final

NUREG-0486

environmental statement

related to operation of

LASALLE COUNTY NUCLEAR POWER STATION UNIT NOS. 1 AND 2

COMMONWEALTH EDISON COMPANY

NOVEMBER 1978

DOCKET NOS. 50-373 and 50-374

U. S. Nuclear Regulatory Commission • Office of Nuclear Reactor Regulation

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NUREG - 0486

FINAL ENVIRONMENTAL STATEMENT

related to operation of

LASALLE COUNTY STATION

UNITS 1 AND 2

Commonwealth Edison Company

Docket Nos. 50-373 & 50-374

Published: November 1978

U. S. NUCLEAR REGULATORY COMMISSION

OFFICE OF NUCLEAR REACTOR REGULATION

SUMMARY AND CONCLUSIONS

This environmental statement was prepared by the U. S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation (the staff).

1. The action is administrative.

2. The proposed action is the issuance of operating licenses to Commonwealth Edison Company, Chicago, Illinois, for the startup and operation of the LaSalle County Station (the station), located near the Illinois River in LaSalle County about 55 km (35 miles) WSW from Joliet, Illinois (Docket Nos. 50-373 and 50-374).

   The facility will employ two boiling-water reactors to produce up to 3293 megawatts thermal (MWt) per unit. A steam turbine-generator will use this heat to provide up to 1078 megawatts electrical (MWe) of electrical power capacity per unit. The maximum design thermal output of each unit is 3434 MWt with a corresponding maximum calculated electrical output of 1124 MWe. The exhaust steam will be condensed by water circulated through a constructed cooling lake; makeup and blowdown water will be taken from and discharged to the Illinois River.

3. The information in this statement represents the second assessment of the environmental impact associated with the LaSalle County Station pursuant to the guidelines of the National Environmental Policy Act of 1969 (NEPA) and 10 CFR Part 51 of the Commission's Regulations. After receipt of an application, in 1971, to construct this station, the staff carried out a review of impacts that would occur during the construction and operation of this station. This evaluation was issued as a final environmental statement in February 1973. As a result of this environmental review, a safety review, an evaluation by the Advisory Committee on Reactor Safeguards, and a public hearing in Morris, Illinois, the AEC (now NRC) issued permits, in September 1973, for the construction of Units 1 and 2 of the LaSalle County Station. As of July 1978, the construction of Unit 1 was 72% complete and Unit 2 was 47% complete. With a proposed fuel-loading date of December 1979 for Unit 1 and December 1980 for Unit 2, the applicant has petitioned for licenses to operate both units and has submitted (April 1977) the required safety and environmental reports to substantiate this petition. The staff has reviewed the activities associated with the proposed operation of this plant, and the potential impacts, with both beneficial and adverse effects, are summarized as follows:

   a. A total of approximately 1240 hectares (3060 acres) will be used for the LaSalle County Station site, of which 833 hectares (2058 acres) will be occupied by the cooling lake. Approximately three hectares (7 acres) of land will be occupied by transmission line tower bases, preempting agricultural use of this area (Sec. 2.2.2).

   b. The heat dissipation system will require a maximum expected consumptive use (by evaporation) of 1.12 m^3/s (39.4 cfs) of makeup water. This represents about 2.7% of the minimum recorded flow of the Illinois River near the site and 1.2% of the 7-day, 10-year low flow. The thermal alterations and increases in total dissolved solids concentrations will not significantly affect the aquatic productivity of the river (Secs.5.3.6 and 5.4.2).

   c. Aquatic organisms entrained in the makeup water system will be killed because of thermal and mechanical shock, although some may escape the condenser inlet and be discharged back to the Illinois River. Therefore, the maximum impact based on the 7-day, 10-year low-flow rate of the river will be the destruction of 3% of the entrainable organisms present in the river as it passes the station intake during such a period (assuming homogeneous distribution of biota in the river). Additionally, densities of aquatic biota are low in this stretch of the Illinois River, which should further reduce entrainment and impingement effects. Thus, impingement and entrainment are not expected to constitute a significant impact even during periods of low river flow (Sec. 5.4.2).

   d. Chemicals and sanitary wastes discharged to the Illinois River will be diluted such that the concentrations will not affect water users or aquatic biota (Sec. 5.3.5).

e. There will be a potential for rime ice formation on vegetation close to the cooling lake and the occurrence of light steam fog in the area and over a state road and county highway near the site during about 100 to 200 hours per year. In addition, considerable dense fog and some icing is expected to occur ten days on a township road just north of the cooling lake during 100 to 200 hours of the year (Sec. 5.4.1.2).

f. The risk associated with accidental radiation exposure is very low (Sec. 7.2).

g. No significant environmental impacts are anticipated from normal operational releases of radioactive materials. The estimated maximum integrated dose to the U. S. population due to operation of the station is 43 man-rem/year, which is less than the normal fluctuations in the 27 million man-rem/year background dose received by the estimated U. S. population in the year 2000 (Sec. 5.5.2).

h. Runoff from the cooling lake dike during heavy rains may cause erosion of the dike and of the banks of the drainage stream (Secs. 5.2 and 4.2.1).

4. The following Federal, state, and local agencies were requested to comment on the draft environmental statement issued in March 1978.

   Advisory Council on Historic Preservation
   Department of Agriculture
   Department of the Army, Corps of Engineers
   Department of Commerce
   Department of Health, Education and Welfare
   Department of Housing and Urban Development
   Department of the Interior
   Department of Transportation
   Department of Energy
   Environmental Protection Agency
   Federal Energy Regulatory Commission
   Illinois State Clearing House
   Illinois Department of Public Health
   Illinois Institute for Environmental Quality
   Board of Supervisors for LaSalle County, Illinois

   Comments on the draft environmental statement were received from the following:

   Department of Agriculture
   Department of the Interior
   Department of Health, Education, and Welfare
   Department of Housing and Urban Development
   Department of Agriculture, Forest Service
   Department of Energy
   Environmental Protection Agency
   Illinois Department of Health
   Elaine Walsh
   Mrs. Susan Mulhall
   Commonwealth Edison

   Copies of these comments are appended to this final environmental statement as Appendix A. The staff has considered these comments and the responses are located in Section 11.

5. This final environmental statement was made available to the public, to the Environmental Protection Agency, and to other specified agencies in November 1978.

6. On the basis of the analysis and evaluation set forth in this statement, and after weighing the environmental, economic, technical and other benefits against environmental costs, and after considering available alternatives at the construction stage, it is concluded that the action called for under NEPA and 10 CFR Part 51 is the issuance of operating licenses for Units 1 and 2 of the LaSalle County Station subject to the following conditions for the protection of the environment:

   a. Before engaging in additional construction or operational activities which may result in a significant adverse environmental impact that was not evaluated or that is significantly greater than that evaluated in this environmental statement, the applicant shall provide written notification to the Director, Division of Site Safety and Environmental Analysis.

b. The applicant will carry out the environmental (thermal, chemical, radiological, ecological) monitoring program outlined in this statement and in the final environmental statement for the construction permits as modified and approved by the staff and implemented in the environmental technical specifications incorporated in the operating licenses for the LaSalle County Station (Sec. 6).

c. If, during the operating life of the station, effects or evidence of irreversible damage are detected, the applicant will provide to the staff an analysis of the problem and a proposed course of action to alleviate the problem.

d. The applicant will conduct a coliforms monitoring program as an indicator of potential hazards of the cooling lake to public health. If a health hazard is declared, public access to the lake will not be allowed until concentrations of fecal coliforms fall below maximum recommended levels (Sec. 6.2.6).

e. After the first year of operation of Unit 2, the applicant will submit to the staff for review and approval a recreational use plan for the station cooling lake. This plan must be approved by the staff prior to any public use of the cooling lake (Sec. 6.2.6).

f. The applicant will institute the requirements related to the problem of erosion of the cooling lake dike and drainage stream banks during heavy rains (Secs. 6.3.4 and 4.2.1).

CONTENTS

CONTENTS

CONTENTS

LIST OF FIGURES

LIST OF TABLES

FOREWORD

This environmental statement was prepared by the U. S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation (the staff), in accordance with the Commission's regulation, 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 esthetically and culturally pleasing surroundings.
- Attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences.
- Preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity and variety of individual choice.
- Achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities.
- Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

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

(i) the environmental impact of the proposed action;

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

(iii) alternatives to the proposed action;

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

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

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

This evaluation leads to the publication of a draft environmental statement, prepared by the Office of Nuclear Reactor Regulation, which is then circulated to Federal, state and local governmental agencies for comment. A summary notice is published in the Federal Register of the availability of the applicant's environmental report and the draft environmental statement. Interested persons are also invited to comment on the proposed action and the draft statement.

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

This environmental review deals with the impact of operation of the LaSalle County Nuclear Station. Assessments that are found in this statement supplement those described in the final environmental statement that was issued in February 1973 (FES-CP) and those described in the hearing board decisions of 5 September 1973 (6AEC645), 19 October 1973 (ALAB-153, 6AEC821), 18 March 1974 (7AEC288), and 15 April 1974 (ALAB-193, 7AEC423) in support of issuance of construction permits for the units. The information to be found in the various sections of this statement updates the above assessments in four ways: (1) by identifying differences between environmental effects of operation (including those which would enhance as well as degrade the environment) currently projected and the impacts that were described in the preconstruction review; (2) by reporting the results of studies that had not been completed at the time of issuance of the FES-CP and which were under mandate from the NRC staff to be completed before initiation of the operational review; (3) by evaluating the applicant's preoperational monitoring program and factoring the results of this program into the design of a post-operational surveillance program and into the development of environmental technical specifications; and (4) by identifying studies being performed by the applicant that will yield additional information relevant to the environmental impacts of operating the LaSalle County Nuclear Station.

The staff recognized the difficulty a reader would encounter in trying to establish the conformance of this review with the requirements of the National Environmental Policy Act with only "updating information." Consequently, a copy of the FES-CP was included in the draft environmental statement as Appendix I. In addition, introductory résumés in appropriate sections of this statement summarize both the extent of "updating" and the degree to which the staff considers the subject to be adequately reviewed.

Copies of this statement are available for inspection at the Commission's Public Document Room, 1717 H Street N.W., Washington, D.C., and at the library of the Illinois Valley Community College, Rural Route No. 1, Oglesby, Illinois. Single copies of this statement may be obtained as indicated on the inside front cover.

Dr. S. S. Kirslis is the NRC Environmental Project Manager for this project. Dr. Kirslis may be contacted at (301)492-8426, or at the following address:

Division of Site Safety
and Environmental Analysis
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

1. INTRODUCTION

1.1 HISTORY

In November 1971, the Commonwealth Edison Company (applicant) filed an application with the Atomic Energy Commission (now Nuclear Regulatory Commission) for a permit to construct the LaSalle County Station. Construction Permits CPPR-99 and CPPR-100 were issued accordingly on September 5, 1973, following reviews by the AEC Regulatory Staff and its Advisory Committee on Reactor Safeguards and after public hearings before an Atomic Safety and Licensing Board in Morris, Illinois, on July 18, 19 and 20, 1973. The conclusions reached in the staff's environmental review were issued in a final environmental statement in February 1973.*

As of July 1978. construction of Unit 1 was approximately 72% complete and the reactor is estimated by staff to be ready for loading of fuel in December 1979. (Unit 2 was approximately 56% complete and the tentative fuel-loading date is estimated by staff to be December 1980). Each unit has a boiling-water reactor which will produce up to 3293 MWt and a net electrical output of 1078 MWe.

In April 1977, Commonwealth Edison Company submitted an application including a final safety analysis report (FSAR) and environmental report (ER)** requesting issuance of operating licenses for Units 1 and 2. Those documents were docketed on May 12, 1977, and the operational safety and environmental reviews were initiated at that time.

1.2 PERMITS AND LICENSES

The applicant has provided a status listing of environmentally related permits, approvals, licenses, etc. required from Federal, regional, state, and local agencies in connection with the proposed project. This information is provided in Chapter 12 of the ER. The staff has reviewed that listing and is not aware of any potential non-NRC licensing difficulties that would significantly delay or preclude the proposed operation of the station.

Pursuant to Section 401 of the Federal Water Pollution Control Act Amendments of 1972 and relative to the operating license application, the Illinois Environmental Protection Agency issued a water quality certification on December 30, 1976.

The Illinois Environmental Protection Agency also issued a National Pollutant Discharge Elimination System (NPDES) permit on December 30, 1976. The NPDES permit became effective immediately. The permit expires on May 31, 1981, and its conditions are applicable to the discharges of the LaSalle County Station.

*Hereinafter this will be cited as the FES-CP.

**LaSalle County Station Environmental Report, Operating License Stage, Vol. 1&2, Commonwealth Edison Company (hereinafter this will be cited as the ER, with specific section number, page number, etc.).

2. THE SITE

2.1 RÉSUMÉ

The staff revisited the LaSalle County Station in June 1977 to determine what changes had occurred at the site and in the surrounding environs since the preconstruction environmental review in 1972. Of interest were changes in regional demography predictions and in land use. Projections of population distribution have been updated and expanded to the year 2020. Land use in the area has changed as a result of construction of the station. Major land use changes have been at the station site and involve conversion of rural acreage to station use, e.g., permanent plant structures, construction facilities, warehouses, parking lot, roads, cooling lake, railroad spur and transmission rights-of-way.

Changes in the local economy due to construction are discussed in Section 2.2.3.

The water use section has been updated with new information, and additional water quality data collected since the issuance of the FES-CP have been incorporated into Section 2.3 to provide more complete pictures of the water quality of the Illinois River and of the local groundwater resources.

The meteorological section (Sec. 2.4) has been updated to include new information for the region and the site.

Additional background information related to the terrestrial and aquatic biota within the environs of the site and the Illinois River is provided in Section 2.5.

Section 2.6 contains information on the background radiological characteristics of the site area. This provides information that was not presented in the FES-CP.

All pertinent geological and seismological data are provided in the applicant's final safety analysis report (FSAR). The results of the staff's evaluation of the FSAR will be presented in the safety evaluation report (SER). Issuance of this environmental statement precedes issuance of the SER.

2.2 REGIONAL DEMOGRAPHY AND LAND USE

2.2.1 Changes in Population

The applicant has updated and expanded data on population distribution within eight kilometers (5 miles) of the site and has included the most recent projections of population up to the year 2020 for the area within 80 kilometers (50 miles) of the site (Figs. 2.1 and 2.2).

In 1970, the population within 80 kilometers (50 miles) was 933,907; this is expected to increase to 1,658,377 by the year 2020 according to the most recent projections (Fig. 2.1). The 1970 and projected 2020 populations of the cities within 80 kilometers (50 miles) which had 1970 populations of 10,000 or more are shown in Table 2.1, and the population data for all communities within 25 kilometers (15 miles) are given in Table 2.2. The towns within 80 kilometers (50 miles) are shown in Figure 2.3, and the major transportation routes in the area are shown in Figure 2.4.

Results of a house count conducted by the applicant in August 1975 indicated that the population within eight kilometers (5 miles), estimated to be 720 persons in 1971 (FES-CP), had increased to 1106 persons. It is projected that during the period 1975-2020, the population of the area will increase by 15% (ER, Fig. 2.1-7).

Twenty LaSalle County Station operating staff members (17% of the permanent staff currently at the plant) and their families have relocated into the local area (ER, Supp. 1, Q340.02-1). All have moved into the communities within 25 kilometers (15 miles) of the station, including Ottawa, Marseilles, and Streator. The population increase resulting from these relocations is estimated to be 64 persons (ER, Supp. 1, Q340.02-1).

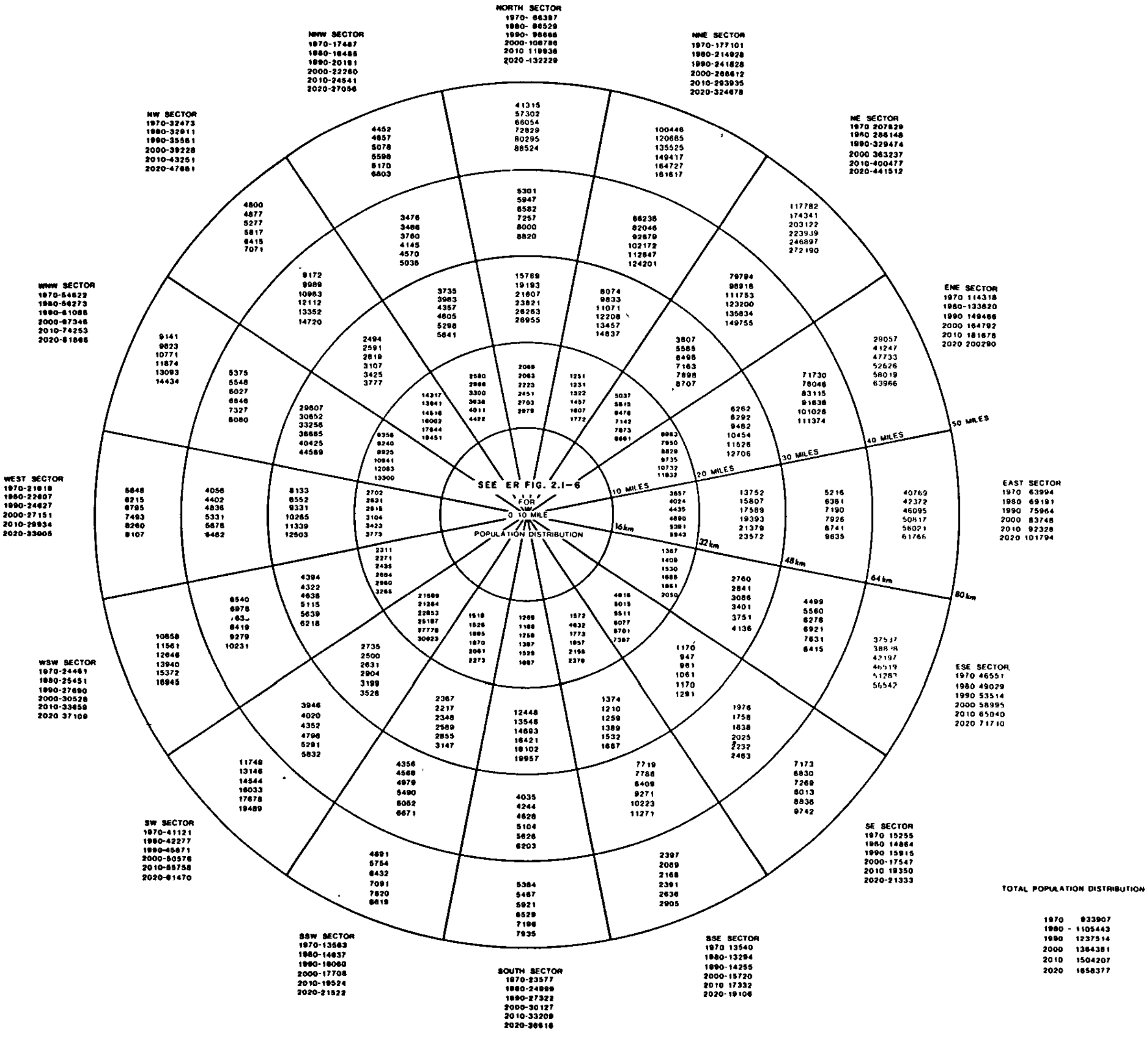

Fig. 2.1. 1970 and Projected Population Distribution through 2020 within 80 Kilometers (50 miles) of the Site. (Modified from ER, Fig. 2.1-8.)

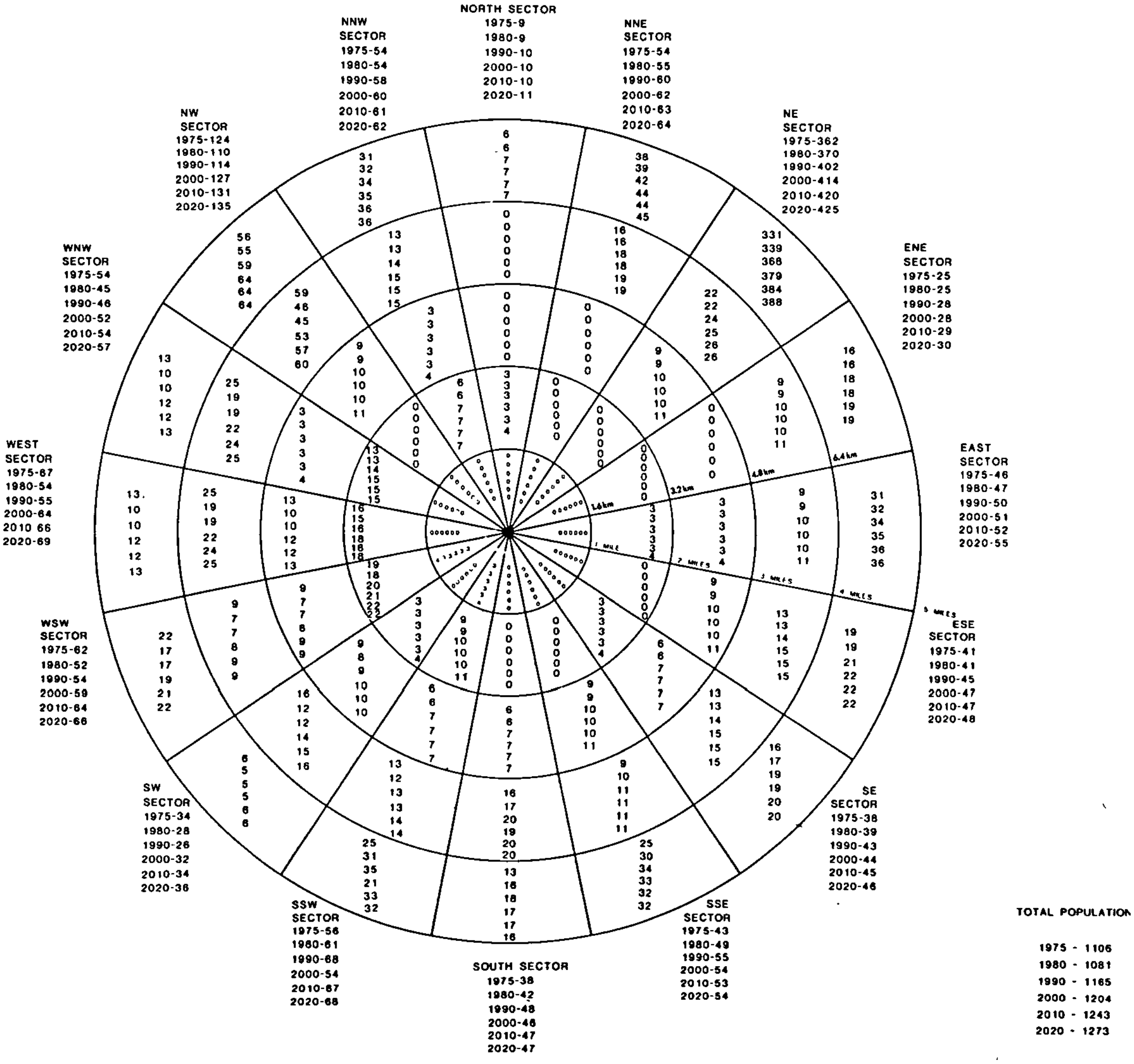

Fig. 2.2. 1975 and Projected Population Distribution through 2020 within Eight Kilometers (5 miles) of the Site. (Modified from ER, Fig. 2.1-7.)

Table 2.1. 1970 and Projected 2020 Populations of Largest[a] Cities within 80 Kilometers of the Site

City[b]	Distance (km) and Direction from the Site	1970 Population	2020 Projected Population
Ottawa	18 NW	18,716	25,904
Streator	19 SW	15,600	21,433
LaSalle	37 WNW	10,736	14,172
Peru	39 WNW	11,772	19,537
Joliet	57 ENE	80,378	127,627
Aurora	64 NNE	74,182	119,100
Romeoville	66 NE	12,674	33,120
Kankakee	69 ESE	30,944	42,365
Naperville	72 NE	23,885	56,185
Woodridge	76 NE	11,028	27,451
DeKalb	77 N	32,949	73,346
St. Charles[c]	79 NNE	11,895	22,601

[a]Includes all cities with 1970 populations of 10,000 or more persons.

[b]All cities listed are in Illinois.

[c]Only part of this city's population lives within 80 kilometers of the site.

Adapted from ER, Table 2.1-3.

Table 2.2. 1970 and Projected 2020 Populations for all Communities within 25 Kilometers of the Site

City	Distance (km) and Direction from the Site	1970 Population	2020 Projected Population
Seneca	9 NE	1,781	2,695
Ransom	10 S	440	796
Kinsman	10.3 SE	153	215
Marseilles	11 NNW	4,320	6,579
Grand Ridge	13.2 W	698	970
Verona	14.5 ESE	220	320
Streator East (U)[a]	17 SW	1,660	3,128
Ottawa	18.2 NW	18,716	25,904
Streator West (U)	18.3 SW	2,077	2,812
Streator	19 SW	15,600	21,433
Naplate	19.6 WNW	686	901
Kangley	20 WSW	290	417
Mazon	20.4 E	727	1,107
South Streator (U)	21.6 SW	1,869	2,836
Morris	24.3 ENE	8,194	12,328

[a](U) indicates unincorporated area.

Adapted from ER, Table 2.1-3.

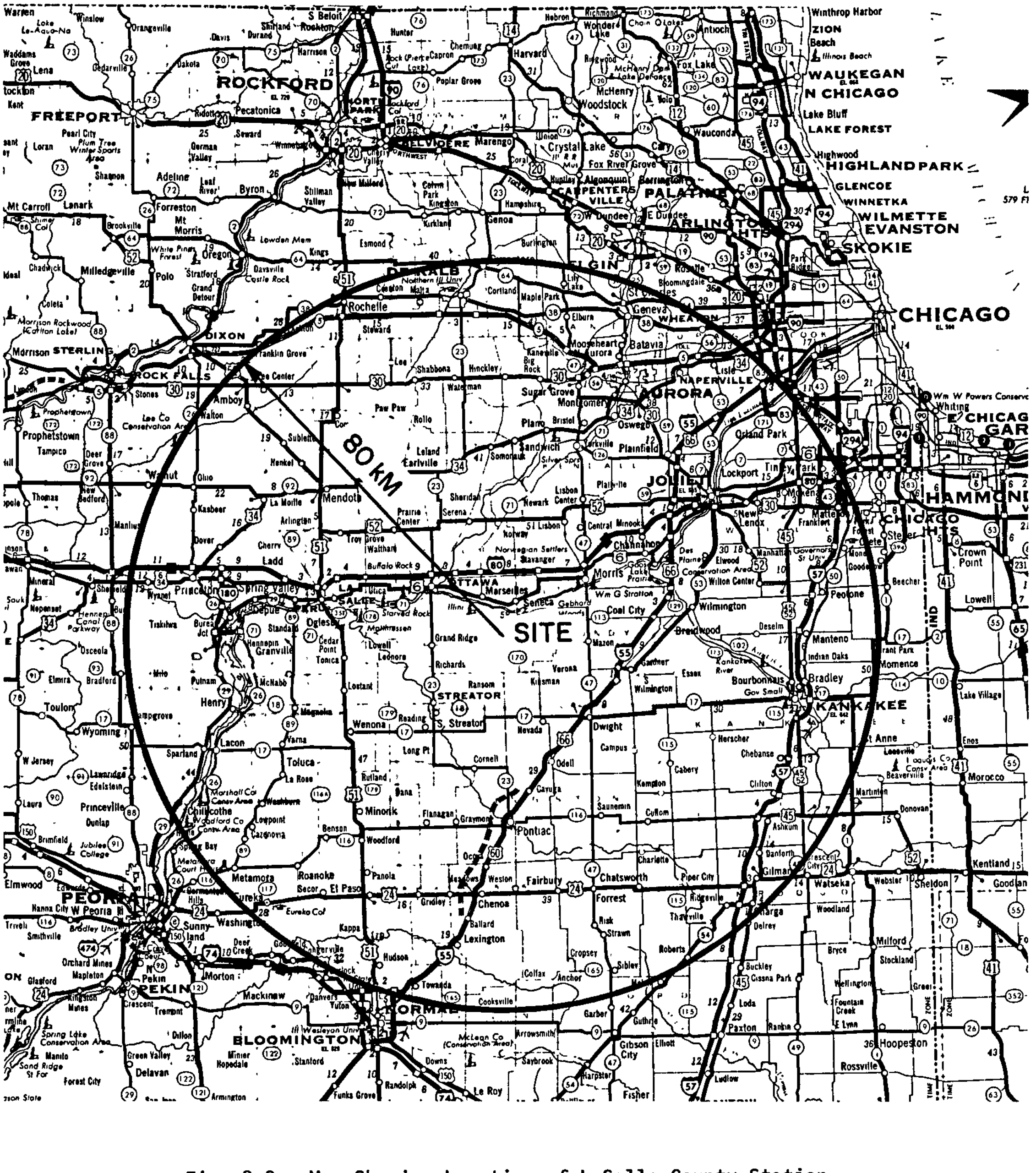

Fig. 2.3. Map Showing Location of LaSalle County Station.

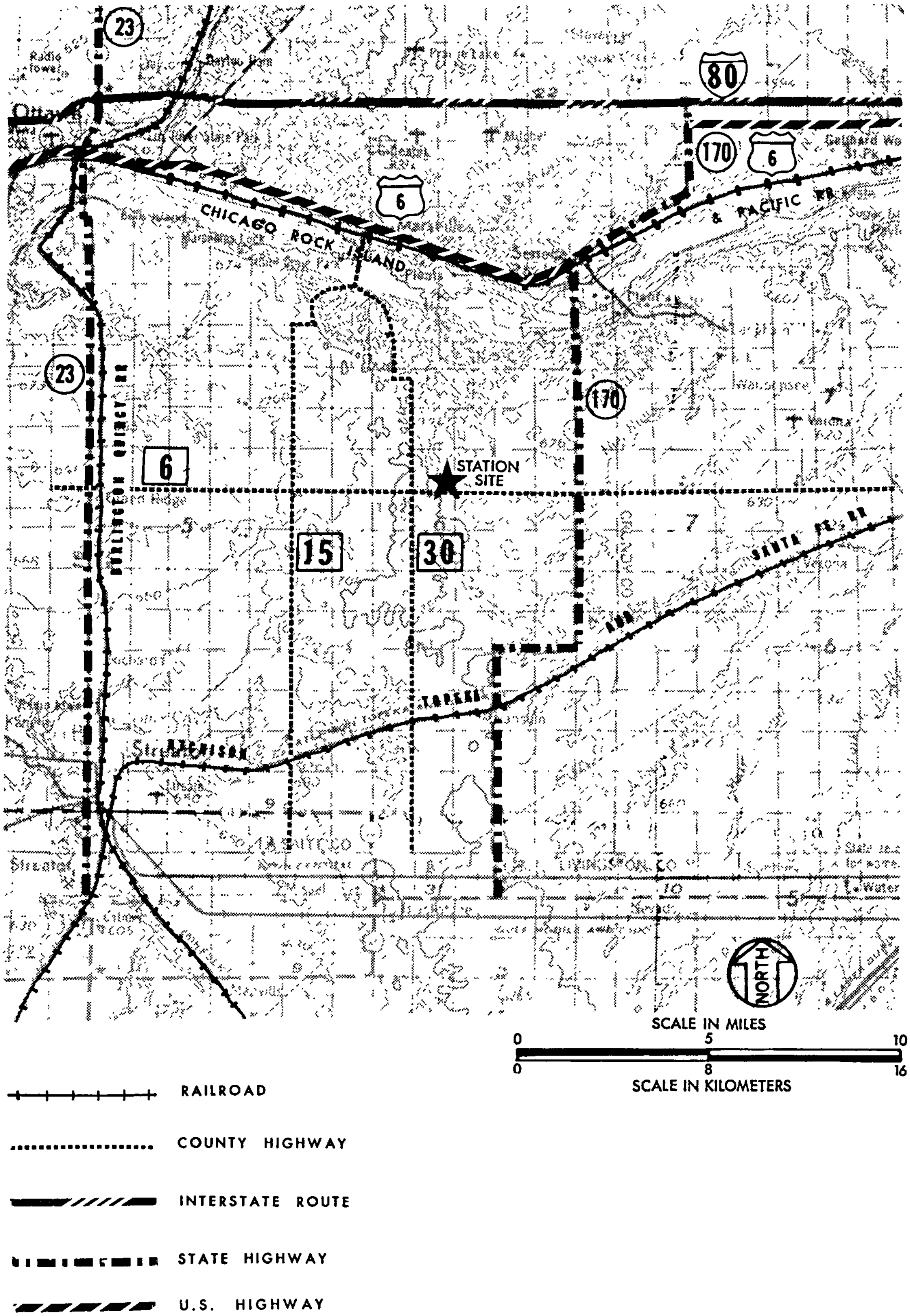

Fig. 2.4. Transportation Routes in Site Vicinity. (Modified from ER, Fig. 2.1-5.)

2.2.2 Changes in Land Use

The area within a 16-kilometer (10-mile) radius of the site (Fig. 2.5), as well as the remainder of LaSalle and Grundy Counties, is predominantly agricultural, a condition on which construction of the station has had no appreciable effect.

Subsequent to the issuance of the FES-CP, the initially proposed 2775-hectare (6860-acre) construction site was reduced to 1240 hectares (3060 acres), of which 833 hectares (2058 acres) comprise the cooling lake (ER, p. 2.1-6). During construction, a total of 15 residences were relocated from the site and along the makeup and blowdown pipeline corridor between the cooling lake and the Illinois River. The site construction preempted agricultural use of 1240 hectares (3060 acres), about 0.46% of the total farmland in LaSalle County (ER, p. 2.1-6). Specific land use modifications have included the building of construction facilities, permanent plant structures, parking lot, road, cooling lake and dike, and a 10.5-kilometer (6-mile) railroad spur from the Santa Fe line south of the site. As of January 1976, 750 hectares (1850 acres) of the 1240 hectares (3060 acres) expected to be used for the plant site and cooling lake had been cleared of vegetation.

Approximately three hectares (7 acres) of land will be occupied by transmission tower bases (ER, p. 4.2-2). The area directly under the towers will to a large extent retain its preconstruction agricultural productivity.

2.2.3 Changes in the Local Economy

During the peak construction period (fourth quarter 1976) there were 2500 trade craftmen on the site. Most of the workers have been hired from the neighboring communities, including Streator, Ottawa, Joliet, and Kankakee. Wages totaling $19 million (current dollars) are expected to be paid during the construction period.

2.3 WATER USE

2.3.1 Regional Water Use

There have been no major changes in water use in the region since issuance of the FES-CP.

2.3.1.1 Surface Water

The Illinois River, the primary surface stream in the region, provides an abundant supply of water and serves as a major transportation route for commercial and recreational navigation. The average river flow near the site is 304 m^3/s (10,750 cfs). Peoria, Illinois, 155 kilometers (97 river miles) downstream from the site, is the nearest point where the river is used for a municipal water supply (ER, p. 2.1-7). Seven industrial users within 80 kilometers (50 river miles) downstream of the site are listed in Table 2.3.

The river traffic passing by the site consists primarily of cargo barges. During 1974, 15,198 barges traveled downriver through the Dresden Lock and 14,286 barges traveled upriver through the Marseilles Lock (ER, p. 2.1-7). The tonnages of various commodities carried by these barges are listed in Table 2.1-12 of the ER. Pleasure boating is the primary recreational use of this stretch of the Illinois River. A total of 1994 pleasure craft passed through the Dresden Lock in 1974 (ER, p. 2.1-7). There is some sport fishing, water skiing, and swimming in the area. There currently is no commercial fishing on the Marseilles Pool of the river.

2.3.1.2 Groundwater

In the area surrounding the site, heavy reliance is placed on the abundant groundwater resources available, in particular those of the Cambrian-Ordovician aquifer. Within 40 kilometers (25 miles) of the site, there are 12 major municipal and industrial groundwater pumping centers (ER, Table 2.4-9). In 1974 total pumpage averaged 5.7×10^7 L/d (1.5×10^7 gpd). Three major industrial and six public groundwater supply points are within 16 kilometers (10 miles) of the site (ER, Tables 2.4-9 and 2.4-10). None is closer than eight kilometers (5 miles), as shown in the ER, Figure 2.4-13.

Groundwater levels have been declining because of increasing withdrawals from the Cambrian-Ordovician aquifer. Between 1963 and 1971, potentiometric levels declined 7.3 meters (24 ft) at Ottawa, 5.2 meters (17 ft) at Marseilles, 5.5 meters (18 ft) at Seneca, and 11.6 meters (38 ft) at Oglesby. However, there has been little decline indicated at the station site (ER, Figs. 2.4-12 and 2.4-15).

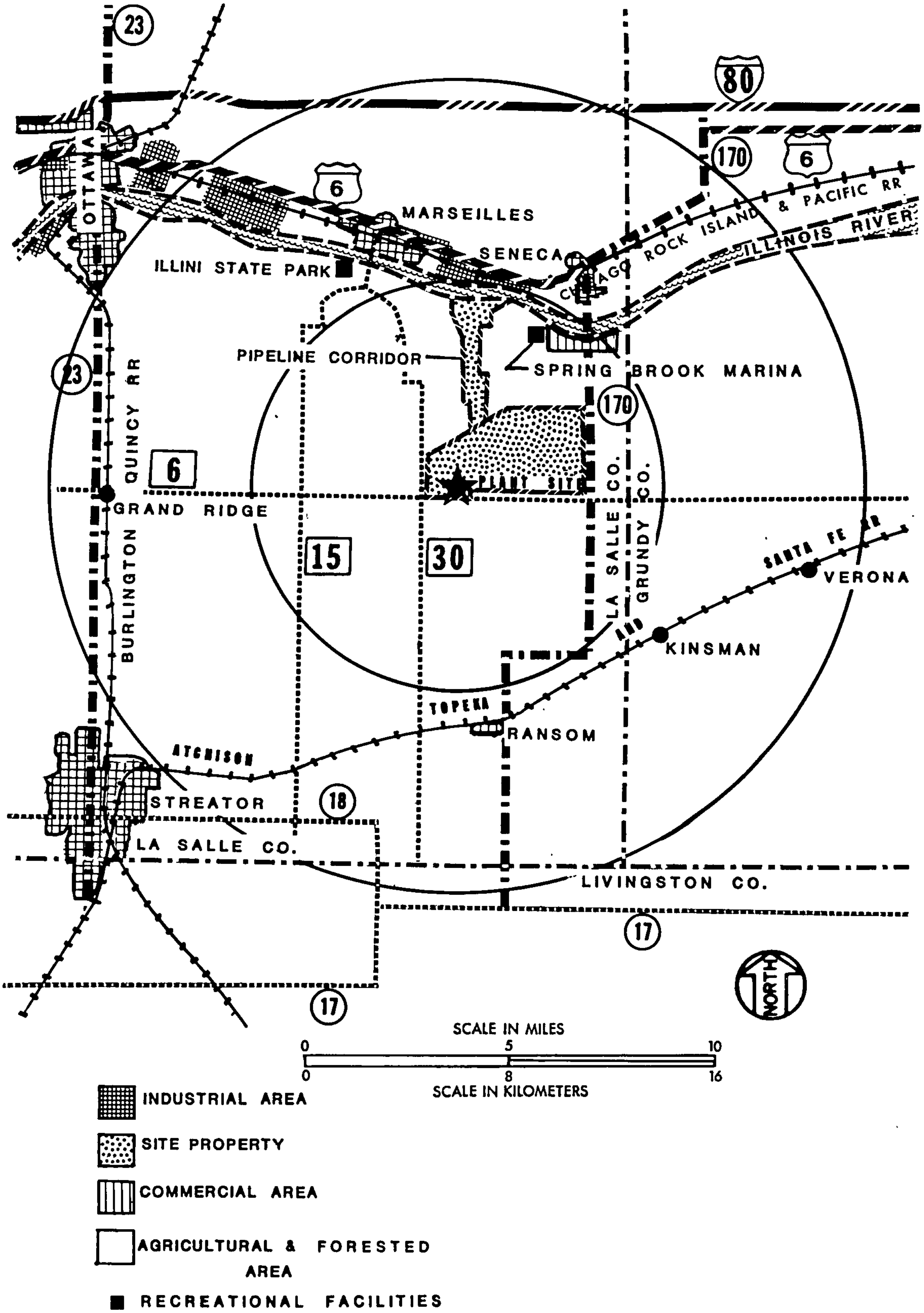

Fig. 2.5. Land Use in the Site Vicinity. (Modified from ER, Fig. 2.1-12.)

Table 2.3. Industrial Water Use along Illinois River within 80 Kilometers (50 river miles) Downstream of the Site

River Mile[a]	Industry	Average Withdrawal (L/s)	Use
248.7	Illinois Nitrogen Corp.	760	Industrial, potable, sanitary
246.7	National Biscuit Co.	30	Industrial
246.6	Marseilles Hydroelectric Plant	Negligible	Industrial
223	Foster Grant Co.[b]	--	--
223	Westclox Corp.	20	Industrial, sanitary
211.9	Hennepin Power Station	10,370	Industrial
209	Jones & Laughlin Steel Corp.	190 to 220	Industrial

[a]The station's intake and discharge structures on the Illinois River are near River Mile 249.5.

[b]Water intake is not currently being used.

Adapted from ER, Table 2.1-13.

2.3.2 Surface Water Hydrology

The major stream in the region is the Illinois River, which has a drainage area of 21,391 square kilometers (8259 mi^2) at Marseilles four kilometers (2.5 miles) downstream of the site.[1] The river flows generally southwesterly from its source (the confluence of the Des Plaines and Kankakee Rivers) to its confluence with the Mississippi River near Grafton. The river is regulated by locks and dams throughout its length (see Fig. 2.6).

The cooling lake intake and discharge are on the Marseilles Pool of the Illinois River near River Mile 249.5. The Marseilles Dam is four kilometers (2.5 miles) downstream and the Dresden Dam is 35 kilometers (22 miles) upstream. The closest station boundary is approximately three kilometers (2 miles) south of the river.

The average discharge at Marseilles Dam for the period 1919 thru 1976 was 304 m^3/s (10,750 cfs).[1] The 7-day, 10-year recurrence-interval low flow is 91.4 m^3/s (3228 cfs). The minimum recorded daily flow, 41.3 m^3/s (1460 cfs), occurred on 16 October 1943, and the maximum daily flow, 2660 m^3/s (93,900 cfs), occurred on 14 July 1951.[1] The minimum flow can be expected to last one day approximately once in every 150 years (ER, p. 2.4-4).

The river is approximately 245 meters (800 ft) wide at the station's outfall structure and widens to 275 meters (900 ft) in the next 300 to 400 meters (1000 to 1500 ft) downstream. The average depth is about three meters (10 ft), and the river is channelized for barge traffic.

River velocities near the discharge area are not well known. The U. S. Geological Survey on 14 September 1972 measured the velocity distribution across the river at a flow of 382 m^3/s (13,500 cfs) (ER, p. 5.1A-20 and 21). The depth average velocity was 0.51 m/s (1.68 ft/s). For a flow of 112 m^3/s (3940 cfs), the river velocity is calculated to be 0.15 m/s (0.48 ft/s) (ER, p. 5.1A-50 thru 52) (assuming that the ratio of the two velocities is just the ratio of the two flows). This assumption of linear relation between flow and river velocity is reasonable since dam regulation maintains water level variations of less than 0.3 meter (1 ft) between normal and low flow.

Ambient river temperatures at Marseilles vary from a minimum of 1.1°C (34°F) in the winter to 31.1°C (88°F) in August.[2] Monthly minimum, average, and maximum temperatures are listed in Table 5.2.

South Kickapoo Creek flows into the Illinois River approximately 400 meters (1300 ft) downstream of the station's discharge structure. Water depth of the South Kickapoo ranges from about 0.5 to 2 meters (2 to 7 ft) near the mouth and is about 0.5 meter (2 ft) at a location approximately one kilometer (0.6 mile) upstream.[3]

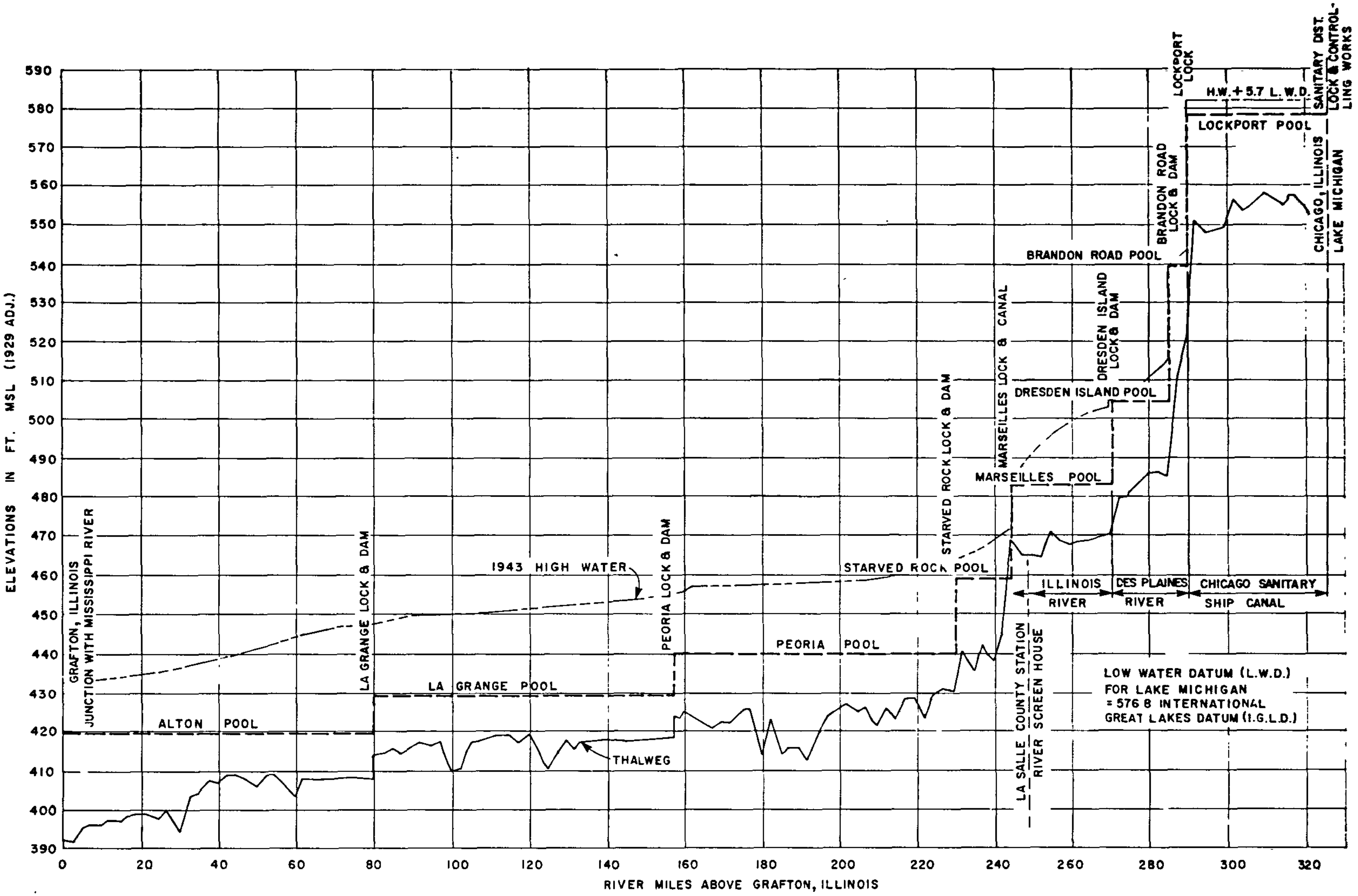

Fig. 2.6. Illinois Waterway Profile. (From ER, Fig. 2.4-2.)

2.3.3 Groundwater Hydrology

Hydrogeologic systems in the upland portion of the site include, in descending order: (1) glacial drift aquitard, (2) buried bedrock valley aquifers, (3) the Pennsylvanian aquitard, and (4) the Cambrian-Ordovician aquifer. These are shown in the stratigraphic chart in the ER, Figure 2.4-8.

Since it is the closest to the surface, the glacial drift aquitard would be the first hydrogeologic system affected by operation of the station. This aquitard is found throughout the upland portion of the site and consists of relatively impermeable silty clay or clay tills with occasional discontinuous pockets of well-graded sand and gravel. The thickness, determined from site borings, ranges from 23 to 55 meters (77 to 180 feet). Groundwater is found principally in the discontinuous sand and gravel pockets.

Water supplies for the LaSalle County Station domestic system and certain other station water needs will be obtained from wells drilled into the Cambrian-Ordovician aquifer, which consists mainly of dolomites and sandstone. Yields normally exceed 30 L/s (500 gpm), and more than 95% of the groundwater withdrawn for municipal use in the area comes from this aquifer. The general direction of flow in the aquifer is toward the Illinois River, where cones of depression occur because of heavy pumping (ER, Fig. 2.4-12).

Piezometers have been installed in 31 borings in the site vicinity, and 20 observation wells have been installed around the cooling lake (ER, pp. 2.4-9 and 2.4-10). Locations of these borings and wells are shown in the ER, Figure 2.4-9. Water level has fluctuated with time, the variations ranging from less than one meter (3.3 ft) in some wells to more than six meters (20 ft) in one (ER, Figs. 2.4-10 and 2.4-11).

The tested interval lies within the glacial drift aquitard except for one (Boring 3) that is in sand and gravel over the divide between the buried bedrock valleys that underlie part of the site and another (Boring 6) that is in the Pennsylvanian aquitard (ER, Table 2.4-5).

2.3.4 Water Quality

2.3.4.1 Surface Water

The portion of the Illinois River in the vicinity of the site has been classified by the state as a public and food-processing water supply.[4] This sector is now used principally for navigation, sewage disposal, and industrial needs.

Illinois River and South Kickapoo Creek water quality data were collected by a consultant for the applicant during three baseline aquatic surveys--in August and October 1972 and January 1973. The results of these surveys are summarized in Tables 2.4 and 2.5 (locations of sampling stations are shown in Fig. 2.7). A more complete description of the baseline surveys and discussion of results are provided in the ER, Section 2.2.1. More recent information on Illinois River quality near Seneca (upstream of the site) reported by the State of Illinois Environmental Protection Agency is given in Table 2.6.

The 1976 Illinois EPA survey and the applicant's baseline surveys have indicated that in the vicinity of the plant the Illinois River is characteristic of a river recovering from upstream pollution. Organic pollution from upstream domestic sewage effluents is a primary contributor to the high average total coliforms count and frequent low dissolved oxygen values recorded (FES-CP, p. II-10). In addition, samples collected during the applicant's baseline surveys indicated that the dissolved oxygen in the Illinois River was not controlled entirely by temperature-solubility relationships, but that a low dissolved oxygen concentration often correlated with indicators of organic loading (ER, p. 2.2-5).

2.3.4.2 Groundwater Quality

Information on groundwater quality is available for two wells on the site. The wells, 496 and 494 meters (1629 and 1620 feet) deep, were drilled into the Cambrian-Ordovician aquifer in 1972 and 1974 to supply water for construction purposes. They are within 610 meters (2000 ft) of the southwestern portion of the plant site (ER, Fig. 2.4-14). Both wells are finished in the Ironton-Galesville Sandstone, the most productive hydrologic unit of the aquifer. Results of chemical analyses of groundwater samples from the onsite wells are summarized and compared with Federal standards for drinking water in Table 2.7. In general, the concentrations of chemical constituents exceeded those recommended in the Federal standards. The chemical analyses of groundwater samples from the onsite wells apply to the entire Cambrian-Ordovician aquifer. The concentrations of the various constituents cannot be determined for the individual hydrogeological units of the aquifer since the wells are open to all of the units below the Oneota Dolomite and since these units are hydrogeologically interconnected (ER, p. 2.4-13).

Table 2.4. Water Quality of the Illinois River in the Vicinity of the Site (all values expressed as mg/liter except as noted and are an average of duplicate measurements)

Parameter	August 30, 1972		October 26, 1972		January 26, 1973		Water Quality Standard[a]	
	Upstream Surface	Downstream Surface	Station 8 Surface	Station 8 3 m Depth	Station 8 Surface	Station 8 3 m Depth	General	Public Water Supply
General Parameters								
Temperature[b]	26.0	26.0	12.6	12.6	5.0	5.2	c	d
Dissolved oxygen (% saturation)	6.4(78)	5.6(68)	10.3(96)	10.2(95)	11.3(88)	11.3(88)	5.0	d
pH[b]	7.7	7.7	8.45	8.05	8.14	8.11	6.5-9.0	d
Total alkalinity	156	155	195	195	176	175	d	d
Specific conductance[d]			568	562	682	685	d	d
Hardness	252	257	307	308	282	283	d	d
Total dissolved solids			444	422	448	442	1000	500
Total suspended solids			64	72	32	32	d	d
Turbidity[b]	66	63	38	41	20	20	d	d
Total solids			540	542	448	442	d	d
Calcium	60	62	79	70	31	31	d	d
Magnesium	24.9	24.8	30	30	27	27	d	d
Potassium			5	5	4	4	d	d
Sodium	23.1	23.1	8	9	27	28	d	d
Chloride	34.5	34.5	32.0	32.5	40.8	41.8	500	250
Sulfate	95	84	90	90	90	90	500	250
BOD	6.4	6.1	4.5	4.6	3	3	d	d
COD	40	40	29.6	29.6	18.7	19.6	d	d
TOC	22	22	8.0	6.0	11	9.0	d	d
Organic nitrogen			1.08	1.16	0.90	0.90	d	d
Ammonia nitrogen	0.44	0.44	< 0.03	< 0.03	< 0.03	< 0.03	1.5	d
Nitrite nitrogen	0.12	0.12	0.076	0.082	0.057	0.061	d	10[e]
Nitrate nitrogen	4.7	4.8	4.55	4.80	3.70	3.20	d	10[e]
Orthophosphate, soluble	0.22	0.22	0.31	0.30	0.212	0.212	d	d
Total phosphate	0.72	0.71	0.51	0.51	0.412	0.412	d	d
Phenols	0.001	0.001	0.009	0.008	< 0.008	< 0.008	0.1	0.001
Oil and grease (hexane soluble)	10	7.6	3.5	3.8	13.2	4.5	d	0.1
Cyanide			< 0.004	< 0.004	< 0.004	< 0.004	0.025	0.01
Trace Metals								
Aluminum			0.2	0.2	0.7	0.8	d	d
Antimony			< 0.05	< 0.05	0.02	0.01	d	d
Arsenic	0.005	0.004	0.003	0.002	0.008	0.004	1.0	0.01
Barium	0.1	0.1	0.1	0.1	0.07	0.1	5.0	1.0
Beryllium			< 0.01	< 0.01	0.001	0.001	d	d
Boron			0.2	0.2	< 0.2	< 0.2	1.0	d
Cadmium	0.0034	0.0032	< 0.01	< 0.01	< 0.01	< 0.01	0.05	0.01
Chromium, hexavalent	< 0.001	0.001					0.05	d
Chromium, total	< 0.001	< 0.001	< 0.02	< 0.02	0.01	0.01	1.0	d
Cobalt			< 0.01	< 0.01	0.02	0.02	d	d
Copper	0.036[f]	0.034[f]	0.01	0.02	< 0.01	< 0.01	0.02	d
Iron	3.6[f,g]	3.2[f,g]	0.8[f,g]	1.1[f,g]	1.0[g]	0.9[g]	1.0	0.3
Lead	0.046	0.048	< 0.01	< 0.01	< 0.01	< 0.01	0.1	0.05
Manganese	0.11[g]	0.11[g]	< 0.02	< 0.02	0.08[g]	0.08[g]	1.0	0.05
Mercury			< 0.001[f]	< 0.001[f]	< 0.0002	< 0.0002	0.0005	d
Molybdenum	< 0.05	< 0.05					d	d
Nickel			< 0.05	< 0.05	0.02	0.02	1.0	d
Selenium	< 0.005	< 0.005	0.5[g]	0.3[g]	0.2[g]	0.3[g]	1.0	0.01
Silver			< 0.01[f]	< 0.01[f]	0.001	0.001	0.005	d
Strontium			0.2	0.2	0.4	0.5	d	d
Tin			< 0.05	< 0.05	< 0.05	< 0.05	d	d
Zinc	0.031	0.025	0.06	0.05	< 0.02	< 0.2	1.0	d

[a] Illinois Pollution Control Board Rules and Regulations, Chapter 3, Water Pollution, Effective March 20, 1975, Section 203 General Standards and Section 204 Public and Food Processing Water Supply.

[b] Temperature expressed as °C; pH expressed as units; specific conductance expressed as μmhos/cm; and turbidity expressed as Jackson Turbidity Units (JTU).

[c] The water temperature at representative locations in the river shall not exceed 15.6°C December, January, and February or 32.2°C March through November during more than 1% of the hours in the 12-month period ending with any month. Moreover, at no time shall the water temperature at these locations exceed the above temperatures by more than 1.7°C.

[d] No Illinois Standards established for this parameter.

[e] Nitrite nitrogen plus nitrate nitrogen as N.

[f] Exceeds General Water Quality Standard.

[g] Exceeds Public Water Supply Standard.

Adapted from ER, Tables 2.2-1 and 2.2-3; station locations are shown on Fig. 2.3.4-1.

Table 2.5. Surface Water Quality of South Kickapoo Creek (all values expressed as mg/liter except as noted and are an average of duplicate measurements)

Parameters	October 26, 1972	January 26, 1973	General Water Quality Standard[a]
General Parameters			
Temperature[b]		1.5	c
Dissolved oxygen		8.6	5.0
pH[b]	8.42	8.3	6.5-9.0
Total alkalinity	257.1	234	d
Specific conductance[b]	648	730	d
Hardness	408	370	d
Total dissolved solids	506	462	1000
Total suspended solids	5	10	d
Turbidity[b]	4.9	6.9	d
Total solids	533	458	d
Calcium	90	34	d
Magnesium	45	43	d
Potassium	3	3	d
Sodium	8	10	d
Chloride	15.7	12.8	500
Sulfate	110	110	500
BOD	< 3	0.9	d
COD	15.8	7.5	d
Total organic carbon	3.0	1	d
Organic nitrogen	0.46	0.48	d
Ammonia nitrogen	< 0.03	< 0.03	1.5
Nitrite nitrogen	0.02	0.017	10[e]
Nitrate nitrogen	4.00	3.30	10[e]
Orthophosphate	0.015	0.010	d
Total phosphate	0.025	0.040	d
Phenols	0.01	< 0.008	0.1
Oil and grease	1.25	4.66	d
Cyanide	< 0.004	< 0.004	0.025
Trace Metals			
Aluminum	0.1	0.2	d
Antimony	< 0.05	0.01	d
Arsenic	0.002	< 0.002	1.0
Barium	0.1	0.1	5.0
Beryllium	< 0.01	< 0.005	d
Boron	< 0.2	0.2	1.0
Cadmium	< 0.01	< 0.01	0.05
Chromium	< 0.02	< 0.01	0.05
Cobalt	< 0.1	0.01	d
Copper	< 0.01	< 0.01	0.02
Iron	0.1	0.8	1.0
Lead	< 0.01	< 0.01	0.1
Manganese	0.02	0.03	1.0
Mercury	< 0.001	< 0.002	0.0005
Nickel	< 0.05	< 0.005	1.0
Selenium	0.2	0.1	1.0
Silver	< 0.01	0.001	0.005
Strontium	0.2	0.5	d
Tin	< 0.05	< 0.05	d
Zinc	< 0.01	0.01	1.0

[a] Illinois Pollution Control Board Rules and Regulations, Chapter 3, Water Pollution, effective March 20, 1975, Section 203, General Standards and Section 204 Public and Food Processing Water Supply.

[b] Temperature expressed as °C; pH expressed as units; specific conductance expressed as μmhos/cm; turbidity expressed as Jackson Turbidity Units (JTU).

[c] The water temperature at representative locations in the river shall not exceed 15.6°C December, January, and February, or 32.2°C March through November during more than 1% of the hours in the 12-month period ending with any month. Moreover, at no time shall the water temperature at these locations exceed the above temperatures by more than 1.7°C.

[d] No Illinois Standards established for this parameter.

[e] Nitrite nitrogen plus nitrate nitrogen as N.

From ER, Tables 2.2-2 and 2.2-4.

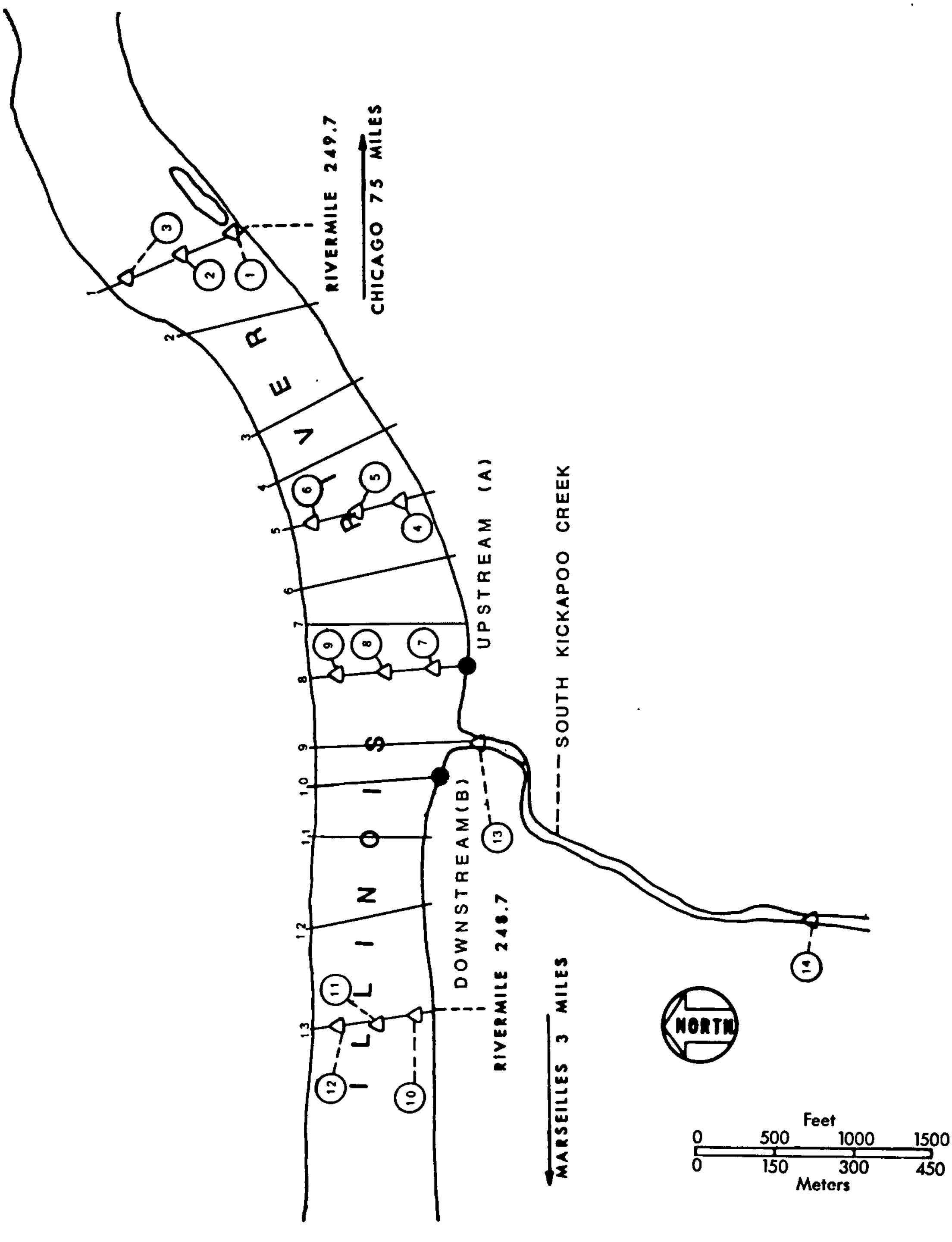

Fig. 2.7. Sampling Locations for LaSalle County Station Baseline Aquatic Survey. (Modified from ER, Fig. 2.2-1.)

Table 2.6. 1976 Illinois River Water Quality Data as Measured at Seneca (All values in mg/liter unless otherwise noted)

Quality Factor	Values, low-high (avg.)
Temperature	32 to 80 (56)°F
Dissolved oxygen	5.0 to 11.7 (7.9)
pH	8.0 to 8.4 (8.2) units
Total phosphorus	0.26 to 1.1 (0.59)
Ammonia nitrogen	0.26 to 3.4 (1.55)
Nitrate plus nitrite	2.8 to 7.8 (4.6)
Arsenic	0.0[a]
Barium	0.0 to 0.1 (0.0)
Cadmium	0.1[a]
Chromium (trivalent)	0.0[a]
Copper	0.0 to 0.7 (0.3)
Lead	0.0 to 0.09 (0.03)
Manganese	0.09 to 4.6 (1.59)
Nickel	0.0[a]
Silver	0.0[a]
Zinc	0.0 to 0.1 (0.0)
Fluoride	0.6 to 1.2 (0.8)
Chloride	45 to 75 (59)
Sulfite	96 to 110 (105)
Boron	0.2 to 0.4 (0.3)
Total iron	0.6 to 0.7 (0.6)
Mercury	0.0[a]
Phenol	0.0 to 0.005 (0.002)
Cyanide	0.0 to 0.01 (0.005)
Total dissolved solids	340 to 500 (425)
Fecal coliforms	100 to 3000 count/100 ml

[a]For all samples.

From 1976 Illinois Water Quality Network Summary Data, Volume 2, Environmental Protection Agency, State of Illinois.

Table 2.7. Water Quality Analyses for Station Water Wells[a]

Chemical Constituent	Well 1[b]	Well 2[c]	Federal Drinking Water Standards[d]	Reason for Limit
pH	8.1	7.0		
Total hardness (as $CaCO_3$)	420	450		
Total alkalinity (as $CaCO_3$)	239	288		
Chloride	303	490	250	Taste & laxative properties
Sulfate	310	390	250	Taste & laxative properties
Sodium[e]	250	340		
Iron	0.2	0.5	0.3	Staining, taste
Silica	3.3	8.2		
Total dissolved solids	1232	1200	500	Taste & laxative properties

[a]All concentrations except pH are given in mg/L.

[b]Analysis performed by Commercial Testing and Engineering Company on samples taken on 11 February 1974.

[c]Analyses performed by NALCO Chemical Company on samples taken on 31 May 1972. The concentrations given are averages of five samples.

[d]National Interim Drinking Water Regulations, EPA-570/9-76-003, effective June 1977.

[e]Sodium reported as Na_2O.

Modified from ER, Table 2.4-7.

2.4 METEOROLOGY

2.4.1 Regional Climatology

The climate of the LaSalle County Station site, located in north-central Illinois, can be described as continental, with characteristic wide ranges in temperature. The site lies along the principal paths of cyclonic and anticyclonic pressure systems tracking east and northeast through the area during the winter and spring, which can result in frequent large fluctuations of temperatures because of the contrasting air masses alternating over the area.

2.4.2 Local Meteorology

Data from the Climatic Atlas;[5] Peoria,[6] located about 108 kilometers (67 miles) southwest of the site; Ottawa,[7] located about 16 kilometers (10 miles) northwest of the site; and available information from the LaSalle County Station and Dresden sites (ER, Sec. 2.3) have been used to assess the local meteorological characteristics of the site.

Mean monthly temperatures may be expected to range from about -4.4°C (24°F) in January to about 23.9°C (75°F) in July.[5-7] Record maximum and minimum temperatures at Peoria have been 45°C (113°F) and -32.8°C (-27°F).[6]

Annual average precipitation at Ottawa is 881 mm (34.7 inches).[7] Precipitation is well distributed through the year, with the maximum monthly average occurring in April and the minimum in February.[5-7] The maximum 24-hour rainfall reported at Peoria was 140 mm (5.52 inches) in May 1927.[6] Annual average snowfall at Ottawa is about 610 mm (24 inches).[5,7] The maximum 24-hour snowfall recorded at Peoria has been 460 mm (18 inches).[6]

At Peoria, heavy fog [visibility 400 m (1300 ft) or less] occurs on about 21 days annually,[6] being most frequent December through February.

The applicant has provided wind roses for the 114.3-meter (375-foot) level of the onsite meteorological tower for the periods March 17, 1976, through March 16, 1977, and October 1, 1976, through September 30, 1977. The wind roses for these two data sets are presented in Figure 2.8. Winds from the WNW (10.1%) were most frequent for both periods, although winds were well distributed among directions from south clockwise through northwest. Two years (1974 through 1975) of wind speed and wind direction data at the Dresden site [located about 40 kilometers (25 miles) northeast of the LaSalle County Station site] are available for the 91.4-m (300-ft) level. This wind rose is presented in Figure 2.9. A comparison of wind roses between the LaSalle and Dresden sites shows that the data from LaSalle have higher westerly frequencies than those from Dresden, which show a much more uniform distribution of wind direction frequencies.

2.4.3 Severe Weather

Because of the location of the site with respect to principal storm tracks and contrasting air masses alternating over the area, severe weather is not uncommon.

Thunderstorms can be expected to occur in the area on about 49 days annually, with about 61% of these days occurring May through August.[6] Severe thunderstorms are accompanied by winds of 26 m/sec (50 knots) or more and/or hail 1.9 cm (3/4 inch) or more in diameter. In the period 1955 thru 1967, 34 occurrences of winds greater than 26 m/sec (50 knots) and nine occurrences of hail 1.9 cm (3/4 inch) or more in diameter were reported in the one-degree latitude-longitude square containing the site.[8] The "fastest mile" wind speed reported at Peoria was 33.5 m/sec (75 mph).[6]

Recent information[9] indicates that 137 tornadoes have been reported in the period 1953 thru 1974 in a 2.6×10^6-ha (10,000-mi^2) area containing the site. Using an average path area of a tornado in Illinois of about 900 ha (3.5 mi^2),[10] the recurrence interval for a tornado at the station site is calculated to be about 460 years.[11]

Ice storms accompanied by strong winds are not uncommon, and the applicant has presented information that an ice storm depositing almost 8 cm (3 inches) of ice can be accompanied by wind speeds of about 13 m/sec (about 30 mph).

