DOCKET-50-254--64
DOCKET-50-265--56

DISCUSSION AND CONCLUSIONS

BY THE

U.S. ATOMIC ENERGY COMMISSION

DIVISIONS OF RADIOLOGICAL AND ENVIRONMENTAL PROTECTION

AND

REACTOR LICENSING

PURSUANT TO APPENDIX D OF 10 CFR PART 50

SUPPORTING THE ISSUANCE OF LICENSES

TO COMMONWEALTH EDISON COMPANY

AND IOWA-ILLINOIS GAS AND ELECTRIC COMPANY

AUTHORIZING 20 PERCENT OPERATION OF

THE QUAD-CITIES STATION UNITS 1 AND 2

DOCKET NOS. 50-254 AND 50-265

Issued: January 24, 1972

NOTICE

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1. INTRODUCTION

The Quad-Cities Station (station) is a nuclear power generating facility jointly owned by the Commonwealth Edison Company and the Iowa-Illinois Gas and Electric Company (applicants). Applications by these two companies for operating licenses, which would authorize the operation of Units 1 and 2 of the station at 2,511 megawatts thermal (MWt) each, are presently pending before the Atomic Energy Commission (Commission). On March 16, 1971, a notice of the proposed issuance of these operating licenses was published in the Federal Register (36 FR 5008). The notice offered an opportunity for a hearing, but there were no requests for a hearing.

On July 12, 1971, notice of the availability of the Final Detailed Statement on Environmental Considerations for Quad-Cities Station Units 1 and 2, prepared by the AEC Division of Radiological and Environmental Protection, was published in the Federal Register (36 FR 13699). The detailed statement considered the environmental aspects associated with full-power operation of the station. It was prepared in accordance with the then current requirements of Appendix D to Title 10 Code of Federal Regulations Part 50 (10 CFR Part 50) published on December 4, 1970, which implements the National Environmental Policy Act of 1969 (NEPA).

On August 25, 1971, the AEC regulatory staff (staff) completed its review of the application for licenses and issued its Safety Evaluation in which it concluded that there was reasonable assurance that Units 1 and 2 of the station could each be operated up to full power (2,511 MWt) without endangering the health and safety of the public. However, on September 9, 1971 the Commission revised Appendix D to 10 CFR Part 50 to comply with the decision of the Court of Appeals for the District of Columbia circuit in Calvert Cliffs Coordinating Committee et al. vs. the Atomic Energy Commission et al. The revised NEPA regulations provided inter alia for a supplemental NEPA review for facilities such as the Quad Cities Units. A supplemental NEPA environmental review of the operation of Units 1 and 2 at full power (including preparation of a section 102(2)(C) impact statement) is presently in progress but has not as yet been completed in accordance with the requirements of Appendix D as revised September 9, 1971.

Appendix D provides a procedure in Section D.3 for issuance of an operating license authorizing the loading of fuel in the reactor core and limited operation of the facility. This procedure may be applied to applications for an operating license for a nuclear facility for which the Commission published a notice of opportunity for hearing prior to October 31, 1971 and no hearing was requested. The limited license may be issued by the Commission, pending the completion of an ongoing NEPA environmental review of a full-power license application, upon a showing that such licensing action will not have a significant adverse impact on the quality of the environment, or after considering and balancing the factors described in Section D.2 of Appendix D, and upon the Commission's making appropriate findings on the matters specified in 10 CFR Part 50.57(a).

On July 16, 1971, the applicants requested that the Commission issue an operating license for Unit 1 authorizing the loading of fuel in the reactor core and other activities which require operation of Unit 1 not in excess of one percent (25 MWt) of full power. In accordance with the provisions of Section D.3 of Appendix D of 10 CFR Part 50, the low-power license requested by the applicants was issued on October 1, 1971. The basis for that action was set forth in a public document entitled, "Discussion and Findings by the Division of Reactor Licensing, U.S. Atomic Energy Commission, Pursuant to Appendix D of 10 CFR Part 50, Supporting the Issuance of an Operating License to Commonwealth Edison Company and Iowa-Illinois Gas and Electric Company Authorizing the Loading of Fuel and Operation not in Excess of 25 MWt, Quad-Cities Station Unit 1, Docket No. 50-254."

On October 12, 1971[(1)], the applicants requested the Commission, in accordance with the provisions of Section D.3 of Appendix D, to authorize limited power operation of Units 1 and 2 during the ongoing supplemental NEPA environmental review of their application for operation of both units at full power. Specifically, the applicants requested the Commission to issue an amendment to Operating License DPR-29 for Unit 1 and to issue an operating license for Unit 2 authorizing (1) fuel loading in Unit 2, (2) conduct of all necessary testing of each unit up to and including its full rated power, and (3) operation of the two units up to an aggregate level of 809 megawatts electrical (equivalent to 2,511 MWt) until March 15, 1972. On November 18, 1971[(2)], the request was amended to extend the period of limited operation until such time as a full-power operating license is received. The applicants stated that the station will operate during the testing period at an average of less than 20 percent of full capacity (1,004 MWt of the station's full capacity of 5,022 MWt). The applicants submitted further that their request meets either of the two standards established by Section D.3 (summarized above).

A determination has not yet been made concerning the applicants' request to operate both units up to an aggregate total of 809 MWe (50 percent of the station capacity). The AEC regulatory staff has completed an environmental review pertaining to the fuel loading, testing and operation of each unit up to 20 percent (502 MWt) of rated reactor power. Under Section D.3 of Appendix D, operation at any level above 20 percent prior to completion of a full NEPA review may not be authorized except upon specific prior approval of the Commissioners.

This report is based upon data from the applicants and other sources, including state and federal agencies, and the evaluation of the data by the AEC regulatory staff. The following analysis and conclusions are limited to the 20 percent case and cover the period ending June 1, 1972, the date when the final impact statement, based on the ongoing full NEPA review, is expected to be completed.

II. STATEMENT OF ENVIRONMENTAL CONSIDERATIONS

A wide range of factors was considered in this environmental review. Because the station is essentially completed, the major environmental impacts of concern are those due to the operation of the once-through condenser cooling system and the radioactive effluents. Thus, the entrainment effects from condenser operation, and the thermal, chemical, and radioactive discharges are the major points of this consideration for limited operation of each unit at 20 percent (502 MWt), of rated power pending completion of the full NEPA review on June 1, 1972. The discussion that follows includes a description of the facility, the impact of its effluents, alternatives to the proposed action, and the effects of delay in facility operation upon the public interest, in accordance with the Commission's regulations in Section D.2 of Appendix D to 10 CFR Part 50.

A. DESCRIPTION OF SITE AND ENVIRONS

1. The Site

The Quad-Cities Station is located in Rock Island County on the east bank of the Mississippi River, about 3 miles north of Cordova, Illinois, and about 20 miles northeast of the Quad Cities-Bettendorf area. The Quad Cities are Davenport, Iowa; Rock Island, Moline and East Moline, Illinois. Bettendorf, Iowa, is an adjacent city to the northeast of the Quad Cities.

The 404-acre site is flat, with a grade level about 9 feet above the maximum recorded flood stage. Surrounding land areas are largely in agricultural use, with an industrial park directly north of the station. There are industrial concentrations in the city of Clinton, Iowa, 7 miles northeast of the station, and in the Quad Cities-Bettendorf area.

The geographical location of the station with respect to the upper Mississippi River system is shown on Fig. 1. Moline, Illinois, is located on the map, and the station location is indicated south of Clinton, Iowa, on the Illinois side of the river. The location of the site with respect to the locks and dams of the Mississippi River is shown in Fig. 2. Sections of river between dams are referred to as "pools" which are numbered consecutively southward from St. Anthony Falls, Minnesota. Distances along the river are designated as "river miles" measured northward from the confluence of the Ohio River. The station is located about midway in Pool 14 at river mile 506.5, and at standard river elevation 572.0 feet. Pool 14 is approximately 25 miles long and 0.5 to 1.5 miles wide.

