALLEY POWER STATION, UNIT NO. 2

Stone & Webster Engineering Corporation (SWEC) is preparing amendments to the Operating License Environmental Report (OLER) for Beaver Valley Power Station, Unit No. 2 (BVPS-2). The OLER requires an identification of the historic and archaeological features within the 10 mile area around BVPS-2 and the effects, if any, of the operation of BVPS-2 on these features.

Given the location of BVPS-2 in Shippingport, Pennsylvania and the fact that no power transmission lines from the station extend into Ohio, it is expected that the operation and maintenance of BVPS-2 and the associated transmission lines will have no effect on cultural resources that are on, or eligible to be on, the National Register in that portion of Ohio within the 10 mile area around BVPS-2. Based on information provided by C. Conklin of the Ohio Historic Preservation Office in a letter dated 20 August 1983, the following sites have been identified as being within the 10 mile area of BVPS-2:

1. Beginning Point of U.S. Public Land Survey.
2. East Liverpool Post Office.
3. East Liverpool Pottery.
4. Cassius Clark Thompson House.
5. Carnegie Public Library.
6. Ikirt House.

Gaston's Mill, Lock No. 36, a National Register Site, and Williamsport Chapel, which is listed on the Ohio Historic Inventory, are located beyond the 10 mile area.

Please review the above list of sites and their approximate locations as shown on the enclosed map.

If you concur with the assessment that the operation and maintenance of BVPS-2 and its associated transmission lines will have no effect on these historic sites, please sign and date this letter in the space provided below and return it to me. If you disagree with this assessment please so indicate below by specifying the differences.

Thank you for your attention in this matter. Please contact Mr. Joel Brown at 617-589-2674 if you have any questions.

EGNelson
Lead Environmental Engineer

EGN:KR

I have reviewed the information and concur with the assessment above.

Name: W. Ray Luce Date: SEP 12 1983

Title: ______ Representing: ______

WEST VIRGINIA
DEPARTMENT OF CULTURE AND HISTORY
JOHN D. ROCKEFELLER IV, GOVERNOR
NORMAN L. FAGAN, COMMISSIONER

August 23, 1983

Mr. Joel Brown
Stone & Webster Engineering Corp.
P.O. Box 2325
Boston, MA 02107

Dear Mr. Brown:

RE: Beaver Valley Power Station, Unit #2
Hancock County, West Virginia

We have reviewed your request for a general assessment of August 3, 1983, in which you bring to our attention the preparation of amendments to the Operating License Environmental Report for the Beaver Valley Power Station, Unit #2 and its impact upon portions of Hancock County, West Virginia.

The information we currently possess in our inventory indicates that the project should not affect any historic or archaeological properties now known to us. This reflects an in-office review and not a systematic field survey and evaluation of the subject area. I have enclosed a list of all National Register sites located in Hancock County.

Thank you for the opportunity to respond on this matter. If we may be of further assistance, please contact our office.

Sincerely,

Rodney S. Collins
Director
Historic Preservation Unit

RSC: kfs;ppw

HANCOCK COUNTY

LAT. LONG.

Old Court House (July 2, 1973) 40° 31' 50" 80° 34' 35"
High and Elm Streets
New Manchester

Peter Tarr Furnace Site (January 1, 1976)
County Route 11 (Kings Creek Road)
Weirton vicinity
UTM
17/536 210/4476200

NRC FORM 335 (2-84) NRCM 1102 3201, 3202

U.S. NUCLEAR REGULATORY COMMISSION

BIBLIOGRAPHIC DATA SHEET

SEE INSTRUCTIONS ON THE REVERSE

1. REPORT NUMBER (Assigned by TIDC, add Vol. No., if any): NUREG-1094 FES

2. TITLE AND SUBTITLE: Final Environmental Statement Related to the Operation of Beaver Valley Power Station, Unit 2

3. LEAVE BLANK

4. DATE REPORT COMPLETED: MONTH September, YEAR 1985

5. AUTHOR(S)

6. DATE REPORT ISSUED: MONTH September, YEAR 1985

7. PERFORMING ORGANIZATION NAME AND MAILING ADDRESS (Include Zip Code):
Division of Licensing
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

8. PROJECT/TASK/WORK UNIT NUMBER

9. FIN OR GRANT NUMBER

10. SPONSORING ORGANIZATION NAME AND MAILING ADDRESS (Include Zip Code): Same as 7. above

11a. TYPE OF REPORT: Environmental Statement

b. PERIOD COVERED (Inclusive dates)

12. SUPPLEMENTARY NOTES: Docket No. 50-412

13. ABSTRACT (200 words or less)

The Final Environmental Statement related to the operation of Beaver Valley Power Station, Unit 2 by Duquesne Light Company, et al (Docket No. 50-412), located in Beaver County, Pennsylvania, has been prepared by the Office of Nuclear Reactor Regulation of the U.S. Nuclear Regulatory Commission. This statement reports on the staff's review of the impact of operation of the plant. Also incluced are comments of state and federal governments, local agencies and members of the public on the Draft Environmental Statement for this project and staff responses to these comments. The NRC staff has concluded, based on a weighing on environmental, technical and other factors, that an operating license could be granted.

14. DOCUMENT ANALYSIS – a. KEYWORDS/DESCRIPTORS

b. IDENTIFIERS/OPEN-ENDED TERMS

15. AVAILABILITY STATEMENT: Unlimited

16. SECURITY CLASSIFICATION: (This page) Unclassified; (This report) Unclassified

17. NUMBER OF PAGES

18. PRICE