In the period 1936 thru 1970, there were about 15 atmospheric stagnation cases (totalling about 63 days) reported in the site area.[12]

2.4.4 Long-Term (Routine) Dispersion Estimates

The applicant has provided two sets of joint frequency distributions of wind speed and direction at the 114.3-meter (375-ft) level by atmospheric stability in accordance with the format described in Regulatory Guide 1.23. The first set, for the period March 17, 1976, through March 16, 1977, was based on measurements of wind speed and direction at the 114.3-m (375-ft) level and atmospheric stability determined by the vertical temperature gradient measured between the 10-m (33-ft) and 61-m (201-ft) levels. The second set, for the period October 1, 1976, through September 30, 1977, was also based on measurements of wind speed and direction at the 114.3-m (375-ft) level, but atmospheric stability was determined by the vertical temperature gradient measured between the 10-m (33-ft) and 114.3-m (375-ft) levels.

Estimates of average atmospheric dispersion conditions have been made for the LaSalle County Station site using each set of available onsite meteorological data as input to the atmospheric dispersion model presented in NUREG-0324,[13] which is based on the "Straight-Line Trajectory Model" described in Regulatory Guide 1.111.[14] Releases from the station vent stack were considered as elevated. An estimate of increase in relative concentration (χ/Q) and relative deposition (D/Q) due to spatial and temporal variations in airflow, not considered in the straight-line model, was included as presented in NUREG-0324. The calculation also included consideration of intermittent releases during more adverse atmospheric conditions than indicated by an annual average calculation as a function of total duration of release (NUREG-0324). Radioactive decay of effluents and depletion of the effluent plume were considered as described in Regulatory Guide 1.111. The data for the period March 17, 1976, through March 16, 1977, provide more conservative estimates of χ/Q and D/Q overall, and these data have been used as bases for the evaluation to determine compliance with Appendix I to 10 CFR Part 50.

2.5 SITE ECOLOGY

2.5.1 Terrestrial Ecology

The ecological communities of the LaSalle County Station site were not described in the FES-CP. Because the data are now available (ER and Refs. 15-17), a characterization of these communities follows.

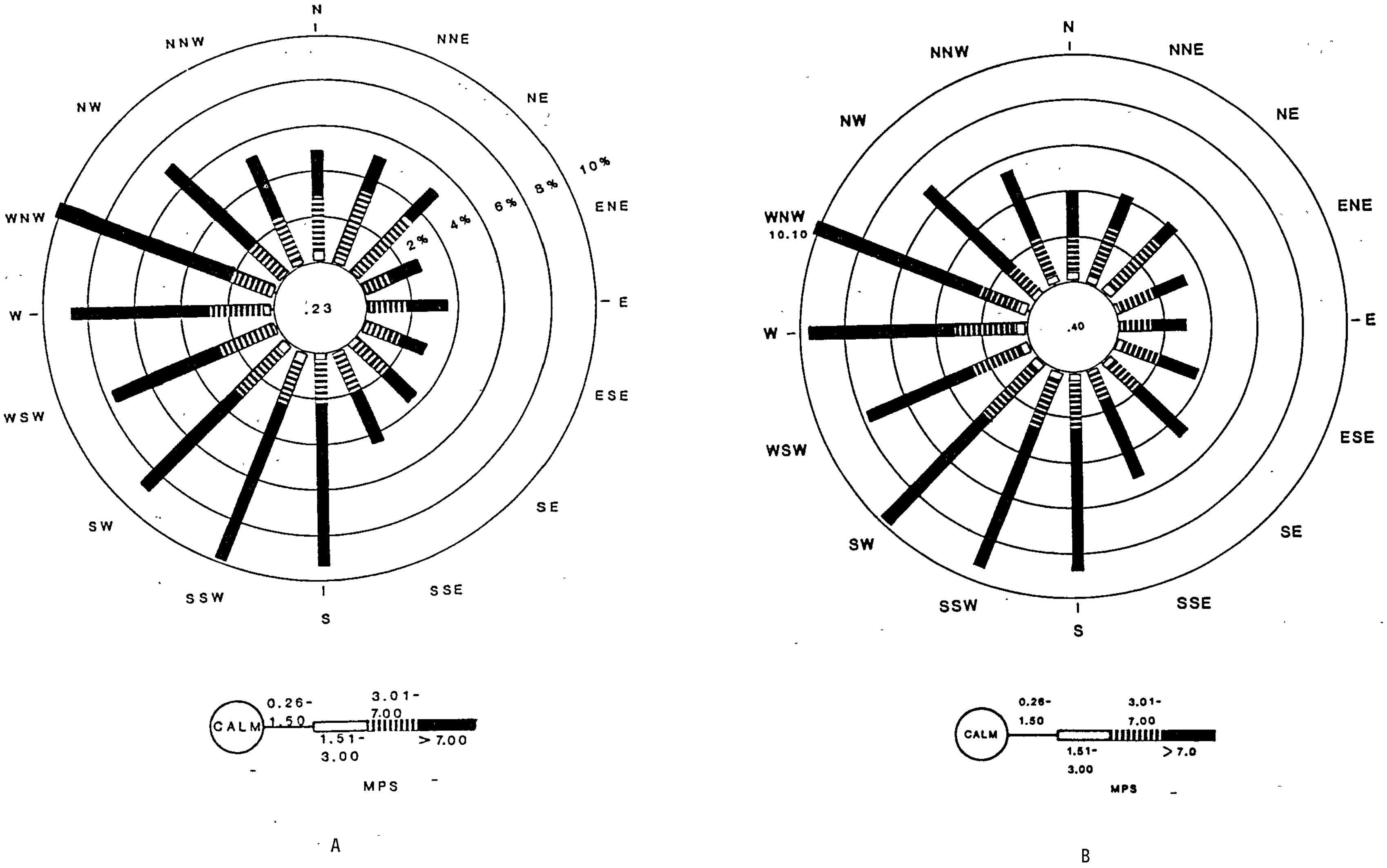

Fig. 2.8. Annual Cycle Wind Roses for the LaSalle County Station Site at the 114.3-Meter Levels for the Periods (A) March 17, 1976, through March 16, 1977, and (B) October 1, 1976, through September 30, 1977.

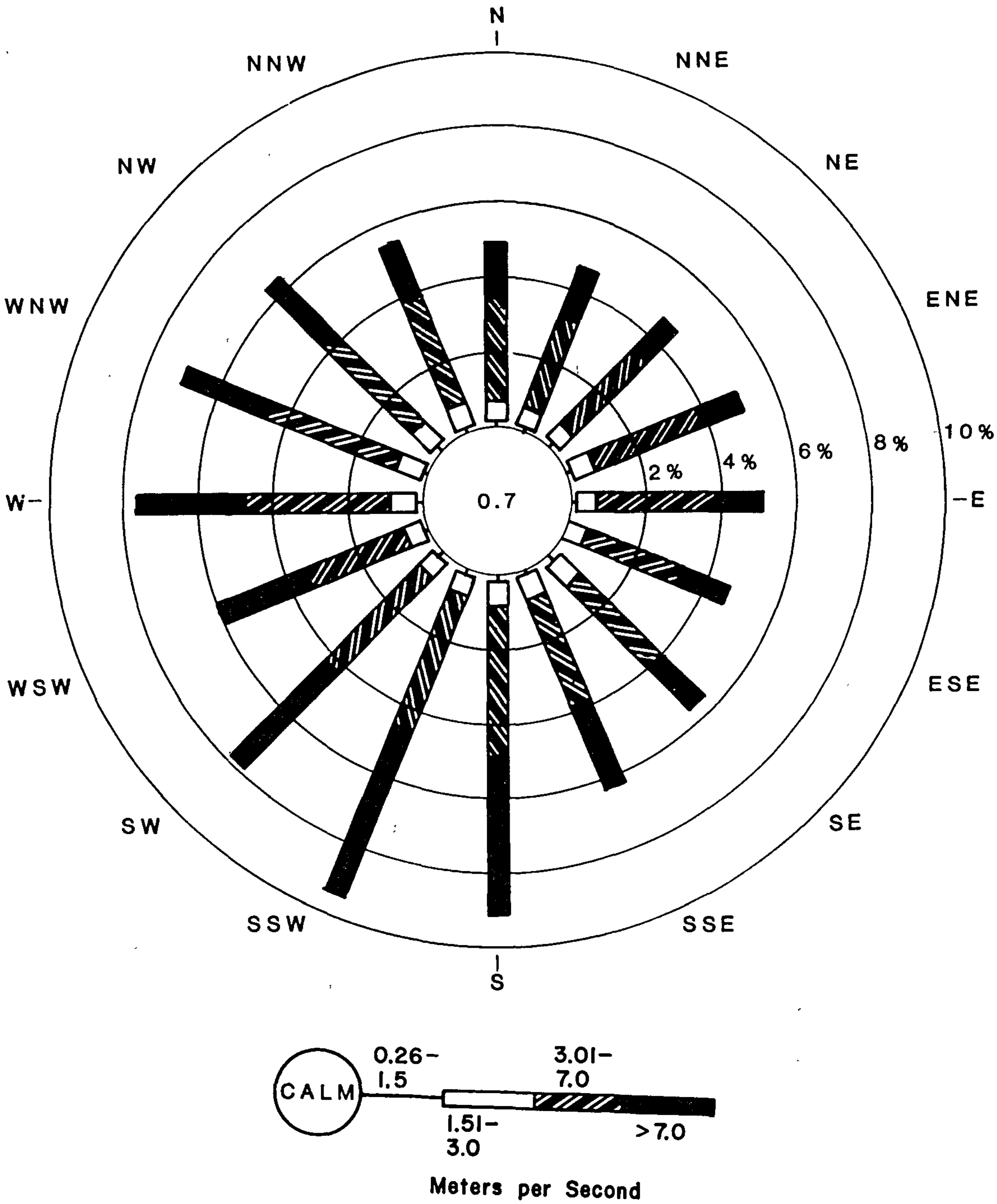

Fig. 2.9. Annual Wind Rose for the Dresden Nuclear Station (1974 thru 1975) at the 91.4-Meter Level. (From ER, Fig. 2.3-5.)

2.5.1.1 Vegetation

The applicant has supplied data for the site which indicate that there are six related vegetative communities: upland woods, Illinois River floodplain woods, creek bottom woods, cleared woods on transmission line right-of-way, intermediate-age old fields, and recently cultivated old fields.[17] These vegetative communities are representative of the general area. Based on the staff's analysis, the ecological relationships among these communities can be explained by two factors, succession and moisture gradient. These two factors typically account for the ecological relationships among communities of any region and therefore are not unexpected.

2.5.1.2 Fauna

Birds

The applicant analyzed the bird species population data to detect differences due to time of day, location of samples, and seasons and found that seasonal variation was the only statistically significant difference.[15] The lack of difference between locations implies that the data represent a single community. Three functional groups of birds (waterfowl, upland game, and raptors) were studied separately. The species which were observed to utilize the site area are listed in Table 2.8.

Mammals

The mammal species composition of the site area has remained unchanged throughout the sampling period.[17] The relative abundances of the species appear to be undergoing normal fluctuations. Ten of the 24 species observed are game species: raccoon, mink, red fox, gray fox, gray squirrel, fox squirrel, beaver, muskrat, eastern cottontail, and white-tailed deer.

2.5.1.3 Endangered Species

Two terrestrial vertebrates (bald eagle and peregrine falcon), but no plants, known or suspected to occur near the site are included on Federal lists of endangered species.[18,19] Although the applicant reports the bald eagle as a potential permanent resident (ER, Table 2.2-38), there has been only a single sighting of a bald eagle [April 1972, on the north-facing bluffs of the Illinois River which are offsite (ER, Table 2.2-59)]. The absence of subsequent sightings (ER and Refs. 15-17) suggests that the species currently utilizes the site area only incidently during migration. Similarly, there was one sighting of a single peregrine falcon [November 1972, in an offsite woodlands (ER, Table 2.2-56)]. Again, this probably represents only incidental use during migration.

One additional species (Indiana bat) which is on the Federal list[18] is listed by the state[20] as occurring in LaSalle County at the Blackball Mine, near Utica, about 30 km (20 miles) northwest of the station. There is no suitable habitat for the bat near the LaSalle County Station site. The staff concludes that the Indiana bat does not occur on or near the station site.

The state has listed one additional species (timber rattlesnake) as being endangered in Illinois and as occurring in LaSalle County.[20] The known population of timber rattlesnakes is at Bailey Falls, near Utica, about 30 km (20 miles) northwest of the station. No suitable habitat exists onsite for this species. The staff concludes that the timber rattlesnake does not occur on or near the station site.

2.5.2 Aquatic Ecology

Since the baseline information indicated that the section of the Illinois River in the station area is characteristic of a river recovering from upstream pollution (FES-CP), it probably contains pollution-tolerant biota. These biota include benthic fauna, such as Tubificidae worms and Chironomidae insects, and fishes such as bullheads, carp, goldfish, and shiners. Aquatic vegetation has generally been reduced and waterfowl populations have decreased significantly in the Illinois River over the past five decades. Reduced abundance and growth rates of the aquatic biota provide evidence of the stress imposed by the pollution in this stretch of the Illinois River (ER, pp. 2.2-16 and 2.2-17).

Limited biological data were collected during the baseline study, conducted from August 1972 thru January 1973 (see Table 6.2 for sampling frequency). More extensive data have been collected since then during the applicant's construction and preoperational monitoring programs on the Marseilles Pool of the Illinois River.[21-24] These data provide a good base for characterizing the Illinois River in the station vicinity, determining construction impacts, and estimating probable station operation impacts.

Table 2.8. Waterfowl, Game Birds, and Raptors Observed near the LaSalle County Station Site

Species	Average Observations[a]				
	February	May	August	November	Total
Waterfowl					
Common goldeneye	1.13	-	-	-	-
Mallard	0.74	-	-	-	-
Canada goose	0.46	-	-	-	-
Lesser scaup	0.06	-	-	-	-
Canvasback	0.01	-	-	-	-
Game Birds					
Ring-necked pheasant	0.24	0.97	0.72	0.41	0.58
Mourning dove	0.19	0.47	1.05	0.10	0.45
Bobwhite	0.62	0.20	0.34	0.03	0.15
Raptors					
Rough-legged hawk	0.87	-	-	0.82	0.42
American kestrel	0.16	0.10	0.58	0.19	0.26
Red-tailed hawk	0.18	0.05	0.10	0.52	0.21
Cooper's hawk	0.52	-	-	-	0.13
Marsh hawk	0.28	0.02	0.02	0.15	0.12
Broad-winged hawk	-	0.02	-	-	0.004
Hawk (species unidentified)	0.06	-	-	-	0.02

[a]Average Observations:

(1) For waterfowl = average number of individuals observed (1974 thru 1976) per kilometer of survey route (Illinois River).

(2) For gamebirds = average number of individuals observed (1974 thru 1976) per kilometer of survey route (county roads).

(3) For raptors = average number of individuals observed (1974 thru 1976) per hour of observation (along county roads).

2.5.2.1 Phytoplankton

The number of taxa represented in phytoplankton collections during the baseline [August 1972 - January 1973 (ER, pp. 2.2-8 thru 2.2-10)] and construction (February 1974 thru November 1976)[21-23] sampling periods varied between 178 and 309, with diatoms being the dominant group. *Cyclotella*, *Melosira*, and *Stephanodiscus* were the dominant diatom genera in all sampling years. Many of the diatoms collected in the station site area are considered to be pollution tolerant (ER, p. 2.2-10 and Ref. 25).

Densities of diatoms were quite variable among seasons, stations, and years. During the baseline study (August 1972, October 1972, and January 1973), diatom densities upstream of the station discharge and intake structure area varied from a high of 1761 units/mL (89% of total phytoplankton) in August 1972 to a low of 450 units/mL (44% of total phytoplankton) in January 1973. Data on downstream densities, 2846 units/mL (91% of total phytoplankton), were available only for August 1972 (ER, Table 2.2-6). As seen in Table 2.9, diatoms were the dominant phytoplankton group during the construction period, never representing less than 58% of the total phytoplankton. During this period, diatom densities were highest during August and lowest during February. There were no apparent differences between diatom densities at upstream or downstream stations over the three-year period. Diatom densities did fluctuate between years, however, but with no apparent trend exhibited.

Primary productivity studies by the applicant indicated that productivity followed the same seasonal trend as diatom densities.[21-23] Productivity rates ranged from a low of 3.81 mg carbon/cubic meter-hour (C/m^3-hr) in February 1975 to a high of 559.30 mg C/m^3-hr in August 1975. Rates between years varied with a consistent trend toward increasing from low values in 1974 (0.74 to 149.49 mg C/m^3-hr) to higher values in 1976 (8.51 to 312.94 mg C/m^3-hr).

Table 2.9. Densities (number units/mL) of Dominant Phytoplankton Groups at Illinois River Stations in the Vicinity of the LaSalle County Station Discharge and Intake Structures, February 1974 thru November 1976[a]

			Month			
Year	Stations[b]	Group	February	May	August	November
1974	U	Bacillariophyta	642(78)[c]	3199(86)	4015(60)	2436(96)
	D	Bacillariophyta	703(92)	3632(92)	3789(58)	1490(95)
1975	U	Bacillariophyta	1373(98)	4996(92)	4678(72)	4386(93)
	D	Bacillariophyta	2012(97)	6682(90)	4570(70)	4107(92)
1976	U	Bacillariophyta	1556(98)	2778(76)	4904(79)	3270(90)
	D	Bacillariophyta	1492(98)	2812(80)	4846(83)	3758(90)

[a]Data taken from Annual "Aquatic Monitoring Program for the Construction Phase of the LaSalle County Station ..." reports (Tables 1.1 of 1974, 1975, and 1976 reports).

[b]U = upstream station, D = downstream station.

[c]Numbers in parentheses indicate percentage of total phytoplankton.

2.5.2.2 Periphyton

During the baseline and construction sampling periods, the number of taxa represented in periphyton collections from artificial and natural substrates varied between 91 and 222 species, respectively, with diatoms and green algae being the dominant groups (ER, pp. 2.2-10 thru 2.12).[21-23] Throughout both sampling periods, *Cyclotella, Navicula,* and *Nitzschia* were the dominant diatom genera; *Stigeoclonium* (ER, p. 2.2-11) and *Cladophora, Rhizoclonium,* and *Ulothrix*[21-23] were the dominant green alga genera during the baseline and construction periods, respectively.

Densities of diatoms and green algae varied among seasons, stations, and years. During the baseline study (August 1972 and January 1973), diatom densities upstream of the station discharge and intake area accounted for 75% of the total periphyton density in August 1972 and 100% in January 1973; green algae accounted for 7% and none of the total periphyton density, respectively. The downstream diatom densities accounted for 94% of the total periphyton density in August 1972 and 92% in January 1973, while the green algae accounted for 1% and none, respectively (ER, Table 2.2-9). As shown in Table 2.10, diatoms were the dominant periphyton group during the warmer months (May, August, and November), and green algae were dominant during February from 1974 to 1976. Diatom densities were generally highest during November and lowest during February. Densities of green algae, on the other hand, were highest during February and lowest during May. There were no apparent differences between diatom densities at upstream or downstream stations over the three-year period. This was also true for green algae densities. While densities of both diatoms and green algae did vary between years, no trend toward increasing or decreasing densities was apparent.

2.5.2.3 Zooplankton

The number of taxa represented in zooplankton collections varied between 21 and 50 species during the baseline (ER, p. 2.2-10) and construction[21-23] periods, respectively, with copepods and rotifers the dominant groups. Throughout both sampling periods, *Cyclops* and *Eucyclops* were the dominant copepod genera, and *Asplanchna, Brachionus, Filinia, Notholca, Polyarthra,* and *Synchaeta* were the dominant rotifer genera.

Densities of copepods and rotifers varied among sampling periods, stations, and years. During the baseline study (October 1972 and January 1973), copepod densities were highest in January 1973 (690 organisms/L) and lowest in October 1972 (220 organisms/L); rotifer densities were also highest during January 1973 (3150 organisms/L) and lowest in October 1972 (100 organisms/L) (ER, Table 2.2-8). During the construction sampling period, rotifers were the dominant zooplankton group, never comprising less than 47% of the total zooplankton.[21-23] Peak densities for both copepods and rotifers generally occurred in August, and minimum densities during February (Table 2.11). Since the data were not available for upstream and downstream locations, it is not known if differences existed between stations. There were no consistent trends of increasing or decreasing densities apparent for either group during the entire sampling period.

Table 2.10. Densities (number × $10^3/cm^2$) of Dominant Periphyton Groups at Illinois River Stations in the Vicinity of the LaSalle County Station Discharge and Intake Structures, February 1974 thru November 1976[a]

Year	Stations[b]	Group	Month			
			February	May	August	November
1974	U	Bacillariophyta	128(12)[c]	0(0)	2390(83)	11928(86)
		Chlorophyta	885(87)	142(81)	402(14)	1796(13)
	D	Bacillariophyta	310(70)	2(1)	6791(96)	5294(67)
		Chlorophyta	132(30)	78(51)	120(2)	2176(28)
1975	U	Bacillariophyta	1970(19)	5528(73)	2524(50)	6041(50)
		Chlorophyta	8336(80)	1301(17)	1331(26)	3286(27)
	D	Bacillariophyta	1516(17)	4763(75)	2588(60)	3558(54)
		Chlorophyta	6920(76)	978(15)	1406(32)	1988(30)
1976	U	Bacillariophyta	54(16)	6996(65)	1918(73)	15108(93)
		Chlorophyta	285(84)	3320(31)	537(20)	972(6)
	D	Bacillariophyta	155(39)	8506(75)	9222(91)	14282(83)
		Chlorophyta	156(40)	2563(22)	778(8)	2692(16)

[a]Data taken from annual "Aquatic Monitoring Program for the Construction Phase of the LaSalle County Station ..." reports (Table B-2 of 1974 report and Tables 3.2 of 1975 and 1976 reports).

[b]U = upstream station; D = downstream station.

[c]Numbers in parentheses indicate percentage of total periphyton.

Table 2.11. Densities (number/m^3) of Dominant Zooplankton Groups at Illinois River Stations in the Vicinity of the LaSalle County Station Discharge and Intake Structures, February 1974 thru November 1976[a]

Year	Groups	Month			
		February	May	August	November
1974	Rotifera	3536(79)[b]	9909(74)	91979(86)	8392(77)
	Copepoda	938(21)	3167(24)	12391(12)	2448(22)
1975	Rotifera	18845(80)	6433(66)	99583(47)	10555(54)
	Copepoda	4432(19)	3214(33)	104301(49)	8674(45)
1976	Rotifera	3515(72)	17428(69)	1124810(98)	27229(88)
	Copepoda	1125(23)	7035(28)	10855(1)	3817(12)

[a]Data taken from annual "Aquatic Monitoring Program for the Construction Phase of the LaSalle County Station ..." reports (Tables 4.2 of 1974, 1975, and 1976 reports).

[b]Numbers in parentheses indicate percentage of total zooplankton.

2.5.2.4 Benthic Macroinvertebrates

The number of taxa represented in benthic macroinvertebrate collections from both artificial and natural substrates during the baseline (ER, pp. 2.2-12 and 2.2-13) and construction[21-23] periods varied between 102 and 143 species, with oligochaetes and insects being the dominant groups. *Limnodrilus* and *Nais* were the most abundant oligochaete genera on natural and artificial substrates, respectively. The most abundant insects collected from natural substrates were the chironomid genera *Cryptochironomous*, *Dicrotendipes*, and *Procladius*, while the chironomid genera *Cricotopus* and *Orthocladius* were abundant on artificial substrates.

Chironomid (insects) and oligochaete densities were quite variable between sampling periods. Oligochaete densities in the baseline study period (August 1972, October 1972 and January 1973) varied from a high of 42.4 organisms per sample in January 1973 to a low 3.0 organisms per sample in August 1972 at the upstream locations, and from a high of 72.3 organisms per sample in January 1973 to a low 2.8 organisms per sample in August 1972 at the downstream stations. Chironomid densities varied from a high of 4.9 organisms per sample in January 1973 to a low of 0.0 organisms per sample in August 1972 at the upstream stations, and from a high of 3.0 organisms per sample in October 1972 to a low of 0.7 organisms per sample in January 1973 at the downstream stations (ER, Tables 2.2-10 through 2.12-12). In the 1974 thru 1976 sampling period,[21-23] oligochaete densities were highest during February and May for both the upstream and downstream locations; however, densities were generally higher at the downstream stations. Chironomid densities during this same sampling period were highest during August and November for both the upstream and downstream stations; however, chironomid densities were also generally higher at downstream stations (Table 2.12).

Table 2.12. Densities (number/m^2) of Dominant Macroinvertebrate Groups from Natural Substrate at Illinois River Stations in the Vicinity of the LaSalle County Station Discharge and Intake Structures, February 1974 thru November 1976[a]

Year	Station[b]	Groups	Month: February	May	August	November
1974	U	Oligochaeta	1510(94)[c]	38(54)	60(19)	0(0)
		Insecta	88(5)	28(39)	257(81)	384(95)
	D	Oligochaeta	1398(56)	468(78)	106(17)	140(18)
		Insecta	1059(42)	109(18)	444(72)	598(76)
1975	U	Oligochaeta	224(69)	312(99)	99(48)	194(73)
		Insecta	86(26)	0(0)	109(52)	66(25)
	D	Oligochaeta	482(72)	1347(94)	113(16)	239(19)
		Insecta	178(27)	24(2)	424(62)	1006(80)
1976	U	Oligochaeta	340(62)	238(91)	59(21)	120(46)
		Insecta	201(37)	24(9)	224(78)	88(34)
	D	Oligochaeta	1320(66)	180(49)	66(18)	85(52)
		Insecta	683(34)	168(46)	293(80)	76(47)

[a]Data taken from annual "Aquatic Monitoring Program for the Construction Phase of the LaSalle County Station ..." reports (Table 5.2 of 1974 report, Table 5.3 of 1975 report, and Table 5.2 of 1976 report).

[b]U = upstream; D = downstream.

[c]Numbers in parentheses indicate percentage of total macroinvertebrates.

While densities between the two sampling periods are not directly comparable, because of different methods of reporting, the same seasonal and station trends existed for both macroinvertebrate groups during both sampling periods.

2.5.2.5 Fish

The number of fish species collected during the baseline (ER, pp. 2.2-14 thru 2.2-17) and construction[21-23] sampling periods varied from 14 (1972 and 1973) to 32 (1975). This difference between the two sampling periods is probably a result of less intensive sampling during the baseline period; the number of species ranged from 29 thru 32 during the construction period, when sampling was more extensive. Six species (Table 2.13) constituted the bulk of the catch, with the carp (*Cyprinus carpio*), emerald shiner (*Notropis atherinoides*), and gizzard shad (*Dorosoma cepedianum*) being the most abundant species.

Table 2.13. Relative Abundance (percent of total catch) of the Six Most Abundant Fishes Collected by Electroshocking at Illinois River Stations in the Vicinity of the LaSalle County Station Discharge and Intake Structures, May 1974 thru November 1976[a]

	May			August			November		
	1974	1975	1976	1974	1975	1976	1974	1975	1976
Upstream									
Emerald shiner	9.1	12.4	32.8	4.4	4.1	10.2	1.7	12.2	37.8
Gizzard shad	1.5	0.6	1.6	51.6	75.6	50.4	55.9	71.4	15.6
Carp	78.8	46.7	20.3	19.8	7.0	5.1	27.1	6.1	26.7
Green sunfish	0.0	27.7	37.5	8.8	8.9	19.0	11.9	6.1	4.4
Bluntnose minnow	0.0	0.0	1.6	1.1	0.0	5.8	0.0	0.0	4.4
White sucker	3.0	1.7	4.7	1.1	0.7	0.7	0.0	0.0	0.0
Total species	8	13	7	14	12	10	6	6	7
Total catch	66	177	64	91	271	137	59	49	45
Downstream									
Emerald shiner	10.3	21.6	14.5	11.9	15.3	18.0	2.3	5.0	3.3
Gizzard shad	7.4	0.9	7.2	27.7	48.9	41.8	43.2	65.0	6.7
Carp	66.2	37.8	49.1	23.8	6.2	4.9	29.6	17.0	66.7
Green sunfish	1.5	19.8	10.9	12.9	1.1	8.2	2.3	5.0	3.3
Bluntnose minnow	0.0	0.9	1.8	1.0	1.1	4.9	0.0	0.0	10.0
White sucker	1.5	2.7	0.0	3.0	17.0	13.1	2.3	0.0	0.0
Total species	9	12	10	17	15	16	8	7	7
Total catch	68	111	55	101	176	122	44	100	30

[a]Data taken from annual "Aquatic Monitoring Program for the Construction Phase of the LaSalle County Station ..." reports (Table 6.5 of 1974 report, Tables 6.4 of 1975 and 1976 reports).

The largest numbers of fish were collected during late summer (August) and the fewest during fall (October thru November) in both the baseline and construction period sampling studies (Table 2.13). Species diversity was greatest in August and least in November during the construction sampling period.[21-23] Species diversity for the baseline sampling period was not comparable since the methods of collection were not consistent (ER, p. 6.1-7). While seasonal trends in species diversity and abundance exist within the years, there were no obvious trends between years. Downstream stations generally had lower species abundance than upstream stations; however, they generally had a higher species diversity than upstream stations. No differences between year or station trends for a particular species were obvious (Table 2.13). As might be expected, seining yielded greater abundances of smaller fish, such as the emerald shiner (Table 2.14), since these collections were made in shallower, nearshore waters.

Measurements of coefficients of condition (weight per unit length) and examinations for external parasites and physical injuries during the baseline (ER, p. 2.2-16) and construction[21-23] sampling periods indicated that carp, black bullheads (*Ictalurus nebulosus*), and gizzard shad were in poor condition. The coefficients of condition were much lower than those reported for these species elsewhere[26] and may have been due to the relatively low primary productivity of the Illinois River. Carp, black bullheads, and green sunfish (*Lepomis cyanellus*) showed signs of external parasites and physical damage (e.g., parasitic copepods, fungal diseases, fin damage, malformed heads and gill covers, and old scars).

The low species abundance and diversity, low condition factors, and the degree of external parasitism and physical damage of the fishes in this area of the Illinois River are indicative of a poor aquatic environment (ER, pp. 2.12-16 and 2.12-17). Barge traffic, habitat alteration,

Table 2.14. Relative Abundance (percent of total catch) of the Six Most Abundant Fishes Collected by Seining at Illinois River Stations in the Vicinity of the LaSalle County Station Discharge and Intake Structures, 1974 thru 1976[a]

	1974	1975	1976
Upstream			
Emerald shiner	94.0	81.7	88.6
Bluntnose minnow	0.3	6.6	5.2
Gizzard shad	3.0	1.7	0.9
Green sunfish	1.4	5.9	0.5
Bullhead minnow	0.0	0.4	1.8
Spottail shiner	0.0	0.7	1.2
Total species	11	11	13
Total catch	705	289	1258
Downstream			
Emerald shiner	99.2	92.3	93.1
Bluntnose minnow	0.0	0.2	1.4
Gizzard shad	0.0	1.1	1.2
Green sunfish	0.0	0.6	0.6
Bullhead minnow	0.1	0.6	0.3
Spottail shiner	0.3	0.7	0.1
Total species	7	15	20
Total catch	1038	543	4284

[a]Data taken from annual "Aquatic Monitoring Program for the Construction Phase of the LaSalle County Station ..." reports (Table 6.11 of 1974 report, Tables 6.12 of 1975 and 1976 reports).

and heavy pollution loads have contributed significantly to the poor water quality of this stretch of the river, which only supports major populations of pollution-tolerant fish (ER, p. 2.2-17). Because of the poor condition of these fish and the low abundance of other fishes, no substantial commercial fishery exists in this stretch of the river (ER, p. 2.1-7).

There are no records, either old or recent, of any rare or endangered fishes in this stretch of the Illinois River. While one federally listed and several state (Illinois) listed species occur in the Illinois River drainage area, none have been found near the LaSalle County Station.[27]

2.6 BACKGROUND RADIOLOGICAL CHARACTERISTICS

The Environmental Protection Agency[28] has reported average background radiation dose equivalents for both Illinois and the LaSalle County Station area (Joliet) as approximately 103 and 105 millirem per year, respectively. Of these totals, for Illinois 43.0, and for the LaSalle County Station area 42.6 millirem per year were attributed to cosmic radiation (Table A-1 of Ref. 28). External gamma radiation (primarily from potassium-40 and the radioactive decay chains of uranium-238 and thorium-232) was estimated as 41.7 and 44.3 millirem per year for Illinois and the LaSalle County Station area, respectively.[28] The remainder of the whole-body dose is due to internal radiation (mostly from potassium-40), which was estimated to average 18 millirems per year nationally.

2.7 ARCHEOLOGICAL AND HISTORIC VALUES

There are no historical and cultural sites recorded in the National Registry of National Landmarks, as supplemented 8 June 1976, or the National Register of Historic Places, as supplemented 3 January 1978, located on the LaSalle County Station site.

The applicant has had archeological surveys conducted at the site and in areas affected by transmission line and pipeline construction.[29,30] No archeological sites were found onsite and four minor archeological sites were found in the transmission line corridor and pipeline areas. Flint debris and two flint knives were the only artifacts found at three of the sites. A fourth site, located less than a kilometer from the Illinois River midway between the blowdown line and the makeup line from the station, yielded a few artifacts from the Middle Woodland Period (100 B.C. to A.D. 400). The artifacts consisted of flint-chipping debris, fire-cracked igneous rock fragments, a flint scraper, a fragment of a flint knife, two possible grinding stones, and a pottery fragment. A small [approximately 0.6 by 1.0 meter (2 ft by 3 ft)] area containing burnt sandstone fragments, possibly used as a hearth, was also observed during the survey. Since site-related construction activities were not conducted at these small sites, no significant impacts have occurred.

The Illinois State Historic Preservation Officer has reviewed the activities and areas associated with the construction of the LaSalle County Station and related transmission lines and has concluded that no historic or archeological sites were affected. Copies of the letters expressing this conclusion are included in this statement as Appendix B.

References for Section 2

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3. THE PLANT

3.1 RÉSUMÉ

There have been a number of changes in station and transmission system designs. Most were minor, but one major change was the reduction of the size of the cooling lake from 1810 hectares (4480 acres) in the original design to 833 hectares (2058 acres) proposed at present, with a subsequent change in flow-through time of from 11 days to 5.5 days. This change will also result in changes in water evaporation and makeup rates, as well as in a number of other attendant factors. These changes are discussed in Section 3.2.

Since the FES-CP was issued, the applicant has modified the liquid, gaseous and solid radwaste treatment system as described in the final safety analysis report and evaluated in the staff's safety evaluation report. New liquid and gaseous source terms based on more recent operating data applicable to the station during normal operation and anticipated operational occurrences have been provided (see Sec. 3.2.3).

Changes within the power transmission system involve lengthening of the rights-of-way from 90 km (56 miles) to 94 km (59 miles) in one of the two station circuits and from 61 km (38 miles) to 66 km (41 miles) in the other (see Sec. 3.2.5).

3.2 DESIGN AND OTHER SIGNIFICANT CHANGES

3.2.1 Water Use

Condenser cooling will be the principal use for water in the station. At design power, the condensers will require about 78 m^3/s (2750 cfs) of cooling water. In addition, the service water systems will require 3.34 m^3/s (118 cfs) of water (ER, Sec. 3.3). Water both for condenser cooling and service water systems will be withdrawn from and returned to the cooling lake.

The applicant expects a net annual average water consumption from the Illinois River of 1.12 m^3/s (39.4 cfs). The total water intake will be 2.62 m^3/s (92.5 cfs), but the blowdown of 1.50 m^3/s (53.1 cfs) will be returned to the river. At 72% capacity factor, the annual average total water intake will be 2.2 m^3/s (78 cfs) and the blowdown will be 1.41 m^3/s (49.7 cfs) (ER, Sec. 3.3).

The station potable water [0.65 L/s (0.023 cfs)] and water for recreational purposes [0.68 L/s (0.024 cfs)] will be obtained from two deep wells in the Cambrian-Ordovician aquifer. (Recreational use may be for campers, picnickers, boaters, and field sports.) In addition, about 1.1 L/s (0.04 cfs) of well water will be required as makeup for the radwaste system and the main power cycle for the two-unit operation (ER, Sec. 3.3). After use and after suitable treatment, these waters will be discharged to the river through the cooling lake blowdown system.

The annual average water use from all sources for two-unit operation at a 100% capacity factor is indicated in Figure 3.1.

3.2.2 Heat Dissipation System

3.2.2.1 Cooling Lake

Operating at full power, the station will produce 15.3×10^{12} Joule/hr (14.5×10^9 Btu/hr) of waste heat, which will be transferred to the cooling water circulating at about 78 m^3/s (2750 cfs) through the condensers (ER, Sec. 3.4). This is a change from the heat rejection rate cited in the FES-CP: 16.0×10^{12} Joule/hr (15.2×10^9 Btu/hr). The temperature of the cooling water will rise approximately 13°C (24°F) during passage through the condensers. In addition, 0.364×10^{12} Joule/hr (0.3440×10^9 Btu/hr) of waste heat will be transferred to 3.33 m^3/s (118 cfs) of water circulating through the service water system. The waste heat will be dissipated to the atmosphere primarily by evaporation, radiation, and direct heat transfer from the surface of a constructed cooling lake (Fig. 3.2) with a surface area of 833 hectares (2058 acres) when the surface elevation is at 213.4 meters MSL (700 ft MSL). The average water depth

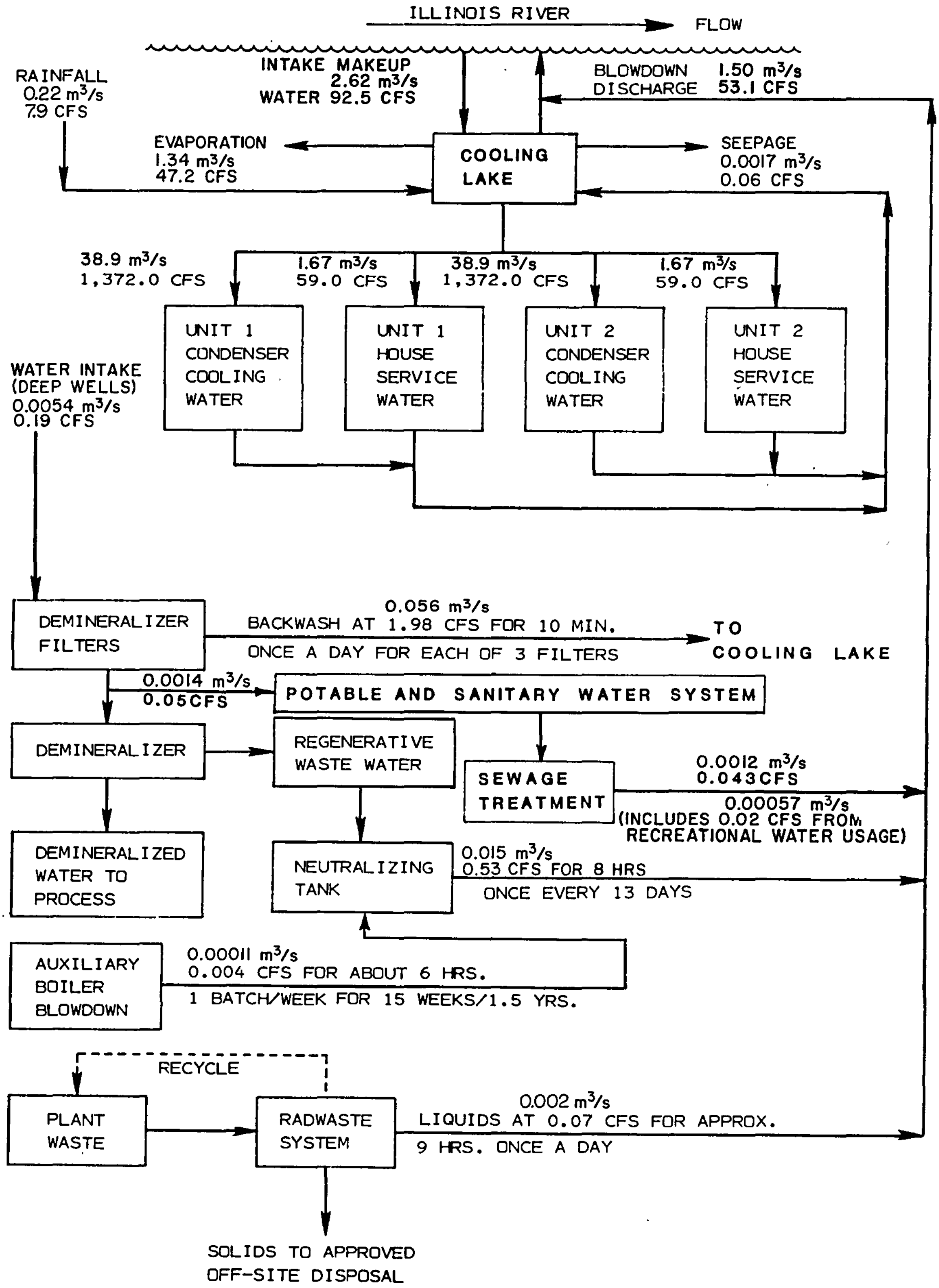

Fig. 3.1. Average Annual Station Water Use. (Modified from ER, Fig. 3.3-1.)

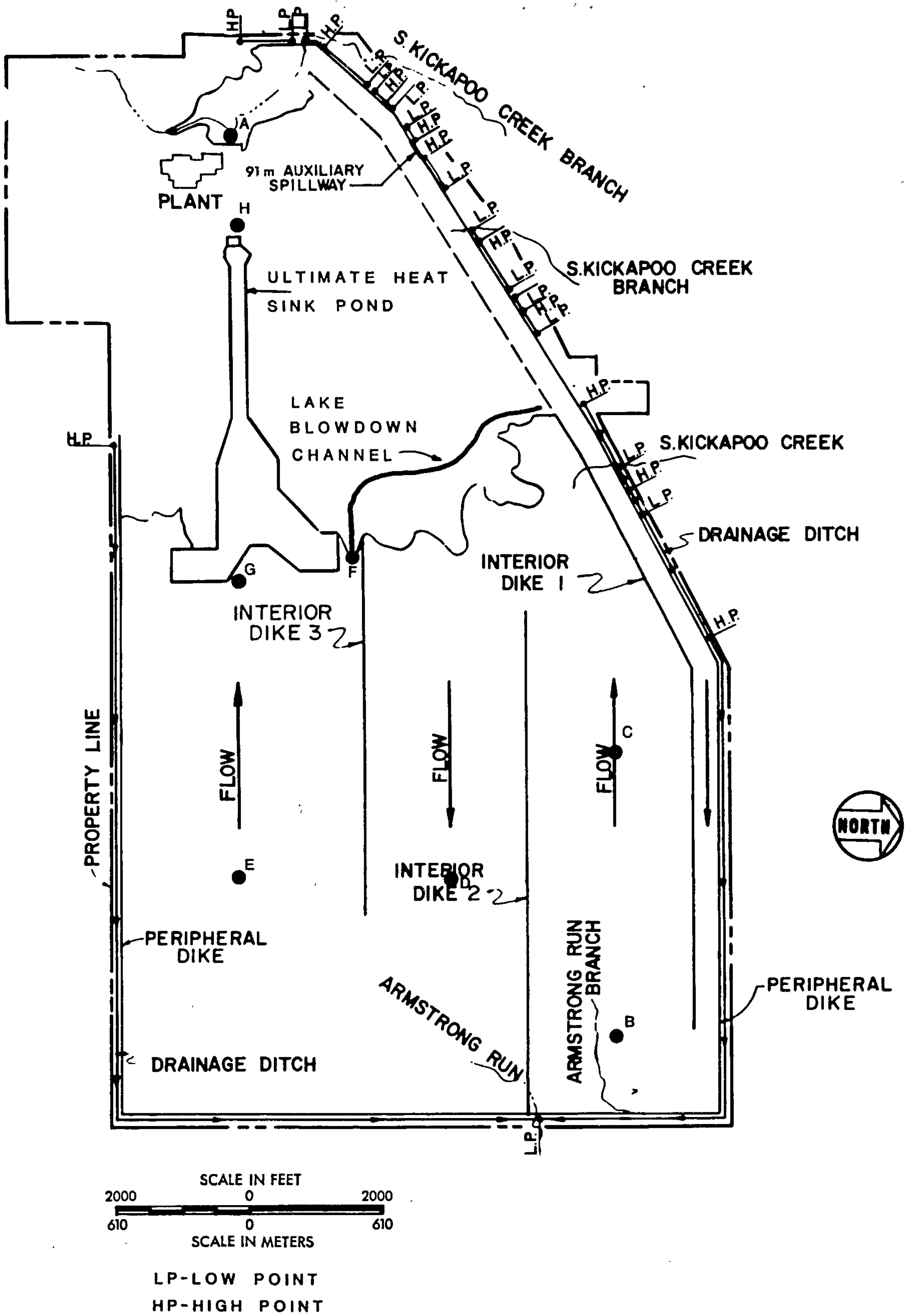

Fig. 3.2. LaSalle County Station Cooling Lake Plot Plan. (Modified from ER, Fig. 3.4.1.)

in the lake will be approximately 4.7 meters (15.4 ft). Internal dikes that guide the flow of water will prevent short-circuiting of the cooling water, so that the average circulation time will be about 5.5 days (ER, Sec. 3.4).

A reduction in size of the cooling lake is the major change in the plant design presented in the FES-CP. The original design was for a lake of 1810 hectares (4480 acres). This was reduced to 886 hectares (2190 acres) in accordance with a settlement agreement which is referred to in the initial decision rendered by the Atomic Safety and Licensing Board on 5 September 1973, and has since been reduced to 833 hectares (2058 acres). The original and current designs of the cooling lake are compared in Table 3.1.

Table 3.1. Comparison between the Original and the Final Proposed Designs for the Cooling Lake

Design Feature	Original Lake	Final Lake
Surface area, ha	1810	833
Average depth, m	4.0	4.7
Volume, m^3	7.2×10^7	3.4×10^7
Flow-through time, days	11	5.5
Evaporation rate, m^3/s	1.08	1.34
Seepage rate, m^3/s	0.14	0.0017[a]
Precipitation rate, m^3/s	0.47	0.22
Runoff rate, m^3/s	0.18	0.0
Blowdown rate, m^3/s	1.90	1.50
Makeup rate, m^3/s	2.47	2.62

Adapted in part from ER, Section 3.4.2.

[a]The staff estimates that total seepage rate through the lake bottom and dike will be about 0.06 m^3/s (see Sec. 3.2.2.1).

The applicant has estimated the seepage through the cooling lake dike to be 0.012 m^3/day per meter of dike length (one gal/day per foot) for a total of 0.0017 m^3/sec (0.06 ft^3/sec) (ER, Supp. 3, p. Q371.5-1). It was estimated that there would be negligible seepage through the lake bottom. The staff believes the value of seepage through the dike estimated by the applicant to be reasonable. However, it also believes that seepage through the lake bottom will be greater than that through the dike. Site investigation has led to the determination that the lake bottom subsurface consists of Wedron silty clay till to a considerable depth (FSAR, p. 2.5-99). Using a value of 6×10^{-7} cm/sec (2.4×10^{-7} inch/sec) for the coefficient of vertical permeability as determined by the applicant (FSAR, p. 2.5-107), seepage through the lake bottom will be about 0.06 m^3/sec (2 ft^3/sec). Therefore, the staff estimates that the total seepage will be close to this value also and has noted this on Table 3.1.

3.2.2.2 Intake and Discharge Structures

The locations of makeup and blowdown lines and of the intake screen house and discharge (outfall) structures are shown relative to the cooling lake and the Illinois River in Figure 3.3. The blowdown line originates in the cooler portion of the lake and has a capacity of 5.66 m^3/s (200 cfs). The average annual blowdown rate will be about 1.50 m^3/s (53.1 cfs). The blowdown will be discharged to the Illinois River through an outfall structure (shown schematically in ER Figs. 3.4-2 and 3.4-3) followed by an open channel about three meters (10 ft) wide and 0.3 meter (1 ft) deep. The discharge is approximately 300 meters (1000 ft) downstream of the intake and is oriented perpendicular to the river (ER, Sec. 3.4).

The makeup water will be pumped through an intake structure shown schematically in ER Figures 3.4-4 and 3.4-5. The structure is located on the south bank of the river, 401.5 km (249.5 mi) upstream of its mouth. Three vertical turbine pumps in the river screen house will have a capacity of 1.9 m^3/s (30,000 gpm) each. When the lake is full, only one or two pumps will be required to maintain the level of the lake. A mechanical trash rake and vertical traveling screens are also installed in the river screen house. Velocities in the intake channel will vary from 0.15 to

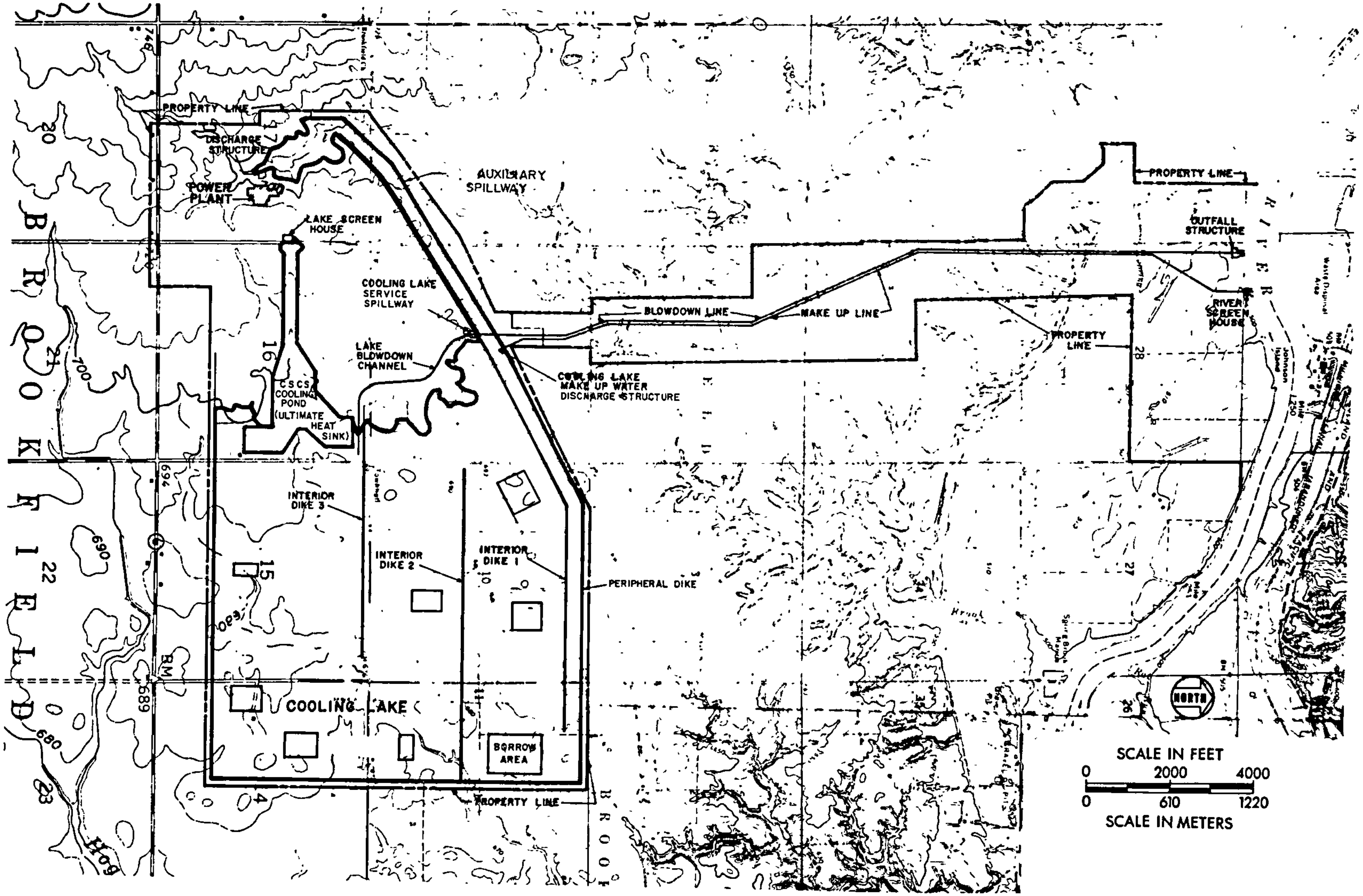

Fig. 3.3. Schematic Diagram Showing Locations of Heat Dissipation System Features. (Modified from ER, Fig. 2.4-6.)

0.09 m/s (0.5 to 0.3 ft/sec), depending on the river level, with one pump operating, and twice these values with two pumps operating. The velocity expected at the screens during normal operation is 0.15 m/s (0.5 ft/sec) (ER, p. 5.4-2).

3.2.3 Radioactive Waste Treatment

Part 50.34a of Title 10 of the Code of Federal Regulations (10 CFR) requires an applicant for a permit to operate a nuclear power reactor to include a description of the design of equipment to be installed for keeping levels of radioactive materials in effluents to unrestricted areas as low as is reasonably achievable. The term "as low as is reasonably achievable" means as low as is reasonably achievable taking into account the state of technology and the economics of improvement 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 Part 50 provides numerical guidance on design objectives for light-water-cooled nuclear power reactors to meet the requirements that radioactive materials in effluents released to unrestricted areas be kept as low as is reasonably achievable.

To meet the requirements of 10 CFR Part 50.34a, the applicant has provided final designs of radwaste systems and effluent control measures for keeping levels of radioactive materials in effluents to unrestricted areas as low as is reasonably achievable within the requirements of Appendix I to 10 CFR Part 50 and the requirements of the Annex to Appendix I dated September 4, 1975, elected in lieu of performing a cost-benefit analysis as required by Section II.D of Appendix I. In addition, the applicant has 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 operation, including anticipated operational occurrences.

The 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 safety evaluation report. The quantities of radioactive material calculated by the staff to be released from the plant will also be presented in Chapter 11 of the safety evaluation report and are found in Section 5.5 of this environmental statement, along with the calculated doses to individuals and to the population that will result from these effluent quantities.

The applicant has submitted draft technical specifications which will establish release rates for radioactive material in liquid and gaseous effluents, and which provide for the routine monitoring and measurement of all principal release points. The purpose of the monitoring and measurement programs is to assure that the facility operates in conformance with the requirements of Appendix I to 10 CFR Part 50.

3.2.4 Chemical, Sanitary and Other Waste Treatment

The types of chemicals used in the major systems of the LaSalle County Station and the treatment and disposal of station wastes as described in Section 3.6 of the ER are largely the same as described in the FES-CP. The chemical consumption rates have been modified, however. The values given in Table 3.2 represent the monthly chemical consumption expected during normal station operation and are approximately two to three times greater than those cited in the FES-CP, Table III-5.

As discussed in the FES-CP, the only liquid waste stream to be discharged from the station to the Illinois River will be through the cooling lake blowdown system. Several design modifications affecting the wastewater streams to be discharged to the cooling lake blowdown system have been made and will necessitate revisions to the identification of certain streams in the NPDES permit (see Sec. 5.3.4).[1] More recent design modifications indicate that the radwaste treatment stream will be routed through a separate pipe to the cooling pond blowdown line. Both the demineralizer regenerant waste and auxiliary boiler system blowdown will be routed to a neutralization tank, the discharge of which will be routed in a separate pipe to the cooling pond blowdown line. The demineralizer filter backwash will also be routed through a separate pipe to the cooling pond. Concentrations of the chemical constituents in the station cooling lake and in the blowdown to the Illinois River are listed in Table 3.3. The effects that this discharge will have on the river water quality are also given in the table. The increase in concentrations of the constituents in the blowdown as compared with the cooling lake water results principally from evaporation in the cooling lake and from increases caused by the addition of effluents from miscellaneous plant operations.

The staff has assessed these minor changes in the plant design and conclude that they will have no effect on the concentrations of chemical constituents in the station cooling lake and in the blowdown to the Illinois River as presented in Table 3.3.

The chemical treatments and waste streams of the major station systems are described in more detail in the following subsections.

Table 3.2. Consumption of Chemicals at the LaSalle County Station

System	Chemical	Disposition of Chemical	Concentration in Effluent into the Illinois River, mg/L[a]	Monthly Consumption
Service water system	NaOCl solution (15% available chlorine)	Sodium hypochlorite is converted to sodium and chloride ions, a small amount forms chloramines. Released to lake from service water.	Negligible	52,000 kg
Regenerant wastes	NaOH (100%)	Released to blowdown line	Negligible	27,000 kg
	H_2SO_4 (93%)	Released to blowdown line	Negligible	49,000 kg
Auxiliary steam system	Na_2SO_3	Sulfite converted to sulfate, released to blowdown	Negligible	140 kg[b]
	Na_3PO_4	Released to blowdown line	Negligible	140 kg[b]
	Na_2HPO_4	Released to blowdown line	Negligible	140 kg[b]
	Morpholine	Decomposed into hydrogen, a nitrogen compound, various carbon compounds	Negligible	30 L[b]
Other chemical wastes	Turco 4324[c]	Released to blowdown line	Negligible	140 kg
	Amway 8[d]	Released to blowdown line	Negligible	140 kg
	Oakite Rustripper[e]	Released to blowdown line	Negligible	45 kg

[a]Concentrations in effluent to the Illinois River are negligible (i.e., equal to or less than 0.1 mg/L).

[b]Boiler chemicals are used only when heating boiler is in operation. Monthly quantities assume full operation for an entire month.

[c]Composition of Turco 4324:

NH_4HCO_3	45 to 55%
$Na_{12}P_{10}O_{31}$	40 to 60%
Inorganic corrosion inhibitor	1%
Non-ionic biodegradable wetting agent	3 to 5%

[d]Composition of Amway 8 unknown (proprietary).

[e]Composition of Oakite Rustripper:

NaOH	70 to 80%
Na_2CO_3	5%
Carboxylic type sequestrants	20 to 30%
Amino-carboxylic type sequestrants	5%

From ER, Table 3.6-4.

Table 3.3. Water Quality and the Effect of LaSalle County Station Discharge to the Illinois River (mg/L except where noted)

	Cooling Lake Quality Analysis		Quality of Station Discharge		Quality of River Below Discharge[a]		Ambient Quality of River at the Station Site
	Expected Nominal[b]	Expected Maximum[b]	Expected Nominal	Expected Maximum	Expected Nominal	Expected Maximum	
Calcium (as Ca)	127	140	130[e]	143[e]	87	87.2	85[c]
Magnesium (as Mg)	46	51	51.1[e]	56.0[e]	31.9	32	31[c]
Sodium (as Na)	27	30	51.4[e]	54.2[e]	18.8	18.9	18[c]
Alkalinity (as $CaCO_3$)	292	323	278.3	308.2	200	200	196[c]
Sulfates (as SO_4)	183	203	222.9[e]	241.6[e]	126.3	126.6	123[c]
Chlorides (as Cl)[c]	43	48	58.3	62.8	29.9	30	29[c]
Nitrates (as NO_3)	25	28					17[c]
Phosphates (as PO_4)	1.9	2.1	1.9	2.1	1.3	1.33	1.3[c]
Silica (as SiO_2)	11.3	12.5					7.6[c]
Iron (as Fe)	3.1	3.5					2.1[c]
Manganese (as Mn)	0.18	0.2					0.12[c]
Total dissolved solids	661	732	739[e]	806.7[e]	455.5	456.6	444[c]
pH (units)	7.8[d]	7.8[d]					7.6[d]
Turbidity (JTU)							40[c]

[a]The column "Quality of River Below Discharge" is based on the ambient water quality data of Peoria (96 miles downstream of the site) for the period 1956 thru 1966 (as found in ER) and assuming complete mixing. The staff has also calculated the "quality of river below discharge" based on ambient water quality data of Seneca (5.6 miles upstream of the LSCS site) for 1976 (see Sec. 2). The staff found no significant difference in the values when based on the Peoria 1956 thru 1966 data or the Seneca 1976 data.

[b]Unless otherwise stated, based on: Quality of Surface Water in Illinois, 1956 thru 1966: State of Illinois, Department of Registration and Education; Illinois State Water Survey, Bulletin 54, page 104; and average and maximum cycles of concentration compiled for LaSalle County Station cooling lake (average cycles of concentration = 1.49, maximum = 1.65) (ER Table 3.6-2).

[c]Based on Quality of Surface Water in Illinois, 1956 thru 1966, page 104, Illinois River at Peoria; State of Illinois, Department of Registration and Education, Bulletin 54.

[d]Based on LaSalle County Station Construction Permit Stage ER, page 6.3.5, Table 6.3-1.

[e]Slight increase in chemical concentration is expected because of consumption of regenerant chemicals (ER Table 3.6-3).

3.2.4.1 Circulating Water System

The circulating water will be drawn from the cooling lake at a rate of 38.9 m^3/s (1372 cfs) per unit and will be discharged back to the cooling lake after passing through the system. No chemical additions will be made to the circulating water system. A mechanical cleaning (Amertap) system will be used instead of chlorination to prevent biological fouling and sedimentation within the main stainless-steel condenser tubes. The applicant has stated (E.R., p. 3.6-1) that no biocide chemicals will be added to the condenser cooling water. Future installation of a pH control system may be necessary for control of scale in the circulating water system. Provisions have been made in the design of the circulating water system to include the scale control equipment if such a system is required.

3.2.4.2 Service Water System

The service water system, a closed-cycle cooling system, will be treated with 52,000 kilograms (115,000 lb) of sodium hypochlorite each month for the removal of biological growths that interfere with the operation of the various heat exchangers. The applicant has not yet determined the exact schedule for chlorine addition. The applicant states that during periods when the chemical is being added, the residual free chlorine concentration will be maintained at or below 0.1 mg/L (FES-CP, p. III-21). The effluent from this system will be released to the cooling lake and will contain sodium and chloride ions and a small amount of chloramines, which will be reduced to chloride ions and ammonia or to the original compounds after a few hours or days in the cooling lake. The applicant expects the total residual chlorine concentration in the cooling lake blowdown released to the river to be well below 0.002 mg/L, the lowest criterion recommended by the EPA for protection of aquatic biota (FES-CP, p. III-21).

3.2.4.3 Cooling Lake

The wastes released from the plant to the cooling lake are condenser and service cooling water and the greensand filter backwash. Blowdown is needed to maintain the total dissolved solids concentration in the system below levels likely to cause scale deposition and fouling. The applicant has chosen to maintain a total dissolved solids concentration in the lake blowdown of less than or equal to 750 mg/L (ER, p. 3.3-1), a limit much lower than the standard of 3500 mg/L set by the State of Illinois (see Sec. 5.3.2). The expected water quality analysis of the cooling lake and the average and maximum concentrations of chemical constituents of the lake blowdown are listed in Table 3.3. In addition to the chemicals already present in the makeup water from the river, the blowdown water will contain additional chloride and sulfate ions resulting from treatment of the plant service water and sewage water with sodium hypochlorite and from discharge of regenerant waste from the steam cycle makeup water demineralizer system.

3.2.4.4 Steam Cycle Makeup

The primary steam cycle at the station will require makeup water to maintain steam chemistry within very stringent limits. The system to supply this high-purity water will produce wastes through the operation of three greensand filters and two ion-exchange demineralizers using a common decarbonator. Physical and chemical impurities will be removed from the raw well water and held within the process equipment. When this equipment has reached its capacity and can no longer reliably supply finished water of the desired quality, the sand filters will be backwashed with well water and the demineralizers will be chemically regenerated by use of sodium hydroxide and sulfuric acid [27,000 kilograms (59,000 pounds) and 49,000 kilograms (109,000 pounds), respectively, per month].

The expected frequency of filter backwash is once per day for ten-minute periods at a rate of 2.4×10^{-2} m^3/s (380 gpm) for each of the three greensand filters. Each demineralizer will be regenerated once every 24 hours (ER, p. 3.6-2).

The discharge from the backwashing operation, containing dissolved and suspended solids collected during the filtering process, will be routed to the cooling lake. The estimated concentrations of this discharge are (ER, p. 3.6-3):

Constituent	Concentration (mg/L)
Chlorides (as Cl)	280
Sulfates (as SO_4)	233
Sodium (as Na)	206
Calcium (as Ca)	109
Magnesium (as Mg)	48.5
Total dissolved solids	1100
Total suspended solids (max)	220

The regenerant wastes, containing the anions and cations initially present in the water and excess sulfates (SO_4) and sodium (Na) from the regenerant chemicals, will be collected and temporarily stored in a neutralization tank prior to mixing with cooling lake blowdown. The average discharge flow from the neutralization tank will be 1.5×10^{-2} m^3/s (240 gpm) for eight hours, and the maximum flow rate will not exceed 6.3×10^{-2} m^3/s (1000 gpm). The regenerant wastes will normally be acidic when mixed with the cooling lake blowdown. The applicant states that the EPA requirement of a pH value of 6 to 9 for the discharge stream will be met. Neutralizing chemicals can be added to the neutralization tank if the cooling lake blowdown alone is insufficient to neutralize the tank effluent (ER, Sec. 3.6.4).

3.2.4.5 Potable and Sanitary Water System

Wastes from the potable and sanitary water system, including that from the adjacent recreational area, will be collected and routed to a sewage treatment plant. The treatment unit can operate either as a contact stabilization system or as an extended aeration system, depending upon the influent flow rate (see Table 3.4).

The wastes from the potable and sanitary water system will be subjected to tertiary treatment in a retention pond with a two-day, full-flow capacity. Sodium hypochlorite will be injected continuously into the pond effluent as it is released. During normal plant operation, the release of effluent from the sewage treatment unit will be continuous at a rate of 7×10^{-4} m^3/s (10.4 gpm) and will contain a maximum concentration of 0.75 mg/L of free residual chlorine, 19 mg/L of five-day BOD, and 24 mg/L of suspended solids. The chemicals expected to be present in the treatment effluent and the Illinois EPA standards that this effluent must meet are listed in Table 3.4. The sewage treatment system effluent will be mixed with cooling lake blowdown before being discharged into the Illinois River (ER, Sec. 3.7).

3.2.4.6 Auxiliary Steam System

An auxiliary (electrode) boiler will provide energy to the radwaste concentrators at times when neither of the two generating units is in operation. During operation, boiler blowdown will be required and will be discharged to the cooling lake blowdown. The auxiliary steam system will consume 140 kilograms (300 pounds) each of Na_3PO_4, Na_2HPO_4, and Na_2SO_3, and 30 liters (eight gallons) of morpholine, monthly (ER, Sec. 3.6.6).

3.2.4.7 Other Waste Systems

Five standby diesel generators, each of 2600 kWe capacity (FSAR, p. 8.3-47), will be a stationary source of nonradioactive gaseous effluents. These units will be tested periodically during normal station operation. The SO_2 and NO_x emission rates for each diesel will be as follows:[2]

Pollutant	Emission Rate (kg/hr)	Annual Emission (metric tons)
Sulfur dioxide	7.35	< 0.9
Nitrogen oxides	87.6	about 9

Laundry wastes will be processed in a reverse osmosis unit, sampled, and then either discharged or processed through the chemical waste system. All effluents containing chemicals from nonradioactive floor drains will be treated in the neutralization tank of the makeup demineralizing system. All effluents from other nonradioactive floor drains that do not contain any chemicals will be sent through inside and outside oil separators, from which the oil-free effluent will be discharged to the cooling lake (ER, Sec. 3.7).

Approximately 90,000 kilograms (200,000 pounds) of miscellaneous solid waste (rags, paper, trash) will be generated annually during station operation. The refuse will be mechanically compacted onsite and transported to a licensed offsite landfill (ER, Supp. 3, Q400.26-1).

The soaps and detergents used for construction and preoperational cleaning will be treated in the sewage treatment plant prior to discharge. The typical consumption of chemicals for decontamination activities during normal plant operation is indicated in Table 3.2 as "Other Chemical Wastes."

Table 3.4. Sewage Treatment System: Influent and Effluent

A. INFLUENT - Amounts Treated and Method of Treatment

Phase	Influent Treated, m^3/day	Treatment
Construction phase	85	Contact stabilization system
Camping season	106 (49 from the recreational area + 57 from the station)	Contact stabilization system
Off-camping season (normal operation)	57 from the station operating personnel	Extended aeration system

B. EFFLUENT - Chemical Concentration in Sanitary Effluent and EPA Limitations as Specified in the NPDES Permit

Constituent	Treatment System Discharge Concentration	Illinois EPA Standards	
		Daily Average	Daily Maximum
5-day biochemical oxygen demand (BOD), mg/L	19[a]	30[b]	45[b]
Total suspended solids, mg/L	24[a]	30[b]	45[b]
Free residual chlorine, mg/L	0.75[a](max)		
Fecal coliforms, counts/100 ml	100[c]	200	400
pH	6-8[c]	6-9	

[a]ER, Sec. 3.7.1.

[b]The arithmetic mean of the five-day BOD samples and the arithmetic mean of the suspended solids values for effluent samples collected in a period of 30 consecutive days shall not exceed a concentration of 30 mg/L, nor 15% of the arithmetic mean of the values for influent samples collected at approximately the same times during the same period. The arithmetic mean of these values for effluent samples collected in a period of seven consecutive days shall not exceed a concentration of 45 mg/L.

[c]Staff estimate.

3.2.5 Transmission System

The transmission system that will connect the LaSalle County Station to the applicant's existing system was described in the FES-CP. Details of the new system have been refined since that time, however, and are discussed in the ER, Section 3.9.

The transmission lines will be brought to the existing Plano substation to the north and to the existing East Frankfort substation to the northeast as before. The present routing of the transmission circuits has resulted in the Plano lines now being 66 km (41 miles) in length rather than 61 km (38 miles) and the East Frankfort lines being 100 km (62 miles) rather than 90 km (56 miles) in length as earlier described.

The LaSalle County Station to East Frankfort route will consist of two 345-kV transmission circuits supported by steel pole structures on the tangent and steel tower structures at the angles except for an 11 km (seven mi) section near East Frankfort where four-circuit steel towers will be used throughout. The right-of-way for the East Frankfort transmission lines will vary in width from 44 to 190 m (145 to 625 ft). Both routes have been selected so as to utilize existing rights-of-way as well as to provide for future transmission lines not connected with the LaSalle County Station. Because of delays being experienced in connection with obtaining a Certificate of Public Convenience and Necessity from the Illinois Commerce Commission for the Plano transmission lines, a temporary connection from the LaSalle County Station to an existing 138-kV line is being constructed. The temporary connection will consist of looping an existing 138-kV circuit into the LaSalle County Station to make two 138-kV circuits. One circuit will connect to Mazon substation and will be 27 km (17 mi) in length. The other circuit will connect to Streator substation and will be 40 km (25 mi) in length. The new construction required to make these circuits consists of two single-circuit wood-pole lines, each 5.6 km (3.5 mi) in length, installed on existing right-of-way.