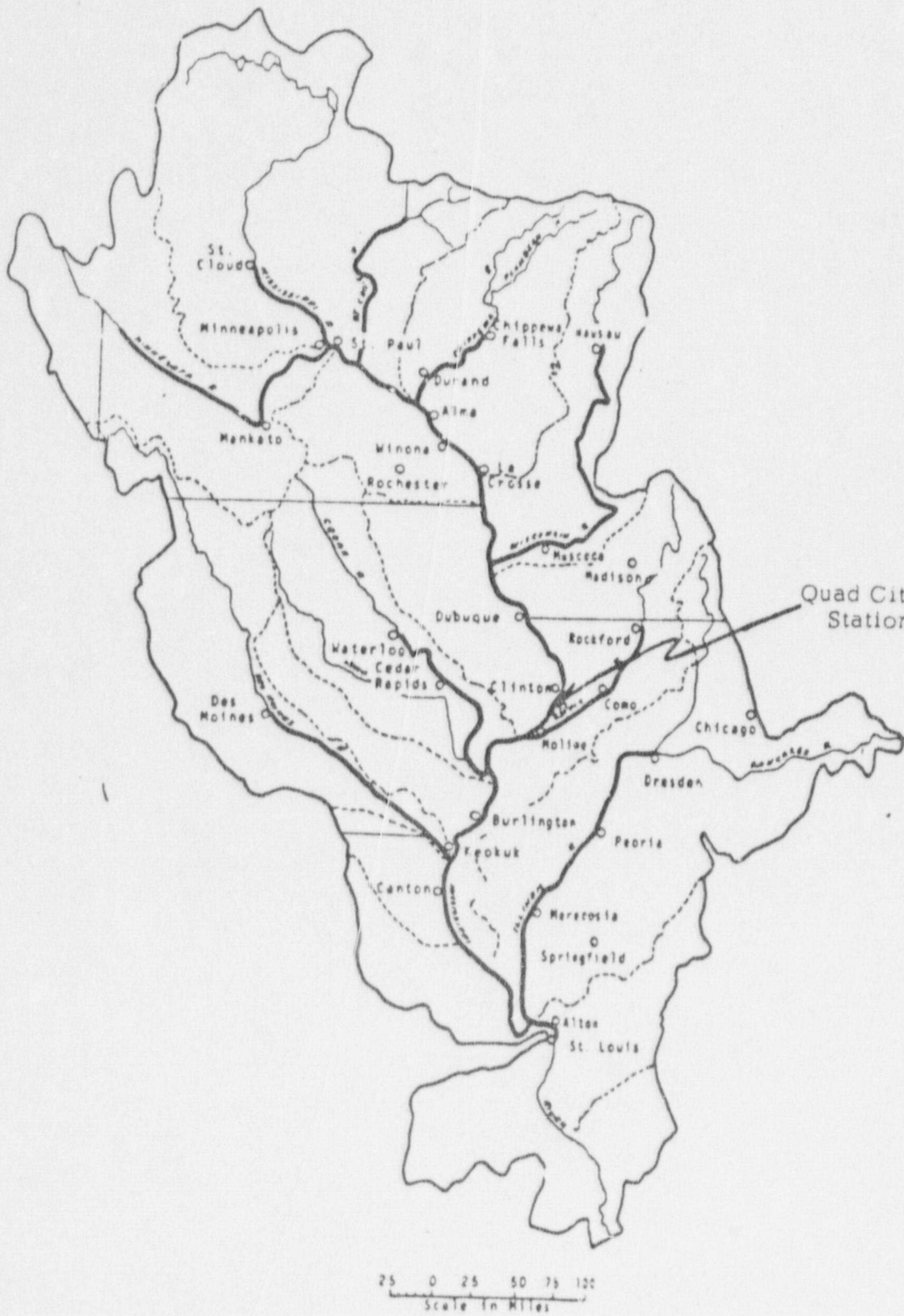

FIGURE 1. Upper Mississippi River Basin

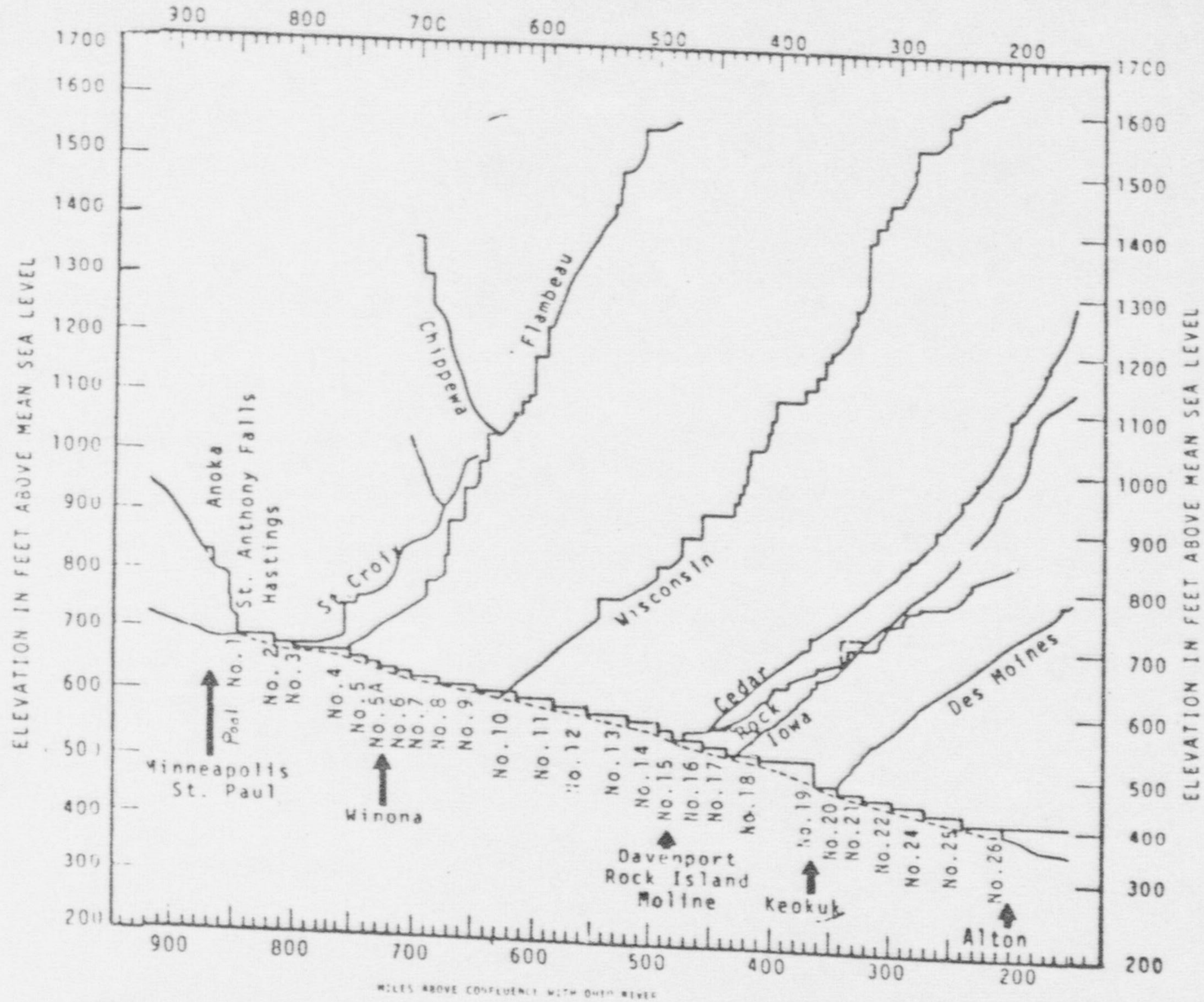

FIGURE 2. Upper Mississippi River Profiles; Main Stem and Major Tributaries

2. The Near-Site Aquatic Environment

Mississippi River flow is controlled below flood stage throughout its length by a series of locks and dams so that its channels are available for transportation. The river water in Pool 14 is a source of municipal and industrial water and is also used for commercial and sport fishing. River shore development within a 25-mile radius of the station consists of residences, industrial plants, a wildlife refuge and recreational sites.

a. River Flow and Temperature

Mississippi River flows by month in Pool 14 are presented in Table 1. High flows result in the spring from melted snow in the Mississippi headwaters. Maximum flow usually occurs in April, the record being 307,000 cubic feet per second (cfs) on April 28, 1965. The lowest flows are observed in winter, usually in December or January. The record low was 6,500 cfs during December 25 to 27, 1933.

Monthly maximum, average maximum and average water temperatures, during the period 1962-70, at the Davenport, Iowa, water plant are shown in Table 2. Similar temperature data for Pool 14 are not available. However, the temperatures in Pool 15 at Davenport, Iowa, 22 miles downstream from the station, are believed to be representative of those in Pool 14. Measurements[5,6] in Pool 14 have indicated temperatures up to 88°F in shallow backwater areas.

b. Water Quality

Although municipal and industrial waste discharge from the Clinton, Iowa area have occasionally resulted in excessive slime growths in the slough areas in the vicinity of the station, Pool 14 is a relatively unpolluted environment. Limited water quality analyses conducted by the applicants' consultant, Industrial Bio-Test Laboratories, Inc. (Bio-Test)[5,6], indicates evidence of nutrient enrichment primarily from agricultural runoff, but no large-scale pollution. Bio-Test studies during 1968-70 indicate that temperature, dissolved oxygen (DO) and ammonia nitrogen values in Pool 14 are less than the maximum limits established by the Illinois Sanitary Water Board.[35] As discussed infra, additional water quality data, including specific element analysis performed and evaluated by Bio-Test, suggest that sufficient baseline information is available to determine any future water quality degradation.

TABLE 1

Monthly Mississippi River Flows (4)

Month	Mean[a] cfs	1-Day 90% Low Flow[b,c] cfs	7-day Low Flow[d] Once in 10 yrs. cfs
Jan.	25,800	17,000	15,900
Feb.	26,900	16,800	15,800
Mar.	49,000	24,800	20,500
Apr.	94,000	43,000	32,100
May	74,000	33,000	24,000
June	62 000	26,200	19,700
July	52,200	20,500	17,300
Aug.	35,000	17,800	15,700
Sept.	34,000	18,300	16,300
Oct.	34,300	18,000	15,400
Nov.	33,700	20,000	17,400
Dec.	27,000	17,500	16,100

[a] Only the record since 1938, for the present system of locks and dams, is considered here. These flows are measured at Clinton, Iowa. Actual flows at the plant are about 1 percent higher, due to confluence of the Wapsipinicon River.

[b] The one-day low flow which is exceeded 90 percent of the time for the period since 1938.

[c] The lowest daily flow since 1938 was approximately 11,000 cfs.

[d] The low flow for a period of 7 consecutive days, the lowest such value expected on a frequency of once in 10 years; statistic for the period since 1938.

TABLE 2

Monthly Maximum, Average Maximum and Average Water Temperature,

1962-70, at Davenport, Iowa Water Plant[4]

Month	Maximum (°F)	Average Maximum (°F)	Average (°F)
January	36	35	33
February	38	34	33
March	54	44	37
April	63	56	49
May	73	70	62
June	81	79	73
July	85	81	78
August	83	81	76
September	80	75	69
October	69	64	57
November	55	50	44
December	42	39	34

C. Aquatic Ecology

Pool 14 encompasses a variety of aquatic habitats and communities in the vicinity of the station. A recent report(7) covers the general history and provides a description of aquatic habitats from Hastings, Minnesota to Alton, Illinois. Major Mississippi River habitats near the station are the channel habitat, off-channel habitat, near-shore habitat, running slough habitat and dead slough habitat. These habitats are chiefly defined by location, depth, bottom material and vegetation.

The main channel in the vicinity of the station is characterized by a scoured sand bottom and the highest current velocity. Directly below the station in the main channel border are several small islands with adjacent, relatively quiet, shallow water areas. Further downstream, across from the main channel, are extensive areas of side channel and slough habitats.

The applicants initiated preoperational environmental studies for the station in 1968. A preliminary study(8) has been followed by a continuing physical, chemical, and biological monitoring program conducted by Bio-Test.

Bio-Test's first report(5) was based on samples collected at 22 locations in different habitats of Pool 14, from river mile 507.6 to river mile 501.3, during the months of August and November 1969, and April 1970. Measurements were made of coliform bacteria concentrations, phytoplankton, periphyton, and benthos populations, and various physical and chemical parameters. The results indicate that the benthos population density (animals per square meter) is relatively low in the main channel, whereas population density and species diversity is highest on rocky bottoms in areas of reduced current. The number of benthic animals in the vicinity of the station is dominated by insects, with fewer crustaceans, oligochaetes, and molluscs. The phytoplankton population (cells per liter) is dominated by diatoms. Blue-green algae never formed a major part of the phytoplankton.

Bio-Test's second report(6) is based on physical, chemical, and biological data collected at 35 stations in July and October 1970. The study covered an area in Pool 14 from 2 miles above the station to 13 miles downstream. This report is more comprehensive than the first in that additional water quality parameters were measured and the biological work included fish sampling and analysis of fish stomach contents as well as more intensive observations of phytoplankton, periphyton, and benthos populations. The report includes no zooplankton data but indicates that zooplankton and aquatic insects predominate in the stomachs of small fish. Diatoms comprised at least 80 percent of the total phytoplankton cell concentrations during both July and October 1970. No excessive growths of attached algae were reported. The benthos population appeared to be dominated by pollution-tolerant tubificid worms at a few stations but generally consisted of organisms such as burrowing mayfly nymphs that are considered to be indicative of relatively unpolluted water.

Other biological studies[9-14] have established the existence of relatively diverse and productive plankton, periphyton, and benthos communities supporting significant commercial and sport fisheries in Pool 14 and other pools in the Upper Mississippi River.

The locks and dams on the Mississippi River system effectively isolate adult fish populations except during periods of flood. Upstream migrations of species are hampered, whereas downstream drift occurs between pools. Serious ecological disturbances in one pool could possibly cause subsequent changes in the ecology of downstream pools, particularly since downstream drift is a major mechanism in energy transfer and dispersal of organisms. Although ecological changes resulting from locks and dams and industrialization have occurred, there remains a wide diversity of fish species in the river. In Pool 14 alone, 64 species have been identified. Recent surveys, however, have collected fewer fish species, suggesting that the diversity may have decreased in recent years.

A considerable amount of sport and commercial fishing occurs in Pool 14, about equal in size of catch by pounds per acre to that of adjacent pools. The combined value of this fishing was conservatively estimated at about $150,000 for 1968[4], of which about one-third was commercial. It was estimated that 20,000 anglers spent 105,000 hours at Pool 14 in 1967 to catch 104,750 fish. The 16-year (1953-68) average annual commercial catch was 318,650 pounds.

Primary sport species in Pool 14 in approximate order of fisherman preference are bluegill and crappie, catfish, and sauger and walleye (Table 3). Certain sport species, such as the northern pike, yellow perch, walleye and sauger occur in limited numbers; they are more numerous further upstream (e.g., Pool 4). These species are apparently not well adapted to conditions in Pool 14 and are not as numerous there, although they do appear in pools as far downstream as Pool 18. Thus, there appears to be a succession of species composition occurring in a downstream direction as a result of changing environmental conditions.

Commercial catches (Table 4) are primarily composed of carp, buffalo, catfish, drum, and sturgeon, with catfish being the preferred species (highest market price).

The upper Mississippi River Wildlife and Fish Refuge, administered by the Bureau of Sport Fisheries and Wildlife, is located on the west bank of the river opposite the site. The Savanna-Clinton District of the refuge, which includes the northern half of Pool 14, reported peak populations of 60,500 ducks and 2,500 geese in 1965. These populations were present in this district of the refuge a sufficient period of time to accumulate more than 2.5 million waterfowl-use days. A significant amount of food consumed by waterfowl using the refuge is produced in the marshes along the river.