The rights-of-way associated with the station (including the right-of-way for the temporary 138-kV line) will generally pass through flat or gently rolling farmland. To the extent possible, the applicant will follow existing property lines and natural boundaries between various types of ground cover. Necessary river and stream crossings will be made with minimal disturbance to the water bodies and their immediate surroundings. Supporting structures will be set far enough back from the river and stream banks so as to minimize the disturbance of existing shoreline vegetation and so preserve the natural appearance at crossings.

The increase in the lengths of the rights-of-way will entail no significant change in the character of the land over which the lines are routed as described in the FES-CP. There should therefore be no change in the impact assessment described in the FES-CP.

References for Section 3

1. Letter from John Hughes, Director of Water Quality, Commonwealth Edison Co., to A. H. Manzardo, Permit Section, U. S. Environmental Protection Agency, Region V, December 1976.

2. "Final Environmental Statement, Yellow Creek Nuclear Plant," p. 3-15, U. S. Nuclear Regulatory Commission, November 1977.

4. STATUS OF SITE PREPARATION AND CONSTRUCTION

4.1 RÉSUMÉ AND STATUS OF CONSTRUCTION

As of July 1978 the construction of Unit 1 was 72% complete and of Unit 2 was 56% complete. The overall construction impacts on the terrestrial and aquatic environment were largely as had been forecasted in the FES-CP. However, a secondary construction impact involving runoff from the cooling lake dike has occurred and is described in Section 4.2. Updated assessments of impacts on the aquatic environment and on water quality are presented in Section 4.3.

4.2 IMPACTS ON TERRESTRIAL ENVIRONMENT

The major terrestrial impacts of construction were associated with the earthmoving program (excavation for the buildings and structures and construction of the cooling lake). The staff is satisfied that the primary, or direct, impacts of construction did not deviate appreciably from the earlier staff predictions (FES-CP, Sec. IV.B, p. IV-1); however, there has been a secondary impact attributable to construction, i.e., some offsite erosion has occurred following failure of the applicant to apply corrective measures to hold erosion in check as committed to in the ER-CP (p. 6.6-28) and as required by the construction permit. In addition, the FES-CP did not address the potential secondary impacts on the natural biota that could result from construction activities.

4.2.1 Erosion and Siltation - Armstrong Run

The wet prairie region of northeastern Illinois and northwestern Indiana (the Illinois and Kankakee River basins) is generally flat and poorly drained. The rich, black (organic loessal) soils have excellent agricultural potential when drained, but are seasonally waterlogged if not drained. The subsoils are sterile glacial clay of low permeability. Because of the drainage problem, these areas were among the last settled in the mid-nineteenth century. During the last century a drainage system has been developed and improved which permits the region to be among the highest yielding areas in the United States for corn and soybeans.

The present drainage system in eastern LaSalle County appears to have been in existence for about a half century. The system consists of a network of drain tiles which are buried under fields and which drain the soil and of grassy waterways which carry surface runoff. Both of these features of the system discharge into moderately large, man-made, grasslined ditches, locally called "runs." The function of these runs is to drain the soil sufficiently to permit use of the land for row crops. The runs have been used as a source of water for agricultural purposes and historically for potable water, but neither of these uses was intended by the design of the system.

Prior to construction the majority of the LaSalle County Station site was drained by Armstrong Run, which is one of the man-made ditches described above (see Fig. 4.1). The area now occupied by the northeast corner of the station cooling lake was drained by a grassy waterway which joins Armstrong Run about 1/2 kilometer (1/4 mile) east of the site boundary.

The surface soil near the site has a high capacity to retain moisture, but the underlying glacial clay permits only very slow drainage downward. Thus, there is a perched water table. This perched water table is recharged by snow melt and by infiltration of rainwater. The function of the drain tiles is to draw down the perched water table by accelerating the lateral movement of the subsurface water. The tiles discharge into Armstrong Run and provide a small perennial flow in the run. This perennial flow fills only a small channel in the bottom of Armstrong Run. The staff concluded from analysis of a preconstruction vertical aerial photograph that the course of the perennial flow within Armstrong Run meanders, and that the freshly exposed bottom (composed of deposited topsoil from adjacent fields) is revegetated by natural reproduction (probably tillering) of the grass in the ditch.

In spite of the high capacity of the soil to retain moisture, during intense rainstorms this capacity is frequently saturated, so considerable runoff occurs. This runoff is carried by the

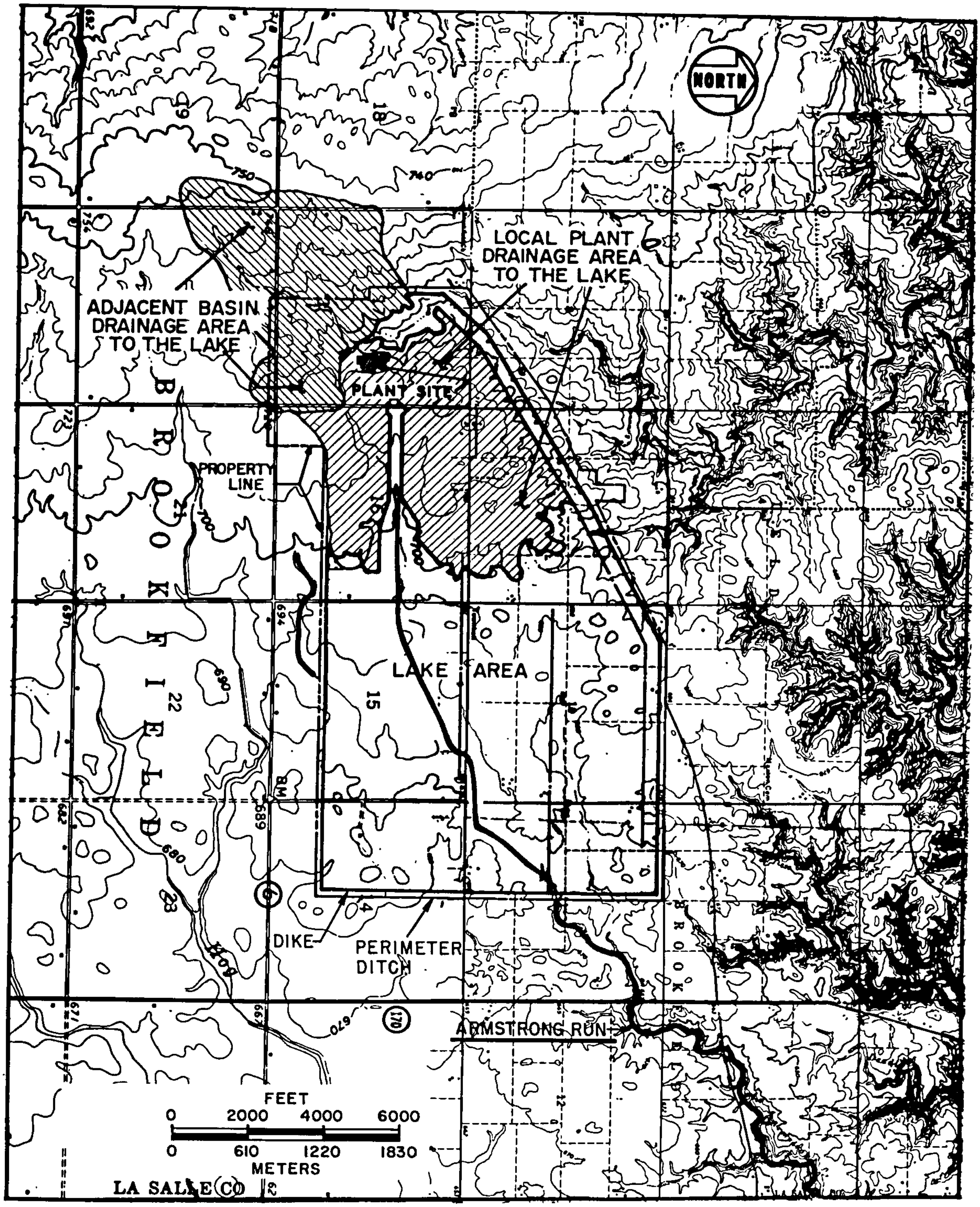

Fig. 4.1. Map of the Project Area Showing Armstrong Run and Other Drainage Features near the Cooling Lake. (Modified from ER, Fig. 2.4-4.)

grassy waterways and by the runs. The staff believes that the runs typically will handle the runoff from the 50- to 100-year return period 24-hour rain when the soil is near saturation before the rain. The local landowners reported to the staff that Armstrong Run has never required maintenance, although they believe that other runs in the region have required maintenance dredging. The landowners further reported that Armstrong Run has sufficient capacity to carry more runoff than they have observed to occur during about 20 years.*

Prior to the construction of the LaSalle County Station cooling lake, the watershed of Armstrong Run above the site boundary was approximately 410 hectares (1020 acres), all of which was level agricultural fields as described above. The present watershed above the site boundary consists of 140 hectares (340 acres), the majority of which is within the dike surrounding the cooling lake. The dike is made of compacted impervious clay from borrow pits within the lake. The final grade of the dike is a 3:1 slope (approximately 20°). The toe of the clay dike continues underground to contact the subsurface clay. All drain tiles encountered were removed or plugged. Thus there should be little contribution to the perennial streamflow in Armstrong Run from the lake or lake basin.

The dike is surrounded by a perimeter ditch which serves to collect all runoff from the dike. The original drainage plan routed water from the northwest portion of the dike to Kickapoo Creek, from the north portion of the dike and the north end of the east portion of the dike to the grassy run near the northeast corner of the lake, and from the remainder of the dike to Armstrong Run at the site boundary. This plan led to problems with the grassy run and associated drain tiles, apparently because the runoff volume exceeded the capacity of the grassy waterway. This problem was resolved by diverting this runoff to Armstrong Run at the site boundary. A small basin was provided where Armstrong Run leaves the site. The basin was too small to handle the runoff which actually occurred from the dike.

The dike and perimeter ditch slopes were topsoiled, seeded, fertilized and mulched to establish a vegetative cover to stabilize the slopes. However, on the east portion of the dike (which crosses Armstrong Run, see Fig. 4.1) none of these steps were taken for one year following completion of the east portion of the dike in the fall of 1976, although all other portions of the dike were seeded promptly (ER, Supp. 4, Question 050.03).

The applicant has predicted peak discharges from the 1-year, 10-year, and 100-year 24-hour storms for preconstruction conditions, during construction (i.e., while the east portion of the dike was not vegetated), and for postconstruction conditions. Some of the applicant's predictions are shown in Table 4.1. The applicant used the unit hydrograph method, a model which estimates peak discharges from rainfall data, subject to a set of parameters which describe the basin geometry.

Table 4.1. Predicted Peak Discharge (m^3/s) to Armstrong Run at Site Boundary

	Applicant's Estimate[a]		Staff Estimate[b]	
Storm	10-year, 24-hour	100-year, 24-hour	100-year, 24-hour	100-year, 1-hour
Preconstruction	36.93	52.87	9	32
During construction[c]	12.91	18.32	4	34
Post-construction[d]	10.68	15.29	3	25

[a]Applicant's estimate is from ER, Supp. 4, Table Q050.02-1.

[b]Staff estimate for preconstruction is based on extrapolation from stream gaging records on Gimlet Creek at Sparland, Illinois, and from storm data for Aurora, Illinois. Other staff estimates are based on triangular hydrograph calculations.

[c]Assumes dike is constructed but not vegetated.

[d]Assumes successful vegetation establishment on dike.

*Meeting between landowners and U. S. Nuclear Regulatory Commission staff in Ottawa, Ill., 24 August 1977.

The staff concurs with the applicant's choice of the unit hydrograph method for estimating the peak discharges into Armstrong Run in the absence of gaging records for the Run. However, the staff adjusted the unit hydrograph model (Ref. 1, page 41) to duplicate the gaging records for Gimlet Creek (gaging station No. 5-5590 at Sparland, Illinois)[2-4] using the best available precipitation data (Aurora, Illinois)[5] as the preconstruction conditions on Armstrong Run. Gimlet Creek is the nearest gaged stream with a comparable watershed area, on similar terrain and unconsolidated deposits, and in the Illinois River basin. Aurora, Illinois, is the nearest precipitation gage from which climatologic studies are available[5] and which should be beyond the effects of Lake Michigan. The staff also disagrees with the values used by the applicant for the appropriate runoff curve number (or "runoff coefficient," the fraction of rain water which flows over the ground, rather than into it). Using the techniques outlined in Ref. 1 (page 28), the staff calculated the following runoff coefficients:

Preconstruction: 0.65
Construction (bare dike): 0.90
Postconstruction: 0.80

On the other hand, the applicant used the following runoff coefficients:

Preconstruction: 0.50
Construction (bare dike): 0.57
Postconstruction: 0.50

The staff cannot accept the use of the applicant's coefficients because:

- The watershed slope for preconstruction and for postconstruction increases from 40:1 to 3:1;
- The amount of topsoil at the preconstruction and at the postconstruction stages decreases from one meter of topsoil over relatively impervious glacial till, to one tenth of a meter of topsoil over a compacted clay dike.
- The difference between the preconstruction runoff coefficient and the construction coefficient (i.e., 0.07) is too low to accurately represent the effect of both the increased watershed slope and the bare clay face of the east dike.

The applicant's predictions for the 100-year, 24-hour storm and the staff's predictions for the same storm behave approximately the same and differ only in magnitude. Since the issue is the relative erosivity of the discharge, the relevant predictions are the effects from construction of the station on the relative discharge (Table 4.2).

Table 4.2. Relative Peak Discharge[a] to Armstrong Run at Site Boundary Compared to Preconstruction Conditions

Storm	Applicant's Estimate		Staff Estimate	
	10-year, 24-hour	100-year, 24-hour	100-year, 24-hour	100-year, 1-hour
Preconstruction	1.00	1.00	1.00	1.00
During construction	0.35	0.34	0.44	1.06
Post-construction	0.30	0.28	0.33	0.78

[a]The ratio of the peak discharge for construction or postconstruction conditions to the peak discharge for preconstruction conditions resulting from the same storm.

The staff analysis revealed a much more serious problem with the applicant's predictions of peak discharge. Although a long-duration* storm, such as the 24-hour storm, yields a higher total volume of rainwater than does a short-duration storm, such as the one-hour storm, the intensity

*The length of time during which the storm produces rainfall.

of the rainfall is much higher during a short-duration storm (i.e., local thunderstorm) than in a long-duration storm (i.e., general rainstorm over a broad area). This can be illustrated from the rainfall intensities for Aurora, Illinois, which are as follows:

	Storm Duration	
Return Period	1-hour	24-hour
10-year	14 μm/s (1.98 in./hr)	1.2 μm/s (0.17 in./hr)
25-year	17 μm/s (2.46 in./hr)	1.4 μm/s (0.21 in./hr)
50-year	21 μm/s (2.92 in./hr)	1.7 μm/s (0.24 in./hr)

The critical factor here is the rate of rainfall (minus infiltration, or rainfall intensity times runoff coefficient, called excess rainfall) compared to the maximum rate at which the water flows across the ground, provided that the total rainfall exceeds the total infiltration during the storm. For Armstrong Run, the rainfall intensity and duration which produces the highest intensity of excess rainfall and which produces a total rainfall greater than the total infiltration occurs during the one-hour storm. Therefore, the runoff which is most significant with respect to changes in the basin characteristics is that produced by the one-hour storm. Hence, the staff has predicted the effects of construction of the station on runoff produced by the 100-year return period, one-hour-duration storm (Tables 4.1 and 4.2). This is an example of an analytical technique that describes the relatively much higher intensity storms (compared to a 24-hour storm) which occurred, including other one-hour and storms of somewhat longer duration. The point is that the use of the 24-hour storm (which has a relatively low intensity) is not appropriate for analysis of the Armstrong Run erosion problem.

As noted above, the relevant predictions are for the effects on relative peak discharge. The staff assessment is that at least a 6% increase in peak discharge occurred for the 100-year, one-hour storm during construction while the east portion of the dike was not vegetated. Load-carrying capacity, L (or erosivity), is exponentially related to discharge,[6] Q,

$$L = KQ^j$$

where: j is less than or equal to 3, but greater than or equal to 2.
K is an emperically determined coefficient.

Thus, a 6% increase in discharge during construction would produce a 12% to 19% increase in erosivity (using the range of values for j). Similarly, a 22% reduction in discharge under postconstruction conditions would produce a 53% to 61% decrease in erosivity.

The failure to revegetate a portion of the dike (fall 1976) resulted in considerable rill erosion of the exposed gray clay during 1976 and 1977. The silt-laden runoff water from the dike was transported via the perimeter ditch to Armstrong Run, where some of the gray clay was deposited. The effect of this silt deposition is similar to what occurred naturally due to topsoil deposition in the Run. Under preconstruction conditions, there was a balance in the bottom of the Run between the amount of soil eroded and the amount deposited. This balance between deposition and erosion is what causes streams to meander. However, because the freshly deposited material was the same color as the existing deposits, it was not obvious that this process was occurring. During construction, while the dike was not vegetated, the fresh silt deposits were a strikingly different color, and so the process became obvious to the casual observer. The staff believes that any excess deposition which may have occurred has not significantly affected the capacity of the Run.

The increased peak discharges from high intensity storms which occurred during construction resulted in erosional cutting of the banks of Armstrong Run. In some places the previously sloped bank is now nearly vertical and some agricultural land has slumped into the Run. At other places, the bank is undercut, so that additional land has been removed from agricultural use because the undercut land will not support agricultural equipment. The staff estimates that the total loss (as of August 1977) is 0.1 hectare (0.25 acre) of tillable land. However, during the same period when this erosion was occurring, the north-central Illinois region (in which LaSalle County is located) received unusually heavy rainfall (approximately equal to the 50-year return period rains). This raises the question as to whether the erosion was due to the construction of LaSalle County Station or solely to the unusual rainfall. The staff has reviewed the available information, including staff observations, to resolve this question, and has concluded that three factors other than rainfall intensity contributed to the observed erosion in Armstrong Run:

- The peak discharges from high intensity storms during construction were greater than that which would have been produced by preconstruction conditions, because the east portion of the dike was not vegetated.

- The altered peak discharges from high intensity storms resulted in an increased load-carrying capacity (or erosivity). For example, the predicted 6% increase in peak discharge for a one-hour storm produced a 12% to 19% increase in erosivity.

- Since the dikes are composed of subsoil material, which is infertile, the vegetative cover of Armstrong Run on this silt is less vigorous than on the sediments from the fertile and fertilized topsoil of the row crop fields. As a result, Armstrong Run is now more susceptible to erosion. This factor is reversible by natural processes (i.e., vegetational vigor will recover as clay deposition ceases and topsoil deposition resumes).

The construction permits issued for the LaSalle County Station Units 1 and 2 contain, among others, the following two conditions:

a. To minimize erosion during other construction related to the station, the applicant shall provide early planting, cover, ditches, and control structures.

b. The applicant shall implement a monitoring program to determine environmental effects which may occur as a result of site preparation and station construction and operation. If harmful effects or evidence of irreversible damage are detected by the monitoring program, the applicant will provide to the staff an analysis of the problem and a plan of action to be taken to eliminate or significantly reduce the detrimental effects or damage.

The failure of the applicant to promptly vegetate the dike contributed significantly to the erosion of Armstrong Run and was a violation of condition "a." It further appears to the staff that the failure of the applicant to provide the staff with an analysis and a remedial plan of action for the resultant erosion could be considered a violation of condition "b." Thus, the adverse effects of the construction activities must be mitigated and prevented in the future, as described below. The remedial steps must be taken on this construction permit matter well in advance of the possible issuance of the operating licenses (which may not occur until 1980).

The staff has predicted that the complete, successful establishment of vegetation on the dike and in the perimeter ditch will reduce the peak discharges in Armstrong Run to less than the preconstruction amount (see Table 4.1). However, since the applicant did not seed the exposed dike until the fall of 1977, the successful establishment of this cover cannot be verified until the spring 1978 growing season. The runoff from a properly vegetated dike should not be sufficient to initiate erosional cutting of the banks of Armstrong Run, but the staff believes that such runoff is more than sufficient to continue cutting the already eroded banks. Therefore, the staff requires that several measures be taken by the applicant to ensure that the erosion problem is solved. (Note: in the following requirements, reference to the dike includes the perimeter ditch surrounding the exterior of the dike, as well as the dike itself.)

Requirements

1. Since the reduction of the discharge depends upon the integrity of the vegetative cover on the dikes, the applicant shall routinely (at least semiannually) monitor the initial vegetation on the entire dike by quantitative methods (such as those described in App. G) to estimate cover. This should be done until the vegetation is established, but not for less than three years commencing with the spring 1978 growing season.

2. The applicant shall monitor the entire dike by visual inspection for vegetative integrity at the beginning of the fall planting season (August),[7] and at the beginning of the spring planting season (May). This requirement shall continue for the life of the station.

3. If a failure of the vegetative cover of the dike is detected, the affected area shall be revegetated in a timely manner (i.e., at the beginning of the next planting season, spring or fall).

4. Since the banks of Armstrong Run will continue to erode until the existing erosion in the Run is repaired, the applicant shall regrade where necessary and revegetate those portions of Armstrong Run where bank erosion now appears. The grading shall be timed to match the next planting season (May 1979)[7] so that immediate reseeding of the sloped sides is possible. The reseeding shall use suitable sod-forming grass species,[7] and include the use of netting, mulch, and a soil binder.

5. The revegetation in Armstrong Run shall be monitored routinely (at least semiannually) to ensure its success, and repair work taken promptly if any failure of reseeding is detected. The monitoring of the revegetation in Armstrong Run should continue until the vegetation on both the dike and the Run is successfully established and documented by the Commonwealth Edison Company. Successful establishment of the vegetation will be determined through NRC staff review of the Commonwealth Edison Company documentation.

The staff also considered whether removal of the clay deposits presently in Armstrong Run should be undertaken and concluded that this is not necessary because (a) the total amount of clay deposits is not great, (b) the clay deposits are only a minor possible contributing factor to the erosion, (c) the vigor of the vegetation will recover from the adverse impacts of clay deposition as future deposition of black topsoil buries the clay deposits, and (d) the staff predicts a large reduction in erosivity of the postconstruction discharge. Furthermore, the staff believes that the removal of the clay deposits is not desirable. The increased risk of erosion resulting from disturbance of the bottom of Armstrong Run is not warranted by the minor possible contribution to the erosion problem by the clay deposits.

The above requirements are necessary to eliminate or significantly reduce the detrimental effects, and to prevent further detrimental effects, resulting from the failure of the applicant to follow the applicable conditions of the construction permits.

4.2.2 Biota

The applicant's analysis of three years of monitoring data indicates random fluctuations in bird community composition.[8] In a few instances, there is a weak trend in the data. In these instances, the relative abundance of one species increased (with a decrease in relative abundance of another species) between the first and second years, and between the second and third years. Although some of these trends appear to coincide with construction activity, the trends are not statistically significant, and hence are insufficient to support a conclusion that adverse impacts are being caused by construction.

Three functional groups of birds (waterfowl, upland game, and raptors) were studied separately. Among these groups only the waterfowl show any trend (decrease in absolute numbers) in their fluctuations. However, this trend appears to have started prior to construction of the LaSalle County Station and to be related to channelization and pollution of the Illinois River. When waterfowl habitats become established in the cooling lake, this trend will probably be reversed, resulting in a beneficial impact.

The vegetation and the mammal community variations have no detectable correlation with construction.

4.3 IMPACTS ON AQUATIC ENVIRONMENT

4.3.1 Effects on Water Use

Construction of the station intake and discharge structures in the Illinois River has been completed, and no adverse effects on water supply or navigation have occurred. All dredged and excavated materials were placed in a confined area to prevent them from entering the Illinois River.

Filling of the cooling lake requires approximately 3.9×10^7 m^3 (1.4×10^9 ft^3) of water from the Illinois River and almost three months time at a pumping rate of 5.7 m^3/s (200 cfs). This represents 1.8% of the normal river discharge (6% of the 7-day, 10-year low flow). Lake filling began in July 1977 and is scheduled to be completed in October 1978. Since the lake filling as scheduled will not take place during a period of low river flow, the effect on the Illinois River will be small.

Other construction water needs [150 m^3/day (40,000 gpd)] are supplied from two deep onsite wells that tap the Cambrian-Ordovician aquifer (ER, p. 4.1-4). Although this is the most heavily used aquifer for municipal and domestic water in the area, its capacity is great, and the removal of small amounts of water by the station has not caused any adverse effects. An extensive dewatering system for construction activities below the water table was not necessary.

4.3.2 Effects on Water Quality

Information available for the first three years (1974 thru 1976) of the applicant's five-year monitoring program indicates that construction of the station has not degraded Illinois River water quality. (A summary of the water quality analyses is presented in the ER, Tables 4.1-2 thru 4.1-12 and 4.1-14, 15 and 18.) Although the concentrations of most water quality parameters varied throughout the year, concentrations upstream and downstream of the construction site were similar, thus indicating that construction activities caused no significant, if any, impact on water quality.

4.3.3 Effects on Aquatic Biota

As indicated in Section 2.5.2, most of the changes in the diversity and abundance of aquatic biota during the construction phase (1974 thru 1976) were of a random nature. There were no consistent trends to indicate that construction activities were having any impact on the aquatic biota of the Illinois River or South Kickapoo Creek. Since most of the construction that would affect these two water bodies is complete (construction of the discharge and intake structures and corridors), no additional impacts are expected. Therefore, the staff's assessment that no impacts should occur to the aquatic biota of these two bodies of water as a result of construction activities (FES-CP, p. IV-1) appears to be supported by the construction phase aquatic monitoring program.

4.4 RADIATION EXPOSURE TO CONSTRUCTION WORKERS

During the period between the start-up of Unit 1 and the completion of Unit 2 construction, the construction personnel working on Unit 2 will be exposed to sources of radiation from the operation of Unit 1. The main sources of radiation exposure to the workers will be the gaseous effluents from Unit 1 and scattered radiation from the nitrogen-16 in the Unit 1 turbine. The applicant has estimated that the Unit 2 construction force will receive about 130 man-rem due to the operation of Unit 1. This value for the radiological impact on the construction work force resulting from the construction activities in the radiation field of the operating reactor is similar to those for other plants of a like design and is therefore a reasonable estimate.

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7. "Critical Area Planting," Standards and Specifications, Technical Guide Section IV, U. S. Dept. of Agriculture, Soil Conservation Service - Illinois, February 1974.

8. "Terrestrial Monitoring Program for the Construction Phase of the LaSalle County Station 1976," 3rd Annual Report to Commonwealth Edison Co., NALCO Environmental Sciences, April 1977.

5. ENVIRONMENTAL EFFECTS OF STATION OPERATION

5.1 RÉSUMÉ

There have been several minor changes in the staff's evaluation of environmental effects of station operation since the issuance of the FES-CP. The staff has reassessed, in light of applicable effluent limitations and water quality standards, the station's impact on water quality. The assessment of terrestrial impacts has been expanded and updated to reflect the effects of the smaller and warmer cooling lake. The staff believes there will be more frequent and extensive incidents of fogging and icing in the area surrounding the lake than were considered in the FES-CP or in the CP-stage ASLB Hearing Board decisions. Cooling water intake and discharge impacts on the aquatic environment have been analyzed in greater detail by the staff. The evaluation of radiological impacts has been updated using new source term calculations, and a comparison of station radioactive emission levels with 10 CFR Part 50, Appendix I design objectives has been added. New generic material has been added concerning transportation of radioactive material and the environmental effects of the uranium fuel cycle. The analyses of land use in the CP-stage ASLB Hearing Board decisions remain valid. (The changes resulting from the reduction of the station site area due to the use of a smaller cooling lake are discussed in Section 4.) A new subsection on socioeconomic impacts due to station operation has been added.

5.2 IMPACTS ON LAND USE

In addition to the construction impacts on the land use at the site and in transmission corridors as discussed in Section 2.2.2, the operation of the LaSalle County Station could affect the adjacent farmland unless runoff from the dikes and erosion is controlled in accordance with the requirements set forth in Section 4.2.1.

The daily traffic increase caused by the commuting to and from work by the 403 operation staff members, who will be distributed over three shifts, would not likely exceed 150 to 250 vehicles during the peak hour. If the commuting traffic pattern of the operating staff is similar to that of the workers during the construction phase, a large portion of this traffic would be on Route 170, passing through Seneca (ER, Supp. 1, Q340.02). Based upon information received from local officials by the applicant, the resulting traffic impacts are expected to be relatively small (ER, Supp. 1, Q340.02-4).

The additional traffic generated from the operation of the station will not exceed 10% of the average daily traffic along Route 170 between the station and Seneca.[1] Class "A" service level[2] (a federally established classification reflecting applicable traffic regulations, traffic capacity, and physical condition in which the road is maintained) will be maintained during the life of the LaSalle County Station.

5.3 IMPACTS ON WATER USE

5.3.1 <u>Thermal</u>

5.3.1.1 Cooling Lake Blowdown

The applicant has calculated the expected temperatures at various locations on the cooling lake for the four seasons for plant capacity factors of 100% and 72% (ER, Tables 3.4-2 and 3.4-3); the average temperature, the temperature exceeded only 5% of the season, and the temperature exceeded only 1% of the season were calculated. The results for the case of 100% capacity factor are given in Table 5.1. The model employed in these calculations was a one-dimensional transient lake model (ER, p. 5.1-2) based on the work of Ryan and Harleman.[3]

The staff has calculated the expected temperature at the cool end of the lake near the point from which the blowdown will be released; the results of the staff analysis for each month of the year for normal and extreme meteorological conditions are given in Table 5.2. (Details of the analysis are discussed in Appendix C.) Also shown in Table 5.2 are the monthly river temperature extremes near Marseilles and the temperature difference between the blowdown and the ambient river water.

Table 5.1. Applicant's Predicted Lake Temperatures for LaSalle County Station Cooling Lake--100% Capacity Factor

Location[a]	Area hectares	Predicted Lake Temperature, °C - Frequency of Occurrence											
		1%				5%				50%			
		Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall
A (plant discharge)		27.2	41.1	46.3	43.1	25.8	39.2	45.0	40.9	21.9	30.7	42.2	33.8
B	101	24.7	38.1	43.2	40.1	23.4	36.2	41.9	37.9	19.6	28.0	39.1	31.2
C	202	22.7	35.8	40.8	37.7	21.4	33.9	39.6	35.7	17.6	25.9	36.8	29.0
D	405	19.2	32.3	37.3	34.3	17.8	30.4	36.0	32.2	14.1	22.3	33.3	25.4
E	607	16.8	30.1	35.2	32.1	15.4	28.2	33.9	30.0	11.6	20.0	31.1	23.1
F (spillway)	802	14.7	28.4	33.7	30.4	13.2	26.5	32.3	28.3	9.4	18.1	29.5	21.2
G	809	14.7	28.4	33.7	30.4	13.2	26.5	32.3	28.3	9.4	18.1	29.5	21.2
H (plant intake)	833	14.5	28.3	33.5	30.3	13.0	26.4	32.3	28.2	9.2	17.9	29.4	21.1

[a]See Figure 3.2.

Adapted from ER, Table 3.4-2.

Table 5.2. Staff's Calculated Blowdown and River Temperatures

Month	Blowdown Temperature, °C		Ambient River Temperature, °C			ΔT_e,[a] °C	ΔT_m,[b] °C	ΔT_n,[c] °C
	Average	Extreme	Maximum	Average	Minimum			
January	18.0	22.4	7.8	3.9	1.1	21.3	14.6	14.1
February	18.7	24.0	9.4	5.0	1.1	22.9	14.6	13.7
March	21.3	25.6	12.2	6.7	2.2	23.4	13.4	14.6
April	26.8	29.6	19.4	12.2	7.8	21.8	10.2	14.6
May	31.2	34.5	22.8	17.8	11.1	23.2	11.7	13.4
June	35.8	39.3	28.9	23.3	16.7	22.6	10.4	12.5
July	38.0	42.1	30.6	26.1	22.2	19.9	11.5	11.9
August	37.2	41.3	31.1	26.7	22.8	18.5	10.2	10.5
September	32.2	36.2	30.6	22.8	16.1	20.1	5.6	9.4
October	26.3	31.6	23.9	17.2	11.1	20.5	7.7	9.1
November	20.0	26.2	18.3	10.6	3.9	22.3	7.9	9.4
December	18.2	23.4	11.1	5.6	1.1	22.3	12.3	12.6

[a]ΔT_e = Extreme blowdown temperature minus minimum river temperature.
[b]ΔT_m = Extreme blowdown temperature minus maximum river temperature.
[c]ΔT_n = Average blowdown temperature minus average river temperature.

Comparison of Tables 5.1 and 5.2 shows that the blowdown temperatures calculated by the staff are higher than those calculated by the applicant. This is because the staff incorporated a greater degree of conservatism into its model, which is less sophisticated than that used by the applicant. Inputs to the staff's model are average or extreme monthly values of the meteorological variables for central Illinois, whereas the applicant uses values for three-hour time intervals from the Peoria weather station. Thus, the applicant can more closely model the progression of lake temperatures as they vary throughout the year.

5.3.1.2 State Thermal Water Quality Standards

The Illinois water quality standards[4] require that:

1. There shall be no abnormal temperature changes that may adversely affect aquatic life unless caused by natural conditions.

2. The normal daily and seasonal temperature fluctuations that existed before the addition of heat due to other than natural causes shall be maintained.

3. The maximum temperature rise above natural temperatures shall not exceed 2.78°C (5°F).

4. In addition, the water temperature at representative locations in the main river shall not exceed the maximum limits mentioned below during more than one percent of the hours in the 12-month period ending with any month. Moreover, at no time shall the water temperature at such locations exceed the maximum limits given below by more than 1.67°C (3°F). Main river temperatures are temperatures of those portions of the river essentially similar to and following the same thermal regime as the temperatures of the main flow of the river. These maximum temperatures are 15.6°C (60°F) for December, January, February, and March, and 32.2°C (90°F) for the remaining months of the year.

5. The water quality standards must be met in the bulk of the body of water. No body of water may be used entirely as a mixing zone for a single outfall or combination of outfalls. Moreover, except as otherwise provided in the regulations, no single mixing zone shall exceed the area of a circle with a radius of 183 meters (600 feet, approximately 26 acres). The mixing zone shall not intersect any area of any such waters in such a manner that the maintenance of aquatic life in the body of water as a whole would be adversely affected, nor shall any mixing zone contain more than 25% of the cross-sectional area or volume of flow of a stream except for those streams where the dilution ratio is less than 3:1.

5.3.1.3 River Discharge (thermal plume)

The applicant has analyzed (ER, p. 5.1-3) the size and extent of the thermal plume, using the workbook produced by Shirazi and Davis.[5] Results of two cases analyzed are given in Table 5.3. Case 1 represents the situation under conditions of maximum blowdown temperature and minimum river temperature. This would result in the largest possible 2.78°C (5°F) isotherm. Case 2 represents the situation under conditions of maximum blowdown temperature and maximum river temperature. Both cases represent maximum blowdown flow rate conditions during the summer. Since the ambient river temperature is 30.6°C (87°F) and the maximum allowable temperature outside the mixing zone is 32.2°C (90°F), the 1.67°C (3°F) excess isotherm is the one of interest. The applicant calculated the area contained within the 0.55°C (1°F) excess isotherm to be 3560 m^2 (0.88 acre), which is more than an order of magnitude smaller than the maximum allowed by the state standards.

Table 5.3. Results of Thermal Plume Analysis

	Applicant's Analysis[a]		Staff's Analysis	
	Case 1	Case 2	Case 1	Case 2
Plant load factor, %	100	100	100	100
Month	July	July	March	July
Blowdown flow rate	2.23 m^3/s	2.23 m^3/s	2.23 m^3/s	2.23 m^3s
Discharge velocity	1.55 m/s	1.55 m/s	1.55 m/s	1.55 m/s
River velocity	0.23 m/s[b]	0.23 m/s	0.12 m/s	0.12 m/s
Blowdown temperature	35.6°C	35.6°C	25.6°C	42.1°C
River temperature	22.2°C	30.6°C	2.2°C	30.6°C
Area of 2.78°C excess isotherm	475 m^2	45 m^2	2500 m^2	400 m^2
% of river cross section occupied by the 2.78°C excess isotherm	12	2.7	9	8[c]
Area of 1.67°C excess isotherm	d/	d/	16,500 m^2	4000 m^2
Area of 0.55°C excess isotherm	18,210 m^2	3560 m^2	d/	d/

[a]ER, p. 5.1-4; ER, App. 5.1A; and ER, Supp. 3, Q400.06.

[b]From applicant's comment I-21, see Appendix A, Pg. A-22.

[c]This is for the 1.67°C excess isotherm.

[d]Information not provided.

The staff has analyzed the two cases presented in Table 5.3 with all parameters the same except (a) maximum blowdown temperature, which was taken from Table 5.2, (b) river velocity, which was the 7-day, 10-year low flow, 91.4 m^3/s (3228 cfs) divided by the average cross-sectional area of the river (ER, Supp. 3, Q400.06), 747 m^2 (8040 ft^2). This results in a velocity of 0.12 m/s (0.40 fps).

Results of the staff's calculations are shown in Figures 5.1 and 5.2 and Table 5.3. It can be seen that the state standards are not violated in either of these extreme examples. For the March extreme, the area encompassed by the 2.78°C (5°F) excess isotherm is 2500 m^2 (0.6 acre), more than an order of magnitude smaller than the maximum allowed. The zone of passage is 91%, which is greater than the minimum of 75% required. For the July extreme, the area encompassed by the 1.67°C (3°F) isotherm is 4000 m^2 (1.0 acre), and the zone of passage is 92%.

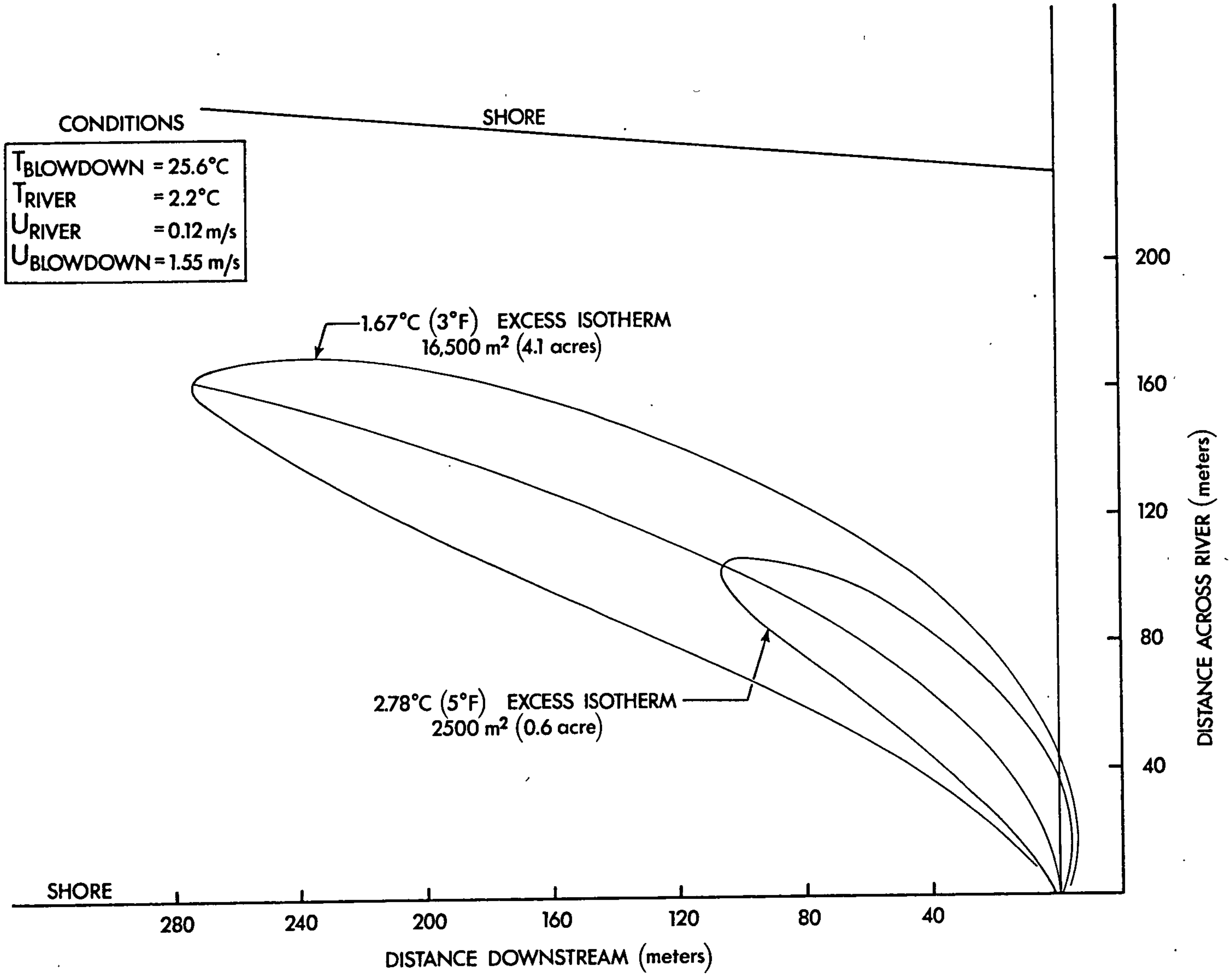

Fig. 5.1. Thermal Plume in the Illinois River under March Extreme Meteorological and Hydrological Conditions.

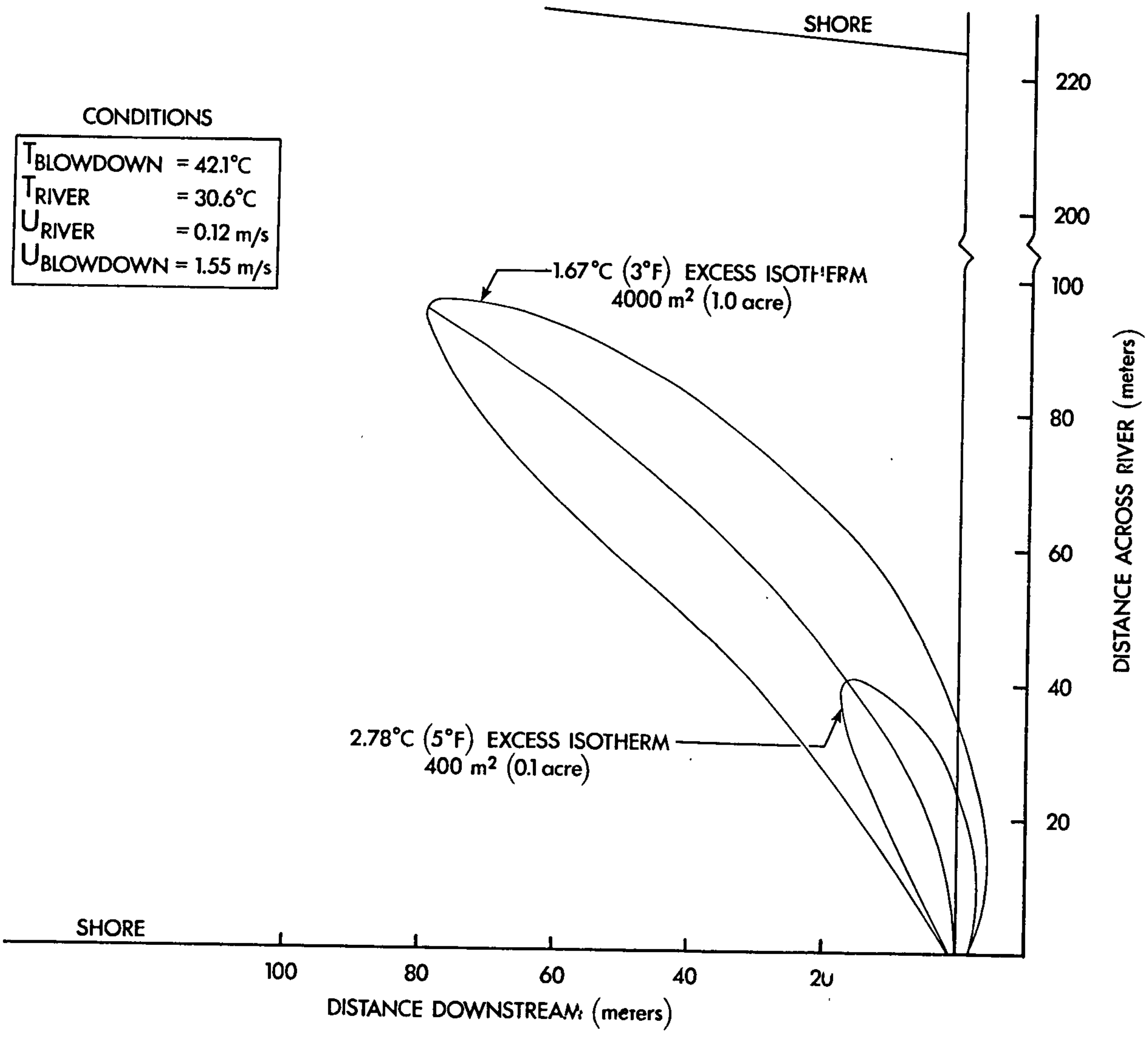

Fig. 5.2. Thermal Plume in the Illinois River under July Maximum Blowdown and River Temperature Conditions.

5.3.1.4 Conclusions

The staff was conservative in its selection of parameters for the calculation of the thermal effects of the LaSalle County Station on the Illinois River. These parameters were:

1. 100% plant load,
2. A wet-bulb temperature exceeded only 2% of the time to determine cooling pond blowdown temperatures,
3. Extreme values of equilibrium temperature and heat exchange coefficient,
4. Minimum (maximum) river temperatures, and
5. Low river flow (7-day, 10-year recurrence interval).

The staff thus expects that the thermal effluent in the Illinois River will always satisfy the state thermal water quality standards and that no alteration in present downstream water use will result.

5.3.2 Industrial Chemical Wastes

As detailed in Section 3.2.4, the chemical discharge from the LaSalle County Station will consist of cooling lake blowdown to which auxiliary boiler blowdown, neutralizing tank effluent, and the effluents from the sewage treatment plant and radwaste plant will be added. The typical water quality of the station's cooling lake, the station's discharge, the Illinois River near the station, and the Illinois River below the discharge are compared in Table 3.3. Because the average river flow of 304 m^3/s (10,750 cfs) is quite large relative to the average blowdown flow rate of 1.5 m^3/s (53 cfs), the concentrations of substances in the discharge will be close to ambient values after the discharge becomes fully mixed with the river water.

The staff expects the concentration of total dissolved solids (TDS) in the blowdown discharged to the river to average 750 mg/L, a level much lower than the maximum standard of 3500 mg/L established by the state.* This will increase the average TDS of the river below the discharge from 440 mg/L to an expected maximum of 457 mg/L (based on the 7-day, 10-year low flow of the Illinois River at Seneca, Illinois, and assuming complete mixing, see Table 3.3). All other chemical releases will also meet the state water quality standards (see Sec. 5.3.4.1).

The applicant's program for chlorination has not yet been defined, but chlorine discharge will be required to meet the Federal requirements specified in 40 CFR 423 (see Sec. 5.3.4.2). Based on information presented in Sections 3.2.4.2 and 3.2.4.7, the staff expects that the total residual chlorine present in the blowdown as a result of chlorination of the service water and sanitary water systems will be well below 0.002 ppm. Although the effluent from the service water system may contain chloramines resulting from the combination of free chlorine with ammonia, the staff concludes that dilution with cooling lake water and further dilution of blowdown in the river will reduce the concentration of such compounds to negligible levels.

5.3.3 Sanitary Wastes

As discussed in Section 3.2.4.7, sanitary wastes from the LaSalle County Station will receive tertiary treatment in a two-day, full-flow capacity retention pond and will be continuously chlorinated for bacteriological and odor control prior to release. The staff believes that the sanitary waste effluent will comply with the applicable standards of the State of Illinois (see Table 3.4). The maximum free chlorine residual in the sewage discharges (0.75 mg/L) will be diluted with the lake blowdown to less than one μg/L and then further reduced by the chlorine demand in the Illinois River. The BOD (19 mg/L) and suspended solids (24 mg/L) also present in the sanitary effluent will be similarly diluted to undetectable levels upon discharge into the river.

5.3.4 Effluent Guidelines and Limitations

Chemical and sanitary waste discharges from the LaSalle County Station will be required to meet the Illinois water quality standards, the U. S. Environmental Protection Agency Steam Electric Power Generating Point Source Category Effluent Guidelines and Standards (40 CFR 423, July 1,

*The water pollution regulations of Illinois state that the TDS shall not be increased more than 750 mg/L above background concentration and in no event shall exceed 3500 mg/L at any time.

1976), and the effluent limitations established by the Illinois Environmental Protection Agency in the LaSalle County Station National Pollutant Discharge Elimination System (NPDES) permit #0048151 (see Appendix D).

5.3.4.1 Compliance with Water Quality Standards

The State of Illinois requires that the quality of the water in rivers be maintained to certain standards and that additional standards for effluents (as presented in the Illinois Water Pollution Control Rules) be met. Whenever a water quality standard is more restrictive than an effluent standard, a mixing zone is set on a case-by-case basis to meet the purpose of the regulation. Two specific restrictions or standards of the "Water Pollution Regulations of Illinois," which were adopted by the Illinois Pollution Control Board in 1972 and amended through 1977, apply to the waters of the Illinois River at the LaSalle County Station. These are (a) General Standards, Section 203, and (b) Public and Food Processing Water Supply maximum permissible levels identified in Section 204. These restrictions, as well as the station discharge values, are itemized in Table 5.4. Whenever the same substance is restricted in both sections of the regulations, the more restrictive limit is cited. It is stated in the limitations that the temperature rise in the Illinois River will not exceed 2.8°C (5°F) outside of a mixing zone with a radius of 180 meters (600 feet). In addition, the water temperature outside the mixing zone shall not exceed the maximum limits of 16°C (60°F) for December through March and 32°C (90°F) for April through November during more than one percent of the hours in the 12-month period ending with any month. At no time shall the water temperature at such locations exceed those maximum limits by more than 1.7°C (3°F). Of the station chemical releases identified in Table 3.3, only a few have corresponding water quality limitations. All of such releases comply with state water quality standards, as demonstrated in Table 5.4 and as discussed in Sections 5.3.2 and 5.3.3.

5.3.4.2 Compliance with Effluent Limitations

The Illinois Environmental Protection Agency (IEPA) has evaluated the proposed mode of operation of the station with respect to the U. S. EPA Steam Electric Power Generating Point Source Category Effluent Guidelines and Standards (40 CFR 423, October 8, 1974) promulgated pursuant to Sections 301 and 306 of P.L. 92-500, Federal Water Pollution Control Act Amendments of 1972. As a result, IEPA has issued an NPDES permit under Section 402 of P.L. 92-500 (see Appendix D) which contains monitoring provisions and effluent limitations that, if observed during plant operation, will ensure compliance with 40 CFR 423.

5.3.5 <u>Effect on Water Users through Changes in Water Quality</u>

The analysis in the FES-CP remains valid. The staff believes that operation of the LaSalle County Station will not affect any of the downstream water users (see Sec. 2.3.1.1) through changes in water quality of the Illinois River. (The river is presently recovering from upstream pollution in the vicinity of the station site.) As indicated in Section 5.3.2, the average river flow of 304 m^3/s (10,750 cfs) is quite large relative to the blowdown flow rate of 1.5 m^3/s (53 cfs); therefore, the concentrations of substances in the discharge will be close to ambient values after the discharge becomes mixed with the river water. All industrial chemical discharges and sanitary waste discharges will meet the state water quality standards, as described in Sections 5.3.3 and 5.3.4.1. The applicant's program for chlorine discharge has not been defined, but will be required to meet the Federal requirements specified in 40 CFR 423.

Under the most conservative conditions (March extreme meteorological and hydrological conditions), the increase in water temperature at the Illinois Nitrogen Corporation (the nearest industrial intake) due to the station discharge will be less than 0.5°C. The staff believes that no adverse impact will result from this maximum temperature increase.

5.3.6 <u>Effects on Surface Water Supply</u>

The consumptive use of water for station operation will average 1.12 m^3/s (39.4 cfs) (see Table 3.1). This amounts to 1.2% of the 7-day, 10-year low flow of the Illinois River, or 0.4% of the average flow. The staff believes that this level of consumptive use will not adversely affect the surface water supply of the Illinois River. The staff is not aware of any other physical effects of plant operation on surface water supply.

Table 5.4. Standards Applicable to the Illinois River from Water Pollution Regulations of Illinois

Substance Regulated	Concentration[a] not to Exceed	Section of Reg. More Restrictive	Expected Quality of Station Discharge[a] Nominal	Expected Quality of Station Discharge[a] Maximum
Unnatural sludge, bottom deposits, floating debris, visible oil, odor, unnatural plant or algal growth, unnatural color or turbidity	None[b]	203		
pH[c]	6.5-9.0[d] (units)	203		
Dissolved oxygen[e]	5.0 (always) 6.0 (16 hrs/day)	203		
Ammonia nitrogen	1.5	203		
Arsenic (total)	0.1	204		
Barium (total)	1.0	204		
Boron (total)	1.0	203		
Cadmium (total)	0.01	204		
Chloride	250	204	58.3	62.8
Carbon chloroform extract	0.7	204		
Chromium (total hexavalent)	0.05	203		
Chromium (total trivalent)	1.0	203		
Copper (total)	0.02	203		
Cyanide	0.025	204		
Fluoride	1.4	203		
Iron (total)	0.3	204		
Lead (total)	0.05	204		
Manganese (total)	0.05	204		
Mercury	0.0005	203		
Nickel (total)	1.0	203		
Nitrate plus nitrite (as N)	10.0	204		
Phenols	0.001	204		
Selenium (total)	0.01	204		
Silver (total)	0.005	203		
Sulfate	250	204	222.9	241.6
Zinc	1.0	203		
Chlorinated hydrocarbon insecticides				
Aldrin	0.001	204		
Chlordane	0.003	204		
DDT	0.05	204		
Dieldrin	0.001	204		
Endrin	0.0005	204		
Heptachlor	0.0001	204		
Heptachlor epoxide	0.0001	204		
Lindane	0.005	204		
Methoxychlor	0.1	204		
Toxaphene	0.005	204		
Organophosphate insecticides				
Parathion	0.1	204		
Chlorophenoxy herbicides				
2,4-Dichlorophenoxyacetic acid (2,4-D)	0.02	204		
2,4,5-Trichlorophenoxy-proprionic acid (2,4,5-TP or Silvex)	0.01	204		
Foaming agents	0.5	204		
Nitrate-nitrogen	10	204		
Nitrite-nitrogen	1	204		
Oil (hexane-solubles or equivalent)	0.1	204		
Total dissolved solids	500	204	739	806.7
Fecal coliform bacteria	200/100 ml (Geometric mean) 400/100 ml (10% of samples)	203		
Toxic substances	0.1 of 48-hour TLm for fish or fish food organisms	203		
Temperature	5°F above natural; also monthly maximum (°F) as follows:	203		

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
60°	60°	60°	90°	90°	90°	90°	90°	90°	90°	90°	60°

[a]All values in mg/L unless stated.

[b]The standards read: "Freedom from unnatural sludge, bottom deposits... ."

[c]The pH limitation is not subject to averaging and must be met at all times.

[d]Except from natural causes.

[e]Minimum concentration.

From Illinois Water Pollution Control Board Rules & Regulations, Chapter 3, Water Pollution; Adopted 7 March 1972, and Amendments through 3 March 1977.

5.3.7 Effects on Groundwater

Underlying the cooling lake is a glacial deposit known as Wedron till, ranging in thickness from 37 to 43 meters (120 to 140 ft) and consisting of silty clay and clay with occasional discontinuous pockets of well-graded sand or gravel (ER, p. 2.4-8). Groundwater occurs in these pockets within three meters (10 ft) of the surface as measured in observation wells by the applicant (ER, Table 2.4-12 and Fig. 2.4-11). The source of this water is normal percolation of rainfall and snow melt. Seepage of cooling lake water is expected to add to these perched aquifers during the life of the station.

Because of the construction of the cooling lake dike as a highly impermeable barrier that ties into the subsurface clay till, seepage of water should be only a minor contributor to these aquifers outside the dike. Groundwater levels in the upper tills will be monitored by the applicant through 20 observation wells around the lake, however, to determine changes in water level after the impoundment is filled with water (ER, p. 2.4-15).

Since these aquifers are not used for domestic purposes on the station site and since any seepage, should it occur, would be limited to the immediate station area, the staff believes such seepage would not present any environmental hazards or health problems to people or animals.

The effect of seepage through the glacial till deposits to underlying aquifers has been addressed in the FES-CP (p. XII-20 and 21). With additional information now available concerning characteristics that affect or determine seepage rates through this till (Sec. 3.2.2), the assessment may be updated.

The staff has calculated that seepage through the Wedron till will amount to 0.06 m^3/sec (2 ft^3/sec) from the entire cooling lake, equivalent to a depth of water of 0.23 m/year (0.7 ft/year). With a porosity of 50%,[6] the seepage flow rate would be about 0.46 m/year (1.4 ft/year) through the till. Assuming the lower value of till thickness, 37 meters (120 ft), it will take about 80 years for the seepage to reach the basement rock under the station site and an indeterminate, but probably very long, additional time to reach a usable aquifer.

This calculation is consistent with that in the assessment in the FES-CP (p. XII-20), although a lower value of till depth and a higher porosity were used as bases in the calculation. On the assumption that seepage water will eventually reach an aquifer, the staff agrees with the earlier evaluation that in view of the long time delay, when the water reaches the aquifer it is expected to be free of any pathogenic organisms that may have been present in the lake water. There is no reason, therefore, that the seepage water should be considered harmful to future populations.

5.4 ENVIRONMENTAL IMPACTS

5.4.1 Terrestrial Environment

5.4.1.1 Biological Effects

Onsite

The cooling lake is expected to attract and support large numbers of waterfowl (FES-CP, Sec. V.C.2, p. V-8; and Ref. 7). This will be beneficial because of the stresses on waterfowl existing prior to the construction of the lake. The increase in waterfowl during fall migration may result in some damage to area crops (especially corn) if harvesting is delayed,[8] but this impact is expected to be relatively minor.

Offsite

It appears that there may be a micrometeorological impact that may extend offsite (Sec. 5.4.1.2). It is unclear what the biological consequences of this will be. The staff notes that the region lies in an ecological transition zone between the eastern deciduous forest formation to the east and the prairie formation to the west.[9] In this transition zone, years which are drier than normal (the long-term climatic average) favor the eastward expansion of prairie, while years which are wetter than normal favor the westward expansion of forest. If the cooling lake causes a shift toward moister conditions, the balance between prairie and forest may be permanently shifted toward an increase in forest species.

Transmission Corridors

The monitoring data have shown that the ecological communities of the cleared woodlands along rights-of-way are not directly comparable to the shrub stage of succession (see Sec. 2.5.1.1). However, the differences are subtle, and therefore do not constitute a significant impact.

5.4.1.2 Atmospheric Effects

A major source of impact on the terrestrial environs from the operation of the LaSalle County Station will be the heat and moisture transferred to the atmosphere from the cooling lake. Under certain meteorological conditions (cool, humid air over warm water), steam fog will form. This fog bank may be carried onto the surrounding land as fog and/or low stratus clouds. With air temperatures below 0°C (32°F), the fog may form light, friable rime ice on vertical objects, such as trees, poles, and vegetation.

In the FES-CP, no significant offsite impacts attributable to the operation of the cooling lake were predicted. The staff's analysis was based on a projected heat load of two 1100-MWe reactors on a 1810 ha (4480-acre) lake, and in part on observations made by the staff on fogging at the nearby Dresden Station, which had just become operational. In addition, the applicant submitted a theoretical analysis of fogging based on the 4480-acre lake which predicted no significant offsite effects.[10-13] Observations of steam fog over the Dresden cooling lake indicated that no significant offsite impacts would occur at the LaSalle County Station. The Dresden Lake at the time was operated in the "helper" mode; that is, the plant was cooled in a once-through manner, the lake and spray canals being used to dissipate part of the heat load to the atmosphere before the cooling water was discharged into the Illinois River. None of the cooling water in the spray canal or cooling pond was recirculated. The Dresden lake is now operated in the closed-cycle mode and is much warmer than before.

The fogging data available to the staff at the time the FES-CP was prepared indicated that fog from cooling ponds usually did not extend more than 150 meters (500 feet) inland before evaporating, becoming quite thin, or lifting to form a low stratus cloud deck.[14,15] These observations also indicated that the ice that was deposited on elevated objects was very light and friable, and was restricted to the area within about 150 meters (500 feet) from the edge of the water. These fogging and icing observations were few in number and were made at cooling lakes (such as Dresden) with heat loads (rate of heat loss per unit area of water surface) much lower than those of the LaSalle County Station cooling pond as it is now being constructed.

Since the FES-CP was issued, the design size of the cooling pond has been reduced by 54% [from 1810 to 833 hectares (4480 to 2058 acres)], with a 5% reduction in the amount of heat discharged (ER, Sec. 3.4). The maximum unit cooling area of the station cooling lake will be 0.38 ha (0.9 acre) per MWe; a more typical value for nuclear plants is 0.6 ha (1.5 acres) per MWe.[16]

The primary effect of the smaller cooling lake will be to increase the temperature of the water in the lake. There will also be an increase in the difference in temperature between the air and water, resulting in greater fluxes of heat and water vapor from the pond surface [values of the air-water temperature difference in excess of 45°C (80°F) were observed at Dresden during the extremely cold month of January 1977].

As a result of the higher water temperatures in the LaSalle County Station cooling lake, steam fog will form more frequently and will be more dense than would have been the case over the larger, cooler water surface of the original design. The inland penetration of such fogs will also be greater, despite the increase in buoyancy. No tested models are available to predict the horizontal extent of cooling-pond fog. The applicant has made systematic observations of fogging and icing conditions at the nearby Dresden nuclear plant, which now has a cooling pond with a slightly higher heat load (0.8 acres/MWe vs. 0.9 acres/MWe for the LaSalle County Station). However, the only fogging and icing data published are those collected prior to the start of closed-cycle operation.[15]

Applicant's Analysis

The applicant's analysis of atmospheric effects is based primarily on the model developed by Hippler[10-13] for an 1810-hectare (4480-acre) lake and later modified for an 886-hectare (2190-acre) lake (ER, Sec. 5.1.4). That study concluded that instances of fog with horizontal visibilities of 0.4 km (0.25 mile) would occur only a few hours per month at distances of 200 meters (660 feet) from the pond. No mention of icing or lake-induced snowfall was made.

Staff's Analysis

The staff's analysis of fogging and icing conditions to be expected from the LaSalle County Station is based in part on the staff's observations made at the nearby Dresden Nuclear Power Station since it started closed-cycle operation and in part on the results of an ongoing research project by the Meteorology Group of Argonne National Laboratory.[17] This project began in November of 1976; the analysis of the data is continuing. Based on these observations and photographs, the staff expects a more severe local steam fog effect than does the applicant. It is the staff's opinion that dense steam fog will be quite common over and near the station cooling pond in the cooler part of the year (November through March). Typically, this fog will either evaporate, become quite thin, or lift to become a stratus-type cloud within approximately 100 to 150 meters (350 to 500 feet) downwind distance from the lake.

Based on experience at the Dresden cooling pond since the station went to closed-cycle cooling, the staff expects operation of the LaSalle County Station cooling lake to produce occasional (on the order of 100 to 200 hours per winter over each road) light steam fog over County Highway 6 and over State Road 170; some of these foggy periods could reduce visibility sufficiently to cause hazards to traffic. During these periods, a thin layer of friable rime ice will form on trees, telephone poles and lines, and other structures along the roads, but no icing of the road surfaces will occur. Some very light snow may fall. The snow will be too light and too dry to create slippery road surfaces, but could decrease traction on icy roads. Considerable dense fog (on the order of 100 or 200 additional hours per winter) and some icing will occur over the township road just north of the cooling lake, with considerable rime ice on trees and other objects in the area.

Unfortunately, the state-of-the-art in cooling pond plume modeling does not permit a more precise assessment of the fogging and icing impacts of the operation of the station cooling pond. However, the staff does expect periods when pond-produced fog covers the highways mentioned above. The staff will require that the applicant initiate a fog monitoring program for the highways in the area during the cooler part of the year to determine the frequency and density of fogs that could produce highway safety problems. If pond-produced fog does create such safety problems or other impacts, the applicant will be required to take measures to reduce or eliminate the hazards. Such measures could include erection of traffic signs, road centerline and edge lights, tree plantings between the lake and the road, fog fences, etc. Some of these measures are presently in use at the Dresden Nuclear Power Plant's cooling lake and spray canal.

5.4.2 Aquatic Environment

As indicated in the FES-CP, aquatic impacts from operation of the station will be confined to the Illinois River. These impacts are described in the FES-CP and include entrainment and impingement of aquatic biota in the intake system and exposure of aquatic biota to chemical and thermal effluents from the discharge. Although changes have been made in the designs of the cooling lake (ER, p. 3.4-1) and the discharge (ER, p. 2.4-7), the conclusions reached in the FES-CP by the staff regarding the significance of intake and discharge impacts remain valid. In fact, as will be discussed below, most changes have further reduced potential impacts.

5.4.2.1 Intake Impacts

Makeup water for the cooling lake will be pumped from the Illinois River through traveling screens on the river shore. The annual average amount of water withdrawn will amount to about 1% of the average annual river flow, or 3% of the 7-day, 10-year low flow (ER, p. 5.1-7). Flow velocities at the traveling-screen surfaces are expected to be less than 0.2 m/s (0.5 fps) 93% of the operating time (72% station capacity), with a maximum of 0.3 m/s (0.9 fps) the remaining 7% of the time (100% station capacity)(ER, p. 3.4-2).

Because of the low intake velocities and volumes of makeup water, entrainment and impingement are expected to be minor. As indicated in Section 2.5.2, densities of aquatic biota are low in this stretch of the Illinois River, which should further reduce entrainment and impingement effects. Also, not all of the organisms entrained in the cooling lake will necessarily be killed. A minor number may be discharged back to the Illinois River in the cooling lake blowdown without passing through the condenser. Some of the organisms that are retained in the cooling lake will be killed because of the high station cooling water recirculation rate, subjecting these organisms to mechanical damage and excessive pressure and temperature (see Sec. 3.2.2).[18,19]

5.4.2.2 Discharge Impacts

For operation at 100% capacity, the highest monthly average blowdown rate to the Illinois River from the station cooling pond would be 2.23 m^3/s, or 78.9 cfs (ER, p. 5.1-4). Based on the proposed discharge design (ER, p. 3.4-2), the area defined by the 2.78°C (5°F) excess isotherm for the staff's worst-case estimate (highest blowdown temperature) would be 2500 m^2 (0.6 acre) and would represent approximately 9% of the river cross section (see Sec. 5.3.1.3). Because of the small size of the plume, aquatic biota will be exposed to the elevated chemical concentrations and temperatures within this area only a short time. Also, the plume will be small enough to allow a large "zone of passage" for aquatic biota such as fish. Finally, the number of organisms that would be affected by the plume is expected to be low since population densities of biota are low in this stretch of the Illinois River (Sec. 2.5.2). The staff expects the discharge impacts to be minimal and of little influence on the natural biotic populations in the river.

5.4.2.3 Lake Nutrients

Factors that were expected to affect the concentrations of nutrients in the station cooling lake and in turn affect the potential of the lake for development as a fishery and general recreational resource were addressed in the FES-CP (pp. V-13 thru 18). Sources of nutrients were listed as (1) those present in Illinois River makeup water, (2) those present in runoff from adjacent fertilized agricultural land, and (3) those resulting from droppings of feces from waterfowl that might utilize the lake. It was concluded that these factors, along with others, could be potentially detrimental to the establishment of a successful fishery management program (sustained high temperatures, poor water quality, introduction of undesirable fish species, and the general morphometry of the lake).

Since issuance of the FES-CP, the design size of the station cooling lake has been reduced in accordance with a settlement agreement reached by the applicant that is referred to in the initial decision rendered by the Atomic Safety and Licensing Board on 5 September 1973, and has since been further reduced to 833 hectares (2058 acres) (see Sec. 3.2.2.1). Use of the lake as a recreational facility was questioned on health reasons and will depend on assurance that the lake will not become a public health hazard. A monitoring program relative to this issue was proposed by the applicant (ER, App. 5.1B; also see Sec. 6.2.6 of this statement). In its review of the proposed monitoring program, the staff indicated that it might be necessary for the program to include monitoring for nuisance algal growths (algal bloom), as well as for sanitary bacterial water quality. This would be determined through a final staff position presented in the operating license application stage environmental review (ER, App. 5.1B, p. 12). The determination is therefore made in the present environmental statement.

In making this determination, the staff has taken into account the changed lake design and has considered updated information on nitrate inputs to the lake as indicated in Table 5.5. Phosphate nutrient inputs from the river (see Table 2.4) and from waterfowl feces are expected to be substantial. However, it is difficult to estimate their equilibrium concentration in the lake because of biological and chemical reactions which may serve to reduce concentrations in the lake water (FES-CP, p. V-16).

The concentrations of nutrients are expected to be adequate to support vigorous algal growth. However, there are factors that will probably reduce this growth potential, such as turbidity of the water and grazing by aquatic organisms. Turbidity will be highest in the summer months when algal growth potential would be expected to be the greatest. The applicant has stated that experience with the operation of cooling lakes at the Dresden, Powerton, and Kincaid generating stations has indicated that algal bloom problems will not arise at the LaSalle County Station (ER, Supp. 3, Q400.08).

Although it has not yet been established whether use of the lake as a recreational facility will be permitted and whether, therefore, algal blooms could be a problem on this account, if such blooms occur, they could cause an adverse environmental effect in the form of malodors resulting from die-off and decay. Decay of large populations of algae can release substances highly toxic to fish and even waterfowl. Furthermore, the presence of large masses of algae could impair the operation of the station condenser cooling systems.

The staff has considered these factors in assessing the need for an algae monitoring program and has also considered whether the monitoring program would be useful in mitigating or preventing adverse effects of algal bloom.

Based on this assessment, the staff believes that a monitoring program specifically for algal blooms will not be required. Experience with existing cooling lakes as cited earlier would support this conclusion. Furthermore, water quality data (e.g., dissolved oxygen and biochemical oxygen demand, see Sec. 6.2.6) from other required monitoring programs will indicate algal bloom conditions. The presence of an algal bloom also would be detected through the normal

Table 5.5. Sources of Inputs of Nitrate to the LaSalle County Station Cooling Lake (mg/L)

Source	Lake as Originally Proposed[a]	Lake as Presently Proposed
River makeup	2.3	4.7[b]
Runoff	2.2	0[c]
Ducks	0.2	0.2[d]
Total	4.7	4.9

[a]See FES-CP, p. V-15.