On the basis of the Bio-Test studies[5,6], it appears that the channel habitat in Pool 14 is the least productive in numbers of organisms and does not serve as a major feeding or spawning area. The off-channel and slack water habitats show greater productivity and probably provide a more favorable environment for reproduction and feeding. These habitats would be especially favorable to fish because of the abundance of prey organisms, relatively weak river currents, variable water depth and sufficient cover for protection against predation. For the majority of fish species occurring in Pool 14, spawning begins in early spring and extends into summer and probably occurs to the greatest extent in the slack water areas. Specific spawning times and locations (e.g., the exact month and slack water site) for the fish species in this pool are not well known.

B. DESCRIPTION OF THE STATION

1. Reactor and Steam-Electric System

The station has two forced-circulation boiling-water reactors and two turbine generators supplied by the General Electric Company. Each reactor has a rated thermal output of 2,511 MWt and each turbine generator a net electrical capacity of 809 MWe.

The reactor fuel consists of slightly enriched (2 or 3 percent by weight) uranium oxide pellets sealed in Zircalloy-2 tubes. Water is both the moderator and coolant. Two recirculation loops force reactor water through jet pumps up through the reactor core, where steam is generated at about 1,000 psi. The saturated steam passes through pipes to the turbine, where some of the thermal energy is converted to mechanical energy and, in turn, by means of the generator, to electrical energy. Exhaust steam is condensed to water which is pumped through demineralizers back to the reactor vessel. The condenser cooling water is in a separate system which does not come in contact with the reactor water steam.

TABLE 3

Sport Catch Statistics - Pools 4, 13, 14, 18[4, 13]

% Total Catch. ( ) indicates fisherman preference rank

Species	Pool 4 (1967)	Pool 13 (1967)	(Pool 14 (1956-58)	Pool 18 (1967)
Walleye and Sauger	33.3 (1)	1.9 (3)	8.7 (3)	6.3 (3)
Carp	0.2	2.3	2.2	3.0
Catfish	6.4	4.9 (2)	6.8 (2)	40.5 (1)
Whitebass	7.0	9.8	9.4	8.9
Drum	2.8	12.4	9.9	12.3
Largemouth bass	1.1	1.9	1.6	1.5
Bluegill-crappie	44.3 (2)	57.4 (1)	48.5 (1)	24.1 (2)
Yellow perch	1.4	0.8	0	0
Bullhead	0.2	8.3	7.8	3.2
Northern Pike	2.1 (3)	0.1	0	0
Other	1.2	0.2	5.1	0.2
	100.0	100.0	100.0	100.0

TABLE 4

Commercial Fishery Statistics - Pools 14, 15, 19 (4)

Total Catch (lbs) in 1968

Species	Pool 14	Pool 15	Pool 19
Carp	80,000	17,000	382,000
Buffalo	129,000	19,000	197,000
Catfish	78,000	11,000	149,000
Drum	34,000	9,000	120,000

2. Effluent Systems

a. Heat Removal Systems

Approximately one-third of the heat generated by the station is converted to electricity. The remaining two-thirds is released to the environment by way of Mississippi River water which is passed through the station's condensers in a once-through cooling system and back to the river. Full power operation of both generating units at a total of 5,022 MWt will cause a 23°F temperature rise in 2,270 cfs of Mississippi River water, the maximum flow through the condensers. At lower station power levels the temperature rise is proportionately lower (e.g., at 50 percent of full power, about 11.5°F temperature rise; at 20 percent of full power, about 4.6°F temperature rise).

(1) Condenser Cooling Water Intake

The supply of cooling water for the condensers is obtained through a short inlet canal with a mouth about 180 feet wide and 12 feet deep. At the maximum flow rate of 2,270 cfs, the intake velocity is calculated to be about 1 foot per second. A floating boom which extends 33 inches beneath the surface is provided at the mouth of the canal to deflect floating material. It may also help to reduce the entrainment of floating fish eggs, larvae and fry.

Between the floating boom and the condensers there is a row of vertical metal bars, commonly referred to as a trash rack. The bars are spaced 2-1/2 inches apart and extend from about 20 feet above the waterline to the bottom of the intake canal. The purpose of the trash rack is to collect and remove large pieces of debris that get past the floating boom.

Each condenser pump is further protected by a set of traveling screens with a 3/8-inch mesh. These screens change positions at preset time intervals or when activated by a buildup of pressure due to the collection of debris. The screens collect the smaller bits of debris that get through the trash racks. They also prevent organisms larger than the mesh from passing through the pumps and condensers.

(2) Condenser

Six pumps take the water from the intake canal and force it through the secondary side of the condensers at 2,270 cfs.

The exhaust steam from the turbines flows through the primary side of the condenser where it is condensed back to water. This water is returned to the reactor to be reheated. At the same time, the heat released by the steam heats the cooling water to a maximum of 23°F above the ambient temperature of the river. The negative pressure in the turbine and in the primary side of the condenser assures that leakage in the condenser will not release radioactivity from the turbine to the river.

The condenser tubes are cleaned by periodically injecting sodium hypochlorite into the water as it enters the condenser. Details of the sodium hypochlorite injection are given in the section on chemical and sanitary wastes.

(3) Condenser Cooling Water Discharge System

Cooling water from the condensers goes to the cooling water discharge canal, where it falls over a 3 foot weir and then passes to the river through a canal 600 feet long and 75 feet wide. The original plan called for this warmed water to be dispersed by a wing dam located immediately downstream from the discharge canal. Upon further consideration, however, the applicants found this plan to be inadequate and it was discarded.

After conducting studies of alternate cooling methods which included ponds, spray canals and cooling towers, the applicants proposed a "jet-diffuser system"[15]. Briefly, this system is designed to disperse the warmed water through a series of jets in a large pipe laid across the Mississippi River. At the present time, the Illinois Pollution Control Board has accepted* this system in principle[34], but the Iowa Water Pollution Control Commission has not. In any case, the jet diffuser system will require 8 or 9 months to construct and thus cannot be made operable before about September 1972.

*The Illinois Pollution Control Board granted the applicants a permit to operate the station at 50 percent of full power which extends for two years from November 15, 1971. This permit grants a temperature variance from the proposed State standards[35] until April 1, 1972. In essence this will permit operation at 50 percent of full power until April 1, 1972. After this date supplemental cooling will be required unless the power level is lowered appropriately, since the proposed State standards require a limit of 5°F after a 600 foot mixing zone. The Applicant's supplemental report[16] provides modeling test data which indicate that operation at 50 percent of full power will violate the proposed State standards if the "side jet" discharge system is the only cooling system used.

When the applicants applied for an interim license for operation up to 50 percent of full power, an interim cooling water discharge system was proposed which consisted of narrowing the exit of the discharge canal to achieve a maximum amount of jet entrainment. This is referred to as the "necked-down, side jet" discharge system(1) or the "side jet" discharge system(16), which is considered by the applicants to be the most effective interim method for reducing the area of heated water in the river.

According to the temperature rise contours(16) derived from modeling experiments related to 50 percent operation and full condenser cooling water flow (2,270 cfs), a river flow above 11,000 cfs forces the warm water against the east shore of the river and around the islands immediately downstream from the station. The temperature rise contour of water 5.8°F above ambient for the 50 percent case will likely extend a short distance beyond the island group immediately downstream from the station (Fig. 3). Below these islands, the main channel moves over to the east bank of the river (Fig. 4). We assume that the warm water will dissipate in this channel a short distance beyond. The area of warm water defined by the 5.8°F temperature rise contour is about 0.3 square-miles (1/5 mile by 1-1/2 miles long). This is approximately 5 percent of the estimated total area in the lower half of Pool 14 (1/2 mile wide by 12 miles long). Furthermore, the island area immediately downstream from the site amounts to 10 percent or less of the total island area in the 5 mile section below the station.