[b]See Table 2.4, Summertime Conditions.

[c]There will be no runoff from agricultural areas into the present lake.

[d]Value from the FES-CP is assumed.

visual process by the station operators and in the experience in the operation of the station's cooling water screen systems. If any corrective or mitigative action is found to be necessary, the staff believes it would be on the latter account. The applicant would be expected to take such action in the normal course of promoting the efficient operation of the station.

5.5 RADIOLOGICAL IMPACTS

5.5.1 Radiological Impacts on Biota other than Man

Depending on the pathway and the radiation source, terrestrial and aquatic biota will receive doses approximately the same or somewhat higher than man receives. Although guidelines have not been established for acceptable limits for radiation exposure to species other than man, it is generally agreed that the limits established for humans are also conservative for other species. Experience has shown that it is the maintenance of population stability that is crucial to the survival of a species, and species in most ecosystems suffer rather high mortality rates from natural causes. While the existence of extremely radiosensitive biota is possible and while increased radiosensitivity in organisms may result from environmental interactions with other stresses (e.g., heat, biocides, etc.), 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 LaSalle County Station. Furthermore, in all the plants for which an analysis of radiation exposure to biota other than man has been made, there have been no cases of exposures that can be considered significant in terms of harm to the species, or that approach the exposure limits to members of the public permitted by 10 CFR Part 20.[20] Since the BEIR Report[21] concluded that the evidence to date indicates that no other living organisms are very much more radiosensitive than man, no measurable radiological impact on populations of biota is expected as a result of the routine operation of this station.

5.5.2 Radiological Impact on Man

The impact on man associated with the routine release of radioactive effluents from the LaSalle County Station has been estimated. The quantities of radioactive material that may be released annually from the station are estimated based on the description of the radwaste systems given in the applicant's environmental report, the FSAR, and using the calculational model and parameters described in NUREG-0016, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Boiling Water Reactors (BWR-GALE Code)," April 1976. Using these quantities and site environs information, the dose commitments to individuals are estimated using models and considerations discussed in detail in Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purposes of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, October 1977. Additional assumptions and models described in Appendix E of this environmental statement were used to estimate integrated population doses.

5.5.2.1 Exposure Pathways

The environmental pathways which were considered in calculating the radiological impact are shown in Figure 5.3. Calculations of radioactive material quantities shown in Tables 5.6 and 5.7 were based on onsite meteorological and hydrological considerations and on exposure pathways at the LaSalle County Station.

In the analysis of all effluent radionuclides released from the station, tritium, carbon-14, radiocesium, and radiocobalt inhaled with air and ingested with food and water were found to account for essentially all total-body dose commitments to individuals and the population within 80 km (50 miles) of the station.

5.5.2.2 Dose Committments from Radioactive Releases to the Atmosphere

Radioactive effluents released to the atmosphere from the LaSalle County Station will result in small radiation doses to the public. Staff estimates of the expected gaseous and particulate releases listed in Table 5.6 and the site meteorological considerations discussed in Section 2.4 of this statement and summarized in Table 5.8 were used to estimate radiation doses to individuals and populations. Dose commitments to individuals and the population can be estimated using different methodologies. The staff's assessment of dose is based on a 50-year commitment and is described in Regulatory Guide 1.109. The results of the calculations are discussed below.

Radiation Dose Commitments to Individuals

The predicted dose commitments to the "maximum" individual from radioiodine and particulate releases are listed in Table 5.9. The maximum individual has been estimated to receive the highest dose commitment from the LaSalle County Station and is assumed to consume well above average quantities of the foods considered (see Table A-2 in Regulatory Guide 1.109). The maximum annual air, total body, and skin doses from noble gas releases are presented in Tables 5.10, 5.11, and 5.12.

Radiation Dose Commitments to Populations

The calculated annual radiation dose commitments to the population within 80 km (50 miles) of the LaSalle County Station from gaseous and particulate releases are presented in Table 5.11. Estimated dose commitments to the U. S. population are presented in Table 5.13. Background radiation doses are provided for comparison.

Within 80 km (50 miles) of the station site, specific meteorological, populational, and agricultural data for each of 16 compass sectors around the station were used to evaluate the doses. Beyond 80 km (50 miles), meteorological models were extrapolated by assuming uniform dispersion of noble gases and continued deposition of radioiodines and particulates until no suspended radionuclides remained. Doses were evaluated using average population densities and food production values discussed in Appendix E. The doses from atmospheric releases during normal operation represent an extremely small increase in the normal population dose from background radiation sources.

5.5.2.3 Dose Commitments from Radioactive Liquid Releases to the Hydrosphere

Radioactive effluents released to the hydrosphere from the LaSalle County Station during normal operation will result in small radiation doses to individuals and populations. Staff estimates of the expected liquid releases listed in Table 5.7, and the site hydrological considerations discussed in Section 2.3 of this statement and summarized in Table 5.14 were used to estimate radiation dose commitments to individuals and populations. The results of the calculations are discussed below.

Radiation Dose Commitments to Individuals

The estimated dose commitments to individuals at selected offsite locations where exposures are expected to be largest are listed in Table 5.9. The standard NRC models given in Regulatory Guide 1.109 were used for these analyses.

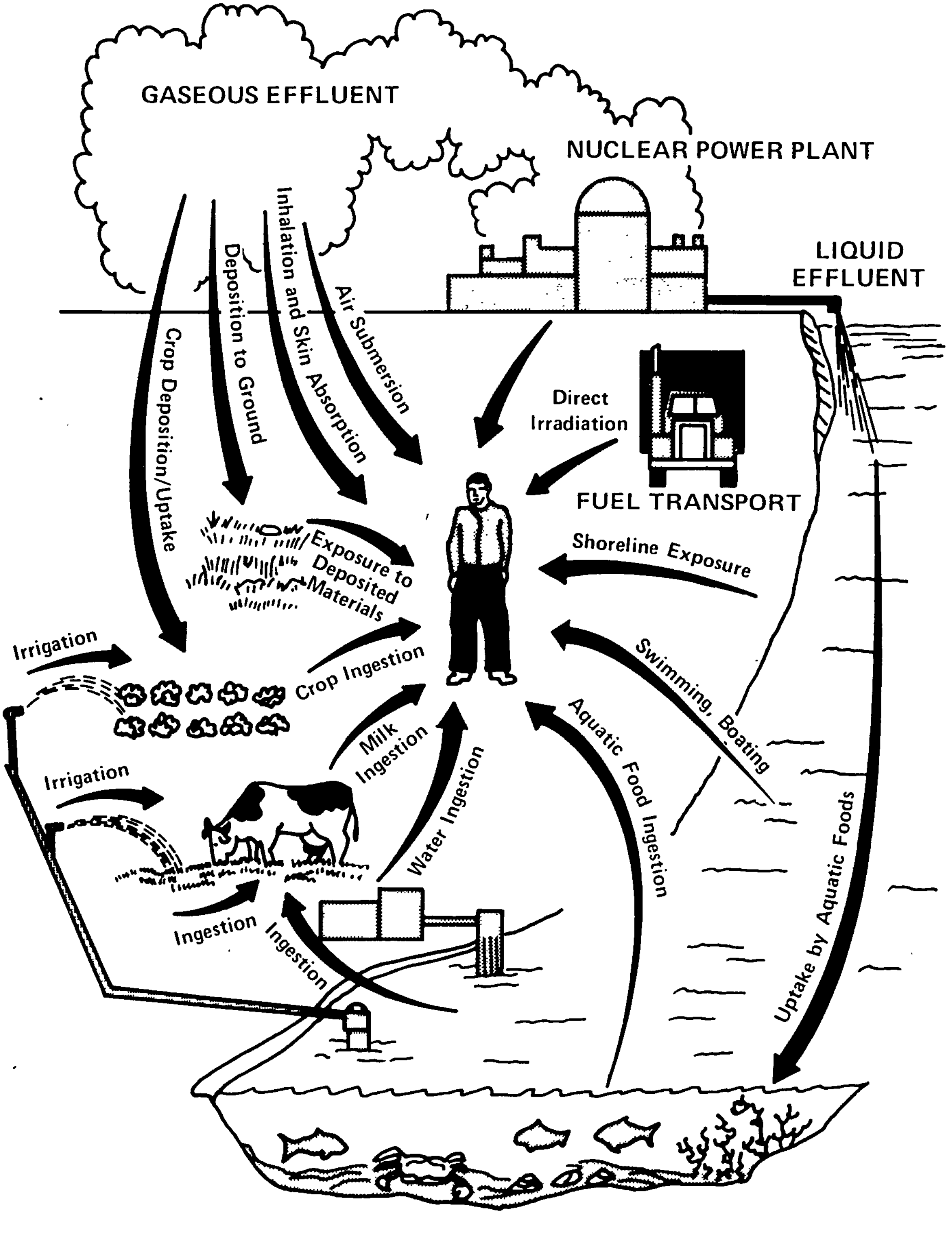

Fig. 5.3. Exposure Pathways to Man.

Table 5.6. Calculated Releases of Radioactive Materials in Gaseous Effluents from LaSalle County Station (Ci/yr/reactor)

Nuclides	Waste-Gas System	Building Ventilation			Gland Seal and Mech. Vacuum Pump	Total
		Reactor	Radwaste	Turbine		
Ar-41	a/	25	a/	a/	a/	25
Kr-83m	5	b/	b/	b/	87	92
Kr-85m	1800	6	b/	68	150	2000
Kr-85	270	b/	b/	b/	b/	270
Kr-87	b/	6	b/	130	520	660
Kr-88	670	6	b/	230	520	1400
Kr-89	b/	b/	b/	b/	2200	2200
Xe-131m	74	b/	b/	b/	b/	74
Xe-133m	17	b/	b/	b/	7	24
Xe-133	11000	130	10	250	2500	14000
Xe-135m	b/	92	b/	650	62	800
Xe-135	b/	72	45	650	920	1700
Xe-137	b/	b/	b/	b/	2700	2700
Xe-138	b/	14	b/	1400	2100	3500
I-131	b/	1.9(-1)[c]	5(-2)	1.9(-1)	1.1(-1)	5.4(-1)
I-133	b/	7.5(-1)	1.8(-1)	7.6(-1)	3.2(-1)	2.0
H-3	-	-	-	-	-	71
C-14	8.0	1.5	b/	b/	b/	9.5
Cr-51	a/	3(-4)	9(-5)	1.3(-2)	a/	1.3(-2)
Mn-54	a/	3(-3)	3(-4)	6(-4)	a/	3.9(-3)
Fe-59	a/	4(-4)	1.5(-4)	5(-4)	a/	1.1(-3)
Co-58	a/	6(-4)	4.5(-5)	6(-4)	a/	1.3(-3)
Co-60	a/	1(-2)	9(-4)	2(-3)	a/	1.3(-2)
Zn-65	a/	2(-3)	1.5(-5)	2(-4)	a/	2.2(-3)
Sr-89	a/	9(-5)	4.5(-6)	6(-3)	a/	6.1(-3)
Sr-90	a/	5(-6)	3(-6)	2(-5)	a/	2.8(-5)
Zr-95	a/	4(-4)	5(-7)	1(-4)	a/	5(-4)
Sb-124	a/	2(-4)	5(-7)	3(-4)	a/	5(-4)
Cs-134	a/	4(-3)	4.5(-5)	3(-4)	3(-6)	4.4(-3)
Cs-136	a/	3(-4)	4.5(-6)	5(-5)	2(-6)	3.6(-4)
Cs-137	a/	5.5(-3)	9(-5)	6(-4)	1(-5)	6.3(-3)
Ba-140	a/	4(-4)	1(-6)	1.1(-2)	1.1(-5)	1.1(-2)
Ce-141	a/	1(-4)	2.6(-5)	6(-4)	a/	7.3(-4)

[a]Less than 1% of total nuclide.

[b]Less than 1.0 curie/yr/reactor for noble gases and carbon-14; less than 10^{-4} curie/yr/reactor for iodine.

[c]Exponential notation; 1.9(-1) = 1.9×10^{-1}.

Table 5.7. Calculated Releases of Radioactive Materials in Liquid Effluents from LaSalle County Station

Nuclide	Release, Ci/yr/reactor	Nuclide	Release, Ci/yr/reactor
Corrosion and Activation Products		Fission Products	
Na-24	5.7(-3)[a,b]	Ru-103	7(-5)
P-32	5.8(-4)	Rh-103m	6(-5)
Cr-51	1.5(-2)	Ru-105	7(-5)
Mn-54	2.3(-4)	Rh-105m	7(-5)
Mn-56	1.7(-4)	Rh-105	3.7(-4)
Fe-55	3.3(-3)	Ru-106	9(-5)
Fe-59	9(-5)	Ag-110m	2(-5)
Co-58	7.7(-4)	Te-129m	1.2(-4)
Co-60	1.6(-3)	Te-129	8(-5)
Cu-64	1.5(-2)	Te-131m	1.3(-4)
Zn-65	6.5(-4)	Te-131	2(-5)
Zn-69m	1.1(-3)	I-131	8.3(-2)
Zn-69	1.2(-3)	Te-132	2(-5)
Zr-95	5(-5)	I-132	8(-5)
Nb-95	7(-5)	I-133	2.2(-2)
W-187	3.3(-4)	Cs-134	1.3(-3)
Np-239	1.3(-2)	I-135	2.9(-3)
		Cs-136	5.5(-4)
Fission Products		Cs-137	2.9(-3)
		Ba-137m	2(-3)
Sr-89	3.2(-4)	Ba-140	1.1(-3)
Sr-90	2(-5)	La-140	5.5(-4)
Sr-91	1.2(-3)	La-141	1(-5)
Y-91m	7.8(-4)	Ce-141	1(-4)
Y-91	2(-4)	Ce-143	4(-5)
Sr-92	4(-5)	Pr-143	1.2(-4)
Y-92	4.3(-4)	Ce-144	1.8(-4)
Y-93	1.3(-3)	All others[b]	6(-5)
Zr-95	2(-5)	Total (except H-3)	1.9(-1)
Nb-95	2(-5)	H-3	15
Mo-99	4.1(-3)		
Tc-99m	5.6(-3)		

[a]Exponential notation; 5.7(-3) = 5.7×10^{-3}.

[b]Nuclides whose release rates are less than 10^{-5} Ci/yr/reactor are not listed individually but are included in the category "All others".

Table 5.8. Summary of Atmospheric Dispersion Factors and Deposition Values for Selected Locations near the LaSalle County Station[a]

Location[b]	Source[c]	χ/Q (sec/m³)	Relative Deposition (m^{-2})
Nearest site land boundary (0.61 km SW)	A	5.6×10^{-8}	9.2×10^{-9}
	B	2.5×10^{-7}	4.0×10^{-8}
Nearest residence, garden and meat (1.6 km SW)	A	2.1×10^{-8}	3.3×10^{-9}
	B	9.4×10^{-8}	1.4×10^{-8}

[a]The dose presented in the following tables are corrected for radioactive decay and cloud depletion from deposition, where appropriate, in accordance with Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light Water Reactors," March 1976.

[b]"Nearest" refers to that type of location where the highest radiation dose is expected to occur from all appropriate pathways.

[c]Source A is continuous stack release; Source B is periodic stack release, 4 times/yr at 24 hours duration each.

Table 5.9. Annual Dose Commitments to a Maximum Individual near the LaSalle County Station due to Particulate and Liquid Effluents

		Dose, (mrem/yr/unit)	
Location[a]	Pathway	Total Body	Thyroid
Iodine and Particulate Doses			
Nearest residence, garden, and meat at 1.6 km SW	Ground deposit	0.041	0.041
	Inhalation	b	0.012
	Vegetation	0.014	0.91
	Meat (child)	b	0.085
Totals		0.055	1.05
Liquid Effluent Doses			
Nearest municipal water intake (Peoria, Ill.)	Drinking (child)	b	0.047
Nearest shoreline (plant outfall)	Shoreline (child)	b	b
Totals		<0.01	0.047

[a]"Nearest" refers to the location where the highest radiation dose to an individual from all applicable pathways has been estimated.

[b]Less than 0.01 mrem/yr.

Table 5.10. Annual Total Body, Skin and Air Doses at the Nearest[a] Site Boundary of the LaSalle County Station due to Gaseous Radioactive Effluents

Location	Dose (mrem/yr/unit)			
	Total Body	Skin	Gamma Air Dose	Beta Air Dose
Nearest[a] site boundary (0.61 km SW)	0.12	0.28	0.18	0.18

[a]"Nearest" refers to that site boundary location where the highest radiation doses due to gaseous effluents have been estimated to occur.

Table 5.11. Calculated Dose Commitments to a Maximum Individual and the Population from the LaSalle County Station Operation[a]

Maximum Individual Doses		
	Appendix I Design Objective	Calculated Doses
	Annual Dose Per Reactor Unit	
Liquid Effluents		
Dose to total body from all pathways	3 mrem	0.002 mrem
Dose to any organ from all pathways	10 mrem	0.047 mrem
Noble Gas Effluents (at site boundary)		
Gamma dose in air	10 mrad	0.18 mrad
Beta Dose in air	20 mrad	0.18 mrad
Dose to total body of an individual	5 mrem	0.12 mrem
Dose to skin of an individual	15 mrem	0.28 mrem
Radioiodines and Particulates[b]		
Dose to any organ from all pathways	15 mrem	1.05 mrem
Population Doses within 80 km (50 miles)		
	Total Body	Thyroid
	Annual Dose Per Reactor Unit	
Natural Radiation Background[c]	140,000 man-rem	
Liquid Effluents	< 1 man-rem	< 1 man-rem
Noble Gas Effluents	< 1 man-rem	< 1 man-rem
Radioiodines and Particulates	< 1 man-rem	7.0 man-rem

[a]Appendix I Design Objectives from Sections II.A, II.B, II.C and II.D of Appendix I, 10 CFR Part 50; considers doses to maximum individual and population per reactor unit. From Federal Register V. 40, p. 19442, May 5, 1975.

[b]Carbon-14 and tritium have been added to this category.

[c]"Natural Radiation Exposure in the United States", U.S. Environmental Protection Agency, ORP-SID-72-1 (June 1972); using the average Illinois state background dose (103 mrem/yr), and year 2000 projected population of 1,400,000.

Table 5.12. Calculated Dose Commitments to a Maximum Individual from the LaSalle County Station Operation[a]

	Annual Dose per Site	
	RM-50-2 Design Objectives	Calculated Doses
Liquid Effluents		
Dose to total body or any organ from all pathways	5 mrem/yr	0.047 mrem/yr
Noble Gas Effluents (at site boundary)		
Gamma dose in air	10 mrad/yr	0.36 mrad/yr
Beta dose in air	20 mrad/yr	0.36 mrad/yr
Dose to total body of an individual	5 mrem/yr	0.24 mrem/yr
Dose to skin of an individual	15 mrem/yr	0.56 mrem/yr
Radioiodine and Particulates[b]		
Dose to any organ from all pathways	15 mrem/yr	2.1 mrem/yr

[a]Guides on design objectives proposed by the NRC staff on February 20, 1974; considers doses to individuals from all units onsite. From "Concluding Statement of Position of the Regulatory Staff," Docket No. RM-50-2, February 20, 1974, pp. 25-30, U. S. Atomic Energy Commission, Washington, D. C.; also published as Annex to Appendix I to 10 CFR Part 50.

[b]Carbon-14 and tritium have been added to this category.

Table 5.13. Annual Total-Body Population Dose Commitments in the Year 2000

Category	U.S. Population-Dose Commitment
Natural Background Radiation[a] (man-rem/yr)	27,000,000
LaSalle County Station, Units 1 and 2 (man-rem/yr/site)	
Plant workers	1,000
General public	
gas and particulates	28
liquid effluents	1
transportation of fuel and waste	14

[a]Using the average U.S. background dose (102 mrem/yr), and year 2000 projected U.S. population from "Population Estimates and Projections," Series II, U.S. Dept. of Commerce, Bureau of the Census, Series P-25, No. 541, February 1975.

Table 5.14. Summary of Hydrologic Transport and Dispersion of Liquid Releases from the LaSalle County Station[a]

Location	Transit Time (hours)	Dilution Factor
Nearest municipal water intake (Peoria, Illinois)	10	160
Nearest shoreline (plant outfall)	0.1	1

[a]See Regulatory Guide 1.113, "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I," April 1977.

Radiation Dose Commitments to Populations

The estimated population radiation dose commitments to 80 km (50 miles) for the LaSalle County Station from liquid releases, based on the use of Illinois River water and the shoreline near the station outfall, are shown in Table 5.11. Dose commitments beyond 80 km (50 miles) were based on the assumptions discussed in Appendix E.

Background radiation doses are provided for comparison. The dose commitments from liquid releases from the LaSalle County Station represent small increases in the population dose from background radiation sources.

5.5.2.4 Direct Radiation

Radiation from the Facility

Radiation fields are produced in nuclear station environs as a result of radioactivity contained within the reactor and its associated components. Although these components are shielded, dose rates around the stations have been observed to vary from undetectable levels to values of approximately 1 rem/year.

Doses from sources within the station are primarily due to nitrogen-16, a radionuclide produced in the reactor core. For boiling water reactors (BWR), nitrogen-16 is transported with the primary coolant to the turbine building. The orientation of piping and turbine components in the turbine building determines, in part, the exposure rates outside the station. Because of variations in equipment lay-out, exposure rates are strongly dependent upon overall station design.

Based on the radiation surveys which have been performed around several operating BWRs, it appears to be very difficult to develop a reasonable model to predict direct shine doses. Thus, older plants should have actual measurements performed if information regarding direct radiation and skyshine rates is needed.

For newer BWRs with a standardized design, dose rates have been estimated using sophisticated Monte Carlo techniques. The turbine island design proposed in the Braun SAR[22] is estimated to have a direct radiation and skyshine dose rates of the order of 20 mrem per year per unit at a typical site boundary distance of 0.6 km (0.4 mile) from the turbine building. This dose rate is assumed to be typical of the new generation of boiling water reactors. The applicant estimates an annual dose of 4 mrem at 0.5 km (1/3 mile) for Units 1 and 2 based on design features utilizing special shielding of the turbines and piping. The integrated population dose from such a facility would be less than one man-rem per year per unit.

The onsite low-level radioactivity storage containers outside the station are estimated to contribute less than 0.01 mrem per year at the site boundary.

Occupational Radiation Exposure

Based on a review of the applicant's safety analysis report, the staff has determined that the applicant is committed to design features and operating practices that will ensure that individual occupational radiation doses can be maintained within the limits of 10 CFR Part 20, and that individual and plant population doses will be as low as is reasonably achievable.[23] For the purpose of portraying the radiological impact of the station operation on all onsite personnel, it is necessary to estimate a man-rem occupational radiation dose. For a station designed and proposed to be operated in a manner consistent with 10 CFR Part 20, there will be many variables which influence exposure and make it difficult to determine a quantitative total occupational radiation dose for a specific station. Therefore, past exposure experience from operating nuclear power stations[24] has been used to provide a widely applicable estimate to be used for all light water reactor power stations of the type and size of the LaSalle County Station. This experience indicates a value of 500 man-rem per year per reactor.

On this basis, the projected occupational radiation exposure impact of the LaSalle County Station is estimated to be 1000 man-rem per year.

Transportation of Radioactive Material

The transportation of cold fuel to each of the LaSalle County Station reactors, of irradiated fuel from each reactor to a fuel reprocessing plant, and of solid radioactive wastes from each reactor to burial grounds is within the scope of the Commission's transportation rulemaking decision "Environmental Effects of Transportation of Radioactive Materials to and from Nuclear Power Plants" promulgated as 10 CFR Section 51.20(g). Pursuant to the rule, the environmental effects of such transportation are summarized in Table 5.15. For a detailed discussion of the transportation of radioactive material, see the NRC report entitled, "Environmental Survey of Transportation of Radioactive Material to and from Nuclear Power Plants" (WASH-1238, December 1972).

5.5.2.5 Evaluation of Radiological Impact

The actual radiological impact associated with the operation of the proposed LaSalle County Station will depend, in part, on the manner in which the radioactive waste treatment system is operated. Based on the staff's evaluation of the potential performance of the radwaste system, it is concluded that the system as proposed is capable of meeting the dose design objectives of 10 CFR 50, Appendix I. The applicant chose to show compliance with the design objectives of RM-50-2 as an optional method of demonstrating compliance with the cost benefit section of Appendix I (Section II.D.). Table 5.11 and Table 5.12 compare the calculated maximum individual doses to the dose design objectives. However, since the station's operation will be governed by operating license technical specifications and since the technical specifications will be based on the dose design objectives of 10 CFR 50, Appendix I, as shown in the first column of Table 5.11, the actual radiological impact of station operation may result in doses close to the dose design objectives. Even if this situation exists, the individual doses will still be very small when compared to natural background doses ($\sim$ 100 mrem/yr) or to the dose limits specified in 10 CFR 20. As a result, the staff concluded that there will be no measurable radiological impact on man from routine operation of the LaSalle County Station.

Effective December 1, 1979, the licensee will be regulated according to the Environmental Protection Agency's 40 CFR Part 190, Environmental Radiation Protection Standards for Nuclear Power Operations, which specifies that the annual dose equivalent does 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 daughter excepted) to the general environment from uranium fuel cycle operations and radiation from these operations.

Table 5.15. Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor[a]

Normal Conditions of Transport	
Heat (per irradiated fuel cask in transit)	250,000 Btu/hr
Weight (governed by Federal or state restrictions)	73,000 lb per truck; 100 tons per cask per rail car
Traffic density	
Truck	< 1 per day
Rail	< 3 per month

Exposed Population	Estimated Number of Persons Exposed	Range of Doses to Exposed Individuals[b] (millirems per reactor year)	Cumulative Dose to Exposed Population (man-rems per reactor year)[c]
Transportation workers	200	0.01 to 300	4
General public			
Onlookers	1,100	0.003 to 1.3	
Along route	600,000	0.001 to 0.06	3

Accidents in Transport	
Radiological effects	Small[d]
Common (nonradiological) causes	1 fatal injury in 100 reactor years; 1 nonfatal injury in 10 reactor years; $475 property damage per reactor year

[a]Data supporting this table are given in the Commission's "Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants," WASH-1238, December 1972, and Supplement I, NUREG-75/038, April 1975.

[b]The Federal Radiation Council has recommended that the radiation doses from all sources of radiation other than natural background and medical exposures should be limited to 5,000 millirems/year for individuals as a result of occupational exposure and should be limited to 500 millirems/year for individuals in the general population. The dose to individuals due to average natural background radiation is about 102 millirems/year.

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

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

5.5.3 Environmental Effects of the Uranium Fuel Cycle

On March 14, 1977, the Commission presented in the Federal Register (42 FR 13803) an interim rule regarding the environmental considerations of the uranium fuel cycle. It is effective through March 14, 1979* and revises Table S-3 of Paragraph (e) of 10 CFR §51.20.** In a subsequent announcement on April 14, 1978 (43 FR 15613), the Commission further amended Table S-3 to delete the numerical entry for the estimate of radon releases and to clarify that the table does not cover health effects. The revised table is shown here as Table 5.16. The interim rule reflects new and updated information relative to reprocessing of spent fuel and radioactive waste management as discussed in NUREG-0116, "Environmental Survey of Reprocessing and Waste Management Portions of the LWR Fuel Cycle,"[25] and NUREG-0216,[26] 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 Atomic Energy Commission report WASH-1248, "Environmental Survey of the Urandium Fuel Cycle."[27]

Specific categories of natural resource use are included in Table S-3 of the interim rule. These categories 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 Table S-3 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.

The following assessment of the environmental impacts of the fuel cycle as related to the operation of the proposed project is based on the values given in Table S-3 and the staff's analysis of the radiological impact from radon 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 conclusions would not be altered if the analysis were to be based on the net electrical power output of the LaSalle County Station.

5.5.3.1 Land Use

The total annual land requirement for the fuel cycle supporting a model 1000-MWe LWR is about 41 hectares (101 acres). Approximately 3 hectares (7 acres) per year are permanently committed land, and 38 hectares (94 acres) per year are temporarily committed. (A "temporary" land commitment is a commitment for the life of the specific fuel-cycle plant, e.g., mill, enrichment plant, or succeeding plants. On abandonment or decommissioning, such land can be used for any purpose. "Permanent" commitments represent land that may not be released for use after plant shutdown and/or decommissioning.) Of the 38 hectares (94 acres) per year of temporarily committed land, 29 hectares (72 acres) are undisturbed and 9 hectares (22 acres) are disturbed. Considering common classes of land use in the U.S.,** fuel-cycle land-use requirements to support the model 1000-MWe LWR do not represent a significant impact.

5.5.3.2 Water Use

The principal water-use requirement for the fuel cycle supporting a model 1000-MWe LWR is that required for removal of waste heat from the power stations supplying electrical energy to the enrichment step of this cycle. Of the total annual requirement of 43×10^6 m^3 (11, 373 x 10^6 gallons), about 42×10^6 m^3 are required for this purpose, assuming that these plants use once-through cooling. Other water uses involve the discharge to air (e.g., evaporation losses in process cooling) of about 0.6×10^6 m^3 per year and water discharged to ground (e.g., mine drainage) of about 0.5×10^6 m^3 per year.

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*The Commission acted on September 12, 1978 (43 FR 41373) to extend the period of effectiveness from September 13, 1978 to March 14, 1979.

**A notice of final rulemaking proceedings was given in the Federal Register of May 26, 1977 (42 FR 26987) that calls for additional public comment before adoption or final modification of the interim rule.

***A coal-fired power plant of 1000 MWe capacity using strip-mined coal requires the disturbance of about 81 hectares (200 acres) per year for fuel alone.

Table 5.16. Summary of Environmental Considerations for Uranium Fuel Cycle[1]

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

Natural resource Use	Total	Maximum effect per annual fuel requirement or reference reactor year of model 1,000 MWe LWR
Land (acres):		
Temporarily committed[2]	94	
Undisturbed area	73	
Disturbed area	22	Equivalent to 110 MWe coal-fired powerplant.
Permanently committed	7.1	
Overburden moved (millions of MT).	2.8	Equivalent to 95 MWe coal-fired powerplant.
Water (millions of gallons):		
Discharged to air	159	=2 pct of model 1,000 MWe LWR with cooling tower.
Discharged to water bodies	11,090	
Discharged to ground	124	
Total	11,373	<4 pct of model 1,000 MWe LWR with once-through cooling.
Fossil fuel:		
Electrical energy (thousands of megawatt hours).	321	<5 pct of model 1,000 MWe LWR output.
Equivalent coal (thousands of MT).	117	Equivalent to the consumption of a 45 MWe coal-fired powerplant.
Natural gas (millions of scf)	124	<0.3 pct of model 1,000 MWe energy output.
Effluents—chemical (MT):		
Gases (including entrainment):[3]		
SO_x	4,400	
NO_x[4]	1,190	Equivalent to emissions from 45 MWe coal-fired plant for a year.
Hydrocarbons	14	
CO	29.6	
Particulates	1,154	
Other gases:		
F^-	0.67	Principally from UF_6 production, enrichment, and reprocessing. Concentration within range of state standards—below level that has effects on human health.
HCl	0.014	
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	NH_3—600 ft^3/s.
Fluoride	12.9	NO_3—20 ft^3/s.
Ca^{++}	5.4	Fluoride—70 ft^3/s.
Cl^-	8.5	
Na^+	12.1	
NH_3	10.0	
Fe	0.4	
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.
Effluents—radiological (curies):		
Gases (including entrainment):		
Rn-222	—	Presently under reconsideration by the Commission.
Ra-226	0.02	
Th-230	0.02	
Uranium	0.034	
Tritium (thousands)	18.1	
C-14	24	
Kr-85 (thousands)	400	Principally from fuel reprocessing plants.
Ru-106	0.14	
I-129	1.3	
I-131	0.83	
Fission products and transuranics	0.203	
Liquids:		
Uranium and daughters	2.1	Principally from milling—included in 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 pct 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 ~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)	3,462	<4 pct 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. These issues which are not addressed at all by the Table may be the subject of litigation in 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 Portions of the LWR Fuel Cycle", NUREG-0116 (Supp. 1 to WASH-1248); and the "Discussion of Comments Regarding the Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle", NUREG-0216 (Supp. 2 to WASH-1248). The contributions from reprocessing, waste management and transportation of wastes are maximized for either of the 2 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 sec. 51.20(g). The contributions from the other steps of the fuel cycle are given in columns A–E of Table S-3A of WASH-1248.

[2] The contributions to temporarily committed land from reprocessing are not prorated over 30 years, since the complete temporary impact accrues regardless of whether the plant services 1 reactor for 1 yr. or 57 reactors for 30 yrs.

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

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

Proportional annual discharges of thermal effluents from the nuclear fuel cycle are about 4% of those from model 1000-MWe LWR using once-through cooling. The consumptive water use of 0.6×10^6 m^3 per year is about 2% of 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 that 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.

5.5.3.3 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 consumption of electrical energy for fuel cycle operations is small and acceptable relative to the net power production of the LaSalle County Station.

5.5.3.4 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 SO_X, NO_X, and particulates. Based on data in a Council on Environmental Quality report,[28] the staff finds that these emissions constitute an extremely small additional atmospheric loading in comparison with these emissions from the stationary fuel-combustion and transportation sectors in the U.S., i.e., about 0.02% of the annual national releases of these pollutants are acceptable.

Liquid chemical effluents produced in fuel-cycle processes are related to fuel-enrichment, -fabrication, and -reprocessing operations and may be released to receiving waters. These effluents are usually present in dilute concentrations such that only small amounts of dilution water are required to reach levels of concentration that are within established standards. The flow of dilution water required for specific constituents is specified in Table S-3. Additionally, all liquid discharges into the navigable waters of the United States from plants associated with the fuel-cycle operations will be subject to requirements and limitations set forth in an NPDES permit issued by an appropriate State or Federal regulatory agency.

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.

5.5.3.5 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 listed in Table S-3. Using these data, the staff has calculated the 100-year involuntary environmental dose commitment* to the U.S. population. It is estimated from these calculations that the overall involuntary total body gaseous dose commitment to the U.S. population from the fuel cycle (excluding reactor releases and the dose commitment due to radon-222) would be approximately 400 man-rem per year of operation of the model 1000-MWe LWR. Based on Table S-3 values, the additional involuntary total body dose commitment to the U.S. population from radioactive liquid effluents due to all fuel-cycle operations other than reactor operation would be approximately 100 man-rem per year of operation. Thus, the estimated involuntary 100-year environmental dose commitment to the U.S. population from radioactive gaseous and liquid releases due to these portions of the fuel cycle is approximately 500 man-rem (whole body) per year of operation of the model 1000-MWe LWR.

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*The environmental dose commitment (EDC) is the integrated population dose for 100 years, i.e., it represents the sum of the annual population doses for a total of 100 years. The population dose varies with time, and it is not practical to calculate this dose for every year.

At this time, the radiological impacts associated with radon-222 releases are not addressed in Table S-3. Principal radon releases occur during mining and milling operations and as emissions from mill tailings. The staff has determined that releases from these operations for each year of operation of the model 1000-MWe LWR are as follows:

Mining	4060 Ci	(Ref. 29)
Milling and tailings (during active milling)	780 Ci	(Ref. 30)
Inactive tailings (prior to stabilization)	350 Ci	(Ref. 30)
Stabilized tailings (several hundred years)	1 to 10 Ci/yr	(Ref. 30)
Stabilized tailings (after several hundred years)	110 Ci/yr	(Ref. 30)

The staff has calculated population dose commitments for these sources of radon-222 using the RABGAD computer code described in NUREG-0002, Section IV.J of Appendix A.[31] The results of these calculations for mining and milling activities prior to tailings stabilization are as follows:

	Radon-222 Releases	Estimated 100-Year Environmental Dose Commitment (man-rem) per Year of Operation of the Model 1000-MWe LWR		
		Total Body	Bone	Lung (bronchial epithelium)
Mining	4100 Ci	110	2800	2300
Milling and active tailings	1100 Ci	29	750	620
Total		140	3600	2900

When added to the 500 man-rem total body dose commitment for the balance of the fuel cycle, the overall estimated total body involuntary 100-year environmental dose commitment to the U.S. population from the fuel cycle for the model 1000-MWe LWR is approximately 640 man-rem. Over this period of time, this dose is equivalent to 0.00002% of the natural background dose of about 3,000,000,000 man-rem to the U.S. population.*

The staff has also considered health effects associated with the releases of radon-222, considering both the short-term effects of mining, milling, and active tailings, and the long-term effects from stabilized tailings. Dose to the bronchial epithelium was used as the standard of comparison. As noted, this dose for mining, milling, and active tailings is approximately 2900 man-rem per year of operation of the model 1000-MWe LWR. For long-term radon releases from stabilized tailings, the staff has assumed that these tailings would emit, per year of operation of the model 1000-MWe LWR, 1 Ci/yr for 100 years, 10 Ci/yr for the next 400 years, and 100 Ci/yr for periods beyond 500 years. With these assumptions, the cumulative radon-222 release from stabilized tailings piles per year of operations of the model 1000-MWe LWR will be 100 Ci in 100 years and 53,800 Ci in 1000 years.[32] The bronchial epithelium dose commitments for these two periods are 56 and 30,000 man-rem, respectively.

*Based on an annual average natural background individual dose commitment of 100 mrem and a stabilized U.S. population of 300 million.

Using a risk estimator of 22.2 cancer deaths per million man-rem lung exposure, the estimated risk of lung cancer mortality due to mining, milling, and active tailings emissions of radon-222 would be 0.065 cancer fatalities per year of operation of the model 1000-MWe LWR. When the risk due to radon-222 emissions from stabilized tailings over a 100-year release period is added, the estimated risk of lung cancer mortality over a 100-year period is estimated to be 0.066 cancer fatalities per year of operation of the model 1000-MWe LWR and, similarly, a risk of 0.74 cancer fatalities over a 1000-year release period. When all other risks of cancer mortalities (e.g., bone cancer) are considered, the overall risks of cancer fatalities per year of operation of the model 1000-MWe LWR are as follows:

0.11 fatalities for a 100-year period

0.19 fatalities for a 500-year period

1.2 fatalities for a 1000-year period.

To illustrate: A single model 1000-MWe LWR operating at an 80% capacity factor for 30 years would be predicted to induce 3.3 cancer fatalities in 100 years, 5.7 in 500 years, and 36 in 1000 years as a result of releases of radon-222.

These doses and predicted health effects have been compared with those that can be expected from natural-background emissions of radon-222. Using data from the National Council on Radiation Protection (NCRP),[33] the average radon-222 concentration in air in the contiguous United States is about 150 pCi/m^3, which the NCRP estimates will result in an annual dose to the bronchial epithelium of 450 mrem. For a stabilized U.S. population of 300 million, this represents a total dose commitment of 135 million man-rem per year. Using the same risk estimator of 22.2 lung cancer fatalities per million man-rem used to predict cancer fatalities for the model 1000-MWe LWR, estimated lung cancer fatalities alone from background radon-222 in the air can be calculated to be 3000 per year. Against this background, the staff concludes that both the dose commitments and health effects of the uranium fuel cycle are insignificant when compared to dose commitments and health effects to the U.S. population resulting from natural background radiation sources.

5.5.3.6 Radioactive Wastes

The quantities of buried radioactive waste material (low-level, high-level, and transuranic wastes) are specified in table S-3. For low-level waste disposal at land burial facilities, the Commission notes in Table S-3 that there will be no significant radioactive releases to the environment. For high-level and transuranic wastes, the Commission notes that these are to be buried at a Federal repository, and that no release to the environment is associated with such disposal. It is indicated in NUREG-0116, in which is provided background and context for the high-level and transuranic Table S-3 values established by the Commission, that these high-level and transuranic wastes will be buried and will not be released to the biosphere. No radiological environmental impact is expected from such disposal.

5.5.3.7 Occupational Dose

The annual occupational dose attributable to all phases of the fuel cycle for the model 1000-MWe LWR is about 200 man-rem. The staff concludes that this occupational dose will not have a significant environmental impact.

5.5.3.8 Transportation

The transportation dose to workers and the public is specified in Table S-3. This dose is small and is not considered significant in comparison to the natural background dose.

5.5.3.9 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), since the data provided in Table S-3 include maximum recycle option impact for each element of the fuel cycle. Thus, the staff's conclusions as to acceptability of the environmental impacts of the fuel cycle are not affected by the specific fuel cycle selected.

5.6 SOCIOECONOMIC IMPACTS

The applicant estimates that less than 20% of the total operating staff of 403, or approximately 68 employees and their families, will relocate to the local area, including the towns of Ottawa, Marseilles, and Streator (ER, Supp. 1, Q340.02). Assuming an average family size of 3.2 persons for the in-migrant workers, about 220 individuals can be expected to relocate to the local area. Overall, the magnitude of the impact will be much smaller during the operation phase than during construction if the permanent operating personnel relocate to the same areas where the influx of in-migrant construction workers occurred.

The impacts, both beneficial and adverse, concomitant with the net increase in population and income (the projected 1979 total payroll: $8.1 million) would affect the local communities but be relatively small. The historical trend in school enrollments and the additional project-related student enrollment projected by the applicant for local schools are shown in Table 5.17. The estimates can only indicate the order of magnitude (not precise values) of student influx given an assumed relocating pattern. Given the trend of declining student enrollment in the last decade in these areas, the overall impact on schools should be negligible.

The applicant's estimates of the 1977 property taxes to be paid on the station consist of 60% personal property tax and 40% real property tax. The 1975 property tax paid by the station operator to various districts is shown in Table 5.18. The property tax projected to be paid by the station for the period 1976 thru 1980 is shown in Table 5.19.

Table 5.17. Enrollment in Local Schools and Projected Influence of Children of LaSalle County Station Permanent Staff

	Enrollment[a]			1979 Projected Impact of Employees' Children	
School	1968/1969	1976/1977	1968/1976 Change	Number of Children Expected[b]	Percentage Increase over 1976/1977
Seneca Elementary	584	554	-5.1%	-	-
Seneca High School	298	327	+9.7%	-	-
Marseilles Unit	1,207	1,029	-14.7%	11	1.1%
Ottawa Elementary	3,346	2,573	-23.1%	18	0.7%
Ottawa Township High School	1,784	1,794	+0.6%	3	0.2%
Grand Ridge	487	442	-9.2%	2	0.5%
Allen Township	121	127	+4.9%	2	1.6%
Streator Elementary	2,995	2,471	-17.5%	14	0.6%
Streator Township High School	1,678	1,717	+2.3%	2	0.1%
Total Region	12,500	11,034	-11.7%[c]	52	0.5%

[a]Information provided by Dr. Joe Mini, LaSalle Co. Superintendent of Schools.

[b]See ER, Suppl. 1, Tables Q340.02-1 and Q340.02-7.

[c]Average decline in enrollment over 1968/1969 thru 1976/1977 = $\frac{(12{,}500 - 11{,}034)\ \text{students}}{8\ \text{years}} = 183\ \frac{\text{students}}{\text{year}}$.

From ER, Supp. 1, Q340.02.

Table 5.18. Percentages of Local Taxes Paid by LaSalle County Station in 1975

Agency	1975 Total Budget[a]	1975 Taxes Paid by Station[b]	Percent of Total Budget Paid by Station in 1975
LaSalle County	$27,790,000	$ 77,300	0.3
Brookfield Township	125,100	85,500	68.3
School District 170	659,720	309,800	47.0
High School District 160	596,500	220,100	36.9
Junior College District 513	3,151,100	49,400	1.6
Marseilles Fire Department	15,000	4,400	29.3
Seneca Fire Department	18,330	5,600	30.6

[a]Obtained from LaSalle County Clerk's Office.

[b]See ER, Supp. 1, Table Q340.02-12.

From ER, Supp. 1, Q340.02.

Table 5.19. Estimated LaSalle County Station Property Taxes, 1976 thru 1980

Agency	1976[a]	1977[a]	1980[b]
LaSalle County	$ 254,200	$ 519,000	$ 875,400
Brookfield Township 29	164,000	213,100	253,900
School District 170	717,000	936,500	1,134,900
High School District 160	625,000	905,500	1,120,000
Junior College District 513	158,400	304,300	532,500
Marseilles Fire Department	13,100	20,600	26,900
Seneca Fire Department	23,400	33,700	40,800

[a]Tax estimate.

[b]Tax estimated on basis of personal property tax being extended (due to expire on 1 January 1979).

From ER, Supp. 1, Q340.02.

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6. ENVIRONMENTAL MONITORING

6.1 RÉSUMÉ

Background surveys on chemical, radiological, meteorological, aquatic, and biological aspects of the site and the adjacent Illinois River were initiated with the start of construction and expanded as part of the effort to prepare for the operating license stage application. These programs, as well as the monitoring programs to be performed during the operation of the station, are described.

6.2 PREOPERATIONAL MONITORING PROGRAMS

6.2.1 Onsite Meteorological Program

The onsite meteorological measurements program consists of an instrumented 121.9-meter (400-ft) tower, located about 204 meters (670 ft) from the 40.8-meter (134-ft) high turbine building and about 274 meters (900 ft) from the 56.4-meter (185-ft) high reactor building. A general guideline for the siting of a meteorological tower is to locate the tower at least ten building heights away from large structures to prevent distortion of meteorological measurements recorded at the tower. At distances less than ten obstruction heights, some influence of the buildings on meteorological measurements can be expected; however, the nature of this influence is dependent on the building shape, building configuration, the parameter being measured, the height of measurement, and the airflow direction. The applicant refers to an "NRC suggestion that the meteorological tower be located five building heights away from the nearest plant structures." However, the NRC is not on record as recommending any particular distance away from major obstructions to airflow for the location of the meteorological tower, because each situation must be evaluated individually.

Because of the height of the station vent stack [112.8 meters (370 ft) above plant grade and 56.4 meters (185 ft) above the top of the reactor building], the principal meteorological measurements at the LaSalle County Station site will be wind speed and wind direction at the 114.3-meter (375-ft) level, and vertical temperature gradient between the 10-meter (33-ft) and the 114.3-meter (375-ft) levels. These measurements are not expected to be significantly influenced by the proximity of the major station structures to the meteorological tower. The lower-level measurements, particularly wind speed and wind direction at the 10-meter (33-ft) level, could be significantly influenced by the major station structures when the wind is from the north quadrant. Because of the influence of plant structures, the applicant has decided to move the wind sensors from the 10-m (33-ft) level to the 61-m (200-ft) level to provide back-up data for the 114.3-m (375-ft) sensors. This change in the meteorological measurement program is acceptable.

Most onsite meteorological measurements were initiated 1 May 1975. Wind speed and wind direction are measured at the 10-meter (33-ft) and 114.3-meter (375-ft) levels; dry bulb and dew point temperatures are measured at the 10-meter (33-ft) level, and dew point temperatures are also measured at the 61-meter (200-ft) level; vertical temperature gradient is measured between the 10-meter and 61-meter levels (since May 1975) and between the 10-meter and 114.3-meter levels (since October 1976). Strip chart records are the primary data recording system, supplemented by magnetic tape recorders. Calibrations have been performed about every two months since the program was initiated.

An error in the measurement of vertical temperature gradient between the 10-meter and 61-meter levels was discovered in March 1976. The applicant determined that all vertical temperature gradient measurements between May 1975 and March 1976 were suspect and should not be used in atmospheric dispersion calculations. The applicant has installed a redundant measurement for vertical temperature gradient, increased the frequency of examining the data for early indications of problems, and increased the availability of replacement parts.

The control room display of meteorological data will include wind speed and direction at the 114.3-meter level and vertical temperature gradient between the 10-meter and 114.3-meter levels.

The applicant shall be required to conduct a monitoring program to measure (1) the frequency, extent, and density of steam fog generated by the cooling lake, and (2) frequency, extent, and environmental impact of icing caused by the cooling lake. The program will include, but not be limited to, visual observations by trained personnel over highways on and near the site, nearby residences, and other sensitive locations. The program shall begin as early as possible after publication of this environmental statement in an effort to obtain one full year of fogging data prior to one-unit operation (if possible), and later to include 12-month period of one unit operation, and at least one 12-month period of data collection of reasonably complete two-unit operation. The frequency of data collection shall be sufficient to determine the daily and annual cycles of steam fog.

The applicant's proposed monitoring program, including methods of observations, locations of monitoring, reporting forms, etc., shall be submitted to the NRC for review and acceptance. The applicant shall submit his observational data in summary form quarterly.

6.2.2 Water Quality Studies

Water quality monitoring was not addressed in the FES-CP. Preoperational monitoring has been conducted by the applicant, however, and is discussed below (ER, Sec. 2.2.1.4).

6.2.2.1 Surface Water

Thermal

Temperatures in the Illinois River near the site were recorded, along with other water quality parameters, on 30 August 1972, 26 October 1972, and 26 January 1973. The temperatures were within the normal range of temperatures measured at Marseilles (see Table 5.2). Because of the availability of temperature data from Marseilles, the staff concludes that long-term preoperational river temperature measurements at the site are not necessary.

Chemical

Data are still being collected by the applicant for the five-year monitoring program initiated in 1974 to evaluate the potential impacts that the construction and operation of the station could have on water quality of the Illinois River and South Kickapoo Creek (ER, Sec. 2.2.1.4). Details of the monitoring program for the Illinois River are described in Table 6.1. Monitoring of South Kickapoo Creek will similarly address the parameters listed in the table (ER, Sec. 6.1.1.1). The staff will require the applicant to submit annual reports of the results of the program for the duration of the five-year schedule.

6.2.2.2 Groundwater

Twenty-nine piezometers have been installed in boreholes at several levels within the glacial drift aquitard, and 20 observation wells have been installed in the vicinity of the cooling lake (ER, p. 2.4-9). Water levels are measured periodically to monitor the response of groundwater levels to precipitation. The staff concludes that the data being collected are sufficient for comparison with results of operational monitoring.

The two wells that were drilled into the Cambrian-Ordovician aquifer during 1972 and 1974 to supply water for construction purposes will also supply station groundwater requirements for the demineralizer, filter, recreation, and potable water supply systems. Chemical analyses were performed on water samples taken from each well (see Table 2.7). The staff concludes that these analyses will provide sufficient data for comparison with results of operational monitoring.

6.2.3 Terrestrial Ecology

Monitoring of terrestrial ecology was not addressed in the FES-CP. Preoperational monitoring has been conducted by the applicant, however.

Pursuant to conditions imposed on the construction permit (FES-CP, p. iii, item 7.d), the applicant has conducted a terrestrial monitoring program at the site. Six representative vegetational communities were selected and sampled at least annually; wildlife survey routes were established and sampled seasonally. The resulting data have provided a reasonable and acceptable means of detecting adverse impacts on biota other than those directly affected by excavation and other earthwork. The staff recommends that these studies be discontinued as scheduled (ER, Sec. 6.1.4.3.2, pp 6-1 to 6.51).

Table 6.1. Illinois River Water Quality Monitoring Programs for the LaSalle County Station during the Baseline (1972 thru 1973) and Preoperational (1974 thru 1978) Periods

Parameter	Period	
	Baseline[a]	Preoperational[b]
Temperature	A, O, J	Monthly
Dissolved oxygen	A, O, J	Monthly
BOD	A, O, J	Monthly
COD	A, O, J	Monthly
pH	A, O, J	Monthly
Hardness	A, O, J	Monthly
Alkalinity	A, O, J	Monthly
Specific conductance	A, O, J	Monthly
Turbidity	A, O, J	Monthly
Total dissolved solids	A, O, J	Monthly
Total suspended solids	A, O, J	Monthly
Total solids	A, O, J	Monthly
Total organic carbon	A, O, J	Monthly
Organic nitrogen	A, O, J	Monthly
Ammonia nitrogen	A, O, J	Monthly
Nitrite nitrogen	A, O, J	Monthly
Nitrate nitrogen	A, O, J	Monthly
Phosphates (ortho- and total)	A, O, J	Monthly
Phenols	A, O, J	Monthly
Oil and grease	A, O, J	Monthly
Cyanide	A, O, J	Monthly
Calcium	A, O, J	Monthly
Magnesium	A, O, J	Monthly
Potassium	A, O, J	Monthly
Sodium	A, O, J	Monthly
Chloride	A, O, J	Monthly
Sulfate	A, O, J	Monthly
Aluminum	O, J	Monthly
Antimony	O, J	Monthly
Arsenic	A, O, J	Monthly
Barium	A, O, J	Monthly
Beryllium	O, J	Monthly
Boron	O, J	Monthly
Cadmium	A, O, J	Monthly
Chromium (hexavalent and total)	A, O, J	Monthly
Cobalt	O, J	Monthly
Copper	A, O, J	Monthly
Iron	A, O, J	Monthly
Lead	A, O, J	Monthly
Manganese	A, O, J	Monthly
Mercury	O, J	Monthly
Molybdenum	A	Monthly
Nickel	O, J	Monthly
Selenium	A, O, J	Monthly
Silver	O, J	Monthly
Strontium	O, J	Monthly
Tin	O, J	Monthly
Zinc	A, O, J	Monthly
Fecal streptococci	A, O, J	Monthly
Fecal coliforms	A, O, J	Monthly
Total coliforms	A, O, J	Monthly

[a]A-August 1972 at surface locations upstream (A) and downstream (B) of the discharge-intake area; O-October 1972 at surface and 3-meter depth at location 8; and J-January 1973 at surface and 3-meter depth at location 8 (see Fig. 2.7 for locations).

[b]At surface locations upstream (1, 2, 8) and downstream (3, 4) of the discharge-intake area (see Fig. 2.7 for locations).

From ER, Sections 6.1 and 6.2.

6.2.4 Aquatic Ecology

No sampling program was described in the LaSalle County Station FES-CP; however, the applicant has been sampling water quality parameters and bacteria levels on a monthly basis at five Illinois River locations (one upstream and four downstream of the discharge-intake area) and at three South Kickapoo Creek locations since 1972 and will continue to do so through 1978. During this same sampling period, phytoplankton, periphyton, zooplankton, macroinvertebrates, fish, and sediments are being sampled quarterly from Illinois River locations upstream and downstream of the discharge-intake area and from two locations in South Kickapoo Creek (macroinvertebrates, fish, and sediments only). More specific details of the baseline and preoperational monitoring programs are given in Tables 6.1 and 6.2. The staff believes that this sampling program, over a five-year period, will provide sufficient data to characterize preoperational conditions for these two water bodies.

Table 6.2. Illinois River Aquatic Biota and Sediments Monitoring Programs for the LaSalle County Station during the Baseline (1972 thru 1973) and Preoperational Periods (1974 thru 1978)

Parameter	Period			
	Baseline		Preoperational	
	Frequency[a]	Locations[b]	Frequency	Locations[c]
Phytoplankton	A, O, J	A, B, 8	Quarterly	1, 3, 4
Zooplankton	O, J	8	Quarterly	1, 3, 4
Fish	A, O, J	A, B	Quarterly	1, 2, 5
Periphyton	A, J	A, B, 1, 7	Quarterly	1 thru 4
Benthic macroinvertebrates	A, O, J	A, B 1 thru 12	Quarterly	1 thru 5
Sediments	O, J	1 thru 12	Quarterly	1 thru 5

[a]A-August 1972; O-October 1972; and J-January 1973.

[b]Location A is upstream and B is downstream of the discharge-intake area, while locations 1 thru 9 are upstream and 10 thru 12 are downstream. With the exception of fish, locations A and B were only sampled in August 1972 (see Fig. 2.7).

[c]Location 1 is upstream and 2 thru 5 are downstream of the discharge-intake area (see Fig. 2.7).

From the ER, Sections 6.1 and 6.2.

6.2.5 Radiological Monitoring

Radiological environmental monitoring programs are established to provide data on measurable levels of radiation and radioactive materials in the site environs. Appendix I to 10 CFR Part 50 requires that the relationship between quantities of radioactive material released in effluents during normal operation be evaluated, including anticipated operational occurrences and resultant radioactive doses to individuals from principal pathways of exposure. Monitoring programs are conducted to verify the in-station controls used for controlling the release of radioactive materials and to provide public reassurance that undetected radioactivity will not build up in the environment. Surveillance is established to identify changes in the use of unrestricted areas to provide a basis for modifications of the monitoring programs.

The preoperational phase of the monitoring program provides for the measurement of background levels and their variations along the anticipated important pathways in the area surrounding the station, the training of personnel, and the evaluation of procedures, equipment, and techniques.

This is discussed in greater detail in NRC Regulatory Guide 4.1, Rev. 1, "Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants," and the Radiological Assessment Branch technical position, August 1977, "Standard Technical Specification for Radiological Environmental Monitoring Program."

The preoperational radiological environmental monitoring program proposed by the applicant is summarized in Table 6.3 and described in more detail in the proposed Appendix B of the applicant's Environmental Technical Specifications (ER, Supp. 2).

Table 6.3. Sample Collection and Analysis, LaSalle County Station - Radiological Monitoring Program

Sample Medium	Type and Frequency of Analysis[a,b]	Collection Sites	Frequency of Collection
1. Airborne			
a. Particulate filter	Gross beta - W Sr-89, 90 - Q. comp. Gamma spec. - Q. comp.	Seneca, Marseilles, Ottawa, Grand Ridge, Streator, Ransom, Route 6 at Gonnam Road, Kernan, and six stations near the site (total of 14 sites)	Weekly
b. Charcoal cartridge	I-131	Same as for 1a	Every 2 weeks beginning 3 months before fuel loading
2. Gamma radiation	TLD	Same as for 1a	Quarterly
3. Surface water	Sr-89, 90 - Q. comp. Gamma Spec. - Q. comp. Gross beta - W Tritium - Q. comp.	Illinois River at intake of Illinois Nitrogen Corp. Illinois River at Marseilles Illinois River at Ottawa Illinois River at Seneca South Kickapoo Creek Cooling lake near recreation area	Weekly
4. Intake discharge pipes	Gross beta - W Sr-89, 90 - M. comp. Tritium - M. comp. Gamma Spec. - M. comp.	I/D pipes if pumping; if not pumping, collect in Illinois River near I/D structures	Weekly
5. Precipitation	Gamma Spec. - Q. comp. Sr-89, 90 - Q. comp. Gross beta - M Tritium - Q. Comp.	Dairies shown on Figure 6.1-8 of ER[c]	Monthly
6. Well water: offsite	Gamma Spec. Sr-89, 90 Gross beta Tritium	Marseilles, Seneca, Ottawa Ransom, Ill. St. Park	Quarterly
7. Well water: onsite	Gamma Spec. - Q comp. Sr-89, 90 - Q. comp. Gross beta - M Tritium - Q. comp.	One onsite well (the one chosen for providing drinking water)	Monthly
8. Vegetables	Gross beta Sr-89, 90 Gamma Spec.	Farms within 10 miles	As available at harvest time
9. Cattle feed and grass	Gross beta Sr-89, 90 Gamma Spec.	Dairies shown on Figure 6.1-B of ER	Quarterly Grass: Summer Feed: Winter
10. Milk	Gamma Spec. Sr-89, 90 - M I-131 (pasture season)	Dairies shown on Figures 6.1-8 of ER	Preoperational phase: monthly all year Operational phase: Monthly. October to March, Weekly, April to September
11. Sediment, aquatic plants	Gross beta Gamma Spec	Just upstream of cooling lake inlet structure Just downstream of cooling lake discharge structure Cooling lake near recreational area	Three times a year if available
12. Fish	Gross beta Gamma Spec. Sr-89, 90	Marseilles pool of Illinois River Cooling Lake	Three times a year

[a]If frequency of analysis is not given, it is the same as frequency of collection.

[b]W - Weekly; M - Monthly; Q - Quarterly; Comp - composite.

[c]ER - Applicant's environmental report.

The staff concludes that the preoperational monitoring program proposed by the applicant for the LaSalle County Station is generally acceptable. As a result of comments on the DES, the LLDs were modified (See Appendix A, comment I-40).

6.2.6 Lake Management Program

Condition E3 of the construction permits[1] requires that the applicant obtain staff approval of a management program which assures that the cooling lake does not become a public nuisance or health hazard. This condition was to be satisfied prior to the start of lake filling.

The applicant transmitted a proposed lake management program to the staff on 27 April 1976. The program emphasized the monitoring of microorganisms (e.g., total coliforms) to indicate if the waters would pose a health hazard. This part of the program was developed in concert with the State of Illinois Department of Public Health and consisted of monitoring details (i.e., location, frequency, technique) and action levels based upon water use. Determinations regarding public nuisance (i.e., water discoloration and odors) would be made using water quality data obtained from other routine monitoring programs. The water quality data include physical and chemical parameters such as temperature, turbidity, dissolved oxygen, biochemical oxygen demand (BOD), oil and grease, and biological parameters such as phytoplankton, zooplankton, and periphyton type and concentration. The preoperational and operational water quality monitoring programs for the LaSalle County Station are discussed in detail in Sections 6.2.2 and 6.3.2 of this statement, and the preoperational and operational aquatic ecological monitoring programs are discussed in detail in Sections 6.2.4 and 6.3.6.

The staff reviewed the proposed lake management program and formally submitted comments by letter to the applicant on 13 December 1976 (ER, pp. 5.1B-10 thru 14). This letter gave staff approval of the monitoring program once the staff comments were incorporated. This was done by the applicant and the final approved program is included in the ER as Appendix 5.1B, "Lake Management Plan and Correspondence."

Since the preoperational and operational monitoring program will monitor water quality (as determined by physical and chemical parameters) and aquatic biology (as determined in part by plankton studies), the lake management monitoring program only requires the additional monitoring for bacteria. In general, the program includes the monitoring of total and fecal coliforms as well as fecal streptococci. The staff reviewed the alternative of monitoring specific pathogens and viruses and concluded that these other microorganisms should not be included in the monitoring program.[2] This conclusion was based on the difficulty of culturing and identifying the organisms, the lack of standardized techniques, the inability to relate specific organism concentrations to a potential health hazard, and the fact that state and local health agencies themselves have not set health limits based on water use for these nonstandard indicators. Furthermore, the Illinois Department of Public Health has stated in a letter to the applicant that they would not recommend monitoring for specific pathogens but recommended that the applicant monitor for coliforms and fecal coliforms as indicators of bacteriological water quality.[3]

Accordingly, it is the current conclusion of the staff and the Illinois Department of Public Health that coliforms be monitored as an indicator of potential hazards of the lake to public health. At the construction permit hearing, however, the staff had suggested that other microorganisms be monitored along with the coliforms. Of primary concern to the staff at that time were the naegleria amoeba and schistosome parasites (pp. 1213 and 1214 of Ref. 4). Since there were no health standards for these pathogens at that time, the staff concluded at the hearing that "...there must be at least one agency, either state or Federal, that does have that responsibility [to look after public health], and it might as well be left to them to set the standards" (p. 1236 of Ref. 4). In light of the present water quality health standards, which do not include limits for these pathogens, and in light of the Illinois Department of Public Health comments referenced earlier in this section, the staff will not independently require that the applicant monitor for naegleria or schistosomes.

The applicant will collect samples and analyze them for fecal and total coliforms and for fecal streptococci a minimum of five times per month (with a minimum sampling interval of three days), beginning after the lake is filled to its anticipated operating level and pumping of water through plant system begins, and ending one year after the second unit is declared operational. Samples will be collected at four locations: at the river basin screen house (control), at the station discharge structure into the cooling lake, at the terminus of the southern interior dike (Dike 3), and at the station intake screen house (see Fig. 1, page 5.1B-7 of the ER).

The monitoring of the cooling lake will continue after the initial monitoring period, and the lake will be opened to the public as long as no health hazard exists. A health hazard will be declared when applicable bacteriological standards[5] are exceeded, and the frequency of sampling will be increased (as recommended by the Illinois Department of Public Health) at this time. If a health hazard is declared, public access to the lake will not be allowed until the concentration of fecal coliforms falls below the recommended 30-day maximum of a geometric mean of 200 per 100 mL or if more than 10% of the samples during any 30-day period exceed 400 per 100 mL based on a minimum of five samples (ER, p. 5.1B-21).

The potential for the cooling lake becoming a public nuisance will be reviewed by the staff through qualitative analysis of the applicant's water quality and lake aquatic ecology data. The primary emphasis will be to review plankton, nutrient, and dissolved oxygen concentrations, which will be used to indicate the presence of an algal bloom or anaerobic conditions. These conditions, when extreme, can cause nuisance odors and water discoloration. The potential for algal blooms is discussed in Section 5.4.2 of this statement.

The recreational use of the cooling lake was considered at the construction permit stage. Originally, potential recreational uses could have included primary water contact sports such as swimming and water skiing, and secondary water contact sports such as fishing, boating, and near-shore picnicking. However, as a result of reducing the lake's size to approximately half of that originally planned, the recreational potential was consequently reduced. Once the cooling lake is filled and in operation, the actual level of recreational use (i.e., primary or secondary water contact) would be determined by the state's public health standards; the better the water quality, the higher the allowable level of water contact.

The applicant has indicated that he plans to wait until the end of the first year of operation of Unit 2 before proposing to the staff that the lake be open to the public for secondary water sports (specifically, boating, fishing, and picnicking).[6] The applicant has not, however, included swimming as a possible recreational use and maintains that it is "...expressly excluded from our commitment to provide a recreation area and the lake will be posted to prohibit swimming."[6] However, this is contrary to the decision of the Atomic Safety and Licensing Appeal Board, which instructed the staff "...to insure that no possible recreational use (including boating and swimming) is laid to rest unless there has been a compelling demonstration that any public health risks are unavoidable."[7] Thus, the staff requires that after the first year of operation of Unit 2, the applicant should submit to the staff for review and approval a recreational use plan for the LaSalle County Station cooling lake. This plan should reflect the water quality as determined by data from the monitoring programs discussed in this section. As warranted by the bacterial data, the recreational use plan should include provisions for primary water contact sports (e.g., swimming) and secondary water contact sports (e.g., boating and fishing),or non-water contact activities. The plan should also include action levels based upon bacterial data for the limiting or cessation of activities, as well as for their resumption. This plan must be approved by the staff prior to any public use of the cooling lake.

6.3 OPERATIONAL MONITORING PROGRAMS

6.3.1 Onsite Meteorological Program

The meteorological measurements program during plant operation is expected to be very similar to the preoperational program, although staff review of the operational program will not be complete until after the issuance of the SER and technical specifications.

The preoperational monitoring program to measure the frequency, extent, and density of steam fog generated by the cooling lake and the frequency, extent, and environmental impact of icing caused by the cooling lake shall be continued to include a 12-month period of one-unit operation and at least one 12-month period of two-unit operation. Records of these observations shall be maintained by the applicant so that NRC inspectors, in consultation with local traffic authorities, may determine whether the hazards require mitigating measures such as those suggested in Section 5.4.1.2.

6.3.2 Water Quality Studies

6.3.2.1 Thermal

The applicant intends to conduct thermal plume measurements in the Illinois River at three-month intervals for a total of four studies to determine the extent of the 2.8°C (5°F) excess isotherm. The program will be instituted after Unit 1 becomes commercially operational and will be repeated when both Units 1 and 2 are in commercial operation (ER, p. 6.2-4).

The staff believes that hydrothermal monitoring not only must demonstrate compliance with state water quality standards, but also must ultimately support the biological studies.[8] For this reason, thermal plume studies should be conducted in conjunction with the biological studies. In addition to seasonal studies, the effects of different operating conditions (e.g., power levels, blowdown rates) and environmental conditions (e.g., low river flows, extreme river temperatures) should be investigated. It is under these conditions that violations of water quality standards or ecological damage would be most likely to occur.

It is essential that the monitoring program provide measurements of outlet temperature, discharge flow rate (discharge velocity), discharge channel width and depth, and plant operating conditions. Also, ambient temperatures and velocities must be measured. Under some circumstances !ambient temperature above 29.4¼C (85¼F)1, the extent of smaller excess temperature isotherms must be measured to assure compliance with state standards.

6.3.2.2 Chemical

For the operational monitoring program, the applicant plans to take water samples upstream of the river screenhouse, in the outfall from the blowdown structure, and downstream of the blowdown (ER, p. 6.2-4). Samples will be taken monthly at a distance approximately ten meters (33 ft) from the south shoreline of the Illinois River. Table 6.4 shows the water quality parameters to be measured during the operational program.

Effluent limitations and monitoring requirements for the LaSalle County Station have been established by the Illinois Environmental Protection Agency in NPDES Permit 0048151 (see Appendix D). In order for the applicant's monitoring program to meet the NPDES permit monitoring requirements, the staff requires that the applicant incorporate the following changes in the chemical effluents monitoring program:

To be sampled weekly (as required by the NPDES Permit) rather than on the monthly basis proposed in the ER:

(a) Cooling pond blowdown - Total dissolved solids and total suspended solids

(b) Low volume waste - Total suspended solids, total copper, total iron.

6.3.3 Groundwater Studies

Twenty observation wells around the cooling lake are presently being monitored to determine natural variation in the water table levels in the glacial drift aquitard (see Sec. 2.3.3). This program should be continued during the filling of the lake and for at least two years thereafter. These measurements should provide information on seepage from the cooling pond. The staff believes that if the seepage is not detectable by anomalous changes in groundwater level, then the studies need not be continued.

6.3.4 Terrestrial Ecology

Successful establishment of vegetation on the cooling lake dike is necessary to prevent erosion and rapid runoff of precipitation from affecting farmland adjacent to the station. Therefore, the applicant is required to institute the following monitoring program and take the necessary corrective action as indicated (note: in the following requirements, reference to the dike includes the perimeter ditch surrounding the exterior of the dike as well as the dike itself):

1. The applicant shall routinely (at least semiannually) monitor the initial vegetation on the entire dike by quantitative methods (such as those described in App. G) to estimate cover. This shall be done until the vegetation is established, but not for less than three years commencing with the spring 1978 growing season.

2. The applicant shall monitor the entire dike by visual inspection for vegetative integrity at the beginning of the fall planting season (August) and at the beginning of the spring planting season (May). This requirement shall continue for the life of the station.

3. If a failure of the vegetative cover of the dike is detected, the affected area shall be revegetated in a timely manner (i.e., at the beginning of the next planting season, spring or fall).

Table 6.4. Water Quality Monitoring Parameters

Bacteria
Fecal streptococci
Total coliforms
Fecal coliforms
Water Chemistry Parameters
Temperature
pH
Dissolved oxygen (DO) and percent saturation
Total dissolved solids (TDS)
Total suspended solids (TSS)
Total solids (TS)
Specific conductance
Langlier saturation index
Ryznar stability index
Ammonia nitrogen (NH_3-N)
Nitrate nitrogen (NO_3-N)
Nitrite nitrogen (NO_2-N)
Oil and grease
Total hardness
Total alkalinity
Chlorides (Cl^-)
Potassium (K)
Biochemical oxygen demand (BOD)
Residual chlorine (Cl_2)
Chemical oxygen demand (COD)
Magnesium (Mg)
Sodium (Na)
Ortho-phosphates (O - PO_4)
Total-phosphates (T - PO_4)
Sulphates ($SO_4^{=}$)
Calcium (Ca)
Iron (Fe) - total
Iron (Fe) - dissolved
Copper (Cu)

From ER, Table 6.2-2.

4. Since the banks of Armstrong Run will continue to erode until the existing erosion in the Run is repaired, the applicant shall regrade where necessary and revegetate those portions of Armstrong Run where bank erosion now appears. The grading shall be timed to match the next planting season (May 1979) so that immediate reseeding of the sloped sides is possible. The reseeding shall use suitable sod-forming grass species and include the use of netting, mulch, and a soil binder.

5. The revegetation in Armstrong Run shall be monitored routinely (at least semi-annually) to ensure its success, and repair work taken promptly if any failure of reseeding is detected. The monitoring of the revegetation in Armstrong Run should continue until the vegetation on both the dike and the Run is successfully established and documented by Commonwealth Edison Company. Successful establishment of the vegetation will be determined through NRC staff review of the Commonwealth Edison Company documentation.

6.3.5 Aquatic Ecology

6.3.5.1 Applicant's Monitoring

The applicant plans to monitor bacteriological levels in the cooling lake to determine if these will be a public health hazard to people if the lake is used for recreational purposes (ER, Appendix 5.1B, pp. 5.1B-1 through 5.1B-21). Also, the applicant plans to monitor aquatic biota in the Illinois River and conduct entrainment and impingement studies. Entrainment and impingement studies will be conducted during operation of the station. Entrainment studies for fish eggs and larvae will be conducted weekly from April through August and impingement will be monitored for two 24-hour periods each week throughout the year (ER, Sec. 6.2.1). Monitoring of aquatic biota in the Illinois River will be done concurrently with thermal plume studies so as to better document any impacts of the plume. The staff requires that the frequency of entrainment monitoring for fish eggs and larvae be increased from weekly to every three days to better document entrainment effects. Aside from this change, the staff finds the applicant's monitoring plans to be satisfactory.

6.3.5.2 Related Environmental Measurement and Monitoring Programs

Illinois Department of Conservation Electroshocking Program

The Illinois Department of Conservation (DOC) samples a network of locations on the Illinois River every year. Their electroshocking program is intended to document annual changes in the fish populations of the river. Two DOC sampling locations are near the LaSalle County Station.

Illinois Natural History Electroshocking Program

The Illinois Natural History Survey (INHS) electroshocks areas in the Illinois River that are located near to the DOC's sample network. The INHS samples three locations in the Marseilles Pool. Analyses of fish species distributions in the Marseilles Pool from work done by the INHS are presented in a report by Sparks and Starett.[9] These analyses support the applicant's fish distribution data, which are summarized in Section 2.5.2.

6.3.6 Radiological Monitoring

The operational offsite radiological monitoring program is conducted to measure radiation levels in the station environs. It assists and provides backup support to the detailed effluent monitoring (as recommended in NRC Regulatory Guide 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water Cooled Nuclear Power Plants"), which is needed to evaluate individual and population exposures and verify projected or anticipated radioactivity concentrations.

The applicant plans essentially to continue the proposed preoperational program during the operating period (see Table 6.3). However, the sampling frequency for charcoal air sample cartridges will be weekly instead of biweekly, and composite surface water samples from the Illinois River will be collected at the nearest downstream indicator station instead of grab samples for the operational program. Other refinements may be made in the program to reflect changes in land use or preoperational monitoring experience.

References for Section 6

1. Construction Permits CPPR-99 and CPPR-100, Commonwealth Edison Company, U. S. Nuclear Regulatory Commission, Docket Nos. 50-373 and 50-374, LaSalle County Nuclear Power Station, Unit Nos. 1 and 2.

2. Memo from Jeremiah D. Jackson to files, July 16, 1976, U. S. Nuclear Regulatory Commission, Docket Nos. 50-373 and 50-374.

3. Letter from Verdun Randolph, Associate Director, Illinois Department of Public Health, to A. O. Courtney, Commonwealth Edison Company, 15 April 1976.

4. LaSalle County Nuclear Power Station, Units 1 and 2, Construction Permit Hearing Testimony, pages 1213 and 1214, 19 July 1973.

5. "General Standards," Section 203, Part II of the Water Quality Standards of the Illinois Pollution Control Board Rules and Regulations, Chapter 3.

6. Letter from R. L. Bolger, Assistant Vice President, Commonwealth Edison Company, to Mr. Youngblood, Chief Environmental Projects Branch 2, U. S. Nuclear Regulatory commission, 4 June 1976.

7. Commonwealth Edison Company (LaSalle County Nuclear Station Units 1 and 2), 7AEC423 at 430, 15 April 1974.

8. I. P. Murarka, A. J. Policastro, J. G. Ferrante, E. W. Daniels, and G. J. Marmer, "An Evaluation of Environmental Data Relating to Selected Nuclear Power Plant Sites. A Synthesis and Summary with Recommendations," Argonne National Laboratory, ANL/EIS-8, November 1976.

9. R. E. Sparks and W. C. Starrett, "An Electrofishing Survey of the Illinois River, 1959-1974," Ill. Nat. Hist. Surv. Bull. 31, Art. 8: 317-380, 1975.

7. ACCIDENT ANALYSIS

7.1 RESUME

The ER has been reviewed with respect to the environmental effects of plant accidents. The results of this review are that the conclusions about environmental risks due to accidents vary in a minor degree with those previously presented at the FES-CP stage. Section 7.2 has been updated to reflect the most recent population projections for the year 2020. Section 7.3 has been updated to reflect the results of the Commission's transportation rulemaking decision "Environmental Effects of Transportation of Radioactive Materials to and from Nuclear Power Plants," promulgated as 10 CFR Section 51.20(g).

7.2 ENVIRONMENTAL IMPACT OF POSTULATED ACCIDENTS

A high degree of protection against the occurrence of postulated accidents in the LaSalle County Station is provided through correct design, manufacture, and operation, and the quality assurance program used to establish the necessary high integrity of the reactor system, which will be considered in the safety evaluation report. System transients that may occur are handled by protective systems to place and hold the plant in a safe condition. Notwithstanding this, the conservative postulate is made that serious accidents might occur, even though they may be extremely unlikely, and engineered safety features will be installed to mitigate the consequences of those postulated events which are judged credible.

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

The Commission issued guidance to applicants on September 1, 1971, requiring the consideration of a spectrum of accidents with assumptions as realistic as the state of knowledge permits. The applicant's response was contained in the environmental report.

The applicant's report has been evaluated, using the standard accident assumptions and guidance issued as a proposed amendment to Appendix D of 10 CFR Part 50 by the Commission on December 1, 1971. Nine classes of postulated accidents and occurrences ranging in severity from trivial to very serious were identified by the Commission. In general, accidents in the high potential consequence end of the spectrum have a low occurrence rate and those on the low potential consequence end have a higher occurrence rate. The examples selected by the applicant for these cases are shown in Table 7.1. These examples are reasonably homogeneous in terms of probability within each class.

The staff's estimates of the dose which might be received by an assumed individual standing at the site boundary in the downwind direction, using the assumptions in the proposed Annex to Appendix D, are presented in Table 7.2. Estimates of the integrated exposure that might be delivered to the population within 80 km (50 miles) of the site are also presented in Table 7.2. The man-rem estimate was based on the projected population within 80 km (50 miles) of the site for the year 2000.

To rigorously establish a realistic annual risk, the calculated doses in Table 7.2 would have to be multiplied by estimated probabilities. The events in Classes 1 and 2 represent occurrences which are anticipated during station operations, and their consequences, which are very small, are considered within the framework of routine effluents from the station. Except for a limited amount of fuel failures, the events in Classes 3 through 5 are not anticipated during station operation, but events of this type could occur sometime during a 40-year station lifetime. Accidents in Classes 6 and 7 and small accidents in Class 8 are of similar or lower probability than accidents in Classes 3 through 5 but are still possible.

Table 7.1. Classification of Postulated Accidents and Occurrences

Class	NRC Description	Applicant's Examples
1	Trivial incidents	Included under routine releases
2	Small releases outside containment	Included under routine releases
3	Radioactive waste systems failure	Equipment leakage or malfunction, release of waste gas storage tank inventory, release of liquid waste storage tank inventory
4	Fission products to primary system (BWR)	Fuel cladding defects and fuel failures induced by off-design transients
5	Fission products to primary and secondary systems (PWR)	Not applicable
6	Refueling accident	Fuel bundle drop, heavy object drop onto fuel
7	Spent fuel handling accident	Fuel assembly drop on fuel storage pool and spent fuel shipping cask drop
8	Accident initiation events considered in design-basis evaluation in the safety analysis report	Loss of coolant accident, rod drop accident, steamline break, instrument line break
9	Hypothetical sequence of failures more severe than Class 8	Not considered

The probability of occurrence of large Class 8 accidents is very small. Therefore, when the consequences indicated in Table 7.2 are weighted by probabilities, the environmental risk is very low.

The postulated occurrences in Class 9 involve sequences of successive failures more severe than those required to be considered in the design bases of protection systems and engineered safety features. Their consequences could be severe. However, the probability of their occurrence is judged so small that their environmental risk is extremely low. Defense in depth (multiple physical barriers), quality assurance for design, manufacture and operation, continued surveillance and testing, and conservative design are all applied to provide and maintain a high degree of assurance that potential accidents in this class are, and will remain, sufficiently small in probability that the environmental risk is extremely low.

The NRC has performed a study to assess more quantitatively these risks. The initial results of these efforts were made available for comment in draft form on August 20, 1974,[1] and released in final form on October 30, 1975.[2] This study, called the Reactor Safety Study, is an effort to develop realistic data on the probabilities and consequences of accidents in water-cooled power reactors in order to improve the quantification of available knowledge related to nuclear reactor accident probabilities. The Commission organized a special group of about 50 specialists under the direction of Professor Norman Rasmussen of MIT to conduct the study. The scope of the study has been discussed with EPA and described in correspondence with EPA which has been placed in the NRC Public Document Room (letter, Doub to Dominick, dated June 5, 1973).

As with all new information developed which might have an effect on the health and safety of the public, the results of these studies will be assessed within the regulatory process on generic or specific bases as may be warranted.

Table 7.2 indicates that the realistically estimated radiological consequences of the postulated accidents would result in exposures of an assumed individual at the site boundary that are less than those which would result from a year's exposure to the maximum permissible concentrations

Table 7.2. Summary of Radiological Consequences of Postulated Accidents[a]

Class	Event	Estimated Fraction of 10 CFR Part 20 Limit at Site Boundary[b]	Estimated Dose to Population in 80-km Radius, man-rem
1.0	Trival incidents	c/	c/
2.0	Small releases outside containment	c/	c/
3.0	Radwaste system failures		
3.1	Equipment leakage or malfunction	0.07	0.98
3.2	Release of waste gas storage tank inventory	0.28	3.88
3.3	Release of liquid waste storage tank inventory	<0.001	0.013
4.0	Fission products to primary system (BWR)		
4.1	Fuel cladding defects	c/	c/
4.2	Off-design transients that induce fuel failures above those expected	0.01	0.38
5.0	Fission products to primary and secondary systems (PWR)	N/A	N/A
6.0	Refueling accidents		
6.1	Fuel bundle drop	0.0015	0.02
6.2	Heavy object drop onto fuel in core	0.012	0.17
7.0	Spent fuel handling accident		
7.1	Fuel assembly drop in fuel rack	0.003	0.05
7.2	Heavy object drop onto fuel rack	N/A	N/A
7.3	Fuel cask drop	0.16	2.25
8.0	Accident initiation events considered in design basis evaluation in the SAR		
8.1	Loss-of-coolant accidents		
	Small break	<0.001	0.006
	Large break	0.01	10.4
8.1(a)	Break in instrument line from primary system that penetrates the containment	<0.001	0.003
8.2(a)	Rod ejection accident (PWR)	N/A	N/A
8.2(b)	Rod drop accident (BWR)	0.014	0.49
8.3(a)	Steamline breaks (PWR's outside containment)	N/A	N/A
8.3(b)	Steamline break (BWR)		
	Small break	0.009	0.13
	Large break	0.05	0.65

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

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

[c]These radionuclide releases are considered in developing the gaseous and liquid source terms presented in Section 3 and are included in the doses in Section 5.

(MPC) of 10 CFR Part 20. The table also shows the estimated integrated exposure of the population within 80 km (50 miles) of the station from each postulated accident. Any of these integrated exposures would be much smaller than that from naturally occurring radioactivity. When considered with the probability of occurrence, the annual potential radiation exposure of the population from the postulated accidents is an even smaller fraction of the exposure from natural background radiation and, in fact, is well within naturally occurring variations in the natural background. It is concluded from the results of the realistic analysis that the environmental risks due to postulated radiological accidents are exceedingly small and need not be considered further.

7.3 TRANSPORTATION ACCIDENTS

The transportation of cold fuel to the station, of irradiated fuel from the reactor to a fuel reprocessing plant, and of solid radioactive wastes from the reactor to burial grounds is within the scope of the Commission's rulemaking decision, "Environmental Effects of Transportation of Radioactive Materials to and from Nuclear Power Plants," promulgated as 10 CFR Part 51.20(g). The environmental risks of accidents in transportation are summarized in Table 7.3.

Table 7.3. Environmental Risks of Accidents in Transport of Fuel and Waste to and from a Typical Light-Water-Cooled Nuclear Power Reactor[a]

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

[a]Data supporting this table are given in the Commission's "Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants," WASH-1238, December 1972 and Supp. I, NUREG 75/038, April 1975.

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

References for Section 7

1. "Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants" (Draft), WASH-1400, August 1974.

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

8. NEED FOR PLANT

8.1 RÉSUMÉ

The need-for-plant analysis has been revised to reflect the changing energy situation since the Arab oil embargo of late 1973. Units 1 and 2 at the LaSalle County Station are now estimated to begin commercial operation in December 1979 and December 1980, respectively, about two years later than schedule dates reported in the FES-CP (December 1977 and September 1978). The Commonwealth Edison forecast of peak load has been revised downward in light of recent changes in the economic and energy situations.

8.2 APPLICANT'S SERVICE AREA AND REGIONAL RELATIONSHIPS

There have been no changes in the applicant's service area, interconnections with other utilities, and participation in MAIN Reliability Council since the writing of the FES-CP.

8.3 BENEFITS OF OPERATING THE PLANT

Benefits are examined from the viewpoint of the demand for baseload electricity and the relative economic and environmental consequences from plant operation compared to other ways to generate electricity. The economic consequences of the operation of LaSalle County Station are discussed in Section 8.3.1. The relative health consequences of the operation of the station are compared to alternative energy sources in Section 8.3.2. The need for the power generated by the station and reserve margin criterion are discussed in Section 8.3.3.

8.3.1 Minimization of Production Costs

The LaSalle County Station has been constructed to provide an economic source of baseload energy for 1980 and following years. Substantial capital as well as environmental costs associated with authorization to complete construction are considered sunk costs and are not relevant to the question of whether the plant should operate. The relevant economic decision variables are fuel costs and operation and maintenance (O&M) costs, because these expenses can be avoided by choosing not to operate the LaSalle County Station units. The decision criterion in this section is to operate the units if system production expenses are reduced by doing so.

The staff has determined that if the LaSalle County Station came on line in 1980, its production costs would be lower than the mix of alternative sources of incremental power available to the applicant. Clearly, if the LaSalle County Station is delayed or postponed, the applicant must use alternative sources to make up power that would have been forthcoming from the LaSalle County Station units. Since all alternative power sources available to Commonwealth Edison will be more costly, the utility will incur incremental costs. The cost differential between producing the energy with the LaSalle County Station versus the alternative constitutes the increased production costs on the system.

The selection of an alternative power source is not something one can readily predict. Logically, the utility will utilize the least expensive alternative available. However, what is available will depend on the demands existing on the applicant's system in 1980 and subsequent years. Seasonal patterns, as well as diurnal patterns of demand, will affect this choice. Also, flexibility in the applicant's planned outages and maintenance checks and the expected length of the delay (if any) may alter the final selection. Depending on these factors, replacement power may be supplied by some combination of base, intermediate, and peaking units on the system, or through outside purchases, or the creation of additional capacity.

8.3.1.1 Applicant's Estimate of Replacement Power Cost

The applicant, in response to questions posed by the staff on the issue of replacement power, has submitted information on LaSalle County Station production costs and the sources and associated production costs of makeup power for the year 1980.

The applicant expects the total operating cost of the LaSalle County Station units to be 6 mills per kilowatt-hour (mills/kWh) for fuel and 2 mills/kWh for operation and maintenance (ER, Supp. 1, Table Q340.01-4). Among the possible replacement energies, the applicant quotes energy costs as shown in Table 8.1. The staff assumes that nuclear replacement energy would cost the same as the operation of the LaSalle County Station units. The applicant's estimated weighted average cost of these fuels when used to replace the LaSalle County Station units not in service is 19.9 mills/kWh. As noted in Table 8.1, about 46% of the fuel is expected to be low-sulfur coal and 31.5% is oil cycling fuels. By operating LaSalle County Station and not using the replacement energy, the applicant expects to save about $106,000,000 per year of delay.

Table 8.1. Applicant's Estimates of 1980 Replacement Energy Costs (mills/kWh)

	High-Sulfur Coal	Low-Sulfur Coal	Oil Cycling	Oil Peaking	Nuclear	Purchased Energy
Fuel cost	8.0	15.0	22.0	40.0	6.0	
Operating and maintenance cost	0.33	0.75	0.66	1.25	2.0	
Total operating cost	8.33	15.75	22.66	41.25	8.0	44
Proportion of replacement energy generated (percent)	10	46	31.5	8	2	2.5

From ER, Supp. 1, Table Q340.01-4.

8.3.1.2 Staff Analysis of Energy Production Costs

The staff analysis in the following paragraphs is not a specific examination of the applicant's system, but is performed to assess the reasonableness of the applicant's view that operation of the LaSalle County Station is economically prudent.

For the sole purpose of this analysis, the staff conservatively assumes that only a temporary delay in operation of the station is hypothetically contemplated, and load growth on the applicant's system will not require the construction of additional capacity. Consequently, the replacement power cost estimates developed herein are modest because they assume that if LaSalle County Station is not operational, the applicant will be able to make up the energy deficiency internally through the utilization of existing capacity. It is further assumed that coal-fired units will be available to make up the energy differences. These assumptions produce cost penalties towards the low end of the possible spectrum; in reality it would be more likely to expect a portion of the makeup power to be made available from oil-fired units or purchased power, each with considerably higher incremental cost.

For this assessment, coal and nuclear fuel and operation and maintenance costs were escalated at 5% per year. Before escalating nuclear fuel costs, certain upward adjustments were made to current costs. In the case of uranium, the base price was adjusted upward from current production costs to reflect the continual depletion of higher-grade ores and the need to open new mining areas. The staff looked at future delivery prices for the nuclear fuel cycle, adjusted costs accordingly, and then assumed an escalation rate the same as general inflation after 1980. Coal fuel costs were likewise escalated at 5% per year to 1980, although the labor component to the coal fuel cycle is greater than nuclear.

8.3.1.3 Operation and Maintenance Costs

The staff performed two independent analyses of the operation and maintenance (O&M) costs associated with coal and nuclear facilities: an independent engineering analysis, "Operating and Maintenance Costs for Large Steam-Electric Power Plants" (OMCST), developed at Oak Ridge National Laboratory;[1] and an economic determination of the 1976 production costs actually incurred and reported by the applicant to the Federal Power Commission (Form 12, Schedule 434). This staff comparison of 1980 coal versus nuclear operating costs is presented in Table 8.2 for both methods. Historical O&M costs should be considered at least as important as the OMCST results in predicting O&M costs for existing facilities.

Table 8.2. Staff Comparison of 1980 Coal versus Nuclear Operating Costs (mills/kwh)

	Commonwealth Edison Estimate (incremental cost)	OMCST[a]		Nonfuel Production Costs[b]	
		Total	Variable	Total	Variable[c]
LaSalle County Station operation	2.5[d]	1.0	0.04	3.0 (2.4-3.9)	0.12 (0.096-0.16)
LaSalle County Station in waiting	-	0.5[e]	0.0	-	-
High-sulfur with scrubber	-	3.1	1.1	-	-
High-sulfur without scrubber	0.33	1.1	0.16	1.8 (0.93-6.9)	0.091 (0.047-0.35)
Low sulfur	0.75	0.99	0.05	3.5 (2.3-9.4)	0.18 (0.12-0.47)

[a]Operation and maintenance as defined by OMCST.

[b]Total production cost minus fuel cost, 1976, reported to FPC, Form 12, Sch. 434, escalated at 5% per year.

[c]Variable assumed to be fraction of total predicted by OMCST, low sulfur.

[d]Estimated cost by applicant (ER, Supp. 3, Table Q400.18-1) based on escalating cost of Table 8.1 at 26%.

[e]Staff estimate of O&M costs incurred if LaSalle County Station operation is delayed.

The OMCST code is designed to assist in examining average trends in costs, in determining sensitivity to technical and economic factors, and in providing cost projections. The OMCST code defines O&M costs as the annual cost for staff, the fixed and variable cost for maintenance materials, the fixed and variable cost for supplies and expenses, the cost for insurance and fees (including nuclear liability insurance), and the cost of administration and general expenses. OMCST breaks down O&M expenses into fixed annual expenses (such as salaries) and variable expenses which are proportional to the amount of energy produced (such as offsite sludge disposal). Commonwealth Edison's estimates for coal O&M expenses are marginal costs of an operating coal-fired unit and should be compared with the variable costs output from the OMCST code. The staff has determined that an additional 0.5 mills/kWh will be absorbed by the applicant if the operation of the LaSalle County Station is delayed. The staff is unable to explain the large discrepancy in the nuclear O&M costs. However, the staff notes the OMCST results are more favorable to operation of the LaSalle County Station than are the Commonwealth Edison estimates.

The staff obtained the nonfuel production costs, which include fixed and variable costs for the year 1976 (as reported to the FPC) for three nuclear, four low-sulfur, and three high-sulfur coal facilities operated by the applicant and escalated those costs 5% per year to 1980. The escalated total nonfuel production costs are presented in Table 8.2. The variable O&M costs are taken to be 4.0% and 5.1%, respectively, of the total nuclear and coal O&M costs. These percentages were obtained from the OMCST results for nuclear and low-sulfur coal. The numbers in parentheses indicate the large spread of the costs for the facilities considered.

Staff analysis of historical operating data of nonfuel production costs predicts somewhat less economic advantage for nuclear than predicted by the applicant. However, the applicant may be able to achieve costs at the lower end of the nuclear cost spectrum (2.4 mills/kWh).

In the staff's view, coal O&M costs could be higher in the future because of the increasing cost to meet sulfur dioxide emission standards by use of scrubbers and coal cleaning. EPA has estimated that to meet the SO_x emission standard of 1.2 pounds SO_x per million Btu (using 3.8% sulfur coal with flue gas desulfurization) would cost approximately 4.4 mills per kilowatt hour.[2] Coal sulfur content of 2.4% would cost about half that amount to remove SO_x. Operation and maintenance costs represent about 38% of these costs.

The staff concludes that the applicant's estimates of O&M costs are reasonable. In the remainder of this section, the staff assumes the "nonfuel production cost" based on Federal Power Commission Form 12 as its estimate.

8.3.1.4 Fuel Cost - Nuclear

The staff examined nuclear fuel cycle costs, particularly those that have a major impact on uncertainty.[3-8] Three cases were examined that incorporated the significant factors which determine how much the utility pays for nuclear fuel. The three areas where prices can vary greatly are (1) yellowcake price, (2) enrichment services, and (3) waste disposal costs. The staff calculated these costs using values cited in GESMO[6] except where more recent information provided an alternative and more expensive nuclear cost. A summary of the fuel cycle costs used in this analysis is presented in Table 8.3. All prices were escalated at 5% per annum to arrive at 1980 costs.

The staff consistently made more conservative assumptions than reported in WASH-1139 to make nuclear fuel more expensive, including (1) tails assay of 0.25 rather than 0.2, and (2) lower reactor thermal efficiency (31% rather than 34%).

Table 8.3. Summary of Nuclear Fuel Cycle Costs, 1976

	Low	Middle	High
Yellowcake, $ per lb	$ 18	$ 20	$ 40
Conversion UF_6/kg HM	7.40	7.40	7.40
Enrichment SWU/kg HM	72	88	105
Fabrication/kg HM	116	116	116
Spent fuel storage/kg HM	25	25	25
Shipping/kg HM	15	15	15
Disposal/kg HM	43	100	250
Decommissioning (in millions of dollars)	12.94	16.77	65.1

Three different cases were estimated to reflect expectations about future prices. For example, the present enrichment price is between $61.30 and $71.68 per separative work unit (SWU). In the analysis it was assumed that three price cases (low, middle, and high) would hold until 1980. The enrichment prices assumed in the analysis ($72, $88, and $105) were selected so as to reflect the prices that may be paid in 1980. The low price assumption ($72) is a continuation of present policies, while the high price reflects what enrichment services might cost utilities in 1980 if these services were turned over to private enterprise.

A similar procedure was used for waste disposal. It was estimated in GESMO that the throwaway fuel cycle cost for waste disposal might range from $50 to $150 per kilogram of heavy metal (kg HM). The staff took the low case to represent a Battelle Northwest estimate of waste disposal and the high case represents the highest known estimates circulated within the Department of Energy. The middle case represents the higher end of estimates from GESMO.

Total cost of the fuel cycle in Table 8.4 for Commonwealth Edison was estimated at 4.5 to 8.4 mills/kWh. The staff's estimate of the most likely price for the applicant is 5.4 mills/kWh in 1980. The staff bases this judgement on the applicant's ownership of Cotter Corporation. Average price to utilities for delivery of yellowcake in 1980 was $18 per pound.[4] Many utilities can expect to pay much more for yellowcake over the life of the plant. Commonwealth Edison owns 100% of the voting stock in Cotter Corporation--a company engaged in uranium mining and milling. Cotter Corporation has a 400-ton-per-day mill in Canon City, Colorado. A new 1500-ton-per-day mill is planned at the same location.[9]

8.3.1.5 Fuel Cost - Coal

Average delivered price of all steam coal to the East North Central Region was about 92 cents per million Btu in the first quarter of 1977.[10] This is a cost equivalent to 9.9 mills/kWh on the average Commonwealth Edison coal plant. The average cost of all coal to Commonwealth Edison reported in the year ending 1976 was 90.77 cents per million Btu, or 9.7 mills/kWh. The

Table 8.4. Nuclear Fuel Cost in Mills per Kilowatt-Hour at 60% Capacity Factor in 1980

	Range	Cost
Fuel cost in mills/kWh	Low	3.5
	Middle	4.4
	High	7.4
Carry costs on inventories		1.0
Total	Low	4.5
	Middle	5.4
	High	8.4

Commonwealth Edison cost is close to the average price for deliveries in the East North Central Region. Commonwealth Edison system is currently burning low-sulfur coal (less than 0.7%) at about 12 mills/kWh and high-sulfur coal (more than 3%) at 7 mills/kWh.[11]

At 5% escalation per year, the staff estimates the price of coal in 1980 will be about 15 mills/kWh for low-sulfur and 8.5 mills/kWh for high-sulfur coal. This high/low spread of about 6 mills/kWh is in close agreement with the spread of 6.6 and 7.7 mills/kWh determined by the Commerce Technical Advisory Board.[12]

The staff assumes that the applicant would replace energy not generated by LaSalle County Station (for whatever reason) with the economically most favorable alternative fuel--coal. The staff further assumes an equal amount of the replacement energy comes from high- and low-sulfur coal. The applicant has assumed (Table 8.1) that 46% of its replacement energy would come from low-sulfur coal. Furthermore, in 1976 the applicant used only 7% more low-sulfur than high-sulfur coal. The staff expects a trend toward the more expensive low-sulfur coal due to the EPA regulations on SO_x mentioned in Section 8.3.1.3. In the staff's view, it is also likely that new capital costs for scrubber units in the range of $135 to $160 per kilowatt would be necessary in addition to the higher operating costs reported in Table 8.2, if the applicant continues to use high-sulfur coal in the future.

8.3.1.6 Summary

The staff estimates of the costs to generate electric energy using nuclear fuel, low-sulfur coal, and high-sulfur coal are summarized in Table 8.5. For nuclear, the staff has chosen the middle cost case at 60% capacity as its reference nuclear fuel cost. If it is assumed that half the replacement energy comes from low-sulfur coal and half from high-sulfur coal, then the operation of LaSalle County Station will incur an advantage of 4 mills/kWh, or about $45 million for the first year of full operation of both units at a 60% capacity factor. If the high nuclear fuel cost case was used, the first year savings would be approximately $11 million.

Table 8.5. 1980 Comparative Operating Costs of Alternative Fuels (mills/kWh)

	Nuclear		Coal	
Component	Operational	In Waiting	Low-Sulfur	High-Sulfur
Operation and maintenance[a]	3.0	0.5	0.2	0.1
Fuel cost	5.4[b]	0.0	15.0	8.5
Total	8.4	0.5	15.2	8.6
Replacement comparison	7.9		11.9	

[a]Marginal or variable O&M cost for existing coal facilities, but the nuclear O&M cost is based on the total cost estimated from FPC form 12 (Column 4, Table 8.2). See Section 8.3.1.3.

[b]From Table 8.4 middle case.

In the staff's view, these comparisons understate the nuclear advantage because of the high air quality penalties associated with burning high-sulfur coal without scrubbers, and pending legislation that by 1980 will probably internalize many of these costs.

8.3.2 Health Effects Attributable to Coal and Nuclear Fuel Cycle Alternatives

In addition to the environmental costs attributable to coal and nuclear fuels (Table 8.6), the differing health effects from using coal and nuclear fuels have been considered in the environmental assessment of each alternative. In making these assessments, the entire fuel cycle rather than just the power-generation phase was considered in order to compare the total impacts of each cycle. For coal, the cycle consists of mining, processing, fuel transportation, power generation, and waste disposal. The nuclear fuel cycle includes mining, milling, uranium enrichment, fuel preparation, fuel transportation, power generation, irradiated fuel transportation, interim storage or reprocessing, and waste disposal.

In preparing this assessment it has been recognized that there are large uncertainties due to the lack of an adequate data base in certain areas of each fuel-cycle alternative. The overall uncertainty in the nuclear fuel cycle is probably about an order of magnitude (increased or decreased by a factor of ten), whereas there is as much as a two-order-of-magnitude uncertainty in the assessment of the coal fuel cycle. The much greater uncertainty associated with the coal fuel cycle results from the relatively sparse and equivocal data regarding cause-effect relationships for most of the principal pollutants in the coal fuel cycle, and the effect of Federal laws on future performance of coal-fired power plants, mine safety, and culm-bank stabilization.

"Health effects," as the term is used here, is intended to mean excess mortality, morbidity (disease and illness), and injury among occupational workers and the general public. ("Excess" is used here to mean effects occurring at a higher-than-normal rate. In the case of death it is used synonymously with premature mortality.) The most recent and detailed assessments of health effects of the coal fuel cycle have been prepared by the Brookhaven and Argonne National Laboratories.[13-18] The most complete and recent assessment of the radiological health effects of the uranium fuel cycle for normal operations was prepared for the "Final Generic Environmental Statement on the Use of Recycle Plutonium in Mixed Oxide Fuel in Light Water Cooled Reactors" (GESMO I).[6] However, in accordance with 10 CFR Part 51.20(e), the current impact of the uranium fuel cycle (excluding reactors and mines) is defined by the 14 March 1977 revision of Table S-3, 10 CFR Part 51. [Consistent with the Commission's announced intention to reexamine the rule from time to time to accommodate new information (39 FR 14188, 22 April 1974, and 42 FR 13803, 14 March 1977), staff studies are underway to determine what areas, in addition to waste management and reprocessing, may require updating in Table S-3 (Notice of Proposed Rulemaking, Docket No. RM 50-3, Environmental Effects of the Uranium Fuel Cycle, 41 FR 45849, 18 October 1976).] Using the Table S-3 effluents and the models developed for GESMO I, it was possible to estimate the impact of the uranium fuel cycle on the general public for routine operations. These values are shown in Tables 8.7 and 8.8 (see also Tables 8.7a and 8.7b, and 8.8a and 8.8b) and some critical assumptions are shown in Appendix F.

Because Table S-3 excludes radon releases from uranium mines, the health effects of such releases on the general public are not included in the totals listed in Tables 8.7 and 8.8. The effects of such releases would result in some small increases in the total risks of mortality and morbidity as discussed below under "Other Considerations" and footnote f to Table 8.7a.

In addition, Table S-3 does not generically address releases for light water cooled power reactors. The estimated total body population dose commitments for both occupational workers and the general public were taken from GESMO I (U recycle only option). In addition, the occupational dose commitments to workers in uranium mines, mills, uranium hexafluoride plants, uranium fuel plants, and uranium enrichment plants were taken from GESMO I, because they are not considered in Table S-3. However, these dose commitments are comparable to those that would result from the radiological releases described in NUREG-0216, which provides background support for Table S-3.

The dose commitments to the public and occupational workers in the March 1977 Table S-3 were used for estimating health effects from the reprocessing and waste-management aspects of the uranium fuel cycle. The risk estimators used to estimate health effects from radiation dose commitments were taken from GESMO I and WASH-1400.[19]

The impact of accidents in fuel-cycle facilities[20] and reactors[19] generally does not markedly increase the impact of normal operations for the uranium fuel cycle, but has been included in this assessment for completeness. No comparable analysis of health effects resulting from accidents in coal-fired plants is available at this time.

Table 8.6. Comparative Environmental Costs for a 2400-MWe Coal Facility and the LaSalle County Station at Full Output

Impact	Coal	Nuclear
Land Use, hectares		
Station proper and associated ponds, fuel and waste storage areas	∿ 2,100	3,080
Release to Air[a]		
Dust, tonnes/day	27	None
Sulfur dioxide, tonnes/day	310	None
Nitrogen oxides, tonnes/day	176	None
Radioactivity, Ci/yr	Small	59,000
Releases to Surface Water		
Chemicals dissolved in blowdown, tonnes/day	b	b
Radioactivity, Ci/yr	None	30
Water consumed, m^3/min	∿ 73	84
Fuel		
Consumed	∿ 27,000 tonnes/day	1.0 tonnes/day[c]
Ash	∿ 2,700 tonnes/day	
Social	Moderate	Moderate
Esthetic	Both require large industrial type structures and cooling systems (i.e., pond or towers). Coal yard, Ash pit, Tall stack	

[a]Coal-fired plant emissions estimated on the basis that the plant just meets applicable EPA standards.

[b]Information not available.

[c]U_3O_8.

Table 8.7. Summary of Current Energy Source Excess Mortality per Year per 0.8 GWy(e)

Fuel Cycle	Occupational		General Public		Totals
	Accident	Disease	Accident	Disease	
Nuclear (U.S. population)					
(all nuclear)	0.22[a]	0.14[b]	0.05[c]	0.06[b]	0.47
(with 100% of electricity used in the fuel cycle produced by coal power)	0.24-0.25[a,d]	0.14-0.46[b,e]	0.10[c,f]	0.64-4.6[g]	1.1-5.4
Coal[i] (regional population)	0.35-0.65[d]	0-7[e]	1.2[f]	13-110[g]	15-120
Ratio of coal to nuclear (range): 32-260 (all nuclear); 14-22 (with coal power)[h]					

[a]Primarily fatal nonradiological accidents such as falls, explosions, etc.

[b]Primarily fatal radiogenic cancers and leukemias from normal operations at mines, mills, power plants, and reprocessing plants.

[c]Primarily fatal transportation accidents (Table S-4, 10 CFR Part 51) and serious nuclear accidents.

[d]Primarily fatal mining accidents such as cave-ins, fires, explosions, etc.

[e]Primarily coal workers penumoconiosis (CWP) and related respiratory diseases leading to respiratory failure.

[f]Primarily members of the general public killed at rail crossings by coal trains.

[g]Primarily respiratory failure among the sick and elderly from combustion products from power plants, but includes deaths from waste-coal-bank fires.

[h]With 100% of all electricity consumed by the nuclear fuel cycle produced by coal power; amounts to 45 MWe per 0.8 GWy(e).

[i]Coal effects are based on a regional population of 3.8 million people within 80 km of the coal plant. In the year 2020 the population within 80 km of LaSalle County Nuclear Station will be about 1.7 million people. Therefore, the health effects related to coal should be reduced by a factor of about two. The coal effects outside an 80-km radius have not been considered by the staff; however, it is the staff's opinion that they would be greater than those calculated for the 80-km radius.

Table 8.7a. Excess Mortality per 0.8 GWy(e)--Nuclear (Breakdown of Table 8.7)

Fuel Cycle Component	Occupational		General Public		Total
	Accident[a]	Disease[b,c,d]	Accident[d,e]	Disease[b]	
Resource recovery (mining, drilling, etc.)	0.2	0.038	∿ 0	f	
Processing[g]	0.005[h]	0.042	i	0.002	
Power generation	0.01	0.061	0.04	0.011	
Fuel storage	i	∿ 0	i	∿ 0	
Transportation	∿ 0	∿ 0	0.01	∿ 0	
Reprocessing	i	0.003	i	0.050	
Waste management	i	∿ 0	i	0.001	
Total	0.22	0.14	0.05	0.064	0.47

[a]From L. D. Hamilton (editor), "The Health and Environmental Effects of Electricity Generation - A Preliminary Report," Brookhaven National Laboratory, July 1974.

[b]From "Final Generic Environmental Statement on the Use of Recycle Plutonium in Mixed Oxide Fuel in Light Water Cooled Reactors," U. S. Nuclear Regulatory Commission, NUREG-0002, August 1976.

[c]10 CFR Part 51, Table S-3.

[d]10 CFR Part 51, Table S-4.

[e]From "Reactor Safety Study," U. S. Nuclear Regulatory Commission, WASH-1400 (NUREG-75/014), October 1975.

[f]These effects are not included in Table S-3, 10 CFR Part 51. Ref. b (above) indicates about 0.023 excess deaths per 0.8 GWy(e) due to radon-222 emission (4100 Ci).

[g]Includes milling, uranium hexafluoride production, uranium enrichment, and fuel fabrication.

[h]Corrected for factor of 10 error based on referenced value (WASH-1250).

[i]The effects associated with these activities are not known at this time. Although such effects are generally believed to be small, they would increase the total in this column.

Table 8.7b. Excess Mortality per 0.8 GWy(e)--Coal (Breakdown of Table 8.7)[a]

Fuel Cycle Component	Occupational		General Public		Total
	Accident	Disease	Accident	Disease	
Resource recovery (mining, drilling, etc.)	0.3-0.6	0-7	b	b	
Processing	0.04	b	b	10	
Power generation	0.01	b	b	3-100	
Fuel storage	b	b	b	b	
Transportation	b	b	1.2	b	
Waste management	b	b	b	b	
Total	0.35-0.65	0-7	1.2	13-110	15-120

[a]From L. D. Hamilton (editor), "The Health and Environmental Effects of Electricity Generation - A Preliminary Report," Brookhaven National Laboratory, July 1974.

[b]The effects associated with these activities are not known at this time. Although such effects are generally believed to be small, they would increase the total in this column.

Table 8.8. Summary of Current Energy Source Excess Morbidity and Injury per 0.8 GWy(e)

Fuel Cycle	Occupational		General Public		Totals
	Morbidity	Injury	Morbidity	Injury	
Nuclear (U.S. population)					
(all nuclear)	0.84[a]	12[b]	0.84[c]	0.1[d]	14
(with 100% electricity used by the fuel cycle produced by coal power)	1.7-4.1[e]	13-14[b]	1.3-5.3[f]	0.55[g]	17-24
Coal[j] (regional population)	20-70[e]	17-34[h]	10-100[f]	10[g]	57-210
Ratio of coal to nuclear (range): 4.1-15 (all nuclear); 3.4-8.8 (with coal power)[i]					

[a]Primarily nonfatal cancers and thyroid nodules.

[b]Primarily nonfatal injuries associated with accidents in uranium mines such as rock falls, explosions, etc.

[c]Primarily nonfatal cancers, thyroid nodules, genetically related diseases, and nonfatal illnesses--such as radiation thyroiditis, prodromal vomiting, and temporary sterility--following high radiation doses.

[d]Transportation-related injuries from Table S-4, 10 CFR Part 51.

[e]Primarily nonfatal diseases associated with coal mining such as CWP, bronchitis, emphysema, etc.

[f]Primarily respiratory diseases among adults and children caused by sulfur emissions from coal-fired power plants and waste-coal-bank fires.

[g]Primarily nonfatal injuries among members of the general public from collisions with coal trains at railroad crossings.

[h]Primarily injuries to coal miners from cave-ins, fires, explosions, etc.

[i]With 100% of all electricity consumed by the nuclear fuel cycle produced by coal power; amounts to 45 MWe per 0.8 GWy(e).

[j]Coal effects are based on a regional population of 3.8 million people within 80 km of the coal plant. In the year 2020 the population within 80 km of the LaSalle County Station will be about 1.7 million people. Therefore, the health effects related to coal should be reduced by a factor of two. The coal effects outside an 80-km radius have not been considered by the staff; however, it is the staff's opinion that they would be greater than those calculated for the 80-km radius.

Table 8.8a. Morbidity and Injury per 0.8 GWy(e)--Nuclear (Breakdown of Table 8.8)

Fuel Cycle Component	Occupational		General Public		Total
	Morbidity	Injury[a]	Morbidity	Injury	
Resource recovery (mining, drilling, etc.)	c	10	d	∿ 0	
Processing[e]	c	0.6	d	∿ 0	
Power generation	c	1.3	d	∿ 0	
Fuel storage	c	f	d	∿ 0	
Transportation	c	< 1	d	0.1[b]	
Reprocessing	c	f	d	f	
Waste management	c	f	d	∿ 0	
Total	0.84	12	0.84	0.1	14

[a]From L. D. Hamilton (editor), "The Health and Environmental Effects of Electricity Generation - A Preliminary Report," Brookhaven National Laboratory, July 1974.

[b]Table S-4, 10 CFR Part 51.

[c]Nonfatal cancers ≤ fatal cancers (excluding thyroid) or ∿ 0.14.
Nonfatal thyroid cancers and benign nodules ∿ 3 × fatal cancers or ∿ 0.42.
Genetic defects ∿ 2 × fatal cancers or ∿ 0.28.

[d]Reactor accidents: 10 × fatalities or ∿ 0.40 nonfatal cases.
Normal operations: Nonfatal cancers ≤ fatal cancers or ∿ 0.07.
Nonfatal thyroid cancers and nodules ∿ 3 × fatal cancers or ∿ 0.22.
Genetic effects ∿ 2 × fatal cancers or ∿ 0.015.

[e]Includes milling, uranium hexafluoride production, uranium enrichment, and fuel fabrication.

[f]The effects associated with these activities are not known at this time. Although such effects are generally believed to be small, they would increase the total in this column.

Table 8.8b. Morbidity and Injury per 0.8 GWy(e)--Coal (Breakdown of Table 8.8)

Fuel Cycle Component	Occupational		General Public		Total
	Morbidity	Injury	Morbidity	Injury	
Resource recovery (mining, drilling, etc.)	20-70	13-30	b	b	
Processing	b	3	b	b	
Power generation	b	1.2	10-100	b	
Fuel storage	b	b	b	b	
Transportation	b	b	b	10	
Waste management	b	b	b	b	
Total	20-70	17-34	10-100	10	57-210

[a]From L. D. Hamilton (editor), "The Health and Environmental Effects of Electricity Generation - A Preliminary Report," Brookhaven National Laboratory, July 1974.

[b]The effects associated with these activities are not known at this time. Although such effects are generally believed to be small, they would increase the total in this column.

Estimates of death, disease and injury from nonradiological causes for the uranium fuel cycle are from the Brookhaven evaluations,[13-15] with the exception of transportation-accident-related deaths, which were taken from Table S-4, 10 CFR Part 51. The results of these assessments are shown in Tables 8.7 and 8.8. It should be noted that there are two lines under the nuclear fuel cycle: the first assumes all of the electricity used within the uranium fuel cycle is generated by nuclear power (i.e. all-nuclear economy); the second line assumes, as shown in Table S-3 (10 CFR Part 51), that 100% of the electricity used within the nuclear fuel cycle comes from coal power. This is equivalent to a 45-MWe coal-fired plant, or 4.5% of the power produced.

The Uranium Fuel Cycle

Currently the NRC estimates that the excess deaths per 0.8 gigawatt-year electric [GWy(e)] will be about 0.47 for an all-nuclear economy. This is probably somewhat high due to the conservatism required in evaluations of generic plants and sites. (Conservatism is used here to mean that assumptions regarding atmospheric dispersion, deposition of particulates, bioaccumulation, etc., generally result in estimates of impact that are typically "upper bound" estimates. In most cases, the estimates would be lower for real plants.) However, it is not greatly different from estimates by others such as Comar and Sagan[21] (0.11 to 1.0), Hamilton[13] (0.7 to 1.6), and Rose et al.[22] (0.50). The uncertainty in the estimate is about an order of magnitude. If, as shown in Table S-3, 100% of the electrical power used by the uranium fuel cycle comes from coal-fired power plants, the NRC estimates there would be about 1.1 to 5.4 excess deaths per 0.8 GWy(e). Of this total, about one to five excess deaths per 0.8 GWy(e) would be attributable to coal power (see Table 8.7). The uncertainty in the estimate is about one order of magnitude.

The total number of injuries and diseases that might occur among workers and the entire U. S. population as a result of normal operations and accidents in the uranium fuel cycle was estimated to be about 14 per 0.8 GWy(e) for an all-nuclear economy. Injuries among uranium miners from accidents account for 10 of the 14 cases (see Table 8.8a). If 100% of the electrical power used by the uranium fuel cycle comes from coal-fired power plants, the NRC estimates there would be about 17 to 24 injuries and diseases per 0.8 GWy(e). Of this total, about four to ten excess events per 0.8 GWy(e) would be attributable to coal power (see Table 8.8). The uncertainty in the estimate is also about one order of magnitude.

Although anticipated somatic (nongenetic) effects associated with normal releases of radioactive effluents from the nuclear fuel cycle are limited to potential cancers and leukemias, for the higher doses associated with serious nuclear accidents there is some small risk of various nonfatal somatic effects (see Table 8.8, footnote c). At this time only light-water-cooled power reactors have been thoroughly evaluated.[19] However, it should be noted that power reactors probably account for most of the potential health effects associated with nuclear accidents in the uranium fuel cycle.

This results from the fact that power reactors represent 80% of all fuel-cycle facilities expected to be operating for the balance of this century[6] and account for the majority of occupationally exposed individuals. In addition, although the probability of serious accidents is extremely small, if one were to occur, the health effects would be larger than for any other type of fuel-cycle facility. Serious nuclear accidents in power reactors might also contribute about 0.04 excess deaths per 0.8 GWy(e), whereas transportation-related accidents are estimated to contribute about 0.01 excess deaths per 0.8 GWy(e) (see Table 8.7, footnote c).

Early and latent nonfatal somatic effects that might be expected after high radiation doses include a variety of effects (see Table 8.8, footnote c). It is possible that nonfatal somatic effects could be an order of magnitude greater than excess deaths resulting from accidents;[19] thus, the total number per 0.8 GWy(e) would be about 0.4. This accounts for about one-third of the morbidity shown for the general public and an all-nuclear economy in Table 8.8. The number of nonfatal thyroid cancers (5%-10% mortality rate) and benign thyroid nodules would be about 0.6 per 0.8 GWy(e) from routine releases to the public and occupational exposures (primarily external irradiation), whereas other nonfatal cancers would be less than or equal in number to fatal cancers [about 0.2 per 0.8 GWy(e)] (see Table 8.8, footnote c).

It is believed that genetically related diseases (e.g. cystic fibrosis, hemophelia, certain anemias, and congenital abnormalities such as mental retardation, short-limbed dwarfism, and extra digits) and abnormalities in the descendants of workers and the general public from both normal operations and accidents would be perhaps twice the number of excess deaths due to cancer from total body irradiation;[18,23] this could add another 0.3 health effects per 0.8 GWy(e) among workers and 0.2 health effects per 0.8 GWy(e) among the general public (see Table 8.8, Table 8.8a, footnote c).

In assessing the impact of coal power used in the uranium fuel cycle, Table S-3 (10 CFR Part 51) was the basis for the assumption that 100% of the electricity used in the uranium fuel cycle, primarily for uranium enrichment and reactor operation, came from coal-fired plants. Adding

4.5% of the health effects per 0.8 GWy(e) from the coal fuel cycle significantly increases the health effects per 0.8 GWy(e) from the uranium fuel cycle, as shown on the second lines of Tables 8.7 and 8.8.

The Coal Fuel Cycle

Current estimates of mortality and morbidity resulting from the coal fuel cycle are quite uncertain; this is the principal reason for the wide range of values reported in the literature. These uncertainties result from the limited number of epidemiological studies and differences in interpretation of the results of such studies. There is additional uncertainty regarding the effects of new Federal laws on coal-cycle facilities in the next decade. Current estimates of excess deaths for the entire coal cycle range from 15 to 120 per 0.8 GWy(e), whereas disease and injury estimates range from 57 to 210 per 0.8 GWy(e).

In the case of occupational effects, there is considerable uncertainty because of anticipated reductions in health effects resulting from the implementation of the Federal Coal Mine Health and Safety Act of 1969 (PL 91-173). The provisions of this act should result in significant improvement of the underground work environment, particularly regarding coal dust. Coal dust is both a cause of underground explosions and fires, and a cause of coal workers' pneumoconiosis (CWP), commonly called black lung disease, and subsequent progressive massive fibrosis (PMF).[13-17] In addition, more coal in the years ahead is expected to be produced by strip mining, which results in lower mortality rates.[13] As a result, the frequencies of both types of events are anticipated to decline in the years ahead, on a per GWy(e) basis. On the other hand, statistics show new coal miners experience higher mortality and injury rates than experienced miners.[17] As a result of expected increases in coal production, an influx of inexperienced miners will tend to increase the mortality and injury rates for miners as a group.

For the general public, there is also considerable uncertainty in the estimation of health effects. (In the case of coal-plant effluents, consideration of health effects was limited to the population within 80 km of such plants.) For example, although there are estimates of health effects related to burning culm banks (waste banks from coal screening), recent efforts by mine operators have greatly reduced such fires, and future processing activities are expected to avoid fires as a result of new methods of stabilizing the banks to prevent slides.[24] Current estimates of excess deaths in the public from sulfates from such fires range from 1 to 10 per 0.8 GWy(e) (see Table 8.7, footnote g). Power generation is estimated to result in 3-100 excess deaths per 0.8 GWy(e) (see Table 8.7, footnote g), whereas excess morbidity ranges from about 10-100 per 0.8 GWy(e) (see Table 8.8, footnote e).

The uncertainties are even greater in the power-generation phase of the coal cycle, where estimates of health effects range over several orders of magnitude.[21] This is largely due to the lack of a reliable data base for predicting health effects from the various pollutants emitted from coal plants, and the effect of the EPA New Source Performance Standards for coal plants regarding particulate and sulfur emissions in future years on a long-term basis. There is some uncertainty as to whether these standards can be met in large coal-fired power plants over the life of the plant. The major pollutants emitted include:

1. Particulates: Contain large amounts of toxic trace metals in respirable particle size,[25] such as arsenic, antimony, cadmium, lead, selenium, manganese, and thallium;[17] significant quantities of beryllium, chromium, nickel, titanium, zinc, molybdenum, and cobalt;[26] and traces of radium-226 and -228 and thorium-228 and -232.[27]

2. Hydrocarbons: Include very potent carcinogens (cancer-causing substances) such as benzo(a)pyrene.

3. Sulfur oxides.

4. Nitrogen oxides.

5. Other gases and vapors: Include ozone, carbon monoxide, carbon dioxide, mercury vapor, and radon-222.

Regarding the preceding list of pollutants, there are no well-established epidemiologic cause-effect relationships that can be used to estimate total health effects accurately, either from acute exposures during air-pollution episodes or from chronic long-term exposures.

Although definitive cause-effect relationships are lacking, tentative cause-effect relationships for sulfur emissions have been used by numerous groups to estimate health effects from sulfur emissions from coal plants. They are described by the National Academy of Sciences in a recent report to the U. S. Senate.[28] The most widely quoted studies are those by Lave and Seskin,[29] Winkelstein et al.,[30] and an unpublished study by EPA that was used in the National Academy of Sciences study for the U. S. Senate.[28]

In general, the effects range from excess deaths from cardiovascular failure and increases in asthma attacks during severe air pollution to excess respiratory disease from long-term chronic exposures. Most of the acute deaths are among the elderly and the severely ill, whereas morbidity from long-term exposure also includes children. Although widely accepted cause-effect relationships were not derived from studies of acute air-pollution episodes in London in 1952,[31] Donora, Pennsylvania, 1948,[32] and New York,[33] these studies definitely support the conclusions regarding excess death and disease associated with emissions from combustion of coal.

There are no estimates of possible long-term carcinogenic effects by sulfur oxides or associated pollutants. In addition, the recently completed (1976) large-scale EPA Community Health and Environmental Surveillance System (CHESS) study failed to provide any new or definitive cause-effect relationships for any of the pollutants from coal-fired plants that could be used to provide better estimates of health effects than are currently available.[34] (The $22 million CHESS study attempted to correlate air-pollution data collected from six U. S. cities with a variety of health problems.)

Assuming that new coal-fired plants in the 1980s can meet EPA New Source Performance Standards (which could require 90% sulfur removal for high-sulfur coal and about 99% particulate removal) and other Federal laws regarding mine safety and culm-bank stabilization, the number of deaths should be reduced. Thus, current estimates of 15 to 120 per 0.8 GWy(e), due largely to sulfates from combustion coal, may be reduced by about half.

Recently, Argonne National Laboratory developed a predictive model for deaths from emission of benzo(a)pyrene, which indicates about 1 to 4 deaths per 0.8 GWy(e) depending on use of conventional combustion or fluidized-bed combustion.[18] Such effects, although greater than the expected deaths from the entire uranium fuel cycle (all-nuclear economy), do not significantly change the total impact of the coal fuel cycle and were not included in the effects listed in Table 8.7.

Probably the most reliable estimates of deaths associated with the coal fuel cycle are those associated with transportation accidents. Because a 1000-MWe coal-fired plant consumes about 2.7 million tonnes (three million tons) of coal per year, there are literally thousands of carloads of coal being transported by rail from mines to plants. It has been estimated that about one out of every ten trains in the United States is a coal train going to a coal-fired power plant.[35] These trains are estimated to travel an average distance of about 480 km (300 mi) from the mine to the plants.[24] As a result, there are about 1.2 deaths per 0.8 GWy(e) among workers and the general public. Further, because most of these deaths occur at railroad crossings, the numbers can be expected to increase as more automobiles are operated and driven greater distances, and as rail-transportation distances increase when hauling low-sulfur western coals to eastern markets.

Sickness among coal miners and the general public accounts for most of the nonfatal occurrences in the coal fuel cycle, with most of the remainder due to injuries among coal miners. As a result of implementation of Federal laws, it is probable that future rates among underground miners will be substantially reduced. It is not unreasonable to assume that current estimates of about 57 to 210 cases of sickness and injury among workers and the general public could be reduced in the years ahead, inasmuch as occupational sickness and injury currently account for about half of the total nonfatal health effects.

The overall uncertainty in the estimates of health effects for the coal fuel cycle in this assessment is probably about one order of magnitude, since the Brookhaven estimates generally fall within the range of estimates in the literature.

Other Considerations

Although the Reactor Safety Study[19] has helped provide a perspective of the risk of mortality or morbidity from potential power-reactor accidents (the current experience for serious accidents is zero), there is the additional problem associated with individual perception of risk. Thus, although the Study concluded that, "All non-nuclear accidents examined in this study, including fires, explosions, toxic chemical releases, dam failures, airplane crashes, earthquakes, hurricanes and tornadoes, are much more likely to occur and can have consequences comparable to, or larger than, those of nuclear accidents," there will continue to be uncertainty associated with such evaluations. Furthermore, there may be a problem of public acceptance of potential accidents, because the consequences can be severe. In fact, it appears that some people more readily accept, for example, having 55,000 people actually killed each year in violent highway accidents, one or two at a time, than they do the unlikely occurrence of perhaps several thousand possible deaths from a single catastrophic accident during their lifetime.[36]

As noted in footnote 5 to the March 1977 revision of Table S-3 (10 CFR Part 51), the GESMO I radon-222 release increases from 74.5 Ci to about 4800 Ci when releases from mines (and additional releases from mill tailings) are included. This would result in a small increase in the total number of excess deaths shown in Table 8.7, although the mortality per 0.8 GWy(e) for the general public would increase by about 30% (footnote f, Table 8.7a).

With regard to the coal fuel cycle, it is a well established fact that the use of coal results in numerous other costs to society that have not yet been adequately quantified. These include:

1. The short- and long-term impacts of sulfur and nitrogen oxides on biota and materials. Acid rain, for example, is known to be severely damaging to terrestrial and aquatic habitats. Argonne National Laboratory provides a detailed discussion of these and other effects of sulfur and nitrogen oxide emissions.[17] However, as more coal plants come on line, these effects can be expected to expand to surrounding areas.

2. Damage to materials, such as paints, building surfaces, statuary, and metals caused by emissions of sulfur oxides, ozone, and nitrogen oxides. A 1976 review of such effects indicates that the costs could range into billions of dollars per year in the United States alone.[37]

3. Contamination of soil and vegetation to toxic levels by such mechanisms as deposition and bioaccumulation of trace elements present in gaseous emissions.

4. Destruction of entire ecosystems in streams and rivers by acid mine drainage and acidic seepage from sludge burial sites, and the potential for public-health effects from downstream use of such water for domestic or agricultural purposes.

5. In addition to the occurrence of excess mortalities, injuries, and morbidities, the costs to society in terms of medical costs, lost productivity, and other social losses represent a significant consideration that has not been completely evaluated at this time. Some recent studies have attempted to deal with these extremely complex issues,[38,39] and concluded that social costs from one coal-fired plant may currently be about $50 million per year, not considering the rest of the costs for the coal fuel cycle.

6. The possibility of the so-called "greenhouse effect," a phenomenon expected to occur sometime early in the next century as a result of the present and future anticipated production rates of carbon dioxide from the combustion of fossil fuels.[40] Because each 1000-MWe coal plant produces about 6.8 to 9.5 million tonnes (7.5 to 10.5 million tons) of carbon dioxide per year,[13] it is believed these emissions from thousands of fossil-fueled power plants may result in greater releases of carbon dioxide than the atmosphere and oceans can cycle. As a result, the carbon dioxide concentrations would be expected to increase in the atmosphere. Because carbon dioxide strongly absorbs infrared, it is postulated that the mean atmospheric temperature will rise several degrees. This may cause all or part of the polar ice caps to melt, resulting in inundation of many inhabited areas of the world. At the same time, drought would be expected to prevail in many of the agricultural areas of the temperate zones, resulting in huge crop losses. It is possible that the particulates emitted by fossil plants will counteract some of the greenhouse effect by reducing the amount of sunlight reaching the surface of the earth.

   However, another effect from carbon dioxide released by coal combustion occurs because coal has essentially no carbon-14. In effect, the stable carbon dilutes the carbon-14 in the biosphere, resulting in a reduction in the radiological impact of both naturally occurring and man-made carbon-14.

7. An additional consideration that has not been evaluated for the coal cycle--the radiological impact of mining and burning coal. Of interest is the release of radon-222 from the decay of radium-226 in coal. Not only is the radon released during mining and combustion, but it will continue to emanate from flyash for millions of years after the coal has been burned. Although Pohl[41] has shown that this is not a problem with most eastern coal (generally of high sulfur content but with 1-3 ppm uranium content), the average uranium and radium content of large reserves of low-sulfur western coal is as much as 50 times higher than that of most eastern coal.[42,43] Combustion of the coal and disposal of the remaining ash leads to about the same health effects from radon-222 emissions as do uranium-mill-tailings piles. These releases would account for less than 0.01 excess deaths per 0.8 GWy(e) due to fuel-cycle activities during the rest of this century. As a result, such releases do not significantly affect the conclusions reached with regard to a comparison of the two alternative fuel cycles. In addition, some believe[44] that if the physical and biological properties of the radium released from conventional coal-powered plants (burning coal with 1-2 ppm U-238 and Th-232) are considered, such plants discharge relatively greater quantities of

radioactive materials into the atmosphere than do nuclear plants of comparable size. EPA has estimated radiation doses from coal and nuclear plants of early designs and reached similar conclusions.[28]

Summary and Conclusions

For the reasons discussed above, it is extremely difficult to provide precise quantitative values for excess mortality and morbidity, particularly for the coal fuel cycle. Nevertheless, estimates of mortality and morbidity have been prepared based on present-day knowledge of health effects, and present-day plant design and anticipated emission rates, occupational experience and other data. These are summarized in Tables 8.7 and 8.8 (see footnote j, Table 8.8), with some important assumptions inherent in the calculations of health effects listed in Appendix F.

Although future technological improvements in both fuel cycles may result in significant reductions in health effects, based on current estimates for present-day technology, it must be concluded that the nuclear fuel cycle is considerably less harmful to man than the coal fuel cycle.[13-17,21,22,38,39,44-47] As shown in Tables 8.7 and 8.8, the coal fuel-cycle alternative may be more harmful to man by factors of 4 to 260 depending on the effect being considered, for an all-nuclear economy, or factors of 3 to 22 with the assumption that all of the electricity used by the uranium fuel cycle comes from coal-fired plants.

Although there are large uncertainties in the estimates of most of the potential health effects of the coal cycle, it should be noted that the impact of transportation of coal is based on firm statistics; this impact alone is greater than the conservative estimates of health effects for the entire uranium fuel cycle (all-nuclear economy), and can reasonably be expected to worsen as more coal is shipped over greater distances. In the case where coal-generated electricity is used in the nuclear fuel cycle, primarily for uranium enrichment and auxiliary reactor systems, the impact of the coal cycle accounts for essentially all of the impact of the uranium fuel cycle.

However, lest the results of this be misunderstood, it should be emphasized that the increased risk of health effects for either fuel cycle represents a very small incremental risk to the average public individual. For example, Comar and Sagan[21] have shown that such increases in risk of health effects represent minute increases in the normal expectation of mortality from other causes.

A more comprehensive assessment of these two alternatives and others is being prepared by the National Research Council Committee on Nuclear and Alternative Energy Systems.[48] This study may assist substantially in reducing much of the uncertainty in the analysis presented.

8.3.3 Energy Demand

The projections of electricity demand have been revised downward since the issuance of the FES-CP. These downward revisions are at least in part responsible for the delay in initial operation of the two LaSalle County Station units, from December 1977 and September 1978 to December 1979 and 1980. Current forecasts of energy requirements are compared in Table 8.9, along with a partial comparison of peak demand forecasts at the time of the FES-CP (1972) and current (1976).

The current Commonwealth Edison forecast projects both energy and peak demand beyond 1985 at a stable level of growth, 6.1%. From 1976 to 1983 the rate of growth projected by the applicant is 6.5%. In light of recent history since the economic recession and energy events of 1973, the applicant has revised its long-term growth rate downward, from about 7% to about 6%. The staff notes that the historical average annual increase from 1960 to 1973 was 7.7%.

Considerable research and effort have been advanced, especially since 1973, on the subject of energy forecasting. Quantitative efforts have been econometric or time-series approaches. Considerably more effort has been devoted to the residential sector than to the commercial and industrial sectors. Difficulties in the industrial sector include the lack of adequate data by specific industry and a general lack of time-series data that is not dependent on existing established locational preferences. The econometric models include price elasticities, cross-price elasticities, and elasticities of other socioeconomic variables.

The staff has examined the applicant's model and energy consumption projections. The staff has also examined independent estimates that can apply to the Commonwealth Edison service area. The two independent models are represented by the Federal Energy Administration PIES model and the Oak Ridge National Laboratory model.[49,50]

Both the Oak Ridge and FEA models have three sector components (residential, industrial, and commercial), but the applicant only distinguished between a weather and nonweather-sensitive component to peak load growth. The models differ in other important respects. The FEA and Oak

Table 8.9. Applicant's Energy and Peak Load Forecasts, 1972 and 1976

Year	1976 Energy Forecast, 1000 MW hr	Percentage Increase	1976 Peak Demand Forecast, MWe	Percentage Increase	1972 Peak Demand Forecast, MWe	Percentage Increase
1977	67,360	-	14,310	-	17,760	7.4
1978	72,080	7.0	15,280	7.5	19,060	7.3
1979	76,853	6.6	16,460	7.0	20,410	7.1
1980	81,635	6.2	17,550	6.6	21,820	6.9
1981	86,774	6.5	18,690	6.4	-	-
1982	92,252	6.3	19,870	6.3	-	-
1983	98,056	6.3	21,120	6.3	-	-
1984	104,045	6.1	22,410	6.1	-	-
1985	110,406	6.1	23,780	6.1	-	-

Ridge models use pooled time series cross-section data for nine regions in the U. S. The FEA and Oak Ridge models used the East North Central Region and the State of Illinois, respectively, to represent the applicant's service area. The applicant relies on input data for his own service region, and in this respect his model is superior to the other models (ER, Supp. 3, Q400.23-1). Both Oak Ridge and FEA models use lagged consumption in their model. The applicant lags the previous four years of the real price index of electricy entered as independent variables. Although conceptually useful, the lagging of prices for previous years usually involves statistical problems of intercorrelation among the independent variables. Important distinctions among the models are presented in Table 8.10.

Commonwealth Edison expects that the real price of electricity will remain the same (1977 thru 1986) and industrial production will increase at about 4% annually. These expectations are reasonably consistent with the FEA, but they assume lesser price increases than does the Oak Ridge model.

Despite the differences in the models noted in Table 8.10, they all predict reasonably similar growth rates. From the present to the mid 1980s, growth rates in energy demand from each of the models are 4.5% (Commonwealth Edison), 4.23% (FEA), and 4.80% (Oak Ridge). In the staff's view, the similarity of the three results is as much a result of the nature of econometric modeling as a support of credibility for each model. In fact, Commonwealth Edison has departed from its

Table 8.10. Model Assumptions

	Oak Ridge (East North Central Region and Illinois)	FEA[a] (East North Central Region)
Real price increases	2.0 (R)[b] 3.9 (C) 4.5 (I)	-0.5 (R)[b] -0.8 (C) 1.7 (I)
Income increases	N.A.	2.6
Industrial production increases	4.3	4.3
Income elasticity	0.19 (R) 0.76 (C) 1.28 (I)	1.275 (R&C) 1.0 (I)
Price elasticity	-1.2 (R) -1.59 (C) -0.59 (I)	-0.51 (R&C) -0.469 (I)

[a]Table 4, C-10, "1976 National Energy Outlook."

[b](R) residential, (C) commercial, and (I) industrial.

models and has adopted an official growth rate of 6.1% after 1980. The actual load growth rate estimate projected by the applicant for 1976 to 1983 is 6.4%. These adopted growth projections are about 2% higher than model output. In the staff's view, enough valid criticism can be levied against all the models as to justify a higher estimated forecast for prudent planning purposes over the next three to eight years. However, the models, rather than the Commonwealth Edison official estimate, may provide the best single estimate of future consumption over the longer term. The staff has more confidence in the models over the longer than in the short run. With the information available, the staff can neither concur with nor reject the 6.1% long-range growth rate predicted by the applicant.

Due to the discrepancy between model output growth projections and the applicant's estimated growth, the staff examined what effect this difference would have on the need for power. The staff compared the Oak Ridge, FEA, and applicant's peakload growth rate forecasts in conjunction with capacity increases and reserve margins. Both the Oak Ridge and FEA models utilize 1974 as the base year for their long-term growth rates. The peak load growth rates of the Oak Ridge and FEA models were assumed to be 0.5% greater than the energy growth rates. A comparison of the applicant's most recent peak demand forecast with those of Oak Ridge and the FEA models is presented in Table 8.11. The Oak Ridge and FEA models predict almost identical results as the applicant's in 1980. However, because of the long-range discrepancy in growth rates, the staff estimates are less than the applicant's by 1982.

A comparison of the reserve margins for the staff-estimated and applicant-estimated growth scenarios is given in Table 8.12. Byron and Braidwood nuclear facilities are not included in Table 8.12 because they are due to come on line after LaSalle County Station and will be subject to their own licensing reviews. Results are presented with and without the LaSalle County Station units in operation. Commonwealth Edison estimates a reserve margin requirement of about 14%; since FPC recommends a 15 to 25% margin, the staff considers the 14% criterion to be reasonable. The comparison indicates that the reserve margin drops to as low as about 3.3% without the LaSalle County Station units in 1981, the first year in which both units are proposed to meet the summer peak. A slight delay in schedule may mean that Unit 1 will not be available to meet the summer peak in 1980.

The staff concludes that bringing the LaSalle County Station units into operation is justified on the basis of maintaining reasonable reserve margin criteria. The staff cannot conclude that the difference between a 4.3% growth and a 6.5% growth over a period of the next few years can be decided by reference to the differences in estimating procedures by modelers as a substitute for the judgment by the applicant. The applicant has agreed that electricity consumption growth rates will decline, but the magnitude of that decline cannot be determined by reference to models that (in the staff's view) disagree significantly among themselves on model assumptions--data bases, growth in the economy, price elasticities, and model variables. The staff concludes that planning on the basis of a 6.5% growth rate is prudent planning in the short run.

Table 8.11. Peak Demand Projections by the Applicant and the Staff

		Staff	
Year	Commonwealth Edison	Oak Ridge Estimate[a]	FEA Estimate[a]
1976	12,907	13,605	13,458
1977	14,310[b]	14,362	14,095
1978	15,380	15,085	14,761
1979	16,460	15,885	15,460
1980	16,770[c]	16,727	16,191
1981	17,800	17,613	16,957
1982	18,880	18,547	17,759
1983	20,010	19,530	18,599

[a]Based upon 1974 actual peak load of 12,270 MW, first predicted year being 1975. Peak load growth faster than total load.

[b]First estimated number, from ER.

[c]Estimations from ER, Supp., Q340.01-02.