The staff has estimated that operation of the station at 20 percent of full power, and full condenser cooling water flow (2,270 cfs), will result in similar warm water patterns surrounding the islands immediately below the site. This estimate indicates that the temperature rise contour which defines the warm water area will be more nearly 2.3°F as compared to the 5.8°F contour for 50 percent operation.

b. Chemical and Sanitary Wastes

Small amounts of chemicals from regenerating the demineralizers (other than those used in liquid-radwaste treatment) and cleaning the condensers will be intermittently discharged to the river. Before they are discharged, all such aqueous effluents will be sampled and chemically analyzed for compliance with rules and regulations of the State of Illinois.(35)

The regeneration of demineralizer resins will result in an aggregate total of 2 ppm of sulfuric acid, magnesium sulfate, and calcium sulfate in the station condenser discharge for about 1 hour every 2 or 3 days. This concentration is based on a

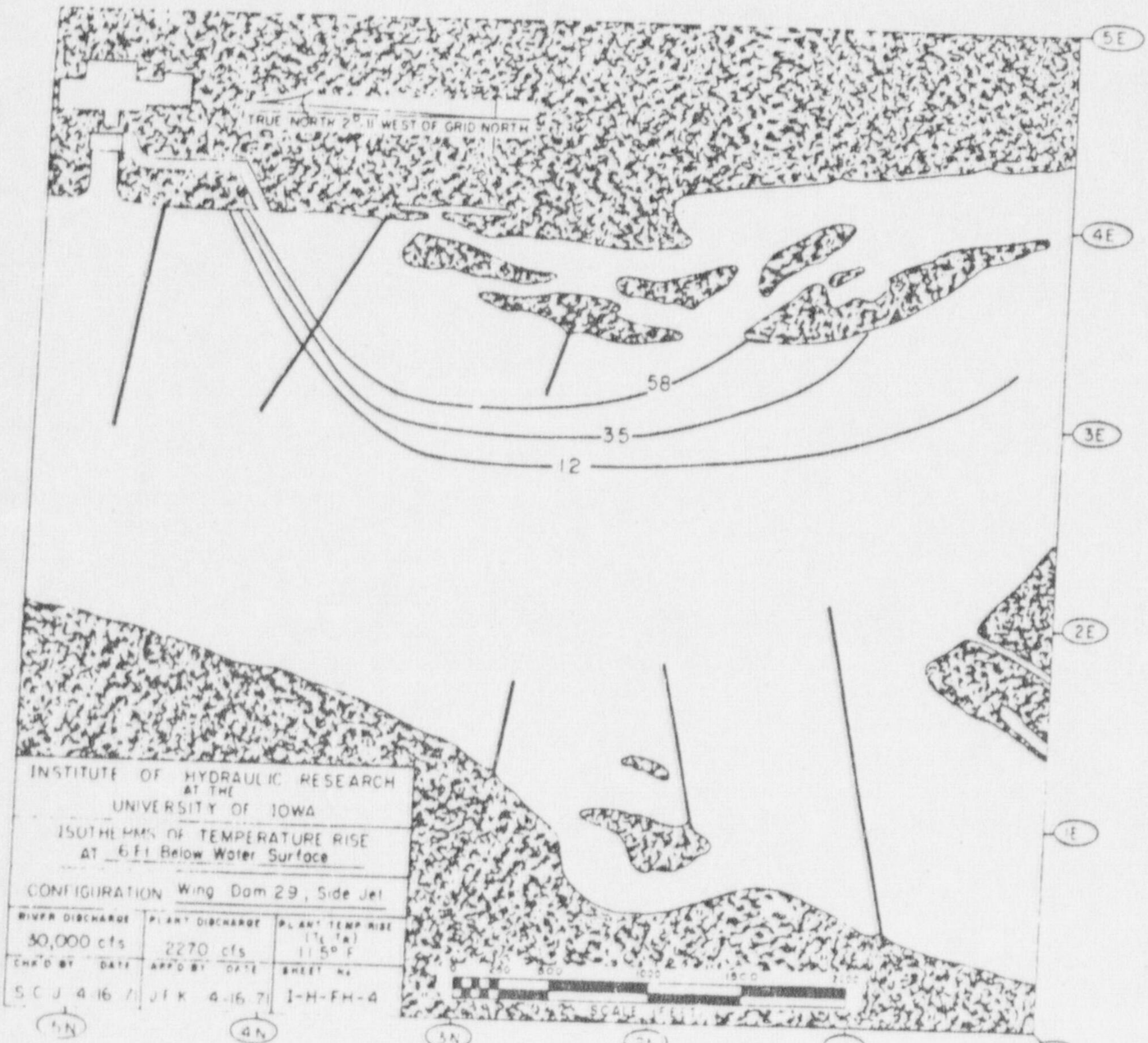

FIGURE 3.(16) TEMPERATURE-RISE CONTOURS AT 6 FT BELOW WATER SURFACE FOR INTERIM SIDE JET

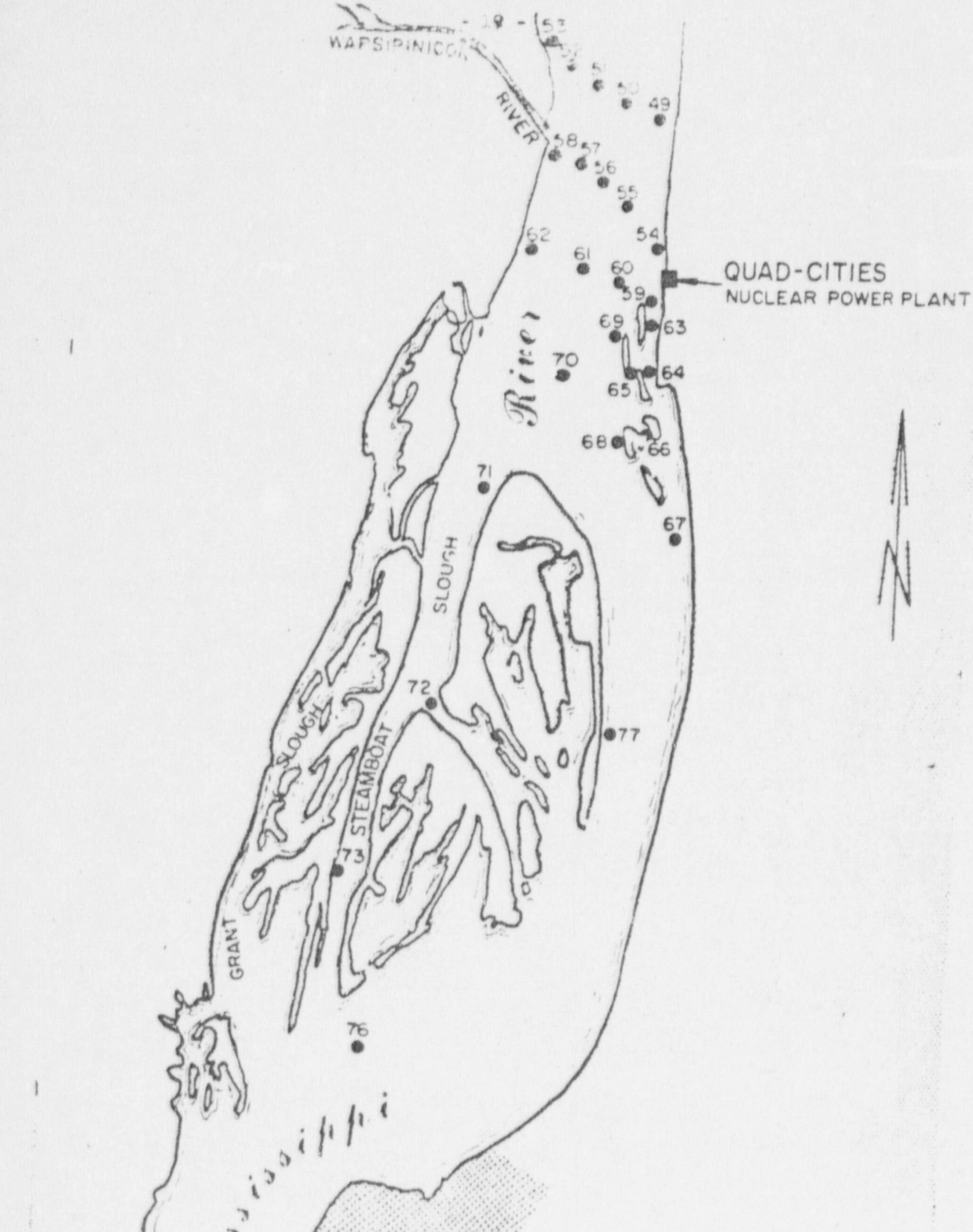

FIG. 4(9) LOCATION:
Mississippi River below the

long-term average plant water requirement of 600,000 to 900,000 gallons per minute. Extreme conditions pointed out by the applicant[16] could increase the concentration to 6 ppm.