Table 8.12. Reserve Margins with and without the LaSalle County Station for Staff and Applicant Load Growth Scenarios

	1979			1980			1981			1982			1983		
Owned capability		18,350			19,398			20,446			20,446			20,446	
Less summer demand limitations		610			640			640			640			640	
Net capability with LaSalle County Station[a,b]		17,740			18,758			19,806			19,806			19,806	
Net capability without LaSalle County Station[b]		17,740			17,740			17,740			17,740			17,740	
Load as estimated by:	CE[c]	OR[c]	FEA[c]	CE	OR	FEA	CE	OR	FEA	CE	OR	FEA	CE	OR	FEA
Peak load	16,460	15,885	15,460	16,770	16,727	16,191	17,800	17,613	16,957	18,880	18,547	17,759	20,010	19,530	18,599
Peak load responsibility	15,836	15,261	14,836	16,146	16,103	15,567	17,176	16,989	16,333	18,256	17,923	17,135	19,386	18,906	17,975
Reserve margin as % of peak load responsibility (with LaSalle County Station)	12.0	16.2	19.6	16.2	16.5	20.5	15.3	16.6	21.3	8.5	10.5	15.6	2.2	4.8	10.2
Reserve margin as % of peak load responsibility (without LaSalle County Station)				9.9	10.2	14.0	3.3	4.4	8.6	-2.8	-1.0	3.5	-8.5	-6.2	-1.3

[a]LaSalle County Station Unit 1 available for summer of 1980 and LaSalle County Station Unit 2 on line for summer of 1981.

[b]Present capacity planning by Commonwealth Edison calls for several additions to capacity after the LaSalle County Station comes on line. Specifically, in the 1981 thru 1983 timeframe, 4420 MWe of additional capacity are planned. This consists of four nuclear units, Byron 1 and 2 in 1981 and 1983 (1120 MWe each), and Braidwood 1 and 2 scheduled for 1982 and 1983 (1090 MWe each). The need analysis presented here excludes these additions.

[c]CE = Commonwealth Edison (applicant); OR = Oak Ridge National Laboratory; FEA = Federal Energy Administration.

8.4 CONCLUSION

The need for the LaSalle County Station generating units has been analyzed from the viewpoints of projected consumption, and from the viewpoint of minimum system cost to the consumer. The staff tested the effect of differing growth rates in consumption and econometric model assumptions and found that lower rates of growth than the applicant's expectations may still provide a less than fully adequate reserve margin in the early 1980s. Therefore, to ensure system reliability, it would be prudent to have LaSalle County Station on line approximately as presently scheduled.

The staff has determined that the operation costs of the LaSalle County Station are competitive with the high-sulfur units currently in operation in the applicant's system. Further, more expensive units using oil or low-sulfur fuel would be necessary to replace the entire 2.2 gigawatts of power represented by the two nuclear units at LaSalle County Station. The saving in operating cost the first full year of operation is estimated to be about $45 million. Also, the analysis of health effects of nuclear versus coal shows nuclear to be favorable.

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9. CONSEQUENCES OF THE PROPOSED ACTION

9.1 ADVERSE EFFECTS WHICH CANNOT BE AVOIDED

The staff has reassessed the physical, social, and economic impacts that can be attributed to the LaSalle County Station. Inasmuch as the station is currently under construction, many of the predicted and expected adverse impacts of the construction phase are evident. The applicant is committed to a program of restoration and redress of the station site that will begin at the termination of the construction period. The staff has identified additional adverse impacts in the form of increased incidence of fogging and icing that would be caused by the reduced size of the cooling lake and the attendant warmer water temperatures. In addition, one adverse effect which has occurred is the erosion of Armstrong Run (Sec. 4.2.1). Unless the staff's required remedial measures are taken, this adverse effect will continue (Sec. 5.4.1.1).

9.2 SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

The staff's evaluation of the use of land for the site of the LaSalle County Station and associated transmission lines has not changed since the preconstruction environmental review. The presence of this station in LaSalle County may influence the future use of other land in its immediate environs; however, major changes in primarily agricultural land use are not expected because of operation of the station.

9.3 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 station. The staff has, however, expanded and updated the discussion on uranium fuel availability. This updated discussion follows in the next subsections.

9.3.1 Replaceable Components and Consumable Materials

Uranium is the principal natural resource irretrievably consumed in facility operation. Other materials consumed, for practical purposes, are fuel-cladding materials, reactor-control elements, other replaceable reactor core components, chemicals used in processes such as water treatment and ion-exchanger regeneration, ion-exchange resins, and minor quantities of materials used in maintenance and operation. Except for the uranium isotopes U-235 and U-238, the consumed resource materials have widespread usage; therefore, their use in the proposed operation must be reasonable with respect to needs in other industries. The major use of the natural isotopes of uranium is for production of useful energy.[1]

The reactor will be fueled with uranium enriched in the isotope U-235. After use in the plant, the fuel elements will still contain U-235 slightly above the natural fraction. This slightly enriched uranium, upon separation from plutonium and other radioactive materials (separation takes place in a chemical reprocessing plant), is available for recycling through the gaseous diffusion plant. Scrap material containing valuable quantities of uranium is also recycled through appropriate steps in the fuel production process. Fissionable plutonium recovered in the chemical reprocessing of spent fuel is potentially valuable for fuel in power reactors.

In view of the quantities of materials in natural reserves, resources, and stockpiles and the quantities produced yearly, the expenditure of such material for the station is justified by the benefits from the electrical energy produced. A more detailed discussion of uranium supply and demand follows.

9.3.2 Uranium Resources Availability

Analysis of uranium resources and their availability has been carried out by the government since the late 1940s. The work was carried out for many years by the Atomic Energy Commission.

The activity was made part of the Energy Research and Development Administration (ERDA) when the agency was created in early 1975, and now the Department of Energy (DOE), as of October 1977.

The domestic uranium industry has, over most of its lifetime, been concerned with discovery and production of uranium at costs in the $8 to $10/lb range or less. Average prices for uranium deliveries in 1976 are reported to be $16.10/lb of U_3O_8.[2] In view of the economic acceptability of higher cost uranium in reactors, resource estimates by DOE in recent years have included resources that would be available at $15 and $30 production cutoff costs. An initial estimate of $50 resources has been made as of January 1977.[3] However, because less attention has been paid to higher cost resources, they are not as fully delineated or as well understood as the $10 resources.

At cost levels above $50, there has been little effort at appraisal of resources or in exploration. Therefore, these resources are poorly known at present and quantitative estimates are not possible (with the exception of the Chattanooga shale). Such resources are known to exist, and efforts are under way to appraise them.

In Table 9.1 are tabulated DOE estimates of domestic uranium resources. These estimates reflect the results of the preliminary phase of the DOE National Uranium Resource Evaluation (NURE) program. The resource estimates totaled 3.5 million tons up to a production cost of $30 and 4.3 million tons at $50. Of this total, 840,000 tons are in the ore reserve category. An additional estimated 140,000 tons are attributed to by-product material through the year 2000.

Table 9.1. U.S. Uranium Resources (tons U_3O_8)

		Potential		
	Reserves	Probable	Possible	Speculative
$10	250,000	275,000	115,000	100,000
$15	410,000	585,000	490,000	190,000
$30	680,000	1,090,000	1,120,000	480,000
$50	840,000	1,370,000	1,420,000	540,000
By-product sources[a]	140,000	---	---	---
	980,000	1,370,000	1,420,000	540,000

[a]By-product of phosphate and copper production.

The domestic industry currently has a production capacity of around 16,000 tons U_3O_8 per year. Plans have been reported to expand capacity to 27,000 tons/year by 1979. Industry planned to spend $535 million in 1977 and $389 million in 1978 on new mining and milling capacity, compared to $255 million spent in 1976. Study of attainable production capability from currently estimated $15 U. S. ore reserves and probable potential resources indicates that production levels of 60,000 tons U_3O_8 per year can be achieved with agressive resource development and exploitation. While the level may be achievable by use of domestic $15 ore reserves and probable resources alone, development and utilization of $15 possible and speculative categories and use of $30 ore reserves and potential resources would provide added assurance that the levels could be attained and sustained. Considering that some imported uranium will add to supplies, it is considered realistic to plan on the basis that a 60,000 tons/year supply is achievable from currently estimated resources. Such a level could be reached by the early 1990s.

The level of nuclear generating capacity supportable with this amount of uranium, as shown in Figure 9.1, will vary with enrichment tails assay and recycle assumptions. Without recycle of uranium or plutonium and with a 0.30% U-235 enrichment tails assay, about 260,000 MWe could be supported. Without recycle, and at 0.20 tails, 310,000 MWe could be supported. As shown in Figure 9.1, all the levels of supportable capacity are above the 236,000 MWe of capacity in operation (46,000 MWe), under construction (95,000 MWe), on order (68,000 MWe), and announced (27,000 MWe) as of January 1, 1977. Thus, presently estimated resources can provide adequate uranium supplies for a sizable expansion to U. S. nuclear generating capacity.

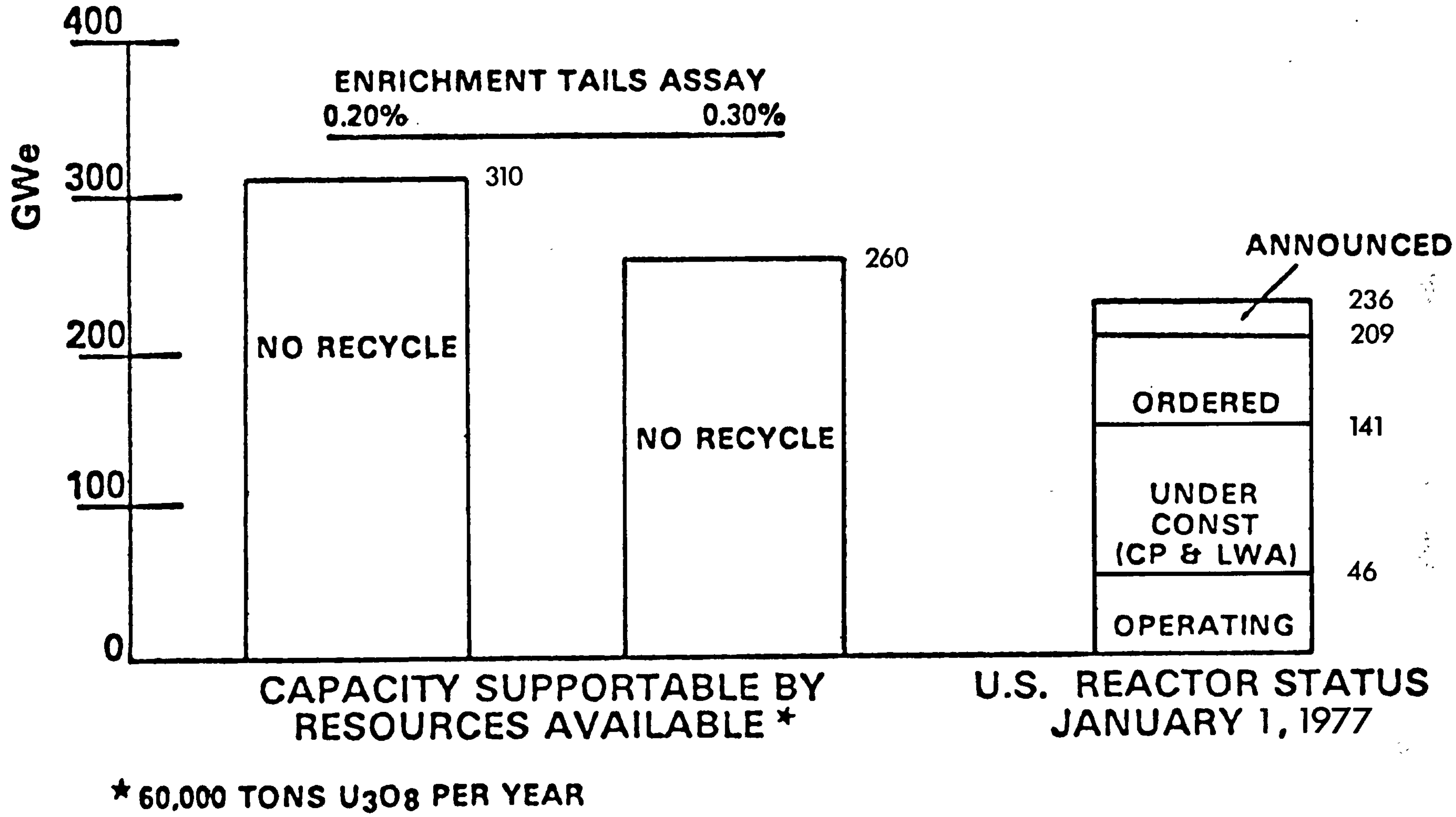

Fig. 9.1. Nuclear Reactor Capacity (GWe).

The cumulative lifetime (30 years) uranium requirements for all these reactor cases would be about equal to the 1.9 million tons in $30 (or the 2.9 million tons at $50) ore reserves, by-product, and probable potential resources. Evaluation of long-term fuel commitments on the basis of ore reserves and probable potential resources is considered a prudent course for planning. The lifetime commitment would be less than half of currently estimated $50 domestic resources, including the possible and speculative categories.

The subject of uranium availability has been considered by the Federal Energy Resources Council, which had participation by the Council on Environmental Quality, the Department of Commerce, Department of Interior (U. S. Geological Survey), Environmental Protection Agency, ERDA, and Federal Energy Administration (FEA). A report issued by the Council, "Reserves, Resources, and Production" (June 15, 1976), states "available data indicates that there are sufficient economically recoverable uranium resources on which to base an expanding national program. The adequacy of uranium to provide fuel (over their 30-year lifetime) for all existing plants and additional reactors which may be placed into service by 1990 is a reasonable planning asssumption."

9.4 DECOMMISSIONING AND LAND USE

In the long-term, beyond the useful life of the proposed generating station, this site may continue to be used for generation of electrical energy. At the termination of such use, the land areas occupied by the nuclear station would be removed from productive use, unless decommissioning measures included removal of all radioactive equipment. Although the specific requirements of decommissioning may not be worked out for several years, the various alternatives should not be diminished by the proposed action of licensing operation. Decommissioning costs have been estimated at 0.23 mills per kilowatt hour. Beneficial use of the site by future generations will not be curtailed, provided the applicant has the capability for removing all radioactively contaminated equipment, assuming that step is desirable.

NRC regulations prescribe procedures whereby a licensee may voluntarily surrender a license and obtain authority to dismantle a facility and dispose of its parts.[4] Such authorization would normally be sought near the end of the nuclear station's useful life. In any event, the Commission requires that a qualified licensee maintain valid licenses appropriate to the type of facility and materials involved. Under current regulations, the Commission generally requires that all quantities of source, special nuclear, and by-product materials not exempt from licensing under Parts 30, 40, and 70 of Title 10, Code of Federal Regulations, either be removed from the site or secured and kept under surveillance.

To date, experience has been gained with decommissioning of six nuclear electric generating stations which were operated as part of the Atomic Energy Commission's power reactor development program: Hallam Nuclear Power Facility, Piqua Nuclear Power Facility, Boiling Nuclear Superheat Power Station, Elk River Reactor, Carolinas-Virginia Tube Reactor, and Pathfinder Atomic Power Plant. The last two facilities were licensed under 10 CFR Part 50; the others were Atomic Energy Commission-owned and operated under the provisions of Part 115.

Three decommissioning modes were examined and included in the fuel cycle cost calculations in Section 8.3.1.4. These modes represent a range of costs for the alternatives available.[5] The alternatives reflect the extent of decontamination of the station site area and timing of the decommissioning action. The three decommissioning actions are described as follows:

Mothball. Putting the facility in a state of protective storage. In general, the facility may be left intact except that fuel assemblies and the radioactive fluids and wastes should be removed from the site. Adequate radiation monitoring, environmental surveillance, and appropriate security procedures should be established under possession-only license to ensure that the health and safety of the public is not endangered. The estimated cost to decommission by this mode is $12.94 million.

Prompt Removal/Dismantling. All fuel assemblies, radioactive fluids and wastes, and other materials having levels of radioactivity which do not meet accepted "unrestricted activity" levels should be removed from the site. The facility owner may then have unrestricted use of the site with no requirement for a license. If the facility owner so desires, the remainder of the reactor facility may be dismantled and all vestiges removed and disposed of. The cost of this alternative mode is estimated at $65.1 million.

The above two alternatives are defined in Regulatory Guide 1.86. A third alternative is a variant on the other two and is the middle-cost alternative:

Mothball-Delayed Removal/Dismantle. This alternative involves mothballing until the level of radioactivity is reduced to the point where the expense associated with removal and dismantling no longer depends significantly on further changes in radioactivity levels. The cost of this mode is estimated at $16.77 million.

These costs were used in estimating fuel cycle costs to the utility as presented in Section 8.3.1.4.

LaSalle County Station is designed to be operated for about 30 years, and the end of its useful life will be approximately in the year 2010. The applicant has made no firm plans for decommissioning, but assumes that the following steps would be taken as minimum precautions for maintaining a safe condition (ER, Sec. 5.8):

1. All fuel would be removed from the facility and shipped offsite for disposition.

2. All radioactive wastes--solid, liquid, and gas--would be packaged and removed from the site insofar as practical.

A decision as to whether the station would be further dismantled would require an economic study involving the value of the land and scrap value versus the cost of complete demolition and removal of the complex. The study would also consider occupational and other radiological risk exposure as a consequence of further dismantling and removal compared to onsite decontamination. However, no additional work would be done unless it was in accordance with rules and regulations in effect at the time.

In addition to personnel required to guard and secure the station, concrete and steel would be used to prevent ingress into any building, particularly the radioactive areas.

References for Section 9

1. "Survey of U. S. Uranium Marketing Activity," U. S. Atomic Energy Commission, WASH-1196(74), April 1974.

2. "Survey of U. S. Uranium Marketing Activity," U. S. Energy Research and Development Administration, Report Number ERDA 77-46, Washington, D. C., May 1977.

3. "Statistical Data of the Uranium Industry," U. S. Energy Research and Development Administration, GJO-100(77).

4. Title 10, "Atomic Energy," Code of Federal Regulations, Part 50, Licensing of Production and Utilization Facilities, Section 50.82, "Applications for Terminations of Licenses."

5. "An Engineering Evaluation of Nuclear Power Reactor Decommissioning Alternatives," Atomic Industrial Forum, Inc., AIF/NESP-009512, November 1976.

10. BENEFIT-COST ANALYSIS

10.1 RÉSUMÉ

There have been changes in the benefit-cost analysis of station operation since issuance of the construction permits. The staff has evaluated the economic benefits and costs of plant operation and has concluded that the benefits outweigh the costs (both environmental and monetary).

10.2 BENEFITS

The primary benefits of LaSalle County Station operation will be the annual production of 11.3 billion kilowatt hours of low-cost energy (at 60% capacity factor) after 1981 under load growth assumptions, and the increase in system reliability brought about by the addition of 2156 MWe of generating capacity to the applicant's system. This electrical energy is expected to be generated as cheaply as other baseload units in the Commonwealth Edison electric system.

10.3 SOCIETAL COSTS

No major economic or societal costs are expected from either station operation or the presence of station personnel and their families living in the area.

10.4 ECONOMIC COSTS

The economic costs associated with station operation beginning in 1980 are the annual $61,000,000 fuel costs and $34,000,000 operation and maintenance costs (1980 dollars). Decommissioning costs for complete restoration of the site are expected to be in the range of $12.94 million to $65.1 million at 1980 cost levels (see Sec. 9.4), a range of $434,000 to $2,180,000 for an annual sinking-fund cost.

10.5 ENVIRONMENTAL COSTS

Current analysis of environmental costs associated with the operation of the LaSalle County Station remains basically unchanged from the analysis performed in connection with the construction permits. Nevertheless, some changes in expected impacts have occurred. There will be an increase in fogging and icing over that predicted in the CP stage; this could have a significant localized effect which could require mitigation (see Sec. 5.4.1.2).

10.6 ENVIRONMENTAL COSTS OF THE URANIUM FUEL CYCLE

The contribution of environmental effects associated with the uranium fuel cycle is indicated in Table 5.16 and described in Section 5.5.3. The staff has evaluated the environmental impacts of the fuel cycle as given in Table 5.16 and Section 5.5.3 and has found these impacts to be sufficiently small so that when they are added to the other environmental impacts predicted for the proposed project, the fuel cycle impacts would not alter the overall benefit-cost balance.

10.7 ENVIRONMENTAL COSTS OF URANIUM FUEL TRANSPORTATION

The contribution of environmental effects associated with the transportation of fuel and waste to and from the facility are summarized in Section 5.4.2.4 and Table 5.15. These effects are sufficiently small as not to alter the conclusion of the benefit-cost balance.

10.8 SUMMARY OF BENEFIT-COST

As a result of this second review of potential environmental, economic, and social impacts, the staff has been able to forecast more accurately the effects of the station's operation. No new information has been acquired that would alter the staff's position related to the overall balancing of the benefits of this station versus the environmental costs. The staff finds that the benefits of minimizing system production economic and environmental costs and meeting potential growth in electrical demand through the addition of 2156 MWe baseload capacity greatly outweigh the environmental, social, and economic costs. Benefits and costs are summarized in Table 10.1.

Table 10.1. Benefit-Cost Summary (see Appendix H for calculations and explanations of table entries.)

Primary Impact and Population or Resource Affected	Unit of Measure	Magnitude of Impact
	Direct Benefits	
Energy (60% Capacity Factor)	kWh/yr × 10^6	11,300
Capacity	kW × 10^3	2,156
	Economic Costs	
Operating (60% Capacity Factor)		
Fuel	$/year	61,000,000
Operation & maintenance	$/year	34,000,000
	Environmental Costs	
1. Impact on Water		
1.1 Consumption	m^3/yr	44.2 × 10^6
	acre-ft/yr	35,800
1.2 Heat discharge to natural water body		
1.2.1 Thermal discharge to river	Joules/sec	218 × 10^6
	Btu/hr	745 × 10^6
1.2.2 Aquatic biota		Insignificant
1.3 Chemical discharge to natural water body		
1.3.1 People		Negligible
1.3.2 Aquatic Biota		Negligible
1.3.3 Water quality		Negligible
1.3.4 Chemical discharge	mg/L	See Table 3.2.4-1
1.4 Radionuclide contamination of natural surface water body	tritium (μCi/yr)	15 × 10^6
	All others (μCi/yr)	1.9 × 10^5
1.5 Chemical contamination of groundwater		
1.5.1 People		Not discernible
1.5.2 Plants		Not discernible
1.6 Radionuclide contamination of groundwater		
1.6.1 People		Not discernible
1.6.2 Plants and animals		Not discernible
1.7 Raising/lowering of groundwater levels		
1.7.1 People		Not discernible
1.7.2 Plants		Not discernible
1.8 Effects on natural water body of intake structure and condenser cooling systems		
1.8.1 Plankton, benthic drift organisms, fish larvae	% of min, 7-day, 10-year low river flow	3
1.8.2 Fisheries		Negligible
1.9 Natural water drainage		
1.9.1 Flood control		Acceptable
1.9.2 Erosion control		Acceptable

Table 10.1. Continued

Primary Impact and Population or Resource Affected	Unit of Measure	Magnitude of Impact
2. Impact on Air		
2.1 Chemical discharge to ambient air		
2.1.1 Air quality		Negligible
2.2 Calculated maximum individual dose from gaseous radioactive effluents		
2.2.1 Noble gas effluents (whole body)	mrem/yr	0.06
2.2.2 Radioiodine and particulates (any organ, all pathways)	mrem/yr	0.70
2.3 Fogging and icing		
2.3.1 Ground transportation		10 days per year
2.3.2 Air transportation		Negligible
2.3.3 Water transportation		Negligible
2.3.4 Plants		Not discernible
3. Total Body Doses to U.S. population General Public, Unrestricted Area.	man-rem/yr (year 2000)	43
	Societal Costs	
1. Operational Fuel Disposition		
1.1 Fuel transport (new)	trucks/yr	5
1.2 Fuel storage		In-building storage
1.3 Waste products (spent fuel)	rail cars/yr	14
2. Station Labor Force	Statement	No significant societal costs are expected
3. Historical and Archeological Sites	Statement	No effect
4. Esthetics	Statement	Acceptable

11. DISCUSSION OF COMMENTS RECEIVED ON THE DRAFT ENVIRONMENTAL STATEMENT

Pursuant to 10 CFR Part 51, the draft environmental statement for the LaSalle County Station was transmitted, with a request for comments, to:

Advisory Council on Historic Preservation
Department of Agriculture
Department of the Army, Corps of Engineers
Department of Commerce
Department of Health, Education and Welfare
Department of Housing and Urban Development
Department of the Interior
Department of Transportation
Department of Energy
Environmental Protection Agency
Federal Energy Regulatory Commission
Illinois State Clearing House
Illinois Department of Public Health
Illinois Institute for Environmental Quality
Board of Supervisors for LaSalle County, Illinois
Lawrence Fichter

In addition, the NRC requested comments on the draft environmental statement from interested persons by a notice published in the FEDERAL REGISTER on April 21, 1978 (43 FR 17047). In response to the requests referred to above, comments were received from:

Department of Agriculture, Economics, Statistics, and Cooperative Service
Department of Agriculture, Forest Service
Department of Agriculture, Soil Conservation Service
Department of Energy
Environmental Protection Agency, Region V
Department of Health, Education, and Welfare
Department of Housing and Urban Development
Department of the Interior
Department of Transportation, Federal Highway Administration
Illinois Department of Public Health
Elaine Walsh
Susan Mulhall
Commonwealth Edison Company

The comments are reproduced in this statement as Appendix A. The staff's consideration of the comments received and its disposition of the issues involved are reflected in part by revised text in the pertinent sections of this final environmental statement and in part by the following discussion.

The following responses are keyed to the original comment using a letter and number code. For each response, the letter identifies the commentor, and the number identifies the specific comment. The letter designation (e.g., A, B, C) was assigned in chronological order according to when the comments were sent. The number designation (e.g., 1, 2, 3) was assigned in numerical order as to where the specific comment occurred. Additionally, the specific comments in Appendix A are identified by marginal notation and letter-number code. This was done to assist the reader in referring from each specific comment to its response.

A. U.S. DEPARTMENT OF AGRICULTURE, App. A, Page A-3

A-1. Erosion of Adjacent Land
The environmental statement has been revised accordingly.

A-2. Revegetation
Throughout the requirements on page 4-6 of the draft environmental statement, and the preceding discussion, the emphasis is on the integrity of vegetative cover as a means

of stabilizing slopes rather than on the biotic value of vegetation. The staff is stating in item 4 on page 4-6 that the minimum acceptable stabilization is reseeding with sod-forming grasses, and application of netting, mulch and a soil binder. The purpose of item 4 is to achieve normal stabilization. Any measures which may afford greater erosion protection at "critical sections," such as riprap, may be necessary to achieve stabilization.

A-3. Erosion Protection
In the paragraph following item 5 on pages 4-6 and 4-7, the staff concluded that removal of all silt (clay deposits) from Armstrong Run is not warranted, and advised against dredging the Run. However, the staff did not require leaving all of the silt in place. Thus, the applicant may remove some of the silt in critical areas as a part of the reshaping of the Run without conflicting with the requirements in the environmental statement. The staff understands that the applicant has been consulting with the local Soil Conservation Service office in connection with any detailed recommendations in this regard.

B. U.S. DEPARTMENT OF THE INTERIOR, App. A, Page A-12

B-1. Aquatic Monitoring
The staff concurs with this recommendation, since increased sampling will provide more meaningful data by reducing some of the variation due to sampling frequency. Section 6.3.5.1 of the environmental statement has been revised accordingly.

B-2. Recreation Management Plan
The applicant plans to provide a recreational park within the site boundary for camping, picnicking and field sports in an area of about 25 ha (60 acres) on the shoreline of the cooling lake. The park is intended for both day users and overnight campers (ER p. 2.1-4). Boat launching and parking areas will also be provided if use of the lake for recreational purposes is approved.

The staff regards the recreational area plans, which have been developed over a number of years through the construction permit and operating license review stages, as a reasonable and adequate commitment to recreational use and therefore will not require that the recreational use plan be expanded further. The recreational uses are ancillary to the main purpose of the project. All uses, of course, must be compatible with and in the interest of the health and safety of the public as well as the security and safety of the station.

C. U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE, App. A, Page A-10

C-1. Water Standards
The environmental statement has been revised accordingly.

C-2. Radiological Impacts
A statement is included in the final environmental statement (see Sec. 5.5.2.5) pertaining to Commonwealth Edison Company's station being regulated by the requirements specified in the EPA's 40 CFR 190, "Environmental Radiation Protection Standards for Nuclear Power Operations."

C-3. Occupational Radiation Exposure
Under current regulations and experience, the cited occupational man-rem is considered reasonable. As noted in Section 5.5.2.4, there will be many variables which influence occupational exposure and make it difficult to determine a quantitative total occupational radiation dose for a specific station. Therefore, past experience from operating nuclear power stations has been used to provide a widely applicable estimate to be used for all light water reactor power stations of the type and size of the LaSalle County Station. This experience indicates a value of 500 man-rem per year per reactor.

C-4. Radiological Monitoring Program
The staff changes to the preoperational radiological monitoring program listed in item 2 (page 6-7) of the draft environmental statement, included a composite surface water sampler capable of collecting an hourly aliquot relative to the compositing period at two locations. The applicant will be required to incorporate this change (see response to comment I-39).

C-5. Population Exposure to Radiation
The dose models used to estimate the population exposure from gaseous effluents are given in the NRC Regulatory Guide 1.109 (cited in comment C-2 by HEW and in Appendix E

of the environmental statement). The operational offsite radiological monitoring program is conducted to measure radiation levels and radioactivity in the plant environs. It also provides support to the plant effluent monitoring program.

C-6. Emergency Response Planning
Chapter 10, Part 50 of the Code of Federal Regulations (10 CFR 50) contains guidance as to what should go into an emergency response plan for a commercial power facility. Specifically, Appendix E of 10 CFR 50 discusses the content and scope of the emergency plan. The details of this plan are included in the applicant's final safety analysis report and are analyzed as part of the safety review by the NRC staff. Because this is part of the safety review, and not part of the staff's environmental review, the results are contained in the staff's safety evaluation report (SER), not the environmental statement. The SER for the LaSalle County Station is scheduled for publication after the final environmental statement.

C-7. Reactor Safety
The staff acknowledges that the discussion in paragraph 3, page 7-2 of the DES (relative to the discussion with EPA) is somewhat out of date. However, NRC is sponsoring additional work to extend and further examine the analyses reported in the Reactor Safety Study. Furthermore, the staff's conclusion is based upon its independent evaluation of the realistic consequences due to the accidents postulated. The staff did not rely solely upon the Reactor Safety Study for its conclusions.

D. U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT, App. A, Page A-11

D-1. Alternatives to the Proposed Action
The construction permit phase final environmental statement (which was included in the operating license phase draft environmental statement as Appendix I) addressed numerous alternatives to the then-proposed LaSalle County Station. These alternatives included importing large power blocks into the service area, the use of alternative energy sources, and alternative sites and systems for the LaSalle County Station (see Sec. XI.A of the FES-CP).

Consideration of the alternative of license denial is inferred in the analysis and evaluation set forth in the environmental statement. After weighing the environmental costs and after considering available alternatives at the construction stage, the staff concluded that operating licenses for Units 1 and 2 of the station should be issued subject to certain conditions. (See Item 6 of the summary and conclusion in the environmental statement.)

The staff evaluation of operational and management policies and practices (such as quality assurance programs) is included in the safety analysis report which will be issued after the final environmental statement is published.

E. U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, App. A, Page A-2

E-1. Recreational Value Enhancement
The staff believes that tree plantings along the edges of the cooling lake would be detrimental to the cooling effectiveness of the lake because of their interference with normal winds or air motion induced by the lake's warm waters. Plantings in the recreational area planned to be located southwest of the lake on the site are proposed presently by the applicant (see response to comment B-2).

E-2. Transmission Right-of-Way
The discussion of transmission lines is brief because the staff concluded in Section 3.2.5 that there should be no change in the impact assessment as described in the FES-CP.

While the staff agrees in principle that rights-of-way should be managed as potential wildlife habitat, the agricultural character of the LaSalle County Station rights-of-way do not afford any appreciable opportunity for developing a wildlife management program.

F. ELAINE WALSH, App. A, Page A-17

F-1 and F-3. Fog Impacts
The ten days referred to are for fogging anticipated at the LaSalle County Station. This has now been changed to 100 to 200 hours. The original estimate was summed to give an approximate cumulative impact period (i.e., ten days multiplied by about 20 hours per day). Because it was somewhat misleading, this impact estimate was changed

to the 100- to 200-hour figure. Thus, the impacts could range from days to a few hours per day for many (i.e., 50 to 100) days.

The staff recognized that fogging could be a potential problem near the cooling lake. Thus, the applicant is required to monitor the extent and effects of the fog (see Sec. 6.2.1), and if there is a problem, the applicant must mitigate it (see Secs. 5.4.1.2 and 6.2.1).

The Dresden cooling lake, operating in the closed-cycle mode, does create fog more than ten days per year over Lorenzo Road (about 100 m south of the edge of the water surface) and over County Line Road (a meter or two above the water surface). Data on fog and icing frequencies near the Dresden cooling lake from January 1972 through March 1973 have been supplied by the applicant (ER Sup. 6, Q 400.38 through 400.41), but none of the data collected by the applicant since the start of closed-cycle operation have been made available to the staff, including information on traffic accidents, road hazards, etc.

The predicted ten days of fog discussed in the draft environmental statement (page 5-12) would occur at two roads further from the pond than Lorenzo and County Line Roads: County Road 6 (about 300 m or 1000 ft south) and State Route 170 (about 900 m or 3000 ft east of the cooling pond). Since steam fog tends to evaporate, lifts to become a cloud layer, and becomes less dense as the fog moves downwind from the edge of the water, the expected frequency and severity of fogging and icing over those two highways will be less than that observed on Lorenzo and County Line Roads at Dresden. The reduction of visibility over the two roads near LaSalle will be much less than that observed over the roads near Dresden, lowering the hazard to traffic and other impacts.

The applicant has committed to a monitoring program to determine the degree of environmental impact and safety hazard caused by heat and moisture releases from the LaSalle County Station, and has committed to take measures to reduce or eliminate the hazards (see Secs. 5.4.1.2 and 6.2.1).

F-2. <u>Cooling Lake Dike Integrity</u>
See the response to comment K-4.

F-3. <u>Fog Impacts</u>
The response to this comment is included in the response to comment F-1.

F-4. <u>Land Utilization</u>
No floodplain land is involved at the LaSalle County Station site. The site vicinity has an elevation of 210 to 220 m (700 to 724 ft) MSL. At the lower end of Dresden Island (upstream of the site) the nominal river surface elevation is 153.8 m (504.7 ft) MSL. Thus, the LaSalle site is approximately 60 m (195 ft) above the nominal river surface. The LaSalle cooling lake does occupy part of the drainage basin of the headwaters of Armstrong Run, but because of the design basis of the man-made drainage ditches (of which Armstrong Run is an example), these structures do not have floodplains (see Sec. 4.2.1, pp. 4-1 through 4-3).

F-5. <u>Radiological Impacts</u>
The LaSalle County Station is located on a bluff about 8 km (5 mi) south of the Illinois River and about 70 m (230 ft) above the normal level of the Marseilles Pool. The relative location and elevation difference of the LaSalle County Station and the Illinois River preclude flooding with the exception of local drainage. Therefore, the design-basis flood event for the station is the probable maximum precipitation (PMP). A more detailed discussion of the PMP as the design basis for the station will be contained in the staff's Safety Evaluation Report, which is scheduled to be published after this environmental statement. The cooling reservoir is designed to accept the PMP without failure.

Separately, the staff has evaluated the quality of the releases from the station's cooling reservoir and concluded that it meets the radioactive limitations of Appendix I, 10 CFR Part 50. Thus, even if water were released from the station reservoir during extreme precipitation events, such releases would be further diluted and no perceptible radiological hazard would exist.

F-6. <u>Station Decommissioning</u>
Rather than lock an applicant into decommissioning techniques reflecting the state-of-the-art at the time of licensing, the NRC postpones the selection of specific decommissioning methods until the time of decommissioning. This practice enables a licensee to select from the most current decommissioning techniques, and thus would reflect

current state-of-the-art practices. This is why decommissioning details are not determined at the time of an operating license review, and this is why no decommissioning details are contained within the environmental statement.

The NRC has, however, published guidelines for decommissioning. These guidelines are contained in Regulatory Guide 1.86, "Termination of Operating Licenses for Nuclear Reactors." In addition, Section 50.82 of Chapter 10 of the Code of Federal Regulations (10 CFR 50.82) provides that the licensee may dismantle and dispose of the component parts of a nuclear reactor in accordance with existing regulations. In the case of nuclear power reactors, dismantling has usually been accomplished by shipping fuel offsite, making the reactor inoperable, and disposing of some of the reactor components.

The staff has also estimated in general terms the environmental impact from decommissioning light water reactors. NUREG-0116 ("Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle," October 1976) contains in Section 4.8 a discussion of these estimated impacts.

Table 4.31 of NUREG-0116 summarizes these impacts, and includes entries for natural resource use, electrical energy use, radiological impacts, and occupational exposure. Additional information is found within the text of NUREG-0116 on costs, radioactively contaminated waste disposal, occupational and public exposure, accidental public exposure, resource commitments, water use and discharge, and other impacts, such as traffic and electrical consumption.

F-7. Land Utilization
The Atomic Safety and Licensing Appeal Board (ASLAB) accepted the remanded finding that the land necessary for the cooling lake "would not be required to meet domestic needs and to permit at least modest exports of agricultural products during the facility's lifetime." The ASLAB further affirmed the ultimate conclusion that "NEPA considerations do not, in this instance, mandate the replacement of the lake with some other feasible cooling system which might utilize appreciably less land" (ASLAB-193, April 15, 1974).

F-8. Resource Utilization
Consumptive water use amounts to 1.34 m^3/s, which is approximately 1.5% of the 7-day 10-year recurrence-interval low flow of the Illinois River. Thus, even for a "worst-case" situation, consumptive water use is minimal when compared to the river flow. Furthermore, in reality, this water is not lost from the environment, but is returned to it via the hydrological cycle.

F-9. Station Siting
It should be pointed out that the regulations (10 CFR Part 50.13) do not require an applicant to design a nuclear power plant against enemy attack under wartime conditions. Because of their relatively remote and isolated locations, nuclear power plants are not expected to be preferred targets when compared to concentrated facilities represented by large cities. In any event, in view of the separation distances of 24 to 32 km (15 to 20 mi) between the facilities named, the staff considers it unlikely that a single missile, even one utilizing a large nuclear weapon with a typical destructive radius of about 8 km (5 mi), could simultaneously destroy these facilities.

G. SUSAN MULHALL, App. A, Page A-17

G-1. Socioeconomic Impacts
Some of the socioeconomic changes associated with the construction of the plant are stated in various sections of the construction permit stage environmental statement (see, for example, Secs. II, IV, VII, and XI of Appendix I of the operating license stage DES). During the operation of the plant, some of the changes in the quality of life could be perceived as undesirable. However, the socioeconomic impact of plant operation would be minimal since this represents a staff of about 403 workers (see Sec. 5.2). These workers are often recruited from the local community and the work is permanent. Thus, the characteristics of operating personnel at the LaSalle County Station are not expected to be different than for any other stable industrial employment which would draw workers from the nearby community.

G-2. Land Utilization
The siting criteria of the LaSalle County Station were discussed in Sections I-A and XI-B of the construction permit stage FES. These criteria included geologic conditions, water requirements, population density, location within the south-central region of the service area, and the geographic separation of the site from other existing or proposed facilities. It was concluded that of the various alternate sites proposed and studied, none was better suited environmentally than the LaSalle County site.

G-3. Transmission Line Impacts

The largest transmission lines resulting from the construction of the LaSalle County Station have a capacity of 345 kV (see Sec. III-B in the FES-CP and Sec. 3.2.5 of this environmental statement). A farmer working directly under a 345-kV transmission line will be exposed to an electric field of less than 10 kV/m (0.2 kV/in). By comparison, Kouwenhoven et al.* have found no health (physical, mental, and emotional) effects in lineworkers who were exposed to field strengths up to 470 kV/m (12 kV/in). Thus, farmers working directly under the transmission lines from the LaSalle County Station should experience no adverse health effects.

No virgin or mature second growth timber areas exist along the LaSalle County Station transmission rights-of-way.

Based on staff observations along existing transmission lines near the LaSalle County Station site, the soil disturbances due to construction of the line will affect agricultural productivity for only a few growing seasons. It is possible that crop yields may be less on the disturbed site than on the remainder of the field until plowing and routine fertilizing mitigate the effect. The total area involved is generally less than or equal to the area of the tower bases, and is due to mixing clay (from the excavation for tower foundations) with the topsoil.

G-4. Transmission Line Impact Monitoring

Based on the expectation of no adverse effect to farmers below the transmission lines from the LaSalle County Station (see response to comment G-3), the staff will not require the monitoring of electric fields under the power lines. Numerous other environmental parameters will be monitored in the plant area (see Sec. 6.3), and these requirements will be included in the environmental technical specifications for the LaSalle County Station (Appendix B to the operating license). Additional state-required or EPA-required monitoring programs also may be conducted (see, for example, the NPDES permit requirements).

G-5. Station Decommissioning

As was stated in the response to comment F-6 from E. Walsh, the NRC does not require an applicant at the time of licensing to specify in detail the anticipated decommissioning procedure. This practice allows the applicant to use state-of-the-art procedures when he does decommission the facility some 30 or more years from now. The decommissioning technology is not complex, however, and numerous reactors have been decommissioned to date. For more information, NUREG-0116, Regulatory Guide 1.86, and 10 CFR 50.82 should be consulted.

G-6. Radioactive Waste Disposal

The solid wastes referred to on page I-28 are low-level radioactive wastes resulting from routine operation of the facility. The environmental statement goes on to cite examples of such wastes; these include wet wastes (spent demineralized resins, filter sludges, and evaporator bottoms) and dry wastes (air filters, miscellaneous paper and rags from contaminated areas, contaminated clothing, tools, and equipment parts which cannot be effectively decontaminated, and solid laboratory wastes). It is estimated that, for both units, approximately 620 m^3 (22,000 ft^3) of low-level radioactive wastes will be shipped offsite each year. This volume is equivalent to approximately 3000 55-gallon drums.

There are currently six commercially owned low-level waste burial grounds, and five major and nine supplementary Government-owned low-level waste disposal sites now being operated by the U. S. Department of Energy (DOE). The six commercially owned sites are located at Beatty, Nevada; Maxey Flats, Kentucky; West Valley, New York; Hanford, Washington; Sheffield, Illinois; and Barnwell, South Carolina. All but one of these six are licensed by "Agreement States" under the Atomic Energy Act of 1954; the remaining one (Sheffield, Illinois) is licensed by the NRC. Three of the six are currently operating: Beatty, Hanford, and Barnwell. Of the remaining three, two are closed (Maxey Flats and West Valley), and one is full to current capacity (Sheffield). Additional information regarding these burial sites is contained in the draft report "Report of Task Force for Review of Nuclear Waste Management," February 1978, U. S. Department of Energy. It is anticipated that the applicant will use one of the above-noted operational commercially owned low-level waste burial grounds.

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*W. B. Kouwenhoven et al., "Medical Evaluation of Men Working in AC Electric Fields," IEEE Transactions on Power Apparatus and Systems PAS-86(4), April 1967.

H. ILLINOIS DEPARTMENT OF HEALTH, App. A, Page A-14

H-1. Radiological Impacts
Recreational activities on the Illinois River within 80 km (50 mi) downstream of the plant were included in the evaluation of population doses. Swimming along the Illinois River was considered because swimming in the lake has not been approved at this time (see Sec. 6.2.6). Less than 0.01 man-rem of the population dose within 80 km is attributed to recreational activities.

H-2. Radiological Gaseous Effluents
The assumption expressed in this comment is correct. That is, the Table 5.6 heading "Waste-Gas System" does include the releases from the main-condenser air ejector off-gas system for LaSalle County Station, Unit Nos. 1 and 2.

H-3. Ventilation Effluents
The reactor and turbine building ventilation stack effluents have been incorporated in the sources defined as A & B in Table 5.8. Source B is from the mechanical vacuum pump. All other sources were included in Source A.

H-4. Atmospheric Dispersion
The radioactive gaseous effluents from both Unit 1 and 2 are released from a common stack as a continuous release (defined as A) and periodic releases (defined as B). The change in sector direction is the result of using current onsite meteorological and land use data.

Onsite meteorological data were not available for the Construction Permit review. The calculation of relative concentration (χ/Q) values presented in the OL-DES and OL-FES is based on onsite meteorological data as described in Sections 2.4 and 6.2.1.

H-5. Radiation from the Facility
Commonwealth Edison Company estimated an annual skyshine dose rate of 4 mrem/station at the nearest site boundary, which is within the staff's estimate for newer plant designs. Thus, the general value cited by the staff provides a more conservative assessment than that of the specific value cited by the applicant.

H-6. Occupational Radiation Exposure
The estimated man-rem occupational radiation dose is based on routine plant operations, and not accident conditions. Chapter 7 addresses the various consequences of plant accidents.

H-7. Accident Analysis
The consequences of an off-gas system hydrogen explosion are approximately the same as those listed Class 3.2, "Release of Waste Gas Storage Tank Inventory" of Table 7.2 of the final environmental statement.

H-8. Accident Analysis
The maximum population dose occurs for the large pipe break LOCA; this is consistent with the FES-CP. In the interim between the staff's FES-CP and DES-OL, there have been some changes in the dose conversion factors used. The staff presently uses the dose conversion factors listed in Regulatory Guide 1.109. This has resulted in a reduction of whole-body doses in accidents such as radioactive waste gas system failures due to the elimination of the beta skin dose as a whole-body dose, as was formerly used.

H-9. Accident Analysis
The purpose of the environmental impact statement is to realistically estimate the impact on the environment from the proposed facility. In keeping with this, the staff has performed a realistic estimation of the radiological consequences of accidents, as shown in Table 7.2 of the environmental statement, using the source terms given in the proposed Annex to 10 CFR Part 50, Appendix D. The staff does not use the standard BWR source terms given in Regulatory Guide 1.CC (now published as NUREG-0016), since the data of NUREG-0016 are used to calculate doses from routine releases rather than accidents. The conservative doses from postulated accidents will be published in the staff's safety evaluation report, which is scheduled to follow the publication of the final environmental statement.

H-10. Gaseous Radwaste Releases
Our calculated releases from the radwaste building ventilation system for LaSalle County Station, Unit Nos. 1 and 2, considered a decontamination factor (DF) of 100 for particulate removal of HEPA filtration as recommended in Appendix B, Section 11, page C-85, to draft Regulatory Guide 1.CC. The releases (without treatment) given in the table on page C-56 of draft Regulatory Guide 1.CC are "prior to treatment" and

should be reduced by the DF applicable to the proposed treatment system. The staff has calculated the radwaste building effluent releases based on the HEPA filtration using a DF of 100 for particulates and a DF of 1 for noble gases and radioiodines using the reference (BWR-GALE Code) given in Section 5.5.2 (DES-OP).

I. COMMONWEALTH EDISON COMPANY, App. A, Page A-19

I-1. Transmission Line Tower Design
The environmental statement has been revised accordingly.

I-2. Protection against Land Erosion
The staff has reviewed its own analysis and assumptions, and finds no reason to alter the assumptions, as suggested in Attachment A to the comment. Thus, the staff analysis stands as is, along with the conclusion that the failure to seed the exposed dike (for whatever extenuating circumstances) did contribute to the erosion problem.

The change in area drained by the Run certainly will have reduced the total discharge resulting from any rainfall event. However, the changes in watershed geometry have changed the shape of the discharge curve, resulting in a higher peak discharge under certain circumstances (Sec. 4.2.1, p. 4-5) although the area under the curve is reduced. With respect to the proposed changes in Requirements 1 through 5 in Section 4.2, correspondence between the staff and the applicant (see, for example, the May 24, 1978, letter from Voss A. Moore, NRC, to Byron Lee, Jr., Commonwealth Edison Co.) has modified the requirements. The requirements, in their final form, are reproduced in Section 4.2.1 of this environmental statement.

I-3. Protection against Land Erosion
See response to comment A-3.

I-4. Operating License Issuance
The predicted fuel load date of early 1980 is based on the NRC staff estimates which take into account construction milestones and anticipated additional construction time. This estimate is current as of July 1978, but may be revised if warranted.

I-5. Meteorological Data
Section 2.4 of the environmental statement has been modified and addresses this comment.

I-6. Tornado Probabilities
This comment represents the opinion of the applicant. The difference in computed recurrence interval (i.e., 625 vs. 460 yrs) is not considered significant in light of the expected 40-year operating life of the facility.

I-7. Atmospheric Dispersion
The information concerning the frequency of atmospheric stagnation conditions based on Korshover is presented as an indicator of long-term, regional conditions. Onsite meteorological data have been used to describe local conditions in greater detail.

I-8. Meteorological Data
Section 2.4.4 of the environmental statement has been modified, as appropriate, as a result of this comment.

I-9. Transmission Line Impacts
Section 2.7 and Appendix B of the environmental statement have been revised accordingly.

I-10. Cooling Lake Design
Reduction in the cooling pond size is addressed in Section 3.2.2.1.

I-11. Radwaste Treatment System Modification
Section 3 of the environmental statement is limited to descriptive text and proposes to make environmental impact assessments only in unusual cases. As the comment indicates, impact evaluation of any facility changes are presented in Section 5.5 of the environmental statement. The resume of Section 5 notes that radiological impact evaluations have been updated to reflect the new source terms.

I-12. Cooling Water Requirements
The environmental statement has been revised accordingly.

I-13. Cooling Water Requirements
The environmental statement has been revised accordingly.

I-14. Cooling Water Recirculation
The environmental statement has been revised accordingly.

I-15. Cooling Lake Design
The value indicated is based on a volume of 35 × 10^6 m^3 (9 × 10^9 gal), calculated from data in the environmental report, Section 3.4.2.

I-16. Cooling Water Requirements
The environmental statement has been revised accordingly.

I-17. Cooling Water Additives
The environmental statement has been revised accordingly.

I-18. Water Filtration
The environmental statement has been revised accordingly.

I-19. Water Chlorination
The environmental statement has been revised accordingly.

I-20. Transmission Line Design
The new information referred to was submitted as Supplement 6 to the ER and was too late to be included in the draft environmental statement. This information has been used to revise the final environmental statement (See Sect. 3.2.5).

I-21. Blowdown Discharge to the River Impacts
The environmental statement has been revised accordingly.

I-22. Cooling Water System
The environmental statement has been revised accordingly.

I-23. Chlorination of Sewage
The environmental statement has been revised accordingly.

I-24. Water Discharge Quality
The environmental statement has been revised accordingly. The correct value (i.e., 806.7 mg/L) was cited in Section 3.2.4 of the draft environmental statement, and was used in the impact assessment.

I-25. Terrestrial Sampling Program
The staff agrees that monitoring for biological effects of induced changes in microclimate would be very difficult to implement. The continuing changes in land use cited in the comment may preclude establishing any permanent sample locations suitable for detecting the postulated effect if it occurs. Furthermore, as pointed out in this comment, the season most likely to have fogging and icing effects (i.e., winter), is the dormant season for woody and herbaceous vegetation. Consequently, the requirement to monitor Stations 5 and 15 beyond the initial five-year program has been removed.

I-26. Fog Monitoring Program
Section 6.2.1 of the environmental statement has been expanded, where appropriate, to include a fog-monitoring program. This program will begin as early as possible (in an effort to obtain one full year of fogging data prior to one-unit operation) and continue until there is at least one 12-month period of data collected reflecting two-unit operation.

I-27. Aquatic Impacts
The staff did not mean to imply a 100% mortality for all organisms entrained through the condenser. The intent was to indicate that some of the organisms will be killed as a result of this passage. The actual percent mortality will vary depending on the species group (see Ref. 18, Sec. 5). Therefore, the environmental statement has been changed to reflect this intent.

However, at the CP stage the staff did conservatively assume that 100% of the aquatic biota pumped from the Illinois River had been "removed" and not returned. It was concluded in the FES-CP that even at minimum flows (less than the 7-day 10-year recurrence-interval low flow) this impact was acceptable. The staff further qualified this assumption by noting that indeed not all of the biota entrained would be lost. The OL environmental statement does not differ from these assumptions and conclusions.

I-28. Aquatic Impacts
The environmental statement has been revised accordingly.

I-29. Atmospheric Factors
The "unknown multiplier" referred to by Commonwealth Edison Co. in this comment is documented in the March 1976 version of Regulatory Guide 1.111 and in NUREG-0324 (September 1977). This "adjustment" to the straight-line airflow model to account for spatial and temporal variations in airflow is based on a comparison of atmospheric dispersion models using data from the Braidwood site. Results of radiological monitoring programs provide only estimates of airborne concentrations, and the results of radiological monitoring programs are not considered completely sufficient to characterize spatial and temporal variations of airflow. However, the results of the radiological monitoring programs at the Dresden and Quad Cities sites indicate that the adjustments in relative concentration (χ/Q) and relative deposition (D/Q) as used for the LaSalle County Station site area are reasonably conservative.

I-30. Dose Assessments
The dose assessments in the environmental statement are based on the staff's source terms and meteorological evaluation, and not that of the applicant.

I-31. Dose Assessments
The use of special shielding at the LaSalle County Station to minimize direct radiation and skyshine dose rates is mentioned in the revised section on direct radiation (Sec. 5.5.2.4) of the environmental statement. However, for purposes of its analysis the staff relies on its own conservative estimate.

I-32. Dose Assessments
The environmental statement has been revised accordingly.

I-33. Revision of Table S-3
The NRC staff has revised the appropriate sections of the environmental statement to reflect recent information relative to the staff's views on radon-222 values and impacts, and the revised Table S-3.

I-34. Radon Releases
See the response to I-33.

I-35. Economic Impacts
The environmental statement has been revised accordingly.

I-36. Meteorological Monitoring
The environmental statement has been revised accordingly.

I-37. Terrestrial Ecology Monitoring
The sentence has been revised to read "discontinued as scheduled."

I-38. Radiological Monitoring
The bi-weekly frequency for charcoal air sample cartridges is acceptable for preoperational radiological environmental monitoring, but a weekly frequency will be needed for the operational monitoring program. The change in sampling and analysis frequency from weekly to bi-weekly will be determined on documentation of increased sensitivity during operational monitoring at the LaSalle County Station area.

I-39. Radiological Monitoring
The composite surface water sampler recommended by the NRC staff will be required for the operational radiological environmental monitoring program. However, weekly grab samples are acceptable for preoperational monitoring.

I-40. Radiological Monitoring
The LLD's submitted by Commonwealth Edison Co. in Attachment D to their comments are acceptable to the NRC staff, and reference to those LLD's in the draft environmental statement (i.e., Sec. 6.2.5) has been deleted.

I-41. Lake Management Program
Section 6.2.6, "Lake Management Program," has been corrected so that the initial sampling period for fecal and total coliforms and fecal streptococci is consistent with that specified in Enclosure Comment 3 of the December 13, 1976, NRC letter to Commonwealth Edison Co.

I-42. Lake Management Program
In accordance with the Atomic Safety and Licensing Board's decision (as noted in Sec. 6.2.6), the staff will still require that the applicant consider all possible recreational uses of the cooling lake. In developing their recreational use plan, the applicant should, of course, weigh all potential significant costs (such as public

safety and liability, increased rate-payer burden, and degradation of water quality) with the potential benefits of providing the public with a recreational area.

The staff takes note of Commonwealth Edison Co.'s comments regarding the size of the shoreline, and the possibility that higher-powered boats may hinder the use of the lake by smaller vessels (i.e., canoes, rowboats, and sailboats). However, the staff would like to point out that there will be approximately 500 m (1500 ft) of shoreline adjacent to the designated recreational area (see Fig. 5.6-1 of the OL-stage ER), and that the average depth of the cooling lake will be 4.7 m (15 ft) (see Table 3.1). Thus, it appears that there is adequate shoreline available for various recreational uses, and the lake should have enough depth to prevent the resuspension of bottom sediments due to powerboat operation.

The error in Section 6.2.6 pointed out by Commonwealth Edison Co. has been corrected in the environmental statement. The sentence in the draft environmental statement should have had "swimming" as an example of primary-contact sports, and "boating and fishing" as examples of secondary-contact sports.

I-43. Aquatic Ecology Monitoring
The environmental statement has been changed to reflect the applicant's commitment to monitor aquatic biota in concert with thermal studies.

I-44. Radiological Monitoring
The NRC will base changes to the operational monitoring program on the results obtained at the LaSalle County Station during the two years of monitoring.

I-45. Scheduled Station Operation Dates
The environmental statement has been revised accordingly. (See also response to comment I-4.)

I-46. Health Effects of Alternatives
This comment expresses the opinion of the applicant. In that the applicant agrees with the staff about the conclusion of Section 8.3.2 (i.e., that the nuclear fuel cycle has substantially less environmental and health impacts than does the coal fuel cycle), no response is necessary.

I-47. Load Growth Estimates
Commonwealth Edison Co. forwarded new information on load forecasts on June 2, 1978, after the draft environmental statement was published in March 1978. The staff has examined this material to see what impact it may have on the conclusions reached in the draft environmental statement.

Of the material submitted, only two items could alter the substance of the staff's assessment. These are the load forecasts and load additions presented by the Commonwealth Edison Co. With respect to load forecasts, the applicant has reduced its official projection from 6.5% (1976 thru 1983)* to 5.4% (1976 thru 1983).** In the draft environmental statement, the staff examined lower forecasts than the above in evaluating the need for power. Specifically, the staff examined forecasts by the Federal Energy Administration (FEA) and Oak Ridge National Laboratory (ORNL). These lower forecasts were 4.23% and 4.8%, respectively. More recent forecasts by the applicant which are in closer agreement to these latter forecasts do not alter the staff's assessment, but only confirm the substance of the previous assessment.

Projected load additions by the applicant are substantially the same as set forth previously. The operation of Braidwood and Byron nuclear power plants will be subject to subsequent licensing action, and were accordingly not included in the staff's assessment of the LaSalle County Station's impact on reserve margin. By removing these plants from the load addition forecast, the staff and applicant's capability figures are different by about one percent. This difference does not warrant change of the assessment in the environmental statement.

*Table 8.11, DES.

**Table 1.1-7, Supplement 6, Environmental Report, 1 June 1978.

J. U.S. DEPARTMENT OF ENERGY, App. A, Page A-4

J-1. Surface Water Characteristics
The staff does not believe that discharges from the station will have a measurable effect on the chemical quality of the river. At a maximum waste water discharge of 7×10^{-4} m^3/s (10.4 gpm) containing 19 mg/L of 5-day BOD from the sanitary tertiary treatment system (Sec. 3.2.4.5), a cooling lake blowdown rate of 1.50 m^3/s (53.1 cfs), and a 7-day 10-year recurrence-interval river low-flow rate of 91.4 m^3/s (3230 cfs) (Sec. 2.3.2), the contribution of BOD to the river from this source would amount to about 1.5×10^{-4} mg/L. This should be compared to the measured values of BOD ranging from 3 to over 6 mg/L in the river in the vicinity of the station site.

Also, because of the nature of the chemicals added to the water during station operation and again considering the dilution that will be affected in the river, the staff believes that the COD contribution will not be measurable.

J-2. Terrestrial Ecology
As for most terrestrial habitats, the majority of birds near the LaSalle County Station site are passerines (songbirds), accounting for 76% of the summer residents in all habitats based on Forbes-Gross strip census data for 1976 (Sec. 2, Ref. 17). A critical habitat requirement analysis was not undertaken because of the lack of detectable adverse impacts attributable to construction (Sec. 2.5.1.2, p. 2-20).

J-3. Terrestrial Ecology
The staff review of the data, which included Forbes-Gross strip censuses of the four major habitats near the site, does not support a conclusion of data inadequacy but rather supports the applicant's conclusion (ER, Sec. 2.2.2.8.3, p. 2.2-46). For example, using 1976 data (Sec. 2, Ref. 17), the community similarity between the two transmission-line locations (the only replicated habitat) is less than or equal to the community similarities between any other two habitats. Thus, the staff conclusion (Sec. 2.5.1.2, p. 2-20) agrees with the applicant's conclusion that there is no difference in bird populations among habitats.

J-4. Cooling Lake Effectiveness
The average circulation time on p. 3-4, first sentence, should read 5.5 days instead of five days. This is just an approximation, and reflects an average of various circulation efficiencies. Since the parameters used in the blowdown-temperature calculation were conservatively chosen (see Sec. 5.3.1.4), the staff does not believe that larger temperature excesses will occur.

J-5. Radioactive Wastewater Disposal
The environmental assessment of the radioactive waste treatment is the subject of Section 3.2.3 of this environmental statement. Additionally, a description of the radioactive waste treatment systems and the staff's evaluation of the systems will be contained in the Safety Evaluation Report for the LaSalle County Station, Units 1 and 2, and will be published following publication of this environmental statement.

J-6. Ecological Impacts
The staff's assumption that inundation of the cooling-lake area will affect wildlife populations proportionate to the area flooded (Appendix I of the OL-DES, page I-36) was reaffirmed by the staff during the site visits. At those times, the staff noted that the habitats (and their distribution) within the lake perimeter were similar to those within the rest of the township. Furthermore, the issue of secondary effects on riparian habitats downstream from the cooling lake due to the reduced discharge (especially into Armstrong Run) was considered by the staff. However, the staff concluded that the riparian habitats affected are not capable of providing critical habitat components. For example, escape cover is better supplied by the hedgerows along fence lines and, as implied above, these were distributed in proportion to area.

J-7. Biological Effects
The staff agrees with this comment. However, given the preexisting stresses on waterfowl (Sec. 4.2.2, p. 4-7), the effect of increased habitat (in spite of the increased risk of disease problems for waterfowl) is expected to be beneficial to the waterfowl populations.

J-8. Transmission Corridor Ecological Effects
The staff is fully aware of the concern among ecologists about community fragmentation, and shares these concerns. However, due to the predominantly agricultural character of the region, no such effects are anticipated (see also comment E-2).

J-9. <u>Cooling Lake Heat Release</u>
The total energy loss from the smaller pond will be slightly higher (due to lower thermal efficiency of the plant due to higher cooling-water temperature) than from a larger one. Due to higher water temperatures, the relative amounts of energy lost in the latent and sensible-heat transfer processes will also change, with the latent heat flux increasing faster than the sensible heat flux.

J-10. <u>Cooling Lakes Impact Comparison</u>
The heat load of the Dresden cooling pond is slightly higher (12.5%) than that of the LaSalle County Station facility. This difference is significant only for full operation of both facilities for several days (thermal lag of the ponds).

Differences in topography and climate of the two sites are very small--a one degree (F) difference in air temperature between the two locations is trivial compared to an onsite air-water temperature difference of up to 80° or 90°F. The staff position is that the observations of steam fog and icing at Dresden since it began operating in the closed-cycle mode are applicable to the LaSalle County Station. The differences in the heat load, terrain, and climate mentioned in the comment are much smaller than the accuracies of the models used by the applicant in predicting fogging and icing.

J-11. <u>Socioeconomic Impacts</u>
Assuming the employment multiplier of 2.2 (Reference: Erik J. Stenehjem, *et al.*, "A Framework for Projecting Employment and Population Changes Accompanying Energy Development," August 1976), about 890 new jobs may be created directly and indirectly by primary employment at the LaSalle County Station. The majority of these jobs, particularly ancillary service positions, would likely be filled by the local labor force. Therefore, the total population increase due to the operation of the LaSalle County Station will not likely exceed the 1500 persons who make up the population in the daily commuting region for the facility. Some of these families will be located in communities near the plant (e.g., Ottawa, Marseilles, Streator, and Joliet). Additionally, in 1970 there were 48 towns with a combined population of over 100,000 within 40 km (25 mi) of the facility (ER Table 2.1-3). Considering the large number of towns and the baseline population, both in the vicinity of the facility and within the daily commuting distance, the population-related impacts in any single location should not be significant enough to create a financial stress on the local government. Assuming one-third of the primary workers would be relocated in the local communities, and conservatively assuming 3.5 persons per family of those workers, the population influx relocated in these communities would not exceed 500 persons. In addition, most of the secondary and induced job opportunities generated by the primary employment would likely be supplied from the local labor market. Consequently, the population impacts from the increases of secondary and induced jobs will likely be minimal.

J-12. <u>Socioeconomic Impacts</u>
As noted in the above comment, the population-related impacts due to operation of the facility will not be significant enough to create a financial stress on the local government.

J-13. <u>Health Effects</u>
Comparisons of the health effects of the coal and nuclear fuel cycles must reflect current facts until new data become available; there is no technically defensible method of accurately quantifying future effects of new or pending regulations on current data. However, the effect of new regulations on the coal industry do add to the uncertainty of the coal-effects data (see Sec. 8.3.2).

J-14. <u>Health Effects</u>
The NRC staff disagrees with the suggestion that the comparison presented is "slanted in favor of the nuclear health effects described in the text." If anything, the opposite is the case. Current state-of-the-art analyses of the coal fuel cycle do not quantify <u>any</u> coal long-term impacts from the coal fuel cycle (e.g., toxic trace metals leaching to water supplies from piles of coal ash or flue gas desulfurization sludge, impact of the greenhouse effect, and bioaccumulation and cycling of toxic trace metals deposited from plumes emanating from coal-fired plants) or health effects from sulfur oxides and total suspended particulates to current pupulations outside an 80-km (50-mi) area surrounding a coal-fired plant.

On the other hand, health-effects estimates for the nuclear fuel cycle represent estimates of reasonably long-term impacts on the entire U.S. population as a result of deposition, resuspension, bioaccumulation, and cycling of radionuclides in every major pathway currently known to exist.

Furthermore, the effects listed for the coal fuel cycle were taken from work at Brookhaven National Laboratory under the aegis of ERDA (now DOE). That work was recommended by Dr. R. G. Cooper, Division of Technology Overview, ERDA, on February 15, 1977, as the best analyses of the coal fuel cycle available at that time. NRC accepted that recommendation and was promised new information as it became available. The only major modifications of that original work which NRC is aware of are the estimates being prepared by Dr. Leonard Hamilton and his staff at BNL in support of the Risk/Impact Panel of the Committee on Nuclear and Alternative Energy Systems (CONAES) of the National Academy of Sciences. However, that work, which was scheduled for completion in June 1977, has yet to be published.

J-15. Water Consumption

As a result of this comment, the values in Table 8.6 have been recalculated and changed accordingly. Specifically, the value given for water consumption was in error for the nuclear facility. The correct value is now given in this environmental statement. It should be noted, however, that the coal value ($\sim$ 73 m^3/min or 19,000 gpm) is that for three 800 MWe units (2400 MWe total), and the nuclear value (84 m^3/min or 22,000 gpm) is that for the LaSalle County Station (2156 MWe total, see Table 10.1). Correcting for the differing capacities, the ratio of the two values is about 0.78, or nuclear is about 22% less efficient than coal, due to lower operating pressures and temperatures.

J-16. Health Effects of Alternatives

The NRC staff disagrees with the claim that "discrepancies ... create artificially high morbidity and mortality events due to coal." As stated in the text of the environmental statement (see, for example, footnote i of Table 8-7, and Appendix F), the estimated potential risk from the nuclear fuel cycle (from mining, milling, transport, fission, etc.) is to the entire U.S. population, while the major impacts from the coal fuel cycle (from combustion of coal) were restricted to a typical population of 3.8 million people within 80 km (50 mi) of a coal-fired plant. The more restricted area used in the coal-impact estimates represents an affected area as defined by the gaseous-emission plume; the population figure represents an average of numerous population estimates for existing and proposed generating facilities.

As stated in the environmental statement, the population density assumed for the uranium fuel cycle is based on actual (Census Bureau) U.S. populations. In the case of nuclear power plants, the typical density is 60 persons/km^2 (160 persons/mi^2). Furthermore, real differences in populations (and health effects) between coal and nuclear power plants may be even greater than indicated since coal-fired plants tend to be closer to load (urban) centers than nuclear power plants.

K. U.S. ENVIRONMENTAL PROTECTION AGENCY, App. A, Page A-7

K-1. Reduction in the Size of the Cooling Lake

As indicated in the environmental statement, the size of the lake was reduced in accord with a settlement agreement referred to in the initial decision rendered by the Atomic Safety and Licensing Board on September 1973, and was again slightly reduced further to its present size, which is less than half its original design.

In its calculations to determine compliance with thermal limitations, the staff conservatively chose various operational and environmental parameters (see Sec. 5.3.1.4). These included a 100% plant capacity, extreme values of equilibrium-temperature and heat-exchange coefficients, maximum and minimum river temperatures, and low river flows. As a result of these calculations, the staff concluded that the thermal discharge from the facility into the Illinois River will satisfy the state thermal water-quality standards.

Condenser inlet temperatures will be the same as those of the blowdown calculated by the staff in Table 5.2. These should be compared to the applicant's calculated plant-intake temperatures as indicated in Table 5.1. In view of the higher degree of conservatism used by the staff in its calculation, the staff believes the applicant's values, although somewhat lower, are not unreasonable.

K-2. Design and Operation of the Makeup-Water Intake Structure

The environmental statement has been revised to indicate the location of the intake structure on the Illinois River. Monitoring of aquatic biota in the river, entrainment studies of fish eggs and larvae, and fish impingement are discussed in Section 6.3.5.

The staff concurs with the comment that there are other intake designs that could further minimize entrainment and impingement effects. However, biological studies done by the applicant (Sec. 2.5.2) indicate that this stretch of the river is low in biological productivity and that many of the fishes are in poor condition as a result of a high pollution load. The dominant fishes in this stretch of river are pollution-tolerant species (e.g., green sunfish and black bullhead) that are low in abundance. Most of them show signs of parasite infestations and physiological stress. Given these biological data, the low average intake velocities of 0.15 m/s (0.5 fps), the maximum intake velocity of 0.3 m/s (0.9 fps), and low makeup-water requirements (maximum of 28.2 m/s or 92.5 cfs), the staff believes that expenditure of the costs associated with additional impingement-mitigating measures is unwarranted. If the quality of the river should improve in the future and/or high impingement levels are demonstrated, the intake structure can be retrofitted with fish-return devices at that time.

K-3. Water Velocity at the Intake Screens
As stated in Section 3.2.1, Figure 3.1 is the average annual intake at 100% plant capacity. At 72% plant capacity, the average annual intake will be 2.2 m^3/s (78 cfs) as shown in Table 3.3-1 of the ER. The environmental statement has been revised to clarify this.

K-4. Integrity of the Cooling-Lake Dike
The integrity of the dike(s) and the potential effects, should a breach occur, were considered and discussed during the construction-permit review of the LaSalle County Station.

A detailed discussion is contained on p. XII-23 of the FES-CP and on p. 12 of the Safety Evaluation Report of the LaSalle County Station dated 15 August 1972. In brief, the staff stated at that time that it had reviewed the design and stability of the dike, particularly the design factors used for the combined steady-state seepage and earthquakes, and had found them adequate and the design acceptable. The staff concluded that these design criteria proposed by the applicant (including the water levels) are at least as conservative, and in some instances considerably more conservative, than those used by other Federal agencies for the design of similar facilities.

K-5. Water-Use Diagram
The diagram has been revised accordingly.

K-6. Sanitary Waste Disposal
The sanitary waste system is described in Section 3.2.4.5 of the environmental statement. It was built and will be operated in compliance with the construction permit and NPDES permit issued by the Illinois Environmental Protection Agency (EPA). One requirement of these permits is that by-product sludge from the sanitary waste treatment facility be disposed of in an environmentally acceptable manner. The applicant satisfied this requirement by obtaining a sludge-disposal permit from the Illinois EPA. This permit allows disposal at one of two sanitary landfills.

The sanitary waste treatment facility is operated by trained and licensed personnel who are certified by the Illinois EPA. Likewise, maintenance staff service the facility as necessary.

Additional details regarding the applicant's sanitary waste treatment facility are found in Section 5.4 of the ER-OL and in the applicant's 24 August 1978 letter to Ronald L. Ballard, NRC.

K-7. Radwaste Liquid Discharges
The LaSalle County Station, Unit Nos. 1 and 2, are boiling water reactors which do not have blowdown. The steam condensate from the condenser hotwell is treated by deep-bed condensate demineralizers and the beds are ultrasonically cleaned and periodically replaced. The radwaste treatment systems are designed to treat the cleanup wastewater through an evaporator. The evaporator bottoms are solidified for offsite burial. Most of the cleanup wastewater from the evaporator is reused. However, a small fraction of this treated water is discharged to the environment and is included in the liquid effluent considered in Sections 3.2.3 and 5.5.2 of the environmental statement.

K-8. Radiation Exposure during Transportation of Irradiated Fuel
Section 5.5.2.4 of this environmental statement provides an updated analysis of the information found in Section V.E.5.b of the FES-CP, which was included in Appendix I of the draft environmental statement, p. I-48. (The EPA's comment contains an erroneous reference to p. 148 of Appendix I.)

As noted in Section 5.5.2.4, background information leading up to the values cited both in that section and in Appendix I of the DES is found in WASH-1238, "Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants." Specifically, Chapter V of WASH-1238 addresses the impact of transporting irradiated fuel.

According to Subsection D.3 of Chapter V of WASH-1238, the radiation levels will rarely exceed 50 to 60 mrem per hour at the vehicle (i.e., that containing the irradiated fuel) surface. At 1 m (3 ft) distant this would be reduced to 25 mrem per hour, and at 2 m (6 ft) it would be further reduced to 10 mrem per hour.

Based on the above values, an onlooker from the general public might receive up to 1.3 mrem if he spends three minutes very close (i.e., 1 m) to the railcar containing the irradiated fuel. This represents a conservative upper-bound estimate, however.

On the other hand, a brakeman is expected to spend only one to ten minutes per trip in the vicinity of the train car; it is also assumed that there will be ten brakemen involved during an entire shippage. These estimates, along with the radiation values noted above, result in an average exposure of about 0.5 mrem per brakeman per shipment. Therefore, the values quoted in Appendix I to the DES are correct. The primary differences between the two exposures are distance, exposure time, and exposure frequency. Also, the exposure to the onlooker is a conservative upper-bound estimate, whereas the exposure to the brakeman is an average estimate. Also, as noted in the EPA comment, both exposure estimates are far below the Federal Radiation Council's recommended exposure limit of 500 mrem/yr for individuals in the general population (see footnote b of Table 5.15 of this environmental statement).

K-9. Population Exposure to Radiation

The staff does not believe that presently available models are capable of making such projections (i.e., long term and worldwide) with meaningful results. The staff has determined that present methods sufficiently represent the population exposure due to operation of this plant.

APPENDIX A

COMMENTS ON THE DRAFT ENVIRONMENTAL STATEMENT

U.S. DEPARTMENT OF AGRICULTURE
ECONOMICS, STATISTICS, and COOPERATIVES SERVICE
WASHINGTON, D.C. 20250

March 30, 1978

RECEIVED APR 5 1978 U.S. NUCLEAR REGULATORY COMMISSION Mail Section

SUBJECT: Draft Environmental Impact Statement

TO: George W. Knighton, Chief
Environmental Projects Branch 1
Division of Site Safety and
Environmental Analysis
Washington, D. C.

We have no comments on the Draft Environmental Statement related to operation of La Salle County Station, Unit Nos. 1 and 2, Commonwealth Edison Company.

Melvin L Cotner
MELVIN L. COTNER
Director
Natural Resource Economics Division

780960042

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
NORTHEASTERN AREA STATE AND PRIVATE FORESTRY
370 REED ROAD – BROOMALL, PA. 19008
(215) 596-1672

1950
May 16, 1978

Mr. George W. Knighton, Chief
Environmental Projects Branch 1
Division of Site Safety
and Environmental Analysis
U. S. Nuclear Regulatory Commission
Wash., D. C. 20555

Refer to: Docket Nos. 50-373, 50-374
Draft Environmental Statement
LaSalle County, IL
Unit Nos. 1 and 2

Dear Mr. Knighton:

E-1 Planting trees along the edge of the cooling lake would keep it somewhat cooler in the summer. Some flowering shrubs and trees (e.g. crabapple, viburnum, pyracantha) would enhance the recreational value of the area within the site boundaries.

E-2 Not much is written about transmission lines - will there be a separate statement? The right-of-way should be managed to furnish some wildlife habitat and have as natural an appearance as possible.

Thank you for the opportunity to review this Statement.

Sincerely,

for DALE C. VANDENBURG
Staff Director
Environmental Quality Evaluation

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
P. O. Box 678, Champaign, IL 61820

50-373
374

April 27, 1978

Mr. George W. Knighton
Chief, Environmental Projects Branch 1
Division of Site Safety and Environmental Analysis
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Knighton:

This is in response to your letter dated March 27, 1978, requesting comments on the draft environmental statement related to the operation of the LaSalle County Station, Unit Nos. 1 and 2, Commonwealth Edison Company dated March 1978.

A-1 Page 4-3, lines 3 and 4 - Local landowners reported to the staff that Armstrong Run has never required maintenance, etc. Visual investigation indicates some dredging and straightening may have taken place since the original ditch was made or formed. Spoil from dredging was piled along the ditch which created higher banks, therefore, steeper, more erosive areas along the ditch.

A-2 Page 4-6 - Requirements, Item 4 - In regard to the reshaping and revegetation, there may be critical sections along curves that may require rip-rap instead of vegetation to obtain stabilization. During the time of reshaping the determination should be made whether to rip-rap or revegetate.

A-3 Page 4-6, Item 5 - The clay deposits are only a minor possible contributing factor to the erosion problem. However, there are several locations where the silt (clay deposit as the report refers to) are deflecting the channel flow into the banks causing the ditch banks to erode. In these instances it would facilitate channel flow, reduce the erosion potential, and help insure the revegetation to become established by removing critical silt bars.

We appreciate the opportunity to review and comment on this draft environmental statement.

Sincerely,

Daniel E. Holmes

Daniel E. Holmes
State Conservationist

cc: R. Smith
Allan Madison
R. M. Davis, Administrator, SCS, Washington, D.C.
Office of the Secretary, USDA, Washington, D.C.

7812101SS

50-373/374

Department of Energy
Washington, D.C. 20545

JUN 8 1978

Mr. George W. Knighton
Environmental Projects Branch 1
Division of Site Safety
and Environmental Analysis
Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Knighton:

This is in response to your transmittal dated March 27, 1978, in which you invited the Department of Energy (DOE) to review and comment on the Nuclear Regulatory Commission's draft environmental impact statement related to the LaSalle County Station, Unit Nos. 1 and 2, Commonwealth Edison Company.

We have reviewed the statement and have determined that the proposed action will not conflict with current or known future DOE programs. Staff comments are enclosed, which you may wish to consider in the preparation of the final statement.

Thank you for the opportunity to review and comment on the draft statement.

Sincerely,

W. H. Pennington, Director
Division of Program Review and Coordination
Office of NEPA Affairs

Enclosure:
DOE Staff Comments

7816500

STAFF COMMENTS ON THE U. S. NRC DRAFT EIS
LASALLE COUNTY STATION, UNITS NOS. 1 AND 2
-- COMMONWEALTH EDISON

Section 2.3.4.1 (and 5.3.5) Surface Water

J-1 According to the document, "in the vicinity of the plant, the Illinois River is characteristic of a river recovering from upstream pollution." (page 2-11). At the river where the effluent from the cooling lake will be discharged, the dissolved oxygen (DO) concentrations approaches the minimum standard during the warm season (see Table 2.4). The discharge of heat and diluted sewage and chemicals may cause significant effects on the DO content of the river. The depletion may occur by reducing the partial pressure of oxygen, biochemical oxygen demand (BOD), and chemical oxygen demand. The effects would be most significant in the summer months. The possible occurrence of DO depletions below the standard and alternatives to avoid the depletions should be considered.

Section 2.5.1.2 Fauna

J-2 Birds - the failure to mention songbirds in this section is an obvious deficiency. In most terrestrial habitats, the majority of bird species present are songbirds. In addition, some species have critical habitat requirements and are indicators of habitat quality, which should make their treatment important to a study of this type.

J-3 The lack of statistical difference between locations indicates that bird studies were not adequately conducted in the six plant community types mentioned in 2.5.1.1. Roadside observations alone are inadequate for a study of this type.

Section 3.2.2.1, Table 3-4, pp 3-1, 3-4; 3-2 Circulating rate

J-4 The approximate cooling lake water residence time of 5 days is apparently based on an assumed circulating efficiency of about 95%. Table 1 describes the residence time of the cooling lake water with various assumed circulating efficiencies. If the circulating efficiency is considerably less than 95%, the temperature of the effluent from the lake would be higher than that determined in the study. The result of the higher temperatures on the river quality would be a larger temperature plume in the river, possible lowering of the DO content of the river, and stimulation of BOD and COD increases. In the event that the 95% value is uncertain the effects caused by lower circulating efficiencies should be evaluated.

Table 1. Residence Time of Cooling Lake Water with Assumed Circulating Efficiencies

Assumed Efficiency (%)	Residence Time (days)
95	5.4
90	5.1
85	4.8
80	4.5

Section 3.2.4

J-5 The facilities for handling radioactive wastewater were not included. It is not clear whether the plan for handling the radioactive wastewater has been approved. Whether the plan has been approved or not, it is expected that the final decision for the plan is made only after the alternatives to radioactive wastewater discharge and their respective costs are evaluated.

Section 4.2 Impacts on Terrestrial Environment

(and V-8 C. Biological Impacts (Appendix I)

J-6 Any assumption that lake construction adversely impacts wildlife habitat in only the flood area may not be valid. Research in the Columbia River Basin indicates that riparian areas may provide critical habitat components for wildlife in adjacent areas. For example, components vital to birds, such as escape cover or sources of grit, would be eliminated, possibly affecting bird populations beyond the boundary of inundation.

Section 5.4.1.1 Biological Effects

J-7 Onsight - Congregation of large numbers of water-fowl for extended periods can result in disease problems, particularly if this lake stays open throughout the winter. Possibly may not be beneficial to waterfowl.

Section 5.4.1.1 Offsite Transmission Corridors

J-8 An emerging concern among ecologists is the ecological effects of community fragmentation. Subtle edge effects may lead to significant woodland interior effects over time. Such effects include compositional changes toward retrogressive succession. Subtle ecological changes, therefore, do not necessarily mean insignificant impacts.

Section 5.4.1.2

J-9 It is stated that the reduction of the cooling pond size by 54% will increase the temperature of the water in the pond which will result in increased fluxes of heat and moisture. This is a correct statement, however it is not stated whether the total release of heat and moisture to the atmosphere will increase. Due to the smaller surface area of the pond, the total release of heat and moisture to the atmosphere may not change appreciably.

J-10 In the Staff's Analysis of 5.4.1.2 the comparison of the impacts of the Dresden cooling pond to the projected impacts of the LaSalle pond may not be fair. The Dresden cooling pond has a higher heat load and presumably is subject to slightly different meteorological and topographical effects.

Section 5.6 Socioeconomic Impacts

J-11 The socioeconomic analysis in this report is weak. Important issues are not addressed. For example, if 403 direct jobs are created, how many ancillary positions are expected and who will fill them? The size of the employment and population impact may be underestimated by half. In addition,

J-12 what increased expenses (public infrastructure) are likely in the areas of general government, roads, water, sewers, solid wastes, etc.?

Section 8.3.2 Health Effects

J-13 All morbidity and mortality data is based on historical trends. Effluents from the work place conditions in the nuclear fuel cycle have been strictly regulated since the infancy of the industry, while effluents from and work place conditions in the coal fuel cycle have only recently been or are currently being considered for regulation. Although this fact is mentioned in the text it is not considered in the calculations from which the health risk comparisons are made. This fact prejudices the results in favor of the nuclear cycle.

J-14 Uncertainties in health effects resulting from the nuclear cycle waste management, reprocessing, serious accidents, and from the coal cycle long range transport, effluents besides SO_2 particulates secondary effects, create opportunities for bias. Overall interpretation of these uncertainties by the author is slanted in favor of the nuclear health effects described in the text (i.e. genetic related diseases, serious accidents) are not included in the calculations of the table.

Table 8.6 Water Consumed

J-15 Nuclear power generation is currently less thermally efficient than coal power generation, approximately 30% vs 40%. Since the primary consumptive water use in both processes is condensor cooling, water consumption should be higher for nuclear facilities on a per MWe of product produced basis. The table seems to show the opposite.

Tables 8.7, 8.7a, 8.7b, 8.8, 8.8a, 8.8b

The discrepancies between the populations at risk to the coal fuel cycle and the population at risk to the nuclear fuel cycle are significant and create artifically high morbidity and mortality events due to coal.

J-16 The entire U. S. populations with a density of ~ 71 people per square mile is used to calculate excess morbidity and mortality events per 0.8 GWe for the nuclear cycle.

A regional population with a density of 425 people/sq mile mile is used to calculate excess morbidity and mortality events per 0.8 GWy for the coal cycle. Even correcting this coal population by 1/2 as suggested in the footnotes leaves population density for coal at 212 people/sq mile.

The number of events occuring in the general public calculated on a per GWy of electricity produced will be more significant in a highly populated area where more people are at risk to exposure.

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION V
230 SOUTH DEARBORN ST
CHICAGO ILLINOIS 60604

JUL 26 1978

Mr. George W. Knighton, Chief
Environmental Projects Branch
Division of Site Safety
and Environmental Analysis
U.S. Nuclear Regulatory Commission
Washington, D.C.

RE: 78-022-701
D-NRC-F06008-IL

Dear Mr. Knighton:

In response to your letter dated June 1, 1978, we have completed our review of the Draft Environmental Impact Statement (EIS) for the operation of LaSalle County Station, Unit numbers 1 and 2, LaSalle County, Illinois. We have classified our comments as Category 3. Specifically, this means that inadequate information was provided in the EIS to adequately address the environmental impacts on water quality and aquatic life from operation of the plant. The classification and the date of our comments will appear in the Federal Register.

WATER QUALITY

K-1 After reviewing the information provided in the EIS and the environmental report, we have serious questions and concerns over the cooling lake design. The applicant predicts that temperatures of 92.5 °F are expected 1% of the time, and that temperatures of 90 °F are expected 5% of the time at the condensor inlet. Your agency's modeling effort indicates that higher temperatures may occur in the ponds than those predicted by the applicant, but does not report predicted inlet temperatures. These temperature predictions alarm us since the possibility exists that the ponds may be underdesigned and a decrease in generating capacity may result. Rules of thumb equations indicate that for this facility, the ponds should be between 2587 and 4116 acres, rather than the present 2058 acre design. However, the EIS did not provide us with sufficient information to evaluate, in a in-depth manner, whether the cooling ponds may result in operational difficulties. Because of past experiences in our region where the condensor cooling systems have been underdesigned, we believe that the Final EIS must address these questions in a meaningful manner.

K-2 A more detailed discussion of the intake structure is needed including an evaluation of the impacts of the cooling water intake structure on aquatic life. Insufficient information was provided concerning intake

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siting, design, operation, biological monitoring, entrainment and impingement effects. From the information provided in the EIS and from the 316(b) demonstration submitted pursuant to the National Pollutant Discharge Elimination System (NPDES) permit requirement, it is our opinion that other intake system designs are available which would reduce the impact of the cooling water intake structure on the aquatic environment. In the future, we will require better technologies to further reduce impingement. Based upon our review of this facility's intake design, at a minimum, it should be improved by the installation of traveling screen with fish saving devices and running the screens continuously during high impingement periods.

K-3 Our review of the EIS also revealed inconsistencies in the data provided on the expected velocities at the intake screens. Section 5.4.2.1 says that flow velocities at the traveling screen surfaces are expected to be less than .5 ft/sec 93% of the operating time, with a maximum of .9 ft/sec the remaining 7% of the time. Section 3.2.2.2 states that velocities between .5 and .3 ft/sec are expected with one pump operating and twice these values with two pumps operating. Figure 3.1 shows that the average annual intake from the Illinois River will require 2.6 m^3/sec. Since each vertical turbine pump at the facility has a capacity of 1.9 m^3/sec, two pumps will need to be operated at least 50% of the time. Therefore, the velocities at the screen will have to be between .6 and 1.0 ft/sec at least 50% of the time. This issue should be clarified in the Final EIS.

K-4 The cooling lake was created by constructing dikes that total 38,000 feet in length on three sides, with some sections of the dike as high as 14 feet. Adequate information has not been provided in either the environmental report or the Draft EIS to assess the dikes' structural integrity. Considering the enormous volume of water the dikes will contain, an analysis should be done to assess the potential for a breach in the dike and to assess what damage would result if it did happen.

K-5 An inconsistency exists between Figure 3.1 (Water use diagram on page 3-2) and the narrative in Section 3.2.4. The narrative states that the auxiliary boiler system blowdown will be routed to the neutralization tank. Figure 3.1 illustrates that the waste source will be routed in a separate pipe to the cooling pond blowdown discharge. The auxilary boiler blowdown must be treated prior to discharge. This inconsistency should be clarified and appropriate treatment must be provided.

K-6 A more detailed discussion of the sanitary waste system is needed. The discussion should include the method of sludge disposal, operator qualifications and details of proposed operation and maintenance program.

RADIATION

K-7 The applicant intends to release radwaste regenerant liquor periodically by dilution with blowdown. Even though the level may be below 10 CFR 50, it is a good practice to require off-site regeneration of the radwaste demineralizer bed to eliminate all radwaste liquid discharges, as is done at the Palisades Nuclear Plant.

K-8 The statement is made on page 148 paragraph b.5. of Appendix I, Construction Stage, that a member of the public spending 3 minutes at 3 feet from irradiated fuel on a rail car might receive up to 1.3 mrem and a brakeman on the train would receive only 0.5 mrem. It is not logical that a member of the general public who may be exposed for a short period of time while the train is passing or temporarily standing would receive more radiation exposure that the brakeman who is riding the train and will pass near the shipment a number of times during train inspection, switching, etc. However, the radiation exposures are well below the safe levels in both cases.

We are encouraged that your agency is now calculating annual population dose commitments to the U.S. population, which is a partial evaluation of the total potential environmental dose commitments (EDC)of H-3, KR-85, C-14; iodines and "particulates." This is a big step toward evaluating the EDC, which we have urged for several years. However, it should be recognized that several of these radionuclides (particularly C-14 and Kr-85) will contribute to long-term population dose impacts on a worldwide basis, rather than just in the U.S.

K-9 The EIS (1) has limited the EDC to the annual discharge of these radionuclides, (2) is based on the assumption of a population of constant size, and (3) assesses total environmental impact. Assessment of the total impact should incorporate the projected releases over the lifetime of the facility (rather than just the annual release), extend to several half-lives of 100 years, beyond the period of release, and consider, at least qualitatively or generically, the worldwide impacts. Thus, we suggest that future assessments recognize these influences on the total environmental impact. If the model used to predict the total environmental impacts has limitations, these should be indicated.

The EPA has examined your analyses of accidents and their potential risks. The analyses were developed by your agency in the course of its engineering evaluation of reactor safety in the design of nuclear plants. Since these issues are common to all nuclear plants of a given type, we concur with your agency's generic approach to accident evaluation. We expect your agency to continue to ensure safety through plant design and accident analyses in the licensing process on a case-by-case basis.

We completed our review of the final Reactor Safety Study on June 11, 1976, and issued a public-report of its findings. Most of our concerns have been resolved in subsequent discussions with your agency. Our concerns with the Reactor Safety Study may now be focused on two points -- a factor of 4 in latent cancer health effects and a maximum factor of 10 in the probability of Boiler Water Reactor (BWR) scram failure. We

also believe that the methodology of the Reactor Safety Study should be used as a tool in the evaluation of nuclear systems that vary from the models chosen for the study and that a generic analysis should be made on the acceptability of the present risks and the necessity for increased levels of safety.

In response to a 1976 court decision, your agency issued a supplement to WASH-1248 (NUREG-0116) which treated the impacts from reprocessing of spent fuel and impacts from radioactive waste management. Our comments and those of other agencies and individuals resulted in a second supplement to WASH 1248 (NUREG-0216). We have provided additional comments on this supplement and are participating in the Public Hearing on the Environmental Impacts of Fuel Reprocessing and Waste Management (Docket RM-50-3). We have concluded that the supplements do not meet the stated purpose and that there is still need for more substantive information and data to adequately support the impact assessments presented. In particular the UFC standards (40 CFR 19), should be presented in a table; the assessment of dose should not be limited to only the U.S. population; and that the radon dose has not been adequately addressed.

The impact value for routine transportation of radioactive materials has been set at a level which covers 90 percent of the reactors currently operating or under construction. The basis for the impact, or risk, of transportation accidents is not clearly defined. At present, EPA, ERDA, and NRC are each attempting to more fully assess the radiological impact of transportation risks. We will make known our views on any environmentally unacceptable conditions related to transportation. On the basis of present information, we believe that there is no undue risk of transportation accidents associated with the LaSalle County Nuclear Station

Upon completion of its useful life, a commercial light-water nuclear power plant itself becomes a form of radioactive waste. This waste possesses characteristics quite different from those generated during operation but nonetheless, represents a considerable volume and radioactive inventory. Present regulations do not require consideration of a decommissioning plan until near the end of the reactor's useful life. While we and other Federal agencies are actively addressing the issues involved in waste management, decommissioning and the disposal waste resulting from such activities have received little attention. Considering the size, complexity, and number of commercial power reactors that are or will be licensed it would appear prudent to begin planning for decommissioning as early in plant life as possible. For example, it may be necessary to institute design changes to facilitate eventual dismantling. In addition, evaluation of social impacts and resource commitments on present and future generations should be considered so that those receiving the benefits are those responsible for paying the necessary costs of plant retirement. We believe an orderly decommissioning procedure should be developed for each site containing a light-water reactor well before its retirement.

Thank you for providing us with the opportunity to review this Draft EIS. If you have any questions concerning our comments, please contact Mr. Joseph Sovcik at 312/353-2307.

Sincerely yours,

Carol R. Foglesong

for Ronald L. Mustard, Director
Office of Federal Activities

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
FOOD AND DRUG ADMINISTRATION
ROCKVILLE, MARYLAND 20857

MAY 1 1 1978

Mr. Leland C. Rouse
Chief, Fuel Processing
and Fabrication Branch
Division of Fuel Cycle
and Material Safety
Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Rouse:

The Department of Health, Education, and Welfare has reviewed the health aspects of the Draft Environmental Statement related to operation of the LaSalle County Station, Units 1 and 2, Commonwealth Edison Company, Docket Numbers 50-373 and 50-374 and has the following comments to offer.

C-1 Pages 2-16. In Table 2.7 Water Quality Analysis for Station Water Wells it cites the PHS, Drinking Water Standards, U.S. Department of Health, Education, and Welfare, 1962 as the Federal Drinking Water Standard. The National Interim Drinking Water Regulations, EPA-570/9-76-003 were promulgated on December 24, 1975 and became effective 18 months thereafter. In the preface it states that these regulations will replace the PHS Drinking Water Standards of 1962. Likewise, in Section 5.3.4.1, page 5-8 there should be some recognitions of EPA's National Interim Drinking Water Regulations.

C-2 Page 5-14 to 5-22 have estimated the radiological impacts using the NRC models given in Regulatory Guide 1.109. Results of these analysis indicate that the dose commitments will meet NRC radiation protection standards. However, a statement should be included to the effect that Commonwealth Edison Company will conduct its operations to meet EPA's Environmental Radiations Protection Standards for Nuclear Power operation (40 CFR 190) when they become effective on December 1, 1979.

C-3 Page 5-22 and 5-23. The design features and operating practices for control of occupation radiation exposure may need to be reexamined in light of the current review by NRC and congressional hearings. The cited experience of 500 man-rem per year per reactor could possibly underestimate the potential exposure.

C-4 Page 6.5, Section 6.2.5. The radiological monitoring program as designed, should provide adequate measure of the releases of radioactive material

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to the environment. However, in addition, to the changes recommended by the NRC, some consideration should be given to continuous monitoring of the surface water identified as item 3 in Table 6.3. to meet the stated surveillance objectives.

C-5 Sufficient information is not provided in the statement to determine if a dose model using tested computer codes was used to estimate the population exposure from gaseous effluents. If a dose model is used, the radiological monitoring program could provide verification of the estimated doses from the environmental pathways. Furthermore, it could serve to confirm the effectiveness of the in-station controls and to provide assurance that radioactivity undetected by the surveillance program will not buildup in the environment.

Page 7-1. The assessment of postulated accidents using the NRC classification provides reasonable assurance that the realistic situations have been considered. The estimated population dose for the postulated accidents are within acceptable limits.

C-6 It is noted that there is no discussion in this statement on emergency response planning and coordination of such plans with State and local agencies responsible for responding to radiation accidents.

C-7 On page 7-2. para. 3. The discussion relative to the Reactor Safety Study (WASH 1400) is not up-to-date as it concerns the Environmental Protection Agency. Since publication of the study, the EPA has evaluated this report and submitted their findings to NRC. This paragraph should be corrected to more accurately reflect the EPA position.

In summary it is believed that the LaSalle County Station, Units 1 and 2 can be operated to meet current radiation protection guidance and provide adequate protection of the public health and safety.

Sincerely yours,

Charles L. Weaver
Consultant
Office of Medical Affairs
Bureau of Radiological Health

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
AREA OFFICE
1 NORTH DEARBORN STREET
CHICAGO, ILLINOIS 60602

REGION V
300 South Wacker Drive
Chicago, Illinois 60606

50-373/374

15 MAY 1978

IN REPLY REFER TO:

George W. Knighton, Chief
Environmental Projects Branch No. 1
Division of Site Safety and
Environmental Analysis
U.S. Nuclear Regulatory Commission
Washington, D. C.

Dear Mr. Knighton:

Subject: La Salle County Station, Unit No. 1 & 2
Commonwealth Edison Company
NURGE - 0437

My staff has reviewed the Draft EIS for operation of the subject project. We have found the document to be comprehensive, cogent, and organized. Our only comment would be that even given the limited scope of the statement, an alternatives section should be included. This section might include consideration of the alternative of license denial as well as examination of different types of operational and management policies and practices. D-1

Thank you for the opportunity to review this statement.

Sincerely,

Elmer C. Binford, Director
Chicago Area Office

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

50-373/374

ER 78/275

MAY 3 1978

Mr. George W. Knighton, Chief
Environmental Projects Branch No. 1
Division of Site Safety and Environmental Analysis
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Knighton:

Thank you for your letter of March 27, 1978, transmitting copies of the Nuclear Regulatory Commission's draft environmental impact statement for LaSalle County Nuclear Plant, Units 1 and 2, [50-273 and 274], operating stage, LaSalle County, Illinois.

Our comments are presented according to the format of the statement or by subject.

Aquatic Monitoring

B-1 Although we find that the draft statement adequately evaluates fish and wildlife resources, we believe that the frequency of sampling for entrainment studies of fish eggs and larvae should be increased from weekly (from April through August) to once every 3 days. Weekly sampling could cause too much variability in the data between collections. We understand that the Illinois Department of Conservation made a similar recommendation on entrainment studies in their review of the Section 316(b) application.

Lake Recreation Management Program

B-2 Page 6-8 indicates that the NRC requires the applicant to prepare a recreation use plan for the cooling lake after the first year of operation. We recommend that this plan also include project lands not required for operation purposes or lands within the exclusion zone. The recreation use plan should discuss the recreation potential of project lands from the standpoint of land-based facilities required to support

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water-based recreation and recreation that is independent of the cooling lake. We believe that discussion of the recreation potential of both land and water is necessary to provide a complete picture of the recreational value of the project.

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

Sincerely,

Larry E. Meierotto
Deputy Assistant SECRETARY

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
REGION 5
18209 DIXIE HIGHWAY
HOMEWOOD ILLINOIS 60430

April 10, 1978

IN REPLY REFER TO
HED-03

Director, Division of Site Safety and
Environmental Analysis
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Re: Docket: 50-373
50-374

Dear Sirs:

The draft environmental statement for the start-up and operation of the LaSalle County Station, Unit Nos. 1 and 2 has been reviewed and we have no comments.

Sincerely yours,

Donald E. Trull
Regional Administrator

By:
W. G. Emrich, Director
Office of Environment and Design

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STATE OF ILLINOIS
DEPARTMENT OF PUBLIC HEALTH
535 WEST JEFFERSON STREET
SPRINGFIELD, ILLINOIS 62761

PAUL Q. PETERSON, M.D., M.P.H.
DIRECTOR

OFFICE OF ENVIRONMENTAL HEALTH
LEROY E. STRATTON, MSPH, ASSOCIATE DIRECTOR
(AREA CODE 217) 782-6550

May 23, 1978

IN REPLY REFER TO: NS

Mr. Jeremiah D. Jackson
Environmental Project Manager
Division of Site Safety and
Environmental Analysis
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Jackson:

RE: LaSalle County Nuclear Power Station
Draft Environmental Statement (NUREG-0437)
Operating License Stage

After a review of the subject document, the following comments are directed to your attention:

A. Radiological Impact on Man - Section 5.5.2

H-1 (1) Radiological doses received from normal plant operation for recreational activities on the Illinois River, such as boating and swimming is not discussed.

(2) Radioactive Gaseous Effluents - Table 5.6

H-2 In comparison to the LaSalle Final Environmental Statement - Construction Permit (FES-CP) Table III-4, the category "Main Condenser Air Ejector" is not included in Table 5.6. We assume that the term "waste-gas system" provides this information and includes the off-gas system releases.

(3) Atmospheric Dispersion Factors - Table 5.8

H-3 Are the reactor and turbine building ventilation stack effluents incorporated in the sources defined as A & B in this table?

H-4 The direction for the particular site location x/q's has changed from the SW as given in the FES-CP to NNE. Is this a result of the on-site meteorological monitoring program measurements?

(4) Direct Radiation - Section 5.5.2.4

(a) Radiation from the Facility

H-5 Why was the typical direct radiation and skyshine dose rate data from the turbine building used from other than the LaSalle County Nuclear Power Station's architect/engineer's design?

(b) Occupational Radiation Exposure

H-6 Were the control room personnel doses received from accidents considered in the projected man-rem value?

B. Accident Analysis - Section 7.0

H-7 (1) What will be the environmental doses resulting from possible off-gas system hydrogen explosions and shouldn't this type of accident be included in this section?

H-8 (2) In comparing the radiological off-site doses for the nine accident classes, a review of the three information source documents: (1) Final Environmental Statement - Construction Permit Stage, (2) Draft Environmental Statement - Operating Permit Stage, and (3) Commonwealth Edison Company's Environmental Report, it is observed that there is, in some cases, a significant discrepancy for the two (2) categories of estimated fraction of the 10 CFR 20 limit at the site boundary and the estimated dose to the population in a 50-mile radius of the facility among these three documents.

As an example, a comparison of the radiological dose (man-rem) data is as follows:

	FES-CP	DES-OP	CECO's ER
Radwaste System Failure (Waste Gas Storage Tank Release)	13.0	3.88	1.06
Loss of Coolant Accident (LOCA) for Primary Coolant Pipes	6.4	10.4	0.95

For a primary coolant pipe break LOCA, the maximum population dose for the FES-CP and CECO ER occurs for a large pipe break; however, for the DES-OP, it occurs for a small pipe break.

A review of the design changes made since the issuance of the construction permit does not provide an explanation for the above differences.

Enclosed please find a comparison table of the accident category's maximum radiological doses for these three documents.

Your consideration of the above differences is appreciated.

H-9

(3) Usually, the radiological doses calculated using NRC standard Bwr source terms for the primary coolant activity are termed "conservative" and those doses calculated for the utility by the architect/engineer using the nuclear steam supply system (NSSS) vendor's estimated primary coolant source terms are termed "realistic". The conservative doses, in most cases, are larger in magnitude than the realistic doses.

It is noted that the radiological doses calculated by NRC in Table 7.2 are termed "realistically estimated". Were the NRC standard Bwr source terms as given in Regulatory Guide 1.CC for the primary coolant activity used in calculating the doses as given in Table 7.2? If not, what are the conservative doses for the accidents considered?

C. Comparison of Table 5.6 of the DES-OP with the Table on Page C-56 of Regulatory Guide 1.CC

(1) Gaseous Radwaste Releases from the Building Ventilation Systems (Curie/year/reactor)

H-10

It is noted that the gaseous radioactive waste effluent release rates per reactor for the radwaste building for most of the radionuclides except for the noble gases as given in the DES-OP, Table 5.6, are lower by a factor of about 100 than the corresponding release rates per reactor as given in the Table on Page C-56 of Regulatory Guide 1.CC, which are used in the NRC Bwr/Gale computer code to determine the off-site gaseous doses for normal operations.

Please provide an explanation for the reduction of the gaseous effluent release rates as given in the Draft Environmental Statement - Operating Permit (DES-OP) Stage.

Thank you for the opportunity to review the LaSalle County Nuclear Power Station Draft Environmental Statement - Operating Permit Stage. Your consideration of the above comments is appreciated.

Very truly yours,

Gary N. Wright

Gary N. Wright, Chief
Division of Nuclear Safety

RRM:nh

LASALLE COUNTY NUCLEAR POWER STATION
A Comparison of the Radiological Doses (Maximum for Accident Class)

.ASS	ACCIDENT	SOURCE OF INFORMATION					
		FES-CP		DES-OP		CECO ER	
		Est. frct. of 10CFR20 limit at site bdry*	Est. within 50-mile radius (man-rem)	Est. frct. of 10CFR20 limit at site bdry*	Est. within 50 mile radius (man-rem)	Est. frct. of 10CFR20 limit at site bdry*	Est. within 50 mile radius (man-rem)
1	Trivial Incidents	(1)	(1)	(1)	(1)	(1)	(1)
2	Small Releases outside of Containment	(1)	(1)	(1)	(1)	(1)	(1)
3	Radioactive Waste System Failure	0.42	13.0	0.28	3.88	3.8×10^{-5}	1.06
4	Fission Product to Primary System (Bwr)	0.005	0.34	0.01	0.38	7.16×10^{-7}	0.058
6	Refueling Accident	0.001	0.36	0.012	0.17	1.52×10^{-5}	0.36
7	Spent Fuel Handling Accident	0.16	4.9	0.16	2.25	1.34×10^{-6}	0.032
8	Accident initiation events considered in design-basis evaluation in the safety analysis report.	0.02	6.4	0.05	10.4	1.9×10^{-6}	0.95
9	Hypothetical sequence of failures more severe than Class 8.	NOT	CONSIDERED				

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MAY 20, 1978
33 PHEASANT TRAIL
WILMINGTON, IL., 60481

RECEIVED MAY 31, 1978 U.S. NUCLEAR REGULATORY COMMISSION

DIRECTOR OF THE DIVISION OF SITE, SAFETY, AND ENVIORNMENTAL ANALYSIS
NUCLEAR REGULATORY COMMISSION,
WASHINGTON, D.C. 20555

DEAR SIR, LA SALLE COUNTY STATION

F-1 LIVING NEAR ENOUGH TO DRESDEN AND THE MANMADE LAKES, I SERIOUSLY QUESTION WHAT IF ANYTHING HAS BEEN DONE TO CONTROL FOG? (PER 2nd ENV. DRAFT STATEMENT 5-12) As it IS A VERY SERIOUS PROBLEM HERE, WHERE I LIVE. THEY STATE 10 DAYS, OF FOG. NO WAY! IT IS VERY MUCH ABOVE THE 10 DAYS. ALSO THE EARTHEN CONSTRUCTION OF THE

F-2 COOLING LAKES AHVE AN EXCELLENT TRACK RECORD OF CONSTANT SEEPAGE AND BREAK THRU, AS HAS OCCURED HERE AT DRESDEN AND THE FLOODING OF OUR MAIN ROAD IN AND OUT OF HERE. AS WELL AS OUR EMERGENCEY EQUIPMENT REACHING US. I SINCERELEY BELIEVE YOU SHOULD GET FULL FACTS, AS TO # OF DAYS OF FOG, # OF ACCIDENTS DUE TO FOGGING, (INCLUDING AN AMBULANCE TRYING TO ASSIST AN ACCIDENT VICTIM, ETC.) AS WELL AS THE ACCIDENTS AT DRESDEN AND ALL OTHER COOLING LAKES, BEFORE ANY DECISION IS MADE TO

F-3 ALLOW LA SALLE TO CONTINUE PRESENT CONSTRUCTION PLANS. AS I CAN ASSURE YOU COUNTY HIGHWAY 6 AND STATE ROAD 170 WILL PRESENT MAJOR PROBLEMS AND ACCIDENTS, IF FOGGED AND ICED AS OUR LOCAL RAODS ARE HERE, (COUNTY LINE ROAD AND LORENZO ROAD.)

F-4 I ALSO QUESTION IF THEY ARE TAKING FLOOD PLAIN LAND, AS THEY DID HERE IN BOTH WILL AND GRUNDY COUNTIES, FOR THE COOLING LAKES. AND WHAT PRECAUTIONS ARE BEING TAKEN

F-5 TO PREVENT RADIOACTIVE WATER FROM GOING DOWNSTREAM IN THE EVENT OF FLOODING, AS WAS THE VERY NEAR CASE HERE. HAD IT NOT BEEN FOR THE U.S. CORPS OF ENGINEERS AND THE HOVERCRAFT THIS SPRING, I CAN ASSURE I, MY SON, MY NEIGHBORS AND HOW MANY HOMES, PLUS DRESDEN WOULD HAVE BEEN FLOODED THIS YEAR. ALL BECAUSE THEY TOOK OUR FLOOD PLAIN, (PER U.S. ARMY CORPS OF ENGINEERS FLOOD PLAIN MAPS,) THAT I HAVE TAKEN THE TIME TO GO IN AND SEE THEM FOR MYSELF. THIS IS A VERY SERIOUS PROBLEM THAT HAS NOT BEEN PUBLICLY BROUGHT OUT, AND I THINK YOU HAVE THIS RESPONSIBILITY TO US THE PEOPLE AND THIS COUNTRY. AS RADIOACTIVE WATER FROM FLOODING GOING DOWN THE ILLINOIS TO THE MISSISSIPPI ADD THE GULF AND ATLANTIC, IS NOT A VERY PLEASANT THOUGHT. ALL THIS AREA AND THE PEOPLE, SAY GOODBYE FOR ? # OF YEARS.

REFERENCE 9-4

F-6 THE DECOMMISSIONING AND LAND USE, LEAVES ALOT TO BE DESIRED. ALSO WHAT ABOUT THE COOLING LAKES, I DID NOT SEE ANY REFERENCE TO THEM. IN OUR AREA WHERE THEY TOOK FLOOD PLAIN, THEY SHOULD BRING THIS LAND TO ITS ORIGINAL STATE, AND COLLINS AS WELL. AS TO LA SALLE, IT IS YOUR POSITION NOT TO ALLOW THEM TO TAKE THE FLOOD

F-7 PLAIN. ALSO, THEY TOOK PRIME FARM LAND FOR THIS STATION ADD THAT IS NOT NECESSARY WE NEED OUR PRIME FARM LANDS FOR FOOD, NOT GENERATING OF ELECTRICITY. THERE ARE OTHER LANDS AVAILABLE, AS WELL AS QUIT SELLING ELECTRICITY TO OTHER STATES, THIS IS AGAINST THE I.C.C. LAWS, IN THE STATE OF ILLINOIS. BUILDING OF NUCLEAR PLANTS TO FURNISH OTHER STATES AND NOT ILLINOIS, IS A NO-NO AND SHOULD BE. WITH OUR LAND

F-8 USE, WE ARE ALSO LOSING OUR WATER, THEY USE FOR THE PLANT, PLUS COOLING LAKES, ETC. PLUS THE LOSS OF ELECTRICITY IN TRANSIT, IS RIDICULOS, TO [illegible] SELL TO OTHER STATES.

F-9 LAST BUT NOT LEAST IS THE CLOSE PROXIMITY OF DRESDEN, LA SALLE AND [illegible] PLANTS ALL NUCLEAR, ALL ON THE SAME RIVER, CREATE A VERY SERIOUS NATIONAL, [illegible] SECURITY PROBLEM. ONE PROPERLY POSITIONED MISSILE, WILL WIPE OUT THE ENTIRE MID-WEST. AS WELL AS THE OIL (COLLINS) AND OTHER GENERATING STATIONS, WITHIN THE AREA. COM. ED. HAS BEEN PURCHASING IN [illegible] FOR ?. I DOUBT THEY ARE BEING HONEST IN THEIR STATEMENTS FOR THE NECESSITY OF ALL THESE PLANTS, FOR ILLINOIS, ONLY.

COPIES TO: U.S. REP. TOM CORCORAN
U.S. SEN. CHARLES PERCY

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SINCERELY YOURS,
[illegible] WALSH

Mazon, Illinois
May 20, 1978

Director Division of Site Safety & Enviromental Analysis
Nuclear Reg. Comm.
Wash. D.C.

Dear Sirs:

I am writing in regard to the Draft Enviromental Statemant related to the operation of LaSalle Co. Station Units 1 & 2. Docket Nos. 50-373 & 50-374.

G-1 On page 9-1 you state "that major changes in primarily agriculture land use are not expected because of operation of this station". This is far from the truth. I am a resident of this area and living on a farm. I have chosen to live in this area because of the scenic beauty and the small rural town community atmosphere. This monstrously large building complex, the ugly, hazardous transmission lines and various other support organization of the plant complex are already destroying our peaceful, quiet rural small town community life. The big, dirty, noisy, trucks constantly roll by, causing traffic problems and breaking up the roads. This costs us more tax money and definitely destroys our tranquil rural existence. Crime has increased recently in the rural sections by the influx of more people. Our lifestyle that we enjoy is being threatend by the existence of this gigantic proposal to build and operate these electric units.

G-2 Today, farming is a very efficient and competetive industry. U.S.D.A. reports that agriculture uses 3% of the energy in U.S. So, if the cities need this energy I do not believe they have a right to turn our farms into industrial property for their economic interests at our expense. I think they should be required to build the plants closer to the industrial areas. There has to be a balance between envirocment, agriculture and industry and the farmer should be in on the original planning decisions.

G-3 Your division does not deal adequately with the side effects of the operation of the hazardous transmission lines. I feel the U.S. government has an obligation to protect the people that work under these lines. Russian studies have proven the central nervous system can be effected. Older farmers with health problems can not safely work under the lines. There is an intense electric field in the vicinity of the power lines. There snould be real in-depth study of the long term effects of working under the lines as well as the dangers associated with farming under and around them. A virgin timber area near my home looks sad where it has been mutilated for the power line right of way. The ruts caused by the construction crews will cause some farm grounds to be unproductive for at least 10 years.

G-4 Who is monitoring the enviroment of this plant area? Will there be monitoring of the electric field under the power lines? It would be foolish to expect Comm. Edison to do valid tests and report them. I would like enviromental monitoring of both of these areas by the State and U.S. Govt. E.P.A. Will this be done?

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G-5 On page 9-5 you state "The applicant has made no firm plans for decommissioning." This is extremely important to me and especially to our community. If this unit is planned to last 30 years I feel the government has an obligation to protect all of us and the future generations by demanding that the utilities have these plans before receiving a license to operate.

G-6 On page 1-28 you state "All solid waste will be packaged to a licensed burial ground." Where is this burial ground? Illinois Attorney General Scott has stated that no more will be buried at Morris or Sheffield and many other states will not allow it. I feel this is an important problem that should be solved before any more Nuclear plants are allowed to operate. The solution to this could be a dangerous and very costly procedure. It should be solved now.

As the push for greater energy production continues to intensify, my only hope is that the nation adopts the conservation principle and use our farm land more wisely so that the broader quality-of-life values are preserved. Your considerations will be appreciated.

Sincerely yours,

Susan H. Mulhall

Mrs. Susan Mulhall
Route #1
Mazon, Illinois 60444

Commonwealth Edison
One First National Plaza, Chicago, Illinois
Address Reply to: Post Office Box 767
Chicago, Illinois 60690

50-373
374

June 2, 1978

Director, Division of Site Safety
and Environmental Analysis
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Sir:

Enclosed are Commonwealth Edison Company's comments pertaining to the LaSalle County Station Units 1 and 2 Draft Environmental Statement. These comments are being submitted for consideration by the Commission in accordance with 10 CFR Part 51.

Very truly yours,

C. Reed

Cordell Reed
Assistant Vice-President

Enclosure

Commonwealth Edison Comments Pertaining
to the Contents of the LaSalle County
Station, Units 1 and 2, Draft Environmental Statement

PAGE/SECTION		COMMENT
Page i, Item 3a Page 2-7	I-1	As indicated in revised section 3.9 of the LSCS-ER-OLS supplement 6, the proposed lattice towers have been replaced with steel pole structures on portions of the transmission lines. The area to be occupied by the tower bases has been reduced from 16 acres to 7 acres.
Page ii, Item 3h Page iii, Item f Page 4-1, 4-3, 4-4, 4-5, 4-6 & 4-7/ Sec. 4.2.1 Page 6-10/Sec. 6.3.4 Page 9-1/Sec. 9.1	I-2	CECo was prevented from seeding the dike in the vicinity of the Armstrong Run during the 1977 Spring Season because of a labor strike. This portion of the dike (exclusive of access ramps) was seeded during the 1977 fall planting season.) Our determinations indicate that the run-off from the dike did not cause erosion in the Run and our contribution to the silt in the Run was negligible. The area drained by the Run before construction (up to Highway 170) was 1709 acres versus 518 acres post construction. (See response to question 050.02, supplement 4 to the LSCS-ER-OLS). Attached to these comments marked Attachment A, is an evaluation of the NRC's staff analysis and a clarification of CECo's response by our Architect-Engineers that clearly demonstrate that the construction of the dike did not increase the peak discharge in the Armstrong Run compared to the pre-construction conditions. Also attached is a copy of our response to the NRC's IE Inspection Report Nos. 50-373/78-05 and 50-374/78-04 NRC Docket Nos. 50-373 and 50-374 marked Attachment B (Mr. Cordell Reed letter to Mr. J. G. Keppler dated March 17, 1978).

We suggest that the Staff's proposed requirements listed on Page 4-6 receive the following modifications:

Requirement 1: No modification.

Requirement 2: The applicant shall monitor the entire dike visually for vegetative integrity at the beginning of the spring and fall planting seasons (April and August). The requirement that the applicant shall monitor the entire dike after each major rainfall should be dropped. There is no use in monitoring the dike after a major rainfall if it is at a time of the year that repairs to the vegetative cover could not be implemented, such as during mid-July or late fall. This modification would be consistent with the terms of proposed Requirement 5.

Requirement 3: No modification (if Requirement 2 modification is accepted).

PAGE/SECTION | COMMENT

Requirement 4: No modification

Requirement 5: The following sentences should be added: "The monitoring of the revegetation in the Armstrong Run should continue until the vegetation on both the dike and the Run is successfully established and documented by CECo." and "Successful establishment of the vegetation will be determined through NRC's staff's timely review of the CECo documentation.

The last two sentences in the next to last paragraph of Section 4.2.1 on page 4-7 should be replaced by a

I-3 statement such as: "Furthermore the staff believes that removal of the clay deposits is generally not desirable and therefore suggests only the silt deposits that may direct the water flow into a bank so as to cause erosion be removed." This would be consistent with the U.S. SCS recommendation.

I-4 On page 4-6 it is stated that the operating license will not be issued until 1980. This is in conflict with our scheduled fuel loading in early 1979 and operation in September 1979. (See LSCS-ER (OLS) subsection 4.1.1)

2-16/2.4.2

I-5 The new meteorological data (October 1, 1976, through September 30, 1977) should be included in this section. This information was transmitted to the NRC staff on June 2, 1978 in Supplement 6 to the LSCS-ER (OLS).

2-17/Sec. 2.4.3

I-6 Our estimate of recurrence interval for a tornado at the LSCS site of 625 years was based on data obtained of tornadoes in a 10 county area including LaSalle County. The staff's estimate of 460 years is based on information concerning a 10,000 square mile region which is larger area and is not defined. We believe our data is more representative of the LSCS environs.

I-7 NRC has included, in its DES for LSCS, data on atmospheric stagnation obtained from Korshover's (1971) study of the Climatology of Stagnating Anticyclones East of the Rocky Mountains. Fifteen such occurrences are indicated for the LSCS site, for the period 1936 through 1970.

In the LSCS-ER(OLS), data on Inversions and High Air Pollution Potential is presented in subsection 2.3.4.6. Inversion frequency and seasonal mixing depth data are included. In addition, wind roses are provided, describing monthly variation of onsite winds for various speed intervals.

PAGE/SECTION | COMMENT

The question of whether the Korshover data is relevant or appropriate for inclusion in the DES can be addressed by a discussion of the meaning of his term "stagnation." Examination of his paper indicates that the term means an occurrence, for at least four consecutive days, of geomstrophic (calculated) wind speeds corresponding to a surface speed of 7.5 KNOTS (3.9mps). The 7.5 KNOT speed was chosen based upon results from a study of the maximum speeds which were present during a smog episode at Donora, Pennsylvania, in October 1948. Korshover's stagnation term has some limitations. It is based on an approximate relation between geostrophic and actual surface speeds, and it is based on a maximum wind speed characteristic of one extreme smog episode.

In summary, the stagnation statistics provided by the NRC Staff in the DES, based on Korshover's study, merely represent the frequency of occurrence of an extreme diffusion condition and does not objectively describe, in a detailed manner, the diffusion characteristics at a location such as LSCS.

2-17/2.4.4

I-8 Upper level of measurement of temperature should read 200 ft., not 201 ft. Also, the T provided at the time was 200-33 ft. Stability data defined by the temperature gradient between the 33-foot and 375-foot levels have been recorded since October 1, 1976 and one full year (October 1, 1976 through September 30, 1977) of joint frequency data of wind speed, wind direction, and stability, defined by the 33-375 foot T are provided in the revised Section 2.3 of the LSCS-ER(OLS). Supplement 6.

PAGE/SECTION		COMMENT
2-26 /2.7 2-27	I-9	Enclosed with these comments is a copy of the letter dated April 12, 1978 received by CECo from Mr. David Kenney of the Illinois Department of Conservation (Attachment C). The letter indicates Illinois Department of Conservation (IDOC) assessment that transmission line structures will have no effect on archaeological resources. An archaeological survey will be conducted on that portion of the LaSalle-Plano right-of-way which as yet is undetermined, and the results will be transmitted to IDOC at that time. (See revised subsection 2.6.3 in supplement 6 to the LSCS-ER (OLS)).
3-1/3.2 (P 1)	I-10	Reduction of the cooling pond size from 4480 to 2190 acres was addressed and approved during the ASLB hearing prior to the issuance of the construction permits. The final design necessitated a further reduction to the present 2058 acres.
3-1/3.1 (P 1)	I-11	The second paragraph should note that the evaluations are also given in Section 5.5 of this Environmental Statement (DES).
3-1/3.2.1 (P 1, Sentence 2)	I-12	Change "about $78 m^3/s$ (2800 cfs) of cooling water" to "about $78 m^3/s$ (2750 cfs) of cooling water."
3-1/3.2.2.1 (P 1, Senctnce 1)	I-13	Change "about $78 m^3/s$ (2700 cfs) to "about $78 m^3/s$ (2750 cfs).
3-4/3.2.2.1 (P 1, Sentence 1)	I-14	Change "will be about five days" to "will be about 5.5 days."
3-4/Table 3.1	I-15	Change Final Lake-Volume from $3.4 \times 10^7 m^3$ to $3.9 \times 10^7 m^3$.
3-9/3.2.4.1 (P 1, Sentence 1)	I-16	Include "per unit" after "at a rate of $38.9 m^3/s$ (1372 cfs).
3-9/3.2.4.1 (P 1, last sentence)	I-17	The statement "no scale inhibiting chemicals, will be added to the system" is inaccurate. It is stated in the LSCS-ER(OLS) subsection 3.6.2 that no biocide chemicals will be added to the condenser cooling water. Future installation of a pH control system may be necessary for control of scale in the circulating water system. Provisions have been made in the design of the circulating water system to include the scale control equipment should such a control system be required.

PAGE/SECTION		COMMENT
309/3.2.4.4 (P 1, 3rd sentence)	I-18	Please remove the adjective "manganese" in reference to green sand filters. The green sand will be used as a filter medium only and will not be treated with permanganate for iron removal.
3-11/Table 3.4	I-19	Change "Residual chlorine" to "Free Residual Chlorine". Change residual chlorine concentration from 0.74 to range between 0.20 and 0.75 mg/e
3-12/3.2.5	I-20	The transmission system that will connect the LaSalle County Station to the applicant's existing system was described in the FES-CP. Details of the new system have been refined since that time, however, and are discussed in the ER, Section 3.9. The transmission lines will be brought to the existing Plano substation to the north and to the existing East Frankfort substation to the northeast as before. The present routing of the transmission circuits has resulted in the Plano lines now being 66 km (41 miles) in length rather than 61 km (38 miles) and the East Frankfort lines being 100 km (62 miles) rather than 90 km (56 miles) in length as earlier described. The LSCS to East Frankfort route will consist of two 345-kv transmission circuits supported by steel pole structures on the tangent and steel tower structures at the angles except for a 7 mile section near East Frankfort where four circuit steel towers will be used throughout. The right-of-way for the East Frankfort transmission lines will vary in width from 44 to 190 meters (145 to 625 ft.). Both routes have been selected so as to utilize existing rights-of-way as well as to provide for future transmission lines not connected with the LaSalle County Station. Because of delays being experienced in connection with obtaining a Certificate of Public Convenience and Necessity from the Illinois Commerce Commission for the Plano transmission lines, a temporary connection from LSCS to an existing 138 kv line is being constructed. The temporary connection will consist of looping an existing 138kv circuit into LCSS to make 2-138 kv circuits. One circuit will connect to Mazon substation and will be 27 km (17 miles) in length. The other circuit will connect to Streator substation and will be 40 km (25 miles) in length. The new construction required to make these circuits consists of 2 single circuit wood pole lines, each 5.6 km (3.5 miles) in length, installed on existing right-of-way.

PAGE/SECTION		COMMENT
		The rights-of-way associated with the station (including the right-of-way for the temporary 138 kv line) will generally pass through flat or gently rolling farmland. To the extent possible the applicant will follow existing property lines and natural boundaries between various types of ground cover. Necessary river and stream crossings will be made with minimal disturbance to the water bodies and their immediate surroundings. Supporting structures will be set far enough back from the river and stream banks so as to minimize the disturbance of existing shoreline vegetation and so preserve the natural appearance at crossings. The increase in the lengths of the rights-of-way will entail no significant change in the character of the land over which the lines are routed as described in the FES-CP. There should therefore be no change in the impact assessment described in the FES-CP.
5.4/Table 5.3	I-21	For Applicant's Analysis-Case 1: River Velocity 0.23 m/s. Area of 0.55 C excess isotherm = 18,210 m^2 (4.5 acres). (Provided in LSCS-ER (OLS) p. 5.1-3, 5.1-4).
5-7/5.3.1.4 P 1, Sentence 2)	I-22	Change "cooling tower" to "cooling pond."
5-7/5.3.3 P 1, Sentence 3)	I-23	Change "the average free chlorine present in the sewage discharges (0.74 mg/e)" to "maximum free chlorine residual of 0.75 mg/e".
5-9/Table 5.4	I-24	Change Maximum Expected Quality of Station Discharge Total Dissolved Solids from 706.7 to 806.7 mg/L.
5-10/5.4.1.1 6-2/6.2.3	I-25	It is the opinion of the applicant that continuation of the terrestrial sampling program at Station (15) and Station (5) is unnecessary. Based upon the infrequency of dense fogging and the limited area that would likely be affected, according to either the staff's or the applicant's analysis the applicant does not believe that the operation of the LaSalle Cooling Lake will have a major impact on the vegetation of the region. In addition, the fact that any effect would occur during the winter months further emphasizes the lack of necessity for continuing vegetation sampling on or off-site. Woody and herbaceous vegetation are dormant during this period which would minimize any effects that fog formation might cause. Furthermore, the staff is using as a basis for extending the terrestrial monitoring program beyond the construction phase a publication (Troudeau, 1935) which is approximately 43 years old. The region referred to as "The Prairie Peninsula" has experienced a great deal of change in land-use patterns in the last 40 years. In fact during the past century this particular region in question has been extensively cultivated (DES Section 4.2.1). Therefore whether or not the area surrounding the plant, in particular the cooling pond, favors the eastward expansion of a prairie or the westward expansion of a forest is inconsequential because the natural system continues to be disturbed through heavy agricultural practices. An excellent case in point has been demonstrated at construction phase terrestrial monitoring location 5. This location has been selected by the staff as best suited for off-site monitoring outside the influence of the pond. During the present on-going monitoring program this station was abandoned in 1975 because the land owner subjected it to periodic mowing (Nalco. 1976. Terrestrial monitoring Program for the Construction Phase of the LaSalle County Station, 1975). Since that time it has been returned to cultivation. Because almost all parcels surrounding the cooling pond are continually being disturbed, to detect any biological responses to microclimatological changes will be impossible.
5-12/5.4.1.2	I-26	It is recommended that the proposed fog monitoring program commence with the commercial operation of Unit 1 and continue for 1 year following commercial operation of Unit 2. Those monitoring locations at which adverse impacts are not detected will be removed from the program following the 1 year period in which 2 unit operation was in progress.
5-12/5.4.2.1	I-27	"Organisms that ... (see Sect. 3.2.2)[18, 19]" should be changed to "Organisms which are recirculated through the station may be killed because of mechanical damage, excessive pressure and temperature (see sect. 3.2.2)[18,19]".
5-13/5.4.2.2 P 1, Sentence 4)	I-28	Include "staff's" before "worst - case estimates".
5-19/Table 5.8	I-29	The X/Q and D/Q data presented here have apparently included an unknown multiplier (described in the DES, Section 2.4.4) to account for spatial and temporal variations in airflow. Comparison (reported in Semi-annual Reports) between radiological monitoring results

PAGE/SECTION		COMMENT
		collected in the environs of the Dresden Station since 1971, Quad Cities Station since 1973 and estimated radiation doses and airborne concentrations of radionuclides computed with the straight-line model show that a multiplier equal to unity is applicable for calculations of dispersion over the open terrain regions of Illinois. Thus we believe the use of this multiplier is unwarranted.
5-19/Table 5.9	I-30	Dose assessments reported here (and in subsequent tables) should be reduced to reflect erroneous source term and meterological parameters cited above.
5-22/Sec. 5.5.2.4	I-31	The NRC staff has extended the C. F. Braun data to estimate the dose from the LaSalle County Station. This approach is inappropriate for this application. The data utilized by the staff are generic in nature and do not account for those design features utilized at the LaSalle County Station to minimize the dose. Such engineering features include special shielding of the turbines and associated piping andlocating the moisture separators below the turbine deck in a shielded area. The calculated annual dose from the LaSalle County Station, considering these engineering design features, is shown in Table 5.2-8 of the LSCS-ER(OLS) as a 4 mrem per year at the site boundary, 1/3 mile away.
5-22/Sec. 5.5.2.4	I-32	The last sentence of the second to last paragraph on the page should read ". . . . less than 0.01 mrem per year at the site boundary."
5-25/Table 5.16	I-33	On April 10, 1978, the Nuclear Regulatory Commission issued an amendment to 10 C.F.R. §51.20 which eliminated the values for radon-222 releases in Table S-3 (Table 5.16 in the LaSalle Draft Environmental Statement). 43 Fed.Reg. 15613 (April 14, 1978). Absent an effective generic rule covering this issue, it must be dealt with in individual licensing proceedings. National Resources Defense Council v. Nuclear Regulatory Commission (Vermont Yankee), 547 F.2d 633 (D.C. Cir. 1976), reversed on other grounds, Vermont Yankee Nuclear Power Corp. v. Natural Resources Defense Council, ____ U.S.L.W. ______ (April 3, 1978).
		Commonwealth Edison Company believes that the following changes should be made to the LaSalle Draft Environmental Statement to reflect the Commission's amendment to Table S-3:
5-25:		Table 5.16 should be amended to conform to new Table S-3.
5-26 to 5-27		Section 5.5.3, "Environmental Effects of the Uranium Fuel Cycle," should be amended to include a discussion of the doses to the U.S. population expected to result from radon releases associated with the uranium fuel cycle.
8-6 to 8-16:		Section 8.3.3, "Health Effects Attributable to Coal and Nuclear Fuel Cycle Alternatives" should be amended to include a discussion of health effects from radon releases, if any, not previously considered.
10-1:		Section 10.6, "Environmental Costs of the Uranium Fuel Cycle," should be expanded to include a summary of the impacts from radon releases.
	I-34	NEPA requires that radon releases be discussed in the LaSalle Environmental Statement because the fuel requirements of the LaSalle reactors will result in an increase in the amount of uranium mined and milled, and in the radon releases associated with such activities. See 42 U.S.C. §4332(2) (C) (i) (NEPA §102 (2) (C) (i)).
		Commonwealth Edison Company believes that radon releases associated with the uranium fuel cycle, while they must be discussed, do not have a significant impact on the environment and do not change the cost-benefit balance from a nuclear power station such as LaSalle. In the first place, as the Commission notes in its order amending Table S-3, it appears that burial or below grade burial methods"... can be taken in the future to reduce long-term releases from tailings disposal sites." 43 Fed. Reg. 15613, 15615-6 n.5. Indeed, applicants for uranium mill licenses must currently commit to plans for tailings disposal in accordance with NRC staff criteria which includes (a) location of the tailings isolation area such that disruption and dispersion by natural forces are minimized, (b) reduction of the radon release rate from such areas to rwice the release in the surrounding environs, and (c) elimination of the need for monitoring and maintenance. Id.
		Second, radon releases from uranium mill tailings result in very low dose rates to the exposed population. These have health significance only if one uses the unrealistically conservative assumption that the actual risk from low level radiation can be derived from linear extrapolation of dose-incidence curves experimentally determined at high radiation dose rates. This assumption is refuted in National Council on Radiation Protection and Measurements Report No. 43.

PAGE/SECTION	COMMENT
	Finally, health effects from radon releases only appear appreciable when integrated over the 76,000 to 80,000 year half-life of the parent thorium isotope. This involves unreasonable speculation--sheer guessing--about exposed population, climate and geophysical phenomena during that time span. Commonwealth Edison Company believes that health effect estimates should be limited to those periods of time for which reasonably credible estimates can be made. As the Court of Appeals noted in <u>Natural Resources Defense Council</u> v. Morton, 458 F.2d 827 (1972): NEPA requires predictions, but not prophecy, and impact statements ought not to be modeled on the works of Jules Verne or H.G. Wells, <u>Scientists Institute For Public Information</u> v. <u>Atomic Energy Commission,</u> 481 F. 2d 1079 (1973). Even if it were possible, which it is not, to make reasonable estimates of the costs of nuclear power over the eons, to arrive at a NEPA cost-benefit balance it would be necessary to consider the benefits of nuclear power for a similar period. The quantum of energy provided by the LaSalle generating station may set in motion or contribute to economic and social events which have profound effects on the Midwest, the nation, and on human health and welfare in general. Similary, alternative energy sources may conceivably have costs as far into the future, but it is unlikely that anyone can predict such effects for 76,000 years. A licensing board has ruled recently on the basis of staff affidavits that the nuclear fuel cycle, including radon releases from mill tailings, is considerably less harmful to man than is the coal fuel cycle. <u>Washington Public Power Supply System</u> (WPPSS Nuclear Project Nos. 3 and 5) ____ NRC _______ (April 10, 1978 Slip Opinion). Commonwealth Edison Company believes that this conclusion is correct and that by incorporating a summary of these comments and of staff affidavits similar to those used in <u>WPPS</u>, <u>supra</u>, full compliance with the requirements of NEPA can be achieved in the LaSalle Final Environmental Statement.
5-29/Table 5.18 I-35	Change "2.8% of total budget paid by station in 1975 to LaSalle County to "0.3%".

PAGE/SECTION	COMMENT
6-1/Sec. 6.2.1 (Para. 2) I-36	The wind sensors have been moved from the 33-foot level to the 200-foot level of the meteorological tower in May, 1978. For LSCS operations, the prime meteorological base is the 375-foot wind data and the 33-375 foot temperature gradient data. The 200-foot level wind data presently being collected are intended as a backup to this primary reference. The 33-foot level wind sensors were used to back up the 375-foot wind data, but to eliminate any possibility of there being some influence by the major structures, the sensors were moved to the 200-foot level. (See Revised LSCS-ER(OLS) Section 6.1.3, Supplement 6).
6-2/6.2.3 (last sentence, P 2) I-37	Commonwealth Edison Company believes that these studies should be discontinued after 1978. This will conclude the five year monitoring program begun in 1974. During this time any impacts which have occured have been identified. After 1978 most on site construction will take place inside structures now standing. Therefore, since major construction will be completed, the impacts of construction activities on or off site, if any, will be minimal.
6-5/6.2.5 (last paragraph) I-38	The staff wants a weekly exchange of the charcoal cartridges. Currently, we use a bi-weekly frequency at Dresden, Quad-Cities and Zion because we have demonstrated to the NRC that the bi-weekly period is more sensitive. There is no reason to change and furthermore none is offered in the DES.
6-7/6.2.5 Recommendation 2) I-39	NRC wants monthly gamma isotopic analysis. This is acceptable. However, there is no composite sampler; weekly grab samples are compostied monthly or quarterly.
6-7/Table 6.4 I-40	CECo and the NRC have agreed on the LLD's in the attached table (Attachment D) for all environmental radiological programs.
6-8/6.2.6 P 3, Sentence 3) I-41	To be in agreement with the finalization of the lake monitoring program described in correspondence from V. A. Moore to Byron Lee dated December 13, 1976 (see LSCS-ER-OLS Appendix 5.1B, page 5.1B-12) please make the following changes: Insert, following the phrase "beginning after the lake is filled", the phrases "to its anticipated operating level and pumping of water through plant systems begins."
6-8/6.2.6 last 2 paragraphs) I-42	The staff requires consideration of allpossible recreational uses of the lake including primary water contact sports (swimming and water skiing) within the limits of public health risks. We point out that due to the reduction in lake size there is no area of shoreline that can reasonably be developed into a safe

PAGE/SECTION		COMMENTS
		swimming beach. The question of public safety and the liability associated with this activity puts an unwarranted burden on our rate payers. In addition an activity such as water skiing requires boats with high horsepower engines operating at speeds which would greatly increase both wave action and the turbidity of the water. These conditions would lessen the full utilization of the lake for secondary contact water sports such as canoeing, rowing, sailing and fishing. The last sentence on page 6-8 continuing on to page 6-9 appears to be in error since boating and fishing are listed as examples of both primary and secondary contact sports and "secondary contact sports is repeated without apparent purpose.
6-11/6.3.5.1	I-43	To be in concert with thermal studies out-lined in DES Sec. 6.3.2.1, the applicant's aquatic monitoring program will be instituted after Unit 1 becomes commercially operational and will continue for one year after both Units 1 and 2 are in commercial operation.
6-11/6.3.6 (last paragraph)	I-44	During the negotiations referred to previously, CECo. agreed to perform for the first two years of operation, the same program as the pre-operational. Then in the third year of operations, the program would be reduced to that shown in Attachment E.
8-1/8.1 (¶ 1, sentence 3)	I-45	The dates indicated for commercial operation are incorrect. As of February 6, 1978 Units 1 and 2 are scheduled to begin commercial operation in September, 1979 and September, 1980, respectively. (LSCS-ER-OLS Sec. 4.1.1, page 4.1-1)
8-10/Table 8.8 Table 8.7b	I-46	The applicant believes the excess mortality and excess morbility and injury tables for coal fired plants (Tables 8.7b and 8.8, respectively) overstate the health hazards. Nevertheless, we agree that the nuclear fuel cycle has substantially less environmental and health impacts than does the coal fuel cycle.
8-18/8.3.3	I-47	The new load growth estimates should be included in this section. This information was transmitted to the NRC staff on June 2, 1978 in supplement 6 to the LSCS-ER(OLS). The rates of load growth assumed are within the range of load growth mentioned by the staff in chapter 8 of the DES.

EVALUATION OF NRC STAFF'S ANALYSIS OF THE ARMSTRONG RUN EROSION PROBLEM

The following discussion addresses the comments raised by NRC staff in their letter dated February 16, 1978 regarding the Armstrong Run erosion problem due to the construction of the dikes at LaSalle Station.

CHANGES IN PEAK DISCHARGE IN ARMSTRONG RUN

The drainage areas of the Armstrong Run at Commonwealth Edison Company's (CECo.) property line and at Highway 170 before and after the construction of the dike are given below:

	Drainage Area of Armstrong Run in Acres		
Location	Pre Construction	During Construction	Post Construction
At property line	1018	339	339
At Highway 170	1709	518	518

The 339 acres of the drainage area at property line during and post construction stage can be subdivided as follows:

Sub-Area		Acres	% of Total Area of 339 Acres
Steep sloped area of the dike	=	46.6	14
Flat disturbed area for the ditches	=	27.2	8
Undisturbed farm land	=	265.2	78
Totals	=	339.0	100

The drainage area of the Armstrong Run was reduced from 1018 acres to 339 acres after construction of the dikes, a reduction of 67%. For a given rainfall intensity, peak discharge depends on the drainage area and the runoff coefficient. The peak discharge during construction can exceed that under pre-construction conditions only if the runoff coefficient increases by more than 200 percent. (The time of concentration is slightly more under during construction condition compared to pre-construction condition. Longer the time of concentration, the lower is the peak discharge.)