Sodium hypochlorite solution is added to the condenser cooling water three times per day in 40-minute periods to reduce growth of bacteria and other microorganisms in the piping and the condensers. Present practice is to add the solution to each of the four condenser half-units (one at a time for 10 minutes each) every 8 hours. Ten gallons per minute of 15 percent sodium hypochlorite solution are injected with 525 cfs of water. This water is subsequently diluted in the discharge canal and discharged into the river.

The concentration of chlorine (from sodium hypochlorite) in the cooling water of the condenser-half being treated is calculated by the staff, from the applicants' procedures, to be 3.7 ppm. The quantity was chosen by experience to yield a "typical" value of about 0.5 ppm (range 0.2 to 0.7) "free chlorine"* after mixing with the unchlorinated half-condenser stream[16]. The rate of addition will be modified in the light of experience to maintain this level of free chlorine, according to present plans.

In normal operation, the water from the condenser being treated will be diluted 2 to 1 upon mixing with the output of the other condenser, and will then flow into the discharge system. Typically, a substantial reduction in residual chlorine content can be expected to occur prior to discharge due to the reaction of chlorine with oxidizable material in the unchlorinated water. This reduction might be variable with time and with chlorine levels. Recent measurements during unheated operations have shown chlorine levels at the sampling station (perhaps two-thirds of the way down the discharge canal) of about 20 percent of the amount at the condenser center line during experiments at unusually high-free chlorine levels and at higher temperatures, the resultant greater excess of chlorine demand** (over the free chlorine

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* The useful chlorine is present in the forms of the hypochlorite ion and hypochlorous acid, with the relative quantities determined by the pH of the water (1:1 at pH 7.5). The concentration of molecular chlorine in water that would have the same chlorine oxiding capacity as is present in the OCI - and HOCI is called the "free chlorine" level. The 1 ppm free-chlorine half-condenser effluent will contain 0.5 ppm CL in the form of OCI- or HOCI, since in these forms the chlorine has twice the oxidizing capacity per gram as elemental chlorine (valence changes from 1 to -1 during reaction versus the change from 0 to -1).

**The chlorine demand of water is the elemental chlorine equivalent of the amount of free and combined chlorine that will react with oxidizable substances in the water. The substances that provide the chlorine demand vary from case to case, and the rates of oxidation of these substances vary over a considerable range.

level) and the higher reaction rates can be expected to lead to greater chlorine reduction before discharge to the river.

In addition to reacting with the substances comprising the chlorine demand, free chlorine also reacts quickly (at the river water pH) with any dissolved ammonia present to form chloramine. Typical river water levels of ammonia nitrogen (ca. 0.2 ppm) are stoichiometrically equivalent to 0.5 ppm chlorine in hypochloric acid (or 1.0 ppm free chlorine); there is an excess above that required to react with the 0.25 ppm diluted free chlorine present at the beginning of the discharge canal. The extent of the reaction will largely depend upon the relative concentrations of ammonia and free chlorine, since the equilibrium constant for the reaction between these substances favors essentially complete conversion to monochloramine at the river pH. The higher chloramines are reportedly not stable[17,18]. Any chloramine formed will then react with the chlorine demand constituents. Since this reaction is less than that reducing the free chlorine, quantitative estimation of the degree to which all residual chlorine (the sum of free chlorine and combined chlorine) will have dissipated before discharge to the river is difficult.

These considerations suggest the expected residual chlorine concentration in the coolant discharged to the river to be substantially less than 0.25 ppm in a flow of 2,270 cfs. This concentration will be present, under normal full condenser flow, during three 40-minute periods per day. Dilution factors in the river will range from 7 at a minimum river flow of 15,400 cfs to 20 at the average flow rate of 46,800 cfs. Thus, the expected residual chlorine concentrations diffused in the river during periods of chlorination will be substantially less than either 0.04 ppm during minimum flow periods or 0.01 ppm during average flow.

An additional amount of chlorine will be added to the discharge canal in the service water discharge. The service water is chlorinated for two 20 minute periods per day, during which the residual chlorine in the 67 cfs (30,000 gpm) discharge from the service water unit will be about 0.5 ppm (again expected to vary in the range 0.2 to 0.7 ppm). When diluted in the condenser discharge canal at full operation, the service water contribution will be about 0.02 ppm during the chlorination periods, before natural decay as discussed above. The possible chlorine contribution to the river during a 20-minute period is about one-tenth that of the condenser chlorination.

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* Lowest average 7 day rate in 10 year period, see Table 1, pg. 8..

The station has an operable sewage treatment plant which is designed for 15,000 gallons of sewage effluent per day. The plant is licensed by the State of Illinois and is under the supervision of a licensed sewage-treatment operator. It is currently operating at about 5,000 gallons per day. The effluent is chlorinated according to the State standards.

c. Radioactive Wastes

In the operation of nuclear power reactors, radioactive material is produced by fission and by neutron-activation reactions of metals and material in the reactor system. Small amounts of gaseous and liquid radioactive wastes enter the effluent streams, which are monitored and processed within the plant to minimize the radioactive nuclides that will ultimately be released to the atmosphere and the Mississippi River at low concentrations under controlled conditions. The radioactivity that may be released during operation of both Units 1 and 2 at 20 percent of full power will be as low as practicable and in accordance with the Commission's regulations, as set forth in 10 CFR Part 20 and 10 CFR Part 50.

(1) Gaseous Wastes

Present System

During power operation of the facility, radioactive materials released to the atmosphere in gaseous effluents (which arise from the non-condensable gases left after steam condensation from the turbine generator) include fission product noble gases (krypton and xenon), activated argon and nitrogen, halogens (mostly iodines), tritium contained in water vapor, and particulate material including both fission products and activated corrosion products. Fission products are released to the coolant and carried to the turbine by the steam if defects occur in the fuel clad or if uranium is present as an impurity in the clad itself.

The systems of treatment of radioactive gaseous waste currently installed at the station are described in the Final Safety Analysis Report(19) and in the applicants' Environmental Report. The applicants' response of May 11, 1971 (see ref 15, Appendix I) to comments on the draft Environmental Statement describes the system proposed for future installation to maintain gaseous effluents at low levels during extended full power operation.

The major source of gaseous waste activity will be the condenser air ejector effluent. Other sources include the turbine building exhaust, reactor building exhaust, drywell purge and release from the gland seal off-gas system. Prior to release, the gases from the main condenser air ejector are delayed in a 30 minute holdup pipe (to allow decay of activity of short-lived radioactive noble gases), filtered through high efficiency particulate filters and then discharged to the atmosphere through a 310-foot stack.

Turbine building ventilation exhaust contains low concentrations of activity, primarily from steam system leakage, and is discharged to atmosphere without treatment through the main stack. Likewise reactor building ventilation exhaust contributes little activity, particularly at the 20 percent power level, and is discharged without treatment to the building vent stack. Drywell gases are normally purged and exhausted from the reactor building vent stack but can be processed through the standby gas treatment system if the activity level is high. The small quantity of radioactive gases released by way of the gland seal off-gas system is delayed for about 2 minutes to allow decay of the major activation gases (N-16 and O-19) prior to release through the main stack. All sources of gaseous waste are continuously monitored to assure that effluent releases are within applicable standards.