NRC suggested a runoff coefficient of 0.65 for pre-construction condition and 0.9 for bare dike condition. Even assuming that all 339 acres of drainage area at property line consist of bare dike slopes, the discharge during construction stage can only be about half of that under pre-construction condition. Hence, it is proved that the discharge during construction condition can never be greater than or equal to that of pre-construction condition.

REVIEW OF NRC STAFF'S ANALYSIS OF ARMSTRONG RUN EROSION PROBLEM

1. Adjustment of Unit Hydrograph Model: NRC states that they developed a "unit hydrograph and adjusted the unit hydrograph model to duplicate the gaging records for Gimlet Creek using the best available precipitation data from Aurora." For the following reasons, we believe that the adjustment of unit hydrograph is not appropriate:

   a. Triangular unit hydrograph theory, used by us and the NRC was based on the data from a number of watersheds to develop a synthetic unit graph for ungaged streams. For Armstrong Run problem, only the relative values of discharge before and after construction are important and the absolute value of discharge is of lesser importance. So, in the absence of gaging records, as is the case with Armstrong Run, adjustment of unit hydrograph is an unnecessary refinement.

   b. Aurora is a nonrecording precipitation station. Unless the hourly values of precipitation are available, the adjustment of the hydrograph becomes arbitrary. Aurora has only 24 hour precipitation data and is about 80 miles northeast of the Gimlet Creek basin. Since the precipitation station (Aurora) is a nonrecording station and it is 80 miles away from watershed, adjustment of unit hydrograph based on this precipitation data does not improve the accuracy of the unit hydrograph. Gimlet Creek basin with a drainage area of 5.4 square miles, is a small basin and using precipitation from a nonrecording station 80 miles away to adjust the unit hydrograph is questionable. Discharge records are available from 1951 to 1976 for Gimlet Creek. From 1951 to 1976, the yearly peak discharge of Gimlet Creek exceeded 1000 cfs in nine years. Eight of these peaks occurred during June - September period indicating that the peak floods in Gimlet Creek occur due to thunder storms. Thunder storms are very localized and a rain gage 80 miles away is not an appropriate source for precipitation data to adjust the Gimlet Creek unit hydrograph. Wenona, 20 miles east and Edelstein, 12 miles southwest of Gimlet Creek basin, both being hourly precipitation recording stations, would have been better sources for precipitation data.

2. Runoff Coefficients: The basis for our use of runoff coefficients is from References (1)* and (2). NRC calculated the runoff coefficients based on information contained in Reference (3). That procedure is meant to calculate the volume of runoff rather than the runoff coefficient. The following table compares the values of runoff coefficient C used by us and NRC.

*References are provided at the end.

	CECo	NRC
Pre-construction	0.50	0.65
Construction		
Undistrubed land area	0.50	---
Ditch area	0.53	---
Dike face	1.00	0.9
Weighted average value at property line (during construction)	0.59	---
Post Construction	0.50	0.8

As outlined earlier, the surface area of the dike is only 14% of the total area and the undisturbed land area is 78% of the total area. Hence, the weighted average value for C should be used in calculating the peak runoff value during construction conditions. We assume that NRC used a value of 0.9 for the entire 339 acres to obtain the peak discharge during construction conditions based on their statement that the watershed slope for pre-construction and for post construction increases from 40:1 to 3:1. We used a runoff coefficient of 1.0 for the dike surfaces compared to 0.9 used by NRC.

3. Watershed Slope: NRC contends that the watershed slope for pre-construction and for post construction increases from 40:1 to 3:1. The watershed slope under pre-construction conditions is about 300:1. The area occupied by the dikes is only 46.6 acres (14% of the total area) and the slope of the dikes is 3:1. The rest of the drainage area (339-46.6 = 292.4 or 86% of the total area) would have the characteristics of pre-construction conditions. In other words, the slope for only 14% of the area of the watershed

increases from 300:1 to 3:1 and the remaining 86% of the area will have the same slope as that under pre-construction conditions. Assuming the runoff coefficient of 0.9 for the seeded dikes (46.6 acres or 14% of the total area) and 0.65 for the rest of the area, as was used by NRC in their analysis, the weighted average runoff coefficient would be 0.68. This means the runoff coefficient increases from 0.65 during pre-construction to 0.68 during construction stage, an increase of only 5%. However, the drainage area reduces from 1018 acres during pre-construction to 339 acres during construction stage, a decrease of 200%. This would result in a decrease of 195% in discharge. If the discharge were 100 cfs during pre-construction times, the discharge would be reduced to 34 cfs during construction conditions for similar storms. It can also be stated that during and post construction condition discharge would be scaled down to by a factor of 0.33.

It is not known how NRC arrived at their conclusion that discharge increases by 6% during construction stage. It is presumed that NRC might have overlooked that 292 acres of the watershed area (or 86% of the total area) at the property line are undisturbed in terms of changes in slope and runoff characteristics of its surface.

4. Difference in Runoff Coefficients: NRC states that the difference between the pre-construction runoff coefficient and the construction coefficient (i.e., 0.07) is too low to accurately represent the effect of both the increased watershed slope and the bare clay face of the east dike. We do not agree with the above statement for the following reasons.

a. We used a runoff coefficient of 1.0 for the whole dike slope area of 46.6 acres (or 14% of the total area) even though only the east dike is unseeded, compared to a value of 0.9 used by NRC. Since most of the dike is seeded, a coefficient of less than 1.0 should be more representative of the actual conditions. However, to be conservative, a coefficient of 1.0 was used which represents more than adequately the effect of both the increased slope of the dike surface area and the bare clay face of the east dike. The weighted average runoff coefficient (1.00 for 46.6 acres of dike slopes, 0.53 for the disturbed area of 27.2 acres along the ditches and 0.5 for the undisturbed area of 265.2 acres) is 0.57 compared to that of 0.5 for pre-construction conditions, an increase of 14%. Using NRC suggested values of 0.65 for pre-construction and 0.9 for bare clay face gives a weighted average coefficient of 0.68 for during and post construction period compared to a coefficient of 0.65 for pre-construction condition, an increase of only 4.6%. Hence, our runoff coefficients are more conservative compared to those used by NRC and our coefficients adequately represent the changes in runoff characteristics.

5. <u>Storm Durations:</u> NRC states that the staff analysis revealed a much more serious problem with the our prediction of peak discharge. It appears that NRC misunderstood our analysis. We recognize that short duration storms will have higher peaks compared to long duration storms. We used 24-hour rainfall in the interest of developing full hydrograph. The 24-hour rain fall is subdivided into 15 minute increments as per U.S. Army Corps of Engineers method (Reference 4). The following table gives the maximum 15 minute

precipitation for various storms as per the above distribution and as used in our hydrograph analysis.

Precipitation in inches

Storm Return Period	24-hour	Maximum 1 hour rainfall contained in 24 hours	Max. 15-min.	Equivalent Intensity
1	2.5	1.38	0.44	1.76 in./hr.
10	4.3	2.37	0.78	3.12
100	6.0	3.30	1.10	4.40

We chose 15 minute interval because the unit rainfall duration for the unit hydrograph used in their analysis is 15 minutes, which is based on the criterion that it should be one forth or less of lag time for basin (Reference 5). The 24-hour rainfall period contains some one hour periods during which the rainfall is as intense as or more than that used by NRC. For example, for a 10-year storm, 24-hour rainfall period contained a one hour rainfall of 2.37 inches as used by us compared to that of 1.98 inches used by NRC.

In using the rational formula, we used an intensity that corresponds to time of concentration. Chow (Reference 2) states "when using the rational formula, one must assume that the maximum rate of flow, owing to a certain rainfall intensity over the drainage area, is produced by that rainfall which is maintained for a time equal to the period of concentration." The following are the time of concentrations at the property line under various conditions:

Condition	Time of Concentration in Hours	100-year storm Rainfall Intensities Corresponding to Time of Concentration-inches/hour
Pre-construction	2.08	1.7
During construction	2.34	1.5
Post construction	2.34	1.5

The time of concentration increases during and post construction conditions because the drainage area at property line under these conditions is a narrow strip of area along the dikes.

NRC's statement - "The point is that the use of the 24-hour storm (which has a relatively low intensity) is not appropriate for analysis of the Armstrong Run erosion problem" is not right. We used 24-hour storm to get the total runoff sequence during 24-hour period. The 24-hour rainfall period used by us contains one hour periods over which the intensity of rainfall is more severe than that used by NRC.

6. <u>6% increase in Peak Discharge:</u> We do not agree with NRC's statement of at least a 6% increase in peak discharge occurred for the 100-year, one hour storm during construction while the east portion of the dike was not vegetated. According to our analysis as explained in the above paragraphs, there would be a 65% decrease in peak discharge for the 100-year storm during construction period. This is mainly attributable to 67% decrease in drainage area during post construction period (from 1018 acres to 339 acres).

If NRC reviews their analysis in the light of the discussion provided in the above paragraphs we believe that NRC would arrive at similar conclusion that the peak discharge under-construction condition would be lower than that under pre-construction condition.

7. <u>Increase in Erosivity:</u> We do not agree with the conclusion in the statement that "a 6% increase in discharge during construction would produce a 12% to 19% increase in erosivity" as the hypothesis of 6% increase in discharge is not valid in the light of the

discussion in the above paragraphs. There would be a 65% reduction in discharge during and post construction conditions compared to the pre-construction condition. That should result in reduction of the erosivity by 130% to 195% using same equation as suggested by NRC.

8. <u>Erosion and Unusual Rainfall:</u> NRC believes that the erosion in Armstrong Run was mainly due to increased peak discharges. We do not agree with NRC on this point. The erosion is not due to increased peak discharge in the Armstrong Run as discussed earlier. We strongly believe that the erosion is mainly due to unusually heavy rainfall during July, August and September of 1977 at the site area.

Marseilles Lock is the nearest precipitation gage for which the rainfall data was available. The actual recorded and the normal rainfall for these months are given here under.

Month	Rainfall in inches: Actual in 1977	Normal
July	4.05	3.74
August	5.15	3.10
September	10.30	3.38

This clearly shows that the period of August and September of 1977 was a very wet period at the site and the rainfall was unusual and much above normal. The August 1977 rainfall was 66% above normal and September rainfall was 205% above normal. The rainfall on September 1, 1977 at Marseilles was 4.79 inches which is more than the normal rainfall for the entire month. We believe that only the continuous above-normal rainfall over a period of two months caused the erosion in the Armstrong Run.

NRC also was debating about the cause of erosion which can be inferred from their statement that - "this raises a question as to whether the erosion was due to the construction of LaSalle County Station or solely to the unusual rainfall." Based on the results of their analysis, which are very questionable, they concluded the erosion is due to increased discharge.

Requirements specified by NRC: The above analysis together with that provided in supplement 4 of ER clearly demonstrates that, the erosion in Armstrong Run was only due to unusual heavy rainfall and not due to the construction of the dikes. In fact, the construction of the dikes reduces substantially the peak discharges in Armstrong Run. Hence, CECo did not contribute to the erosion problem in Armstrong Run that can be attributed to the increased runoff due to the construction of the dikes.

REFERENCES

1. Handbook of Steel Drainage and Highway Construction Products, Second Edition, American Iron and Steel Institute, New York, N. Y. 1971

2. Handbook of Applied Hydrology; Edited by Ven Te Chow, McGraw-Hill Book Company, 1964, Section 14

3. Handbook of Applied Hydrology, Edited by Ven Te Chow, McGraw-Hill Book Company, 1964, Section 21

4. Engineering and Design - Standard Project Flood Determinations, Report EM 1110-2-1411, U.S. Army Corps of Engineers, 1965

5. Design of Small Dams, United States Bureau of Reclamation, 1974, page 67

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ATTACHMENT B

March 17, 1978

Mr. James G. Keppler, Director
Directorate of Inspection and
Enforcement - Region III
U.S. Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, Illinois 60137

Subject: LaSalle County Station Units 1 and 2
Response to IE Inspection Report
Nos. 50-373/78-05 and 50-374/78-04
NRC Docket Nos. 50-373 and 50-374

Reference (a): J. G. Keppler letter to B. Lee, Jr. dated February 22, 1978

Dear Mr. Keppler:

The following is in response to an inspection conducted by Dr. M. J. Oestmann and Mr. T. H. Essig on January 16-18, 1978 of activities at LaSalle County Station. Reference (a) indicated that two items appeared to be in noncompliance with NRC requirements. These items are addressed in the attachment to this letter.

In a telephone conversation with Dr. M. J. Oestmann of your Staff on March 16, 1978, we were granted a one day extension for our response.

Please refer any additional questions you might have on this subject to this office.

Very truly yours,

C. Reed

Cordell Reed
Assistant Vice-President

attachment

Commonwealth Edison NRC Docket Nos. 50-373
50-374

ATTACHMENT

INFRACTION 1:

Condition 3.E(1) of the Construction Permit requires the licensee to minimize erosion during construction related to the facility.

Contrary to this requirement, the licensee failed to provide early planting and cover after completion of the construction of the east dike of the cooling lake, with a result that the face of the east dike experienced preventable erosion. (Units 1 and 2)

RESPONSE:

Construction of the dike in the vicinity of Armstrong Run was completed in the fall of 1976. This was too late to plant seed. Our intention at that time was to seed during the 1977 spring planting season. However, a labor strike occurred at the station during the spring which prevented the completion of seeding until late summer (fall planting season). Commonwealth Edison believes it was not negligent in failing to seed the dike "by early planting" because the labor strike prevented it. This information was discussed at the September 13, 1977 meeting with the NRC, and again stated in supplement number four to the Operating License Stage - Environmental Report for LaSalle County Station transmitted to the NRC on October 20, 1977. Since planting occurred as soon as possible, we believe that we should not be cited with an infraction regarding this matter.

DEFICIENCY 2

Condition 3.E.(2) of the Construction Permit requires that if harmful effects not considered in the Final Environmental Statement are detected by the monitoring program, the licensee will provide to the Staff an analysis of the problem and a plan of action to significantly reduce the detrimental effects.

Contrary to this requirement, the licensee failed to submit an analysis of the problem and a plan of action to the Staff when erosion conditions in Armstrong Run near the cooling lake dike were brought to their attention. (Units 1 and 2)

RESPONSE:

Commonwealth Edison started seeding the east face of the dike near Armstrong Run prior to the September 13, 1977 meeting with the NRC Staff. After being made aware of a possible problem, we performed an analysis of the situation and determined that the runoff from our dike did not cause erosion in the Run and our contribution to the silt in the Run was negligible. In addition, the daily and monthly inspection program did not indicate any abnormal erosion on the east facing dike. Perimeter ditches and catch basins were inspected and found to be collecting erosion materials from the dike. During any rainy season some erosion of newly laid soil is to be expected and our environmental site inspector, based on his judgment and experience, did not feel that the erosion observed was unusual for this type of construction and, therefore, a problem did not exist.

We made the offer to reimburse the adjacent land owners for fixing of the Run in accordance with the Soil Conservation Service recommendations. We did this on the basis that we may have contributed some silt to the Run but that the water runoff from the bare dike during heavy rains, according to our calculations, is less than what would have occurred during pre-construction conditions. In summary, we took action to eliminate the runoff problem from the bare dike during the first planting season that we were able because of the labor strike; we analyzed the problem and determined we did not cause the erosion; and we offered to "fix" the Run even though we were not a major contributor to the problem. On this basis, we do not believe that we have been deficient in complying with this construction permit item.

ATTACHMENT C

April 12, 1978

Mr. M. S. Turbak
Nuclear Licensing Administration
Commonwealth Edison
P. O. Box 767
Chicago, Illinois 60690

Dear Mr. Turbak:

My staff archaeologist has reviewed the report "An Archeological Survey and Test Excavation Study of the Plano and East Frankfort Transmission Line Corridors, LaSalle, Grundy, Kendall and Will Counties, Illinois." As the transmission structures have been moved to avoid impact, there will be no effect on archeological resources.

We understand that the remaining right-of-way will be surveyed. If sites are found the State Historic Preservation Officer should be consulted concerning mitigation of impact and Advisory Council procedures followed.

Sincerely,

David Kenney

DK/MKB/js

Attachment D

TABLE B.3.2-3

PRACTICAL LOWER LIMITS OF DETECTION (LLD)

FOR ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM

SAMPLE MEDIA	ANALYSIS	LLD (4.66σB)	UNITS
Airborne "Particulate"	Gross Beta[a]	0.01	pCi/m^3
	Gamma Isotopic	0.01	pCi/m^3
	Sr-89,90	0.01	pCi/m^3
Airborne I-131	Iodine-131	0.10	pCi/m^3
Liquids	Sr-89	10	pCi/liter
	Sr-90	2	pCi/liter
	I-131	5[b]	pCi/liter
	Cs-134	10	pCi/liter
	Cs-137	10[c]	pCi/liter
	Tritium	0.2	pCi/ml
	Gross Beta[a]	5	pCi/liter
	Gamma Isotopic	<20	pCi/l for each nuclide
Vegetation	Gross Beta[a]	2	pCi/g wet
	I-131	0.03	pCi/g wet
	Sr-89,90	1	pCi/g wet
	Gamma Isotopic	0.2	pCi/g wet
Soil, Sediment	Gross Beta[a]	2	pCi/g dry
	Sr-89,90	1	pCi/g dry
	Gamma Isotopic	0.2	pCi/g dry
Animal Tissue	Sr-89,90	0.1	pCi/g wet
	I-131 - Thyroid	0.1	pCi/g wet
	Cs-134, 137	0.1	pCi/g wet
	Gross Beta[a]	1.0	pCi/g wet

---

[a] Referenced to Cs-137.

[b] 0.5 pCi/liter on milk samples collected during the pasture season ~~or on potable water when the thyroid is expected to exceed one mrem/yr via water ingestion.~~

[c] 5.0 pCi/liter on milk samples.

[illegible] AND THEREAFTER STANDARD RADIOLOGICAL MONITORING PROGRAM

Attachment E

SAMPLE MEDIA	COLLECTION SITE	TYPE OF ANALYSIS	FREQUENCY	NON-ROUTINE REPORTING LEVELS[b]
1. Air Monitoring	(a) Onsite and near-field 1. Nearfield (#1) 2. Onsite (#2) 3. Onsite (#3) 4. Nearfield (#4) 5. Onsite (#5) 6. Nearfield (#6)	1. Filter - gross beta[a] 2. Charcoal - I-131 3. Sampling Train-Test and Maintenance	1. Weekly 2. Bi-Weekly[c] 3. Weekly	$Cs-134: 10\ pCi/m^3$ $Cs-137: 20\ pCi/m^3$ $I-131\ 0.7\ pCi/m^3$
	(b) Far Field 1. Seneca (#7) 2. Marseilles (#8) 3. Grand Ridge (#9) 4. Streator (#10) 5. Ransom (#11) 6. Kernan (#12) 7. Route 6 at Gonnam Road (#13) 8. Ottawa (#14)	1. Filter Exchange 2. Charcoal Exchange 3. Sampling Train-Test and Maintenance	1. Weekly 2. Bi-Weekly[c] 3. Weekly	Same as 1(a) when analyses are made.
2. TLD	Same as 1	Gamma Radiation	Quarterly	-----
3. Land use census (a) Dairy animals	(a) Enumeration of all dairy animals within 2 miles	To revise environmental dose models, if necessary	Semi-annually	-----
~~(b) [illegible]~~	~~(b) [illegible]~~			
4. Milk	2 DAIRY FARMS (a) ~~Nearby dairy, near one, if possible~~ ~~(b) Nearest "Family Cow" if within 5 miles, if possible~~	I-131	1. Weekly during grazing season (May to Oct.) 2. Monthly (Nov. to April)	I-131: 3 pCi/liter Cs-134: 60 pCi/liter Cs-137: 70 pCi/liter Ba-La-140: 300 pCi/liter
5. Industrial Water Supply	Illinois Nitrogen Corporation	Gross beta[a]	Weekly	See Footnote[d]
6. Cooling Water Sample	(a) Inlet (b) Discharge	Gross beta	Weekly	-----
7. Sediment	(a) Upstream of inlet (b) Downstream of discharge (c) Cooling lake near recreational area	Gamma Isotopic	Annual	-----
8. Fish	MARSEILLES POOL OF ILLINOIS RIVER	GAMMA ISOTOPIC	SEMI-ANNUAL	Mn-54 3x10[4], Fe-59 1x10[4], Co-58 [illegible], Co-60 1x10[4], Zn-65 2x10[4], Cs-134 1x10[illegible], Cs-137 2x10[illegible] pCi/kg wet weigh[illegible]

[a] A gamma isotopic analysis shall be performed whenever the gross beta concentration in a sample exceeds five times (5x) the average concentration of the preceding calendar quarter for the sample location. During one of periods of increasing fallout from nuclear weapons testing, the action level shall be 10x rather than 5x.

[b] Average concentration over calendar quarter.

[c] Bi-Weekly shall mean that the frequency is once every other week.

[d] In units of pCi/liter, the Non-Routine Reporting levels for Industrial Water Supply are H-3: $2x10^4$; Mn-54: $1x10^3$, Fe-59: $1x10^2$; Co-58: $6x10^2$; Co-60: $2x10^2$; Zn-65: $2x10^2$; Zr-Nb-95: $4x10^2$, I-131: 3; Cs-134: 30, Cs-137: 60; and Ba-La-140: $1x10^2$.

APPENDIX B. CORRESPONDENCE RELATIVE TO SITE HISTORICAL AND ARCHEOLOGICAL FEATURES

STATE OF ILLINOIS

DEPARTMENT OF CONSERVATION

605 STATE OFFICE BUILDING
400 SOUTH SPRING ST
SPRINGFIELD 62706

CHICAGO OFFICE— ROOM 100, 160 N. LA SALLE ST., 60601

ANTHONY T DEAN
DIRECTOR

HAROLD L. ELLSWORTH
ASSISTANT DIRECTOR

December 31, 1975

Mr. A.O. Courtney
Environmental Affairs
Commonwealth Edison
P.O. Box 767
72 West Adams Street
Chicago, Illinois 60690

Dear Mr. Courtney:

This letter is to inform you that we have reviewed the specifications of your project of the update of the "LaSalle County Nuclear Station Environmental Report".

Our review of the records indicates that your project will not effect historic, architectural or archaeological projects in this area.

This letter of clearance relates only to cultural considerations and should not be viewed as a blanket write-off which would include natural areas or other concerns of the Department of Conservation.

If you have further questions regarding this, please contact me.

Sincerely,

Anthony T. Dean
State Historic Preservation Officer

ATD/lg

Illinois Department of Conservation
life and land together

605 STATE OFFICE BUILDING • 400 SOUTH SPRING STREET • SPRINGFIELD 62706
CHICAGO OFFICE – ROOM 100, 160 NO. LASALLE 60601
David Kenney, Director • James C. Helfrich, Assistant Director

January 6, 1978

RECEIVED
JAN 13, 1978
U.S. NUCLEAR REGULATORY COMMISSION
Mail Section

Mr. George W. Knighton
Division of Site Safety and
Environmental Analysis
U.S. Nuclear Regulatory Agency
Washington, D.C. 20555

50-373
374

Dear Mr. Knighton:

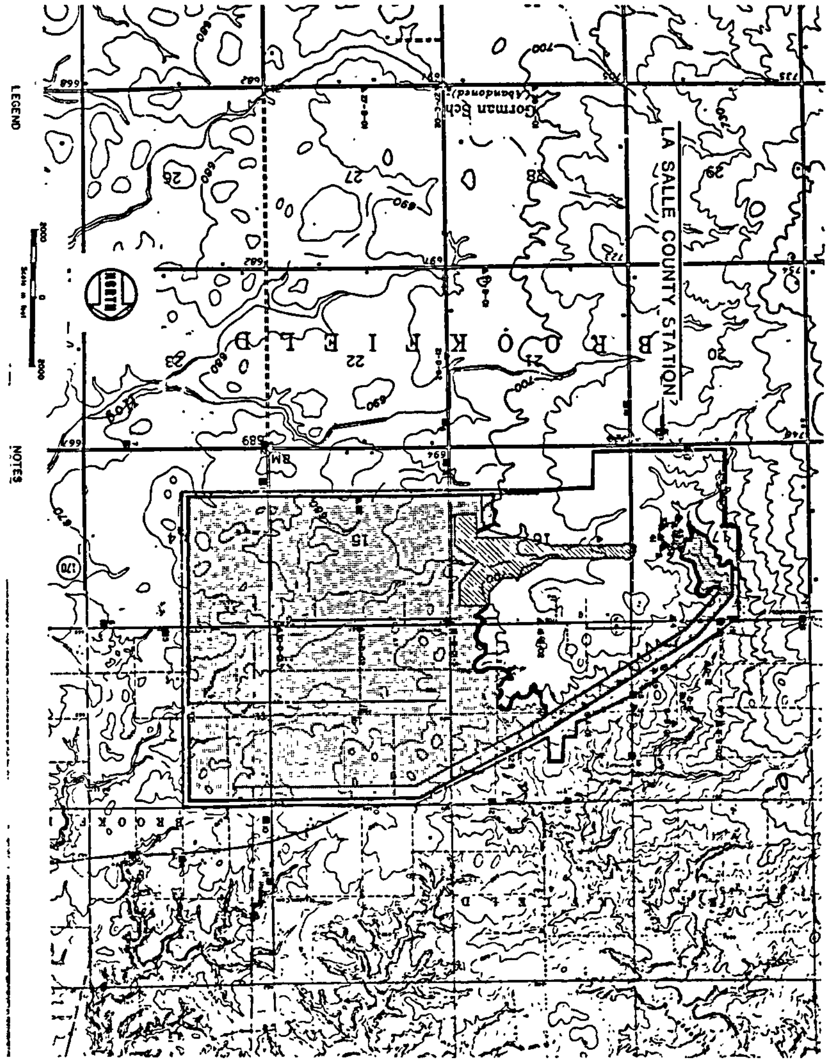
In response to your letter of December 23, 1977, concerning the LaSalle County Station near Ottawa, Illinois, we have consulted our files and have determined that the property occupied by the facility as described on the enclosed map contains no significant historical, architectural or archaeological sites.

Sincerely,

David Kenney
David Kenney
State Historic Preservation Officer

DK/TH/dg
Enclosure

780130014



Illinois Department of Conservation
life and land together

605 STATE OFFICE BUILDING • 400 SOUTH SPRING STREET • SPRINGFIELD 62706
CHICAGO OFFICE – ROOM 100, 160 NO. LASALLE 60601
David Kenney, Director • James C. Helfrich, Assistant Director

April 12, 1978

Mr. M. S. Turbak
Nuclear Licensing Administration
Commonwealth Edison
P. O. Box 767
Chicago, Illinois 60690

Dear Mr. Turbak:

My staff archaeologist has reviewed the report "An Archeological Survey and Test Excavation Study of the Plano and East Frankfort Transmission Line Corridors, LaSalle, Grundy, Kendall and Will Counties, Illinois." As the transmission structures have been moved to avoid impact, there will be no effect on archeological resources.

We understand that the remaining right-of-way will be surveyed. If sites are found the State Historic Preservation Officer should be consulted concerning mitigation of impact and Advisory Council procedures followed.

Sincerely,

David Kenney

DK/MKB/js

APPENDIX C. THEORETICAL PREDICTIONS OF COOLING LAKE PERFORMANCE

There are two extremes in the classification of cooling lakes. In a *completely mixed* pond, the flow between the intake and discharge, combined with wind effects, tends to maintain the pond at a nearly uniform temperature throughout. In a *flow-through* (plug-flow) pond, the temperature decreases continuously along the flow path from intake to discharge. Any given lake will fall somewhere between these two extremes. The LaSalle County Station cooling lake, as a result of diking, would be expected to perform more like a flow-through pond.

The principal mechanisms by which heat is exchanged between the water and the atmosphere are:

- Incoming short-wave solar radiation,
- Incoming long-wave atmospheric radiation,
- Outgoing long-wave back radiation,
- Reflected solar and atmospheric radiation,
- Heat loss due to evaporation, and
- Heat loss or gain by conduction.

The equilibrium temperature, E, is defined as the temperature a body of water would eventually reach when cooled or heated naturally under constant meteorological conditions. A body of water at a temperature different from E will tend to approach E asymptotically. The equilibrium temperature is not a constant, but varies through the day and throughout the year as the meteorological variables change.

Although the temperature of a natural body of water continuously approaches the equilibrium temperature, it lags behind the short-term changes. It is usually close to the equilibrium temperature during the summer and winter, lower during the spring, and higher during the fall.

The simplified model for predicting temperatures in a cooling pond assumes that the net rate of heat exchange, ΔH, across the surface of the pond is proportional to the difference between the surface temperature of the lake, T_S, and the equilibrium temperature, E.

$$\Delta H = -K(T_S - E) \quad (1)$$

The proportionality factor, K, is a complicated function of the meteorological variables, as is E. When appropriate averages are used (e.g., monthly averages), the temperature T_S may be calculated within about ±2.8°C (±5°F).

For a flow-through pond, the differential equation that relates the transient temperature response to the heat input to the lake is:[1]

$$\rho C_p L \frac{dT}{dt} = -K(T - E), \quad (2)$$

where ρ = density of water (1000 kg/m^3),

C_p = specific heat of water (4184 J/kg·°C),

L = average depth of lake (m),

T = surface water temperature (°C), and

t = time (sec).

In Eq. 2, ρ and C_p are assumed to be constant.

If K and E are constant throughout the period of interest, the solution of Eq. 2 is

$$\frac{T - E}{T_o - E} = \exp -K(t-t_o)/\rho C_p L, \quad (3)$$

where T and T_0 are the surface temperatures at times t and t_0, respectively. If T_0 is the station discharge temperature (at time t_0), T_F is the temperature at the cold end of the lake and $t_F - t_0$ is the residence time, then

$$\frac{T_F - E}{T_0 - E} = \exp -Kt_F/\rho C_p L. \tag{4}$$

If the analysis is extended to a closed-cycle pond, then the water that has cooled to a temperature T_F now passes through the condenser, and its temperature is increased to $T_F + \Delta T_C$, where ΔT_C is the temperature rise across the condenser. The above equations may then be reapplied.

Thackston and Parker have calculated the equilibrium temperatures and heat exchange coefficients for 88 locations throughout the country.[2] Figure C.1 is a plot of these parameters for Springfield, Ill., for the 12 months of the year. The solid curve delineates values that correspond to average meteorological conditions. The dashed curve corresponds to extreme meteorological conditions and results from assuming that all meteorological variables are at the value which is exceeded only once in ten years. The probability that all these variables are at the extremes simultaneously is small. The uncertainty in E is typically ±2.8°C (±5°F), the uncertainty in K approximately ±40%. One of the largest contributors to the uncertainty is the specific form chosen for the wind formula for determining the heat loss due to evaporation. Thackston and Parker have employed a very conservative formula, so that it is not unreasonable to expect that there will be more cooling than predicted using their values.

The residence time, t_F, in Eq. 4 is given by

$$t_F = \frac{V}{Q} = \frac{AL}{Q}, \tag{5}$$

where V = volume of lake (m^3),

A = surface area of lake (m^2),

L = average depth of lake (m), and

Q = flow rate (m^3/day).

Using the values appropriate to the LaSalle County Station cooling lake, the residence time is found to be approximately 5.5 days (surface elevation, 210 meters, or 700 feet).

If one applies Eq. 3 starting with January 1, with $T_0 = E_{JAN} + \Delta T$, $t_0 = 0.5$ day, and $K = K_{JAN}$, then T corresponds to the temperature of the water after one-half day of cooling (or equivalently, the temperature of the water at that location in the lake that encompasses 1/11 of the surface area, starting at the discharge). E_{JAN} and K_{JAN} should next be incremented by $(E_{FEB}-E_{JAN})/60$ and $(K_{FEB}-K_{JAN})/60$ respectively, and the T_0 should be set equal to the T just calculated. In other words, allow E and K to change as they might be expected to do, rather than assume that they are constant for the entire month. Eq. 3 should then be reapplied and the process should be continued to obtain the temperature at the end of each half-day. After 5.5 days, the water is in the vicinity of the intake structure, which is near the point from which the blowdown is released. This T should then be incremented by ΔT and the process continued.

This method of calculation must, in actuality, be extended to periods of more than a year's duration since the assumption $T_0 = E_{JAN} + \Delta T$ was just an initial value chosen to begin the process; the iterations converge quite rapidly.

References for Appendix C

1. J. R. Edinger and J. C. Geyer, "Heat Exchange in the Environment," Publication No. 65-902, Edison Electric Institute, New York, 1965.

2. E. L. Thackston and F. P. Parker, "Effects of Geographical Location on Cooling Pond Requirements and Performance," Report for Project No. 16130-FDQ-30/71 to the U. S. Environmental Protection Agency, March 1971.

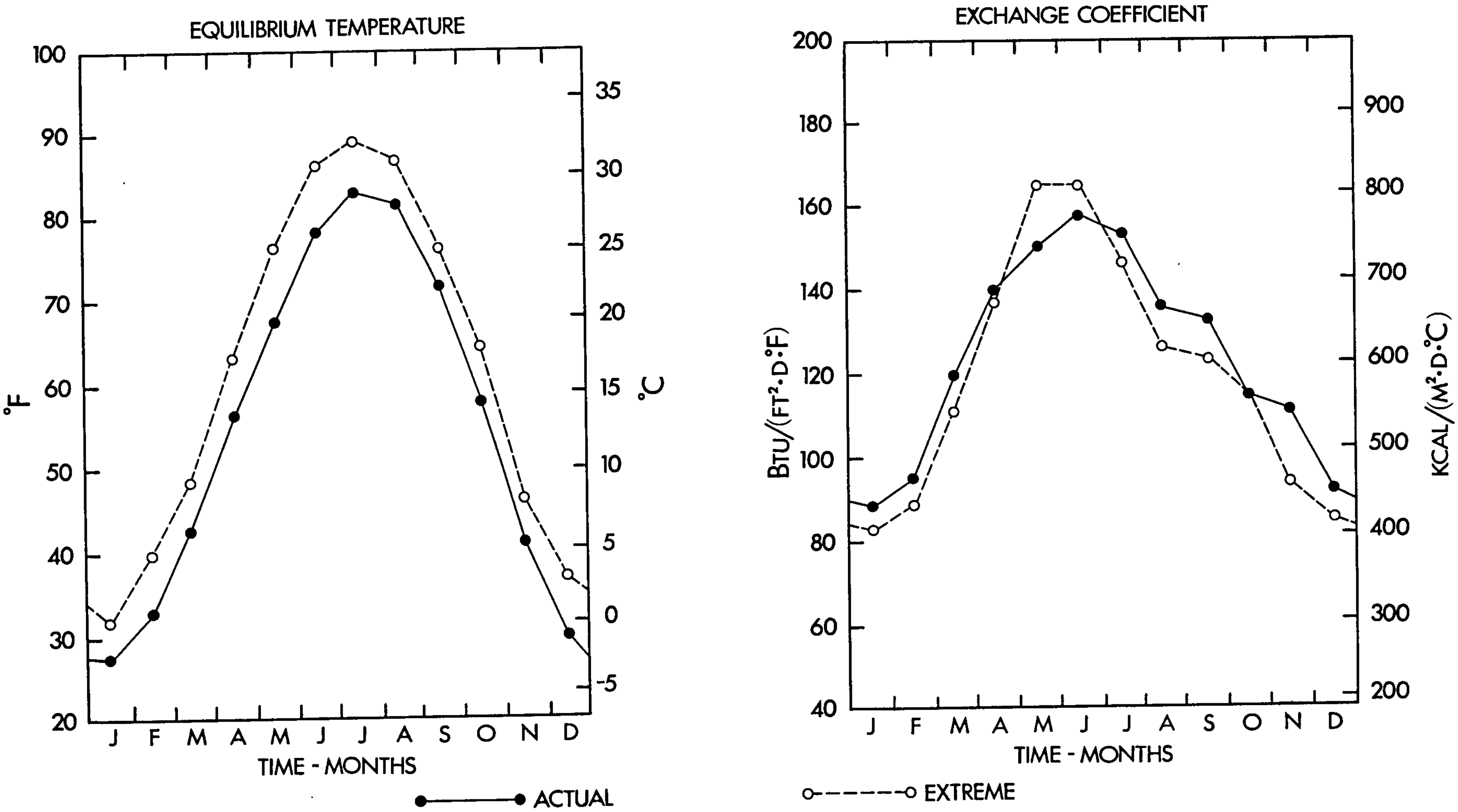


Fig. C.1. Equilibrium Temperatures and Heat Exchange Coefficients for Springfield, Ill. (Modified from E. L. Thackston and F. P. Parker, "Effects of Geographic Location on Cooling Pond Requirements," U.S. EPA, March 1971.)

APPENDIX D. STATE CERTIFICATION AND NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT FOR LASALLE COUNTY STATION

Illinois Environmental Protection Agency
Richard H. Briceland, Director
2200 Churchill Road, Springfield, Illinois 62706
Telephone: (217) 782-6171

La Salle file

December 30, 1976

COMMONWEALTH EDISON COMPANY
NPDES Modified Permit Certification
Braidwood Station NPDES Permit #IL 0048321
Byron Station NPDES Permit #IL 0048313
LaSalle County Station NPDES Permit #IL 0048151

Mr. A. H. Manzardo
USEPA
Region V
230 South Dearborn
Chicago, Illinois 60604

Dear Mr. Manzardo:

The Illinois Environmental Protection Agency has reviewed the modified permits for the subject discharges that went to Public Notice on November 30, 1976.

Inasmuch as the proposed permits are in compliance with the applicable provisions of the Illinois Environmental Protection Act, this Agency hereby provides State Certification of the subject permits. This Agency also certifies that the discharge will comply with the applicable provisions of Sections 301, 302, 306, and 308 of the FWPCA, as amended, provided that the final NPDES Permit is issued substantially in the form as public noticed.

Should you have any questions or comments, please contact S. Alan Keller of my staff.

Very truly yours,

William H. Busch

William H. Busch, Manager
Permit Section
Division of Water Pollution Control

WHB:SAK:psb

cc: Region I
Region II

Permit No. IL 0048151

Application No. IL 0048151

AUTHORIZATION TO DISCHARGE UNDER THE

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Federal Water Pollution Control Act, as amended, (33 U.S.C. 1251 et seq; the "Act"),

COMMONWEALTH EDISON COMPANY

is authorized by the United States Environmental Protection Agency, Region V,

to discharge from a facility located at LaSalle County Station
Units 1 and 2
LaSalle County, Illinois

to receiving waters named Illinois River

in accordance with effluent limitations, monitoring requirements and other conditions set forth in Parts I, II, and III hereof.

This permit and the authorization to discharge shall expire at midnight, May 31, 1981 . Permittee shall not discharge after the above date of expiration. In order to receive authorization to discharge beyond the date of expiration, the permittee shall submit such information, forms, and fees as are required by the Agency authorized to issue NPDES permits no later than 180 days prior to the above date of expiration.

This permit, reissued in accordance with 40 CFR 125, shall become effective 30 days from this date of signature and supersedes NPDES Permit number IL 0048151 dated May 21, 1976 .

Signed this December 30, 1976.

Dale J Bryson

Acting Director, Enforcement Division

Permit No. IL 0048151

PART I

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning with the start up of Unit 1 and lasting until the expiration date, the permittee is authorized to discharge from outfall(s) serial number(s) 001a Cooling Pond Blowdown*

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTIC	DISCHARGE LIMITATIONS kg/day (lbs/day)		Other Units (Specify)		MONITORING REQUIREMENTS	
	Daily Avg	Daily Max	Daily Avg	Daily Max	Measurement Frequency	Sample Type
Flow-M^3/Day (MGD)	-	-	-	-	Continuous	
Temperature (°F)	-	-	-	**	Continuous	
Total Suspended Solids	-	-	-	***	1/week	grab
Total Dissolved Solids	-	-	-	****	1/week	grab

For the purpose of this permit, the discharge is limited solely to non-contact cooling water free from process and other wastewater discharges. In the event the permittee shall require the use of cooling water treatment additives, including chlorine, this permit must be modified in accordance with Part II B4.

*Heat may be discharged in blowdown from the colling pond provided the temperature at which the blowdown is discharged does not exceed at any time the lowest temperature of recirculated cooling water prior to the addition of the make-up water (i.e., cold-side blowdown).

, *, ****, See page 4 of 12.

The pH shall not be less than 6.0 nor greater than 9.0 and shall be monitored 2/Week by Grab Sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): at a point representative of the discharge but prior to entry into the Illinois River.

PART I

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on the effective date of the permit and lasting until the expiration date the permittee is authorized to discharge from outfall(s) serial number(s) 001(b) sanitary treatment plant waste.

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTIC	DISCHARGE LIMITATIONS				MONITORING REQUIREMENTS	
	kg/day (lbs/day)		Other Units (Specify)			
	Daily Avg	Daily Max	Daily Avg	Daily Max	Measurement Frequency	Sample Type
Flow-M^3/Day (MGD)	-	-	-	-	Measure when monitoring	
Total Suspended Solids	-	-	30 mg/l©	45 mg/l©	Monthly	Grab
BOD_5	-	-	30 mg/l©	45 mg/l©	Monthly	Grab
Fecal Coliform	-	-	200 counts/100 ml	400 counts/100 ml	Monthly	Grab

© See Page 4 of 12.

The pH shall not be less than 6.0 nor greater than 9.0 and shall be monitored Weekly by Grab Samples.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): at a point representative of the discharge but prior to mixing with any other wastewater and subsequent discharge to the Illinois River.

** THERMAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

Discharge of wastewater from this facility must not alone or in combination with other sources cause the receiving stream to violate the following thermal limitations:

a. Maximum temperature rise above natural temperature must not exceed 5°F.

b. Water temperature at representative locations in the main river shall not exceed the maximum limits in the following table during more than one (1) percent of the hours in the 12-month period ending with any month. Moreover, at no time shall the water temperature at such locations exceed the maximum limits in the following table by more than 3°F. (Main river temperatures are temperatures of those portions of the river essentially similar to and following the same thermal regime as the temperatures of the main flow of the river).

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
(°F)	60°	60°	60°	90°	90°	90°	90°	90°	90°	90°	90°	60°
(°C)	15.6	15.6	15.6	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	15.6

c. The mixing zone shall not extend over more than 25% of the cross-sectional area of the river or over more than 26 acres of the river.

***Not to exceed background concentration of the Illinois River intake water based upon the average of three months sampling.

****Total dissolved solids shall not be increased more than 750 mg/l above background concentration levels and in no case shall the concentration of 1000 mg/l be exceeded in the receiving stream.

© The arithmetic mean of the five-day Biochemical Oxygen Demand samples collected in a period of 30 consecutive days shall not exceed a concentration of 30 milligrams per liter nor 15 percent of the arithmetic mean of the values for influent samples collected at approximately the same times during the same period. The arithmetic mean of these values for effluent samples collected in a period of seven consecutive days shall not exceed a concentration of 45 milligrams per liter.

The arithmetic mean of the suspended solids values for effluent samples collected in a period of 30 consecutive days shall not exceed a concentration of 30 milligrams per liter nor 15 percent of the arithmetic mean of the values for influent samples collected at approximately the same times during the same period. The arithmetic mean of these values for effluent samples collected in a period of seven consecutive days shall not exceed a concentration of 45 milligrams per liter.

PART I

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

3. During the period beginning on the effective date of the permit and lasting until the expiration date the permittee is authorized to discharge from outfall(s) serial number(s) 001(c) Low Volume Waste*

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTIC	DISCHARGE LIMITATIONS kg/day (lbs/day)		Other Units (Specify)		MONITORING REQUIREMENTS	
	Daily Avg	Daily Max	Daily Avg	Daily Max	Measurement Frequency	Sample Type
Flow-M^3/Day (MGD)	-	-	-	-	Measure when monitoring	
Total Suspended Solids	-	-	-	15 mg/l	Weekly	Composite
**Oil and Grease	-	-	-	15 mg/l	Monthly	Grab
Total Copper	-	-	-	1.0 mg/l	Weekly	Composite
Total Iron	-	-	-	1.0 mg/l	Weekly	Composite

*Low volume waste shall mean, taken collectively as if from one source, wastewater from all sources except those for which specific limitations are otherwise required in this permit, including but not limited to wastewater from the demineralizer, auxiliary boiler blowdown, and radwaste system.

**If the Permittee after monitoring for at least 6 months determines that he is consistently meeting the effluent limits contained herein, the Permittee may request of the Regional Administrator and the Director that the monitoring requirements be reduced or eliminated. Upon written notification by the Regional Administrator and the Director, the Permittee will monitor as directed.

The pH shall not be less than 6.0 nor greater than 9.0 and shall be monitored Weekly by Grab Sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): At a point representative of the discharge but prior to mixing with other waters and subsequent discharge to the Illinois River.

PART I

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

4. During the period beginning on the effective date of the permit and lasting until the permittee is authorized to discharge from outfall(s) serial number(s) 001(d) Intake Screen Backwash

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTIC	DISCHARGE LIMITATIONS kg/day (lbs/day)		Other Units (Specify)		MONITORING REQUIREMENTS	
	Daily Avg	Daily Max	Daily Avg	Daily Max	Measurement Frequency	Sample Type
Flow-M^3/Day (MGD)	-	-	-	-	Monthly	Daily Average Flow Estimate

There shall be no discharge of floating solids or visible foam in other than trace amounts.

PART I

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

5. During the period beginning on the effective date of the permit and lasting until the expiration date the permittee is authorized to discharge from outfall(s) serial number(s) 002 - Construction Runoff

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTIC	DISCHARGE LIMITATIONS kg/day (lbs/day)		Other Units (Specify)		MONITORING REQUIREMENTS	
	Daily Avg	Daily Max	Daily Avg	Daily Max	Measurement Frequency	Sample Type
Flow-M^3/Day (MGD)	-	-	-	-	Measure when monitoring	
Total Suspended Solids	–	–	–	50 mg/l	Weekly	Grab

The pH shall not be less than 6.0 nor greater than 9.0 and shall be monitored Weekly by Grab Samples.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): At a point representative of the discharge but prior to entry into the Illinois River

6. Rainfall Runoff

1. Rainfall runoff from construction activity at the generating facility site and from material storage areas shall be controlled to meet all effluent restrictions specified in Part I A (2) of this permit.

2. Any untreated overflow from facilities designed, constructed, and operated to treat the volume of material storage runoff, and construction runoff which is associated with a 10 year, 24 hour rainfall event shall not be subject to the limitations for Suspended Solids and pH specified in Part I A (2) of this permit.

7. Erosion Control

The permittee shall utilize EPA Publication No. 430/9-73-007 "Process, Procedures, and Methods to Control Pollution Resulting from Construction Activity, " October 1973, in developing and implementing procedures and methods for controlling erosion and sediment deposition.

As a minimum, the following practices shall be instituted:

1. Minimization of the duration of excavation and grading activities.
2. Control of the speed and volume of storm water runoff, as necessary, by:
   a. Proper sizing of drainage ditches:
   b. Use of energy dissipative devices such as check dams and pooling areas.
3. Construction of sediment traps and settling areas as necessary to prevent sediment from leaving the stite.
4. Soil stabilization by minimizing slopes, revegetating spoil banks and cleared surfaces by seeding or sodding and through the proper and timely surfacing of parking lots, roads and laydown areas with crushed rock or gravel.
5. Taking all necessary precautions to minimize erosion through propoer timing and installation of necessary erosion control devices, by avoiding land clearing in fall (insofar as feasible) and prior to installation of sediment traps, runoff drainage or any necessary impoundments for sediment control.

PART I.

MONITORING AND REPORTING

1. Representative Sampling - Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge.

2. Reporting - The permittee shall record monitoring results on Discharge Monitoring Report forms, using one such form for each discharge each month. The completed monthly forms shall be retained by permittee for a period of three months beginning with each calendar quarter, and the forms from those three months shall be mailed to USEPA no later than the 28th day of the following month; i.e. (a) January, February, March (submit April 28); (b) April, May, June (submit July 28); (c) July, August, September (submit October 28); October, November, December (submit January 28).

The permittee shall retain a copy of all reports submitted. All reports shall be submitted to:

U. S. Environmental Protection Agency
Attention: Chief, Compliance Unit
230 South Dearborn Street
Chicago, Illinois 60604

The permittee shall submit these monitoring reports each month to the appropriate District Office of the Illinois Environmental Protection Agency by the 15th day of the following month unless otherwise directed by the Illinois Environmental Protection Agency.

3. Noncompliance Notification - If, for any reason, the permittee does not comply with or will be unable to comply with any daily maximum effluent limitation specified in this permit, the permittee shall provide the Regional Administrator and the State with the following information, in writing, within five (5) days of becoming aware of such condition. (a) a description of the discharge, (b) cause of noncompliance; (c) the period of noncompliance, including exact dates and times; (d) if not corrected, the anticipated time the noncompliance is expected to continue, and (e) steps being taken to reduce, eliminate and prevent recurrence of the noncomplying discharge.

4. Definitions

a. "Daily Average" Discharge

1. Weight Basis - The "daily average" 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 was operating. Where less than daily sampling is required by this permit, the daily average discharge shall be determined by the summation of the measured daily discharges by weight divided by the number of days during the calendar month when the measurements were made.

2. Concentration Basis - The "daily average" concentration means the arithmetic average (weighted by flow value) of all the daily determinations of concentration made during a calendar month. Daily determination of concentration made using a composite sample shall be the concentration of the composite sample. When grab samples are used, the daily determination of concentration shall be the arithmetic average (weighted by flow value) of all the samples collected during the calendar day.

b. "Daily Maximum" Discharge

1. Weight Basis - The "daily maximum" discharge means the maximum total discharge by weight permitted during any calendar day.

2. Concentration Basis - The "daily maximum" concentration means the maximum value in terms of concentration permitted in the discharge during any calendar day.

5. Test Procedures - Test procedures for the analysis of pollutants shall conform to regulations published pursuant to Section 304(g) of the Act, under which such procedures may be required.

6. Recording of Results - For each measurement or sample taken pursuant to the requirements of this permit the permittee shall record the following information: (a) the exact place, date, and time of sampling; (b) the dates the analyses were performed, (c) the person(s) who performed the analyses; (d) the analytical techniques or methods used, and (e) the results of all required analyses.

7. Additional Monitoring by Permittee - If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified above, the results of such monitoring shall be included in the calculation and reporting of the values required in the Discharge Monitoring Report Form (EPA No. 3320-1). Such increased frequency shall also be indicated.

8. Records Retention - All records and information resulting from the monitoring activities required by this permit including all records of analyses performed and calibration and maintenance of instrumentation and recordings from continuous monitoring instrumentation shall be retained for a minimum of three (3) years, or longer if requested by the Regional Administrator or the State Water Pollution Control Agency.

PART II - A. MANAGEMENT REQUIREMENTS

1. Change in Discharge - All discharges authorized herein shall be consistent with the terms and conditions of this permit. The discharge of any pollutant identified in this permit more frequently than or at a level in excess of that authorized shall constitute a violation of the permit. Any anticipated facility expansions, production increases, or process modifications which will result in new, different, or increased discharges of pollutants must be reported by submission of a new NPDES application or, if such changes will not violate the effluent limitations specified in this permit, by notice to the permit issuing authority of such changes. Following such notice, the permit may be modified to specify and limit any pollutants not previously limited.

2. Facilities Operation - The permittee shall at all times maintain in good working order and operate as efficiently as possible all treatment or control facilities or systems installed or used by the permittee to achieve compliance with the terms and conditions of this permit.

3. Adverse Impact - The permittee shall take all reasonable steps to minimize any adverse impact to navigable waters resulting from noncompliance with any effluent limitations specified in this permit, including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge.

4. Bypassing - Any diversion from or bypass of facilities necessary to maintain compliance with the terms and conditions of this permit is prohibited, except (i) where unavoidable to prevent loss of life or severe property damage, or (ii) where excessive storm drainage or runoff would damage any facilities necessary for compliance with the effluent limitations and prohibitions of this permit. The permittee shall promptly notify the Regional Administrator and the State in writing of each such diversion or bypass.

5. Removed Substances - Solids, sludges, filter backwash, or other pollutants removed from or resulting from treatment or control of wastewaters shall be disposed of in a manner such as to prevent any pollutant from such materials from entering navigable waters.

6. Power Failures - In order to maintain compliance with the effluent limitations and prohibitions of this permit, the permittee shall either: (a) in accordance with the Schedule of Compliance contained in Part I, provide an alternative power source sufficient to operate the wastewater control facilities; or, if no date implementation appears in Part I, (b) halt, reduce or otherwise control production and/or all discharges upon the reduction, loss, or failure of one or more of the primary sources of power to the wastewater control facilities.

B. RESPONSIBILITIES

1. Right of Entry - The permittee shall allow the head of the State Water Pollution Control Agency, the Regional Administrator, and/or their authorized representatives, upon the presentation of credentials (a) 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 (b) 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; and to sample any discharge of pollutants.

2. Transfer of Ownership or Control - In the event of any changes in control or ownership of facilities from which the authorized discharges emanate, the permittee shall notify the succeeding owner or controller of the existence of this permit by letter, a copy of which shall be forwarded to the Regional Administrator and the State Water Pollution Control Agency.

3. Availability of Reports - Except for data determined to be confidential under Section 308 of the Act, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the State Water Pollution Control Agency and the Regional Administrator. As required by the Act, effluent data shall not be considered confidential. Knowingly making any false statement on any such report may result in the imposition of criminal penalties as provided for in Section 309 of the Act.

4. Permit Modification - After notice and opportunity for a hearing, this permit may be modified, suspended, or revoked in whole or in part during its term for cause including, but not limited to, the following: (a) violation of any terms or conditions of this permit, (b) obtaining this permit by misrepresentation or failure to disclose fully all relevant facts; or (c) a change in any condition that requires either a temporary or permanent reduction or elimination of the authorized discharge.

5. Toxic Pollutants - Notwithstanding Part II, B-4 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 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, this permit shall be revised or modified in accordance with the toxic effluent standard or prohibition and the permittee so notified.

6. Civil and Criminal Liability - Except as provided in permit conditions on "Bypassing" (Part II, A-4) and "Power Failure" (Part II, A-6), nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance.

7. Oil and Hazardous Substance Liability - 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 Act.

8. State Law - 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 established pursuant to any applicable State law or regulation under authority preserved by Section 510 of the Act.

9. 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, nor any infringement of Federal, State or local laws or regulations.

10. 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 circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

PART III

OTHER REQUIREMENTS

Additional Reporting of Monitoring to Illinois Environmental Protection Agency

Monitoring results obtained during the previous one month shall be summarized and reported on Discharge Monitoring Report Forms (EPA No. 3320-1, postmarked no later than the 15th day of the month following the completed reporting period. The first report is due on August 15, 1976. The signed reports required herein, shall be submitted monthly to the State at the following address:

Environmental Protection Agency
State of Illinois
Division of Water Pollution Control
2200 Churchill Road
Springfield, IL 62706

This permit is specifically for the listed pollutants to be discharged from the designated outfalls only. Discharge of pollutants added in other than trace amounts or discharged from an undesignated outfall is not permitted.

Polychlorinated Biphenyls

There shall be no discharge of polychlorinated biphenyls.

Reissuance Provision

NPDES Permit No. IL 0048151, as reissued on DEC 4 . containing herein all modifications supersedes, for all purposes on and after the date of reissuance, the original permit issued and dated May 21, 1976. However this reissuance is not in derogation of any action heretofore taken under the original permit issued and dated May 21, 1976, nor does this reissuance relieve the permittee of any liability for violation of any provision of the original permit issued and dated May 21, 1976, committed prior to the effective date of this reissuance.

PART III

Section 316(b) Requirements

Within 180 days of the issuance of this permit, the permittee shall submit to the Regional Administrator and the Illinois Environmental Protection Agency a demonstration detailing the ability of the intake system for the cooling pond to meet the requirements of Section 316(b) of the Act. The report shall be based on presently available information regarding receiving water hydrology, intake siting and design, proposed intake operation and potential adverse effects on aquatic populations. Development of the report shall be guided by the "Development Document for Minimizing Adverse Environmental Impact for Cooling Water Intake Structures", as proposed by the U.S. EPA, and any other publications relating to intake impacts.

This report will be evaluated with regard to Section 316(b) of the Act. As a result of this evaluation, the Regional Administrator may modify the permit in accordance with Part II B.4 to establish an implementation schedule or monitoring program to insure compliance with Section 316(b).

APPENDIX E. NEPA POPULATION DOSE ASSESSMENT

Population dose commitments are calculated for all individuals living within 80 km (50 miles) of the station, employing the same models used for individual doses (see Regulatory Guide 1.109). In addition, population doses associated with the export of food crops produced within the 80-km (50-mile) region and the atmospheric and hydrospheric transport of the more mobile effluent species, such as noble gases, tritium, and carbon-14, have been considered.

NOBLE GAS EFFLUENTS

For locations within 80 km (50 miles) of the station, exposures to these effluents are calculated using the atmosphere dispersion models in Regulatory Guide 1.111 and the dose models described in Section 5.5 and Regulatory Guide 1.109. Beyond 80 km (50 miles), and until the effluent reaches the northeastern corner of the United States, it is assumed that all the noble gases are dispersed uniformly in the lowest 1000 meters (3300 ft) of the atmosphere. Decay in transit was also considered. Beyond this point, noble gases having a half-life greater than one year (e.g., Kr-85) were assumed to completely mix in the troposphere of the world with no removal mechanisms operating.

Transfer of tropospheric air between the northern and southern hemispheres, although inhibited by wind patterns in the equatorial region, is considered to yield a hemisphere average tropospheric residence time of about two years with respect to hemispheric mixing. Since this time constant is quite short with respect to the expected mid-point of plant life (15th yr), mixing in both hemispheres can be assumed for evaluations over the life of the nuclear facility. This additional population dose commitment to the U. S. population was also evaluated.

IODINES AND PARTICULATES RELEASED TO THE ATMOSPHERE

Effluent nuclides in this category deposit onto the ground as the effluent moves downwind, which continuously reduces the concentration remaining in the plume. Within 80 km (50 miles) of the station, the deposition model in Regulatory Guide 1.111 was used in conjunction with the dose models in Regulatory Guide 1.109. Site-specific data concerning production, transport, and consumption of foods within 80 km (50 miles) of the station were used. Beyond 80 km (50 miles), the deposition model was extended until no effluent remained in the plume. Excess food not consumed within the 80-km (50-mile) distance was accounted for, and additional food production and consumption representative of the eastern half of the country was assumed. Doses obtained in this manner were then assumed to be received by the number of individuals living within the direction sector and distance described above. The population density in this sector is taken to be representative of the eastern United States, i.e., about 62 people per square kilometer.

CARBON-14 AND TRITIUM RELEASED TO THE ATMOSPHERE

Carbon-14 and tritium were assumed to disperse without deposition in the same manner as krypton-85 over land. However, they do interact with the oceans. This causes the carbon-14 to be removed with an atmospheric residence time of four to six years, with the oceans being the major sink. From this, the equilibrium ratio of the carbon-14 to natural carbon in the atmosphere was determined. The same ratio was then assumed to exist in man so that the dose received by the entire population of the U. S. could be estimated. Tritium was assumed to mix uniformly in the world's hydrosphere, which was assumed to include all the water in the atmosphere and in the upper 70 meters (230 ft) of the oceans. With this model, the equilibrium ratio of tritium to hydrogen in the environment can be calculated. The same ratio was assumed to exist in man, and was used to calculate the population dose, in the same manner as with carbon-14.

LIQUID EFFLUENTS

Concentrations of effluents in the receiving water within 80 km (50 miles) of the station were calculated in the same manner as described above for the Appendix I calculations. No depletion of the nuclides present in the receiving water by deposition on the bottom of the Illinois River was assumed. It was also assumed that aquatic biota concentrate radioactivity in the same manner as was assumed for the Appendix I evaluation. However, food consumption values appropriate for the average individual, rather that the maximum, were used. It was assumed that all the sport and commercial fish and shellfish caught within the 80-km (50-mile) area were eaten by the U. S. population.

Beyond 80 km (50 miles), it was assumed that all the liquid effluent nuclides except tritium have deposited on the sediments so they make no further contribution to population exposures. The tritium was assumed to mix uniformly in the world's hydrosphere and to result in an exposure to the U. S. population in the same manner as discussed for tritium in gaseous effluents.

APPENDIX F. ASSUMPTIONS RELATED TO ESTIMATES OF FUEL-CYCLE HEALTH EFFECTS

Following are some important assumptions affecting evaluations of fuel-cycle health effects.

The Uranium Fuel Cycle[1]

a. For mine and mill emissions it was assumed that population density in the United States varies from 2.9 persons/km^2 (7.5 persons/mi^2) in the west to 62 persons/km^2 (160 persons/mi^2) in the east, all uniformly distributed. For all other facilities, density was assumed to be 62 persons/km^2. [It should be noted that most of the calculated health effects would occur outside the 80-km (50-mile) radius of the plant. The mortality rate for the U. S. population is about 2,000,000 per year for all causes.]

b. "Box" atmospheric dispersion model was used with vertical dispersion limited to 1000 m, 2 m/sec windspeed, and 1 cm/sec deposition velocity for particulates.

c. A 50-year dose commitment for one year of operation of each type of fuel-cycle facility was calculated. The 50-year commitment considered biological uptake of long-lived radionuclides for 40 years following the year of release. The total impact of the fuel cycle to the U. S. population for 1975-2000 was calculated using the needs for all types of facilities in order to meet current projections of power plants.

d. Radioactive materials were not considered to be removed from food chains except by radioactive decay. Only in the case of carbon-14 was an environmental sink assumed to be acting on biological availability.

e. Krypton-85 and carbon-14 not removed from the plume in the U. S. were assumed to mix uniformly in the world's atmosphere. Tritium was assumed to be mixed uniformly in the world's circulating water volume.

f. Resuspension of deposited particulates was considered.

g. Bioaccumulation of radioactivity in food chains was considered (generally upperbound estimates).

h. An 80% capacity factor was assumed.

The Coal Fuel Cycle[2-6]

Because the major impact of the coal fuel cycle results from power-plant emissions, only those critical assumptions will be discussed:

a. Actual population distributions within 80 km (50 miles) of several nuclear-plant sites were used; the average population of 3.8 million people experiences about 36,000 per year mortality rate from all causes.

b. Actual meteorological data from the same plants, to calculate inhalation exposures to sulfates out to 80 km, were used.

c. A 1000-foot stack for emissions was assumed.

d. Use of 3%-sulfur coal with 12% ash and 28 MJ/kg (12,000 Btu/lb) (eastern coal) for an upper-bound estimate of health effects was assumed; use of 0.4%-sulfur coal with 3% ash and 28 MJ/kg (eastern coal) for a lower-bound estimate was assumed.

e. A removal of 99% particulates from plant emissions was assumed.

f. A 10%-per-hour oxidation rate for conversion of sulfur oxides to sulfates was assumed.

g. The dose-response relationships of Lave and Seskin,[5] Winklestein et al.,[6] and others[2-4] were used to calculate excess mortality and morbidity; adjustments were made for fractions of sulfates in the total suspended particulates.

h. Resuspension of deposited particulates was not directly considered, although deposition was.

i. A 75% capacity factor was assumed.

References for Appendix F

1. "Final Generic Environmental Statement on the Use of Recycle Plutonium in Mixed Oxide Fuel in Light Water Cooled Reactors," U. S. Nuclear Regulatory Commission, NUREG-0002, August 1976.

2. L. D. Hamilton (editor), "The Health and Environmental Effects of Electricity Generation - A Preliminary Report," Brookhaven National Laboratory, July 1974.

3. L. D. Hamilton and S. C. Morris, "Health Effects of Fossil Fuel Power Plants," in: Population Exposures - Proceedings of the Eighth Midyear Topical Symposium of the Health Physics Society, October 1974.

4. L. D. Hamilton, "Energy and Health," in: Proceedings of the Connecticut Conference on Energy, December 1975.

5. L. B. Lave and E. P. Seskin, "An Analysis of the Association between U. S. Mortality and Air Pollution," J. Am. Statistical Assoc. 68:284-290, 1970.

6. W. Winkelstein, Jr., et al., "The Relationship of Air Pollution and Economic Status to Total Mortality and Selected Respiratory System Mortality in Men: I. Suspended Particulates," Arch. Environ. Health 14:162-171, January 1967.

APPENDIX G. QUANTITATIVE METHODS FOR ESTIMATING VEGETATIVE COVER IN CONNECTION WITH DIKE MONITORING PROGRAM

The staff recommends the use of 20-meter-long line transects oriented perpendicular to the dike and located randomly (not permanent sample locations) along the dike as the samples. For each sample, 5 one-meter-long subsamples should be chosen for measurement of percentage cover (± 0.5%). This use of subsamples affords a statistical definition of "failure of the vegetative cover" by a two-stage analysis described below.

Analysis Stage 1 is a test for significance among the sample means or average cover of the samples. This should be done by a one-way classification analysis of variance (ANOVA), using an arcsine transformation of the subsample data, i.e.,

$$\theta_{ij} = \arcsin \sqrt{c_{ij}}$$

where c_{ij} = percentage cover of the i.th subsample of the j.th sample. The staff recommends using an F ratio which is significant at the 1% level as the criterion for concluding that an ecologically significant difference exists among sample means. (Note: the degrees-of freedom for the F ratio are ν_1 = the number of subsamples per sample minus one, ν_2 = the number of samples minus one).

Analysis Stage 2, to be completed if, and only if, there is a significant difference among sample means, determines which, if any, samples indicate a failure of vegetative cover. The sample means should be determined from the transformed data,

as

$$\bar{c}_j = (\sin \bar{\theta}_j)^2$$

and the grand mean of all data should be calculated as

$$\bar{\bar{c}} = (\sin \bar{\bar{\theta}})^2.$$

The lower confidence interval (L.C.I.) for the grand mean can then be calculated as follows

$$C.I = t_{05} \cdot MS_{W/I}$$

where t_{05} is the one-tailed Student's t value for probability = 0.05 and degrees of freedom ν = number of subsamples times the number of samples, minus one; and $MS_{W/I}$ is the mean square within groups from the ANOVA calculations. This is the confidence interval about the transformed data, so

$$L.C.I. = [\sin (\bar{\bar{\theta}} - C.I.)]^2.$$

Finally, any sample mean, $\bar{c}_j$, which is less than the lower confidence interval, L.C.I., is a sample in which the vegetative cover has failed.

APPENDIX H. EXPLANATION AND REFERENCES FOR BENEFIT-COST SUMMARY

Economic Impact of Plant Operation

Direct Benefits - Energy: 1078 MWe per unit x 2 units x 8760 hr/yr x 0.6 plant factor
Capacity: refer to Section 10.2

Economic Costs - Fuel: refer to Section 10.4
Operation and maintenance: refer to Section 10.4

Environmental Impact of Plant Operation

(The index numbers used in this and the next section correspond to those used in Table 10.1)

Item 1.1 - Impact on water: refer to Table 3.1 (includes evaporation and seepage)

Item 1.2 - Heat discharge to natural water body

1.2.1 Thermal discharge: refer to Table 5.3, Staff's Analysis - Case 1
1.2.2 Aquatic biota: refer to Section 5.4.2

Item 1.3 - Chemical discharge to natural water body.

1.3.1 People: refer to Section 5.3.2
1.3.2 Aquatic biota: refer to Section 5.4.2
1.3.3 Water quality: refer to Section 5.3.4
1.3.4 Chemical discharge: refer to Section 3.2.4

Item 1.4 - Radionuclide contamination of natural surface water body: refer to Section 5.5.2

Item 1.5 - Chemical contamination of groundwater: refer to Section 5.3.7

Item 1.6 - Radionuclide contamination of groundwater: refer to Section 5.5.2

Item 1.7 - Raising/lowering of groundwater levels: refer to Section 5.3.7

Item 1.8 - Effects on natural water body of intake structure and condenser cooling systems.

1.8.1 Plankton, benthic organisms, fish larvae: refer to Section 5.4.2
1.8.2 Fisheries: refer to Section 5.4.2

Item 1.9 - Natural water drainage: refer to Section 4.2.1

Item 2.1 - Chemical discharges to ambient air

2.1.1 Air quality: refer to Section 3.2.4

Item 2.2 - Calculated maximum individual dose from radioactive effluents

2.2.1 Noble gas effluents: refer to Table 5.6
2.2.2 Radioiodine and particulates: refer to Table 5.6

Item 2.3 - Fogging and icing: refer to Section 5.4.1.2

Item 3 - Total body doses to U. S. population: refer to Table 5.13

Societal Costs

Item 1 - Operational fuel disposition

1.1 Fuel transport (new): FES-CP, Page V-28
1.2 Fuel storage: ER-OL, Page 3.5-1
1.3 Waste products: FES-CP, Page V-31

Item 2 - Station labor force: refer to Section 5.6

Item 3 - Historical and archeological sites: refer to Section 2.7

Item 4 - Esthetics: FES-CP, Page III-1

NRC FORM 335 (7-77)

U.S. NUCLEAR REGULATORY COMMISSION

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4. TITLE AND SUBTITLE *(Add Volume No., if appropriate)*
Final Environmental Statement related to the operation of LaSalle County Nuclear Station, Unit Nos. 1 and 2

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MONTH: October | YEAR: 1978

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13. TYPE OF REPORT
Final Environmental Statement

PERIOD COVERED *(Inclusive dates)*
Operating License Stage

14. *(Leave blank)*

15. SUPPLEMENTARY NOTES
This report pertains to Docket Nos. 50-373 and 50-374.

16. ABSTRACT *(200 words or less)*

A Final Environmental Statement for the LaSalle County Nuclear Station, Unit Nos. 1 and 2, proposed for operation by Commonwealth Edison Company has been prepared by the Office of Nuclear Reactor Regulation of the Nuclear Regulatory Commission. This Statement provides a summary of environmental impacts and beneficial and adverse effects of the proposed operation of the facility. Also included are comments of governmental agencies and other individuals on the Draft Environmental Statement and staff responses to these comments. On the basis of the analysis and evaluation set forth in the Final Environmental Statement, and after weighing the environmental, economic, technical and other benefits against environmental costs and after considering available alternatives, the NRC staff has concluded that the action called for is the issuance of operating licenses for Units 1 and 2 of the LaSalle County Station, subject to conditions for the protection of the environment.

17. KEY WORDS AND DOCUMENT ANALYSIS

17a. DESCRIPTORS

17b. IDENTIFIERS/OPEN-ENDED TERMS

18. AVAILABILITY STATEMENT
Releasable to the public.
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