On the basis of operating experience with power reactors of similar design, it is expected that the off-gas system described above will keep release of gaseous radioactive wastes within small fractions of the limits specified in 10 CFR Part 20 at 20 percent power. In order to reduce these levels to the lowest practicable during extended full power operation which may entail local failures of fuel clad integrity, the applicants will install additional gaseous-holdup equipment. A modification to the present system will allow recombination of the hydrogen and oxygen formed in the reactor coolant, a condenser to remove much of the water vapor, and an 8-bed charcoal system to provide additional retention time for the krypton and xenon and to provide additional absorption for particulate matter. These modifications will be operable within 2-1/2 years and should further reduce offsite exposures from gaseous radioactive releases from the condenser air ejector by a factor of about 40.

At power levels of 20 percent or less in each unit with the presently installed gaseous waste system, discharges will be at low levels since little fuel failure is expected at this low power and little diffusion of fission products from the fuel pellets will take place at low operating temperatures. On the basis of startup experience at other operating plants with similar gaseous waste systems, we anticipate activity releases at the rate of less than 2,000 μCi/sec from each unit or a total of less than 4,000 μCi/sec from the station, primarily noble gases. Some iodines may also be released in gaseous form We anticipate releases at the rate of less than 0.25 Ci/year of I-131 from both units from the stack and less than 0.01 Ci/year from both units from the reactor building vent at 20 percent power.

(2) Liquid Wastes

Liquid radioactive wastes from drain sumps, drain tanks, and floor drains are collected, filtered, and temporarily stored prior to discharge to the Mississippi River. During normal operations, water from the primary reactor system will be demineralized and placed in the condensate storage tank for reuse in the reactor. The condensate from the future off-gas system will also be placed in condensate storage.

Spent resins from the radwaste demineralizer are not regenerated but are disposed of as solid radwaste. The use of non-regenerative demineralizers leads to smaller volumes of liquid wastes, and thus less addition of activity to the environment, than if a regenerating resins system were used in the same manner.

The applicants plan to recycle water as a fundamental plant process. Both the condensate-demineralizer system and the reactor-water cleanup system are designed to assure requisite purity and activity levels to permit recycling of most of the plant water that contains radionuclides. Recycling is also provided for about 60 percent of the water that goes through the liquid-radwaste system.

The only liquid wastes expected to be discharged offsite are from floor drains and sumps, laboratory drains, decontamination solutions (very infrequently), and laundry wastes. After filtration and sampling, these wastes are diluted and discharged into the Mississippi River.

The applicant indicates[16,36] that further processing equipment will be installed in the liquid waste system which will reduce discharges to the Mississippi River to less than 1.2 curies per year after December 3, 1973. At 20 percent power or less in each unit with the presently installed liquid radwaste system, discharges will also be at very low levels. On the basis of startup experience at other operating plants with similar floor drain systems, we anticipate activity releases at the rate of about 3 curies/year from each unit or a total of about 6 curies per year from the station, primarily activated corrosion products. Less than 4 curies of tritium are also anticipated to be released.

(3) Solid Wastes

Solid wastes from the reactor operation are composites of spent resins from the liquid-radwaste demineralizer and precipitates are insoluble matter that comes from filters or is washed into the condensate phase separator. The spent resins and the slurry from the condensate phase separator are dewatered in a centrifuge. Separated liquid waste returns to the liquid-radwaste stream, whereas the solids are mixed with concrete in drums for shipment offsite to a licensed burial ground. The drums will be shipped by vehicles with suitable shielding in compliance with AEC and DOT regulations.

C. ENVIRONMENTAL IMPACT OF STATION OPERATION

1. Heat Removal System Effects

a. Condenser Cooling Water Intake

The floating barrier at the mouth of the intake canal presents a retarding influence on fish eggs and larvae as well as floating debris. We have reviewed the applicants data as well as searched for additional data elsewhere but have found that there is no evidence available that indicates the effectiveness of the barrier in reducing the flow of fish eggs and larvae into the intake canal, thus protecting them from being entrained in the condenser cooling channel. Some rather large tree branches were observed on the trash racks during the site visit* which indicated that the barrier is not completely effective in stopping large pieces of debris.

With all six intake pumps operating at full capacity (2,270 cfs), we have calculated the linear velocity of the water at the floating barrier to be about 1 foot per second (fps). Since this velocity is nearly the same as current speeds in the river, all but immature fish and plankton will be able to enter and leave the intake canal at will. Some fish and other organisms may enter the intake canal and establish semi-permanent populations. The canal may be an attractive habitat for a variety of reasons, i.e., available food source, spawning sites and

*A site visit was made by AEC environmental protection staff members to aid in their independent review of the station and its effects. The site visit included detailed observation of the site environs, inspection of the station, and discussions with the applicants' environmental consultants and staff.

protective cover. However, should concentrations develop to the extent that high densities result and persist over time, damage to fish may occur due to increased incidence of disease. A possibility exists that walleye and sauger, which are believed to spawn predominately in the rocky areas near the locks and dams, may utilize the rock-lined intake canal for spawning. Such an occurrence would probably result in entrainment of a large fraction of the annual spawn.

Trash rack bars, spaced 2-1/2 inches apart and extending to the bottom of the intake canal, are the first obstacle between the floating barrier at the entrance of the intake canal and the condensers. Such a mesh size will certainly permit the passage of small organisms. Small fish can pass between the bars and reach the traveling screens.

A set of traveling screens with 3/8 inch mesh protect the entrance to the pumps and condensers. These screens are normally stationary and change position at preset time intervals or when activated by buildup of pressure due to the collection of debris. Plankton will pass through these screens, as will fish eggs and larvae. The traveling screens are not expected to mechanically damage the larger fish that swim through the trash racks because the screens are not in continuous motion and the water velocity is still low at this point (we calculate about 1-1/2 fps).

There will be entrainment of phytoplankton, zooplankton and immature stages of fish. However, since plankton concentrations in the vicinity of the stations are not well known, and since the actual spawning locations have not been well identified, the percentage of aquatic life that will be entrained is impossible to estimate. Obviously, if the majority of the spawning adults of a particular fish species spawn immediately above or within the intake canal, the reproductive success of that species will be reduced. The staff has taken account of these considerations in its overall assessment (see below).

In summary, the non-motile organisms (those which either do not swim or cannot overcome the current) which are small enough to pass through the traveling screens will be entrained. Those non-motile organisms which are too large for the screens will be trapped on the screens and lost. Motile organisms, mostly fish, may be attracted to the area between the trash rack and screens and congregate in large numbers. Such congregations could be detrimental to the fish (e.g., increased disease susceptibility) and to the operation of the station.

These problems will occur to some unknown extent, and determination of the degree of occurrence and the need for remedial action, if called for, will be part of the environmental surveillance program.

b. Condenser Passage

In passing through the condensers and the discharge canal, the entrained organisms will be subjected to a sudden increase in temperature (up to 4.6°F) which will last about 5 minutes. The entrained organisms will also be subjected to periodic chemical damage when sodium hypochlorite is used to clean the condenser tubes, and to continuous mechanical damage due to turbulence and abrasion against tubing walls. These chemical and thermal effects are not readily separable from each other or from the mechanical effects; hence, individual assessment of each effect is not entirely possible. When intake temperatures are relatively high (June, July and August, Table 2, p. 9), and the reactor is at full power, nearly 100 percent mortality of entrained organisms may occur. At 20 percent power the mortality rate will be lower because of the lower thermal impact (4.6°F vs 23°F) and because the lower maximum temperature (intake temperature plus thermal impact) is not as near the lethal limits. However, we do not expect the maximum possible mortality rate of 100 percent of the entrained organisms in the condensers to cause more than a 20 percent reduction of the total plankton (assuming plankton population proportional to water intake) immediately downstream during low flow (11,000 cfs). Normally, the flow is much larger and the percentage reduction of plankton will be much less.

Our review of laboratory and field studies of condenser passage established the potential for adverse effects on such entrained organisms.[20] The field studies were conducted at several power plants throughout the country which are using river or estuarine water for once-through cooling (notably the Tennessee Valley Authority's Paradise Power Plant on the Green River and the Chalk Point Station on the Patuxent River in Maryland). The data indicate that the passage of young fish through the condensers of the Connecticut Yankee Atomic Power Plant (using 6 percent of the river flow during extreme low-flow conditions) causes 100 percent mortality during much of the low-flow period. Nevertheless, no quantifiable adverse effects on the fish populations and other biota in the Connecticut River have resulted from more than 30 months of operation.[21] TVA's experience at the Paradise Plant on the Green River in Kentucky shows that zooplankton populations recovered a few miles downstream from a greater than 20 percent reduction in passing through the plant.[22]

Based on the above data, we believe that even if it is assumed that 100 percent of the organisms entrained in the Quad-Cities condenser cooling water system will be lost (this amounts to 20 percent of the organisms passing the station at maximum, which is during the lowest flow period), reduction in the number of organisms immediate downstream may occur, but the overall damage to the ecological balance of Pool 14 will be small.

c. Condenser Cooling Water Discharge

Although the mouth of the discharge canal has been necked down to create a current of 4.5 feet per second, many species of fish will be able to overcome the current and enter the canal. The velocity within the canal proper (2.5 fps) is also well within the sustained swimming ability of many species.[23] Their presence in the canal makes them subject to the potential thermal and chlorine effects.

Fish will be attracted to the canal or heated downstream areas when temperatures there are preferable to ambient conditions. Each species typically has a preferred optimum and upper lethal temperature limit based primarily on past acclimation experience. Table 5 summarizes the laboratory and field works of several investigators relative to the temperature tolerances of several species, some of which are common in Pool 14.

During periods of low river temperatures, fish that are attracted to the discharge canal or immediately below will become acclimated to warmer than ambient river temperatures (see Table 2 on page 9). In the case of station shutdown, these fish will be exposed to a rapid return to ambient temperatures and will experience cold shock, which may be a potentially greater threat to fish than increased temperature. Mortality resulting from the inability of fish to acclimate to rapidly lowering temperatures in natural systems has been reported.[24] Although the extrapolation of laboratory bioassay experiments to field conditions is somewhat speculative, the marked temperature ranges between acclimated and lower temperature limits in Table 5 suggest that a sudden decrease of 4.6°F would not cause any large scale fish mortality.

The heated discharge from the canal is likely to affect certain benthic species such as mayfly and stonefly nymphs and caddisfly larvae, and may also affect additional plankton, fish eggs and larva forms within the mixing zone of the discharge. Coutant[20,25] and other workers[24,26] have reported the thermal effects observed in discharge canals and their near environs for a number of operating plants. The most prominent effects noted were seasonal changes in animal diversity and total number of organisms present. At several stations during the summer months, animal diversity and numbers were reduced, indicating thermal stress in the immediate discharge area. During winter at these stations, diversity and numbers of organisms increased. Phytoplankton primary production has also been shown to be affected by an increase in water temperature.[26] Depending on the ambient water temperature and other factors, production can be either increased or decreased.

The studies mentioned above show localized damage. No widespread changes of the nature described have been observed that clearly

TABLE 5[24]

TEMPERATURE TOLERANCE LIMITS FOR SELECTED FRESHWATER FISH, LD_{50} [a]

Fish	Acclimat. Temp. (°F)	Low. Temp. Lim. °F	Low. Temp. Lim. Time, Hr.	Up. Temp. Lim. (°F) °F	Up. Temp. Lim. (°F) Time, Hr.	Preferred Temp. (°F) Lab.	Preferred Temp. (°F) Field
Bass, largemouth	68.0	41.0	24	89.6	72	86.0-89.6	80.0-81.9
	86.0	51.8	24	93.2	72		
Bluegill	59.0	32.0	24	86.0	60	90.1	
	86.0	51.8	24	93.2	60		
Catfish, channel	59.0	32.0	24	86.0	24	-	-
	77.0	42.8	24	93.2	24		
Yellow perch	41.0	-	-	69.8	96		
(winter)	77.0	39.2	24	86.9	96		
(summer)	77.0	48.2	24	89.6	96	75.6, 69.8	54.0, 68.4 - 69.8
Carp	-	-	-	-	-	89.6	-
Walleye	-	-	-	-	-	-	69.1, 72.9 - 73.8

(a) Values are water temperatures in which 50 percent of the test fish survived. See reference for specific experimental conditions and degree of applicability to present use.

indicate point sources of heat or brief chlorination as the cause. Based on these data, any of these localized effects observed at the station will be minimal because of the relatively low temperature of the discharge water compared to ambient in Pool 14.

The canal discharge will result in a portion of the immediate downstream surfac_ area being warmed. However, the temperature increases in the pool downstream will be less than those occurring naturally as a result of daily (diurnal) fluctuations.

Downstream areas that will experience temperature rises consist primarily of the main channel and a small area of islands which comprises only 5 to 10 percent of the total downstream island and slough area and less than 5 percent of the total downstream habitat in Pool 14. Although this Island area has been suggested(27) to be a major area for fish spawning and residence, no evidence of these uses exists.

We have concluded that the small temperature elevations that will occur over these islands and main channel (less than 4.6°F at 20 percent power) will not cause thermal fish kills based on our evaluation of the available data (compare Tables 2 on page 9 and 5 on page 28). Examination of Table 2 indicates that the average temperature of Pool 14 could be raised by 7 to 8°F during the summer without exceeding the temperatures that have occurred naturally. The "average maximum" column shows that a rise of 2 to 4°F could occur during summer without exceeding maximum ambient temperatures. An unlikely addition of 5°F to the maximum recorded temperatures would result in localized temperatures which do not exceed the upper thermal limits of the major species present in Pool 14 (Table 5). However, if such localized temperatures are not preferable to fish, the option of retreat is available to them. Mount, et. al.(27) have suggested that damage (i.e. reduced reproductive success measured by occurrence of spawning, percent of fertile eggs and percent normal larvae produced) to the walleye and sauger could occur in the winter as a result of increased water temperatures. Their results with yellow perch indicate a decrease in reproductive success at 43°F (35 percent fertile eggs and 31 percent normal larvae) compared to 39°F (70 percent ferti ggs and 53 percent normal larvae). At temperatures greater than 43°F reproductive success continued to decrease. We have carefully examined this data in regard to its applicability to Pool 14 and the 20 percent operation under consideration. In this connection account must be taken of several factors: (1) the application of their experimental results to fish in pool 14 represents an extrapolation from the laboratory to Pool 14 and a further extrapolation from yellow perch to walleye and sauger; (2) the results of Mount et. al. apply to a 4°F temperature change while the temperature change around the islands below the station at 20 percent of full power will be appreciably less than 4°F; and (3) even assuming that there is a 50 percent reduction

In fertile eggs spawned by some species in the immediate downstream island areas, there is no evidence (see above) that this will affect the ecological stability of Pool 14. These factors, as well as the extent of the total area affected (as discussed above), indicate that the warm water (resulting from station generation) around the downstream islands will not have a measureable effect on the overall fish population of Pool 14 due to a decrease in normal reproduction of fish in that area.

The effects of small downstream temperature increases on other river biota will be minimal. Effects on phytoplankton are not likely to be observed in terms of a reduction in primary production several hundred feet downstream. Benthic populations will not be exposed to increased temperatures to any extent since the heated water will be primarily a surface to mid-depth phenomenon. Slight alterations in the hatching time of insect larvae could occur in the immediate area of the discharge, but the major portions of the downstream areas will be unaffected.[28,29]

In summary, there are several potential adverse effects that could be caused by the Heat Removal System: the congregation of fish in the intake canal and behind the trash rack; the degree of impingement and damaging of the congregated fish, if any, against the traveling screens; the combined chemical-mechanical-thermal effects on the organisms carried through the condenser; the congregation of fish in the discharge canal; the effects of chlorine residual and warm water on the fish in the discharge canal and aquatic biota in the canal outfall; and the effects of chlorine residual and warm water on the aquatic biota downstream.

Our conclusions are, as previously indicated, that while there may be adverse impacts on the quality of the environment resulting from some or all of these effects, the technical evidence cited in the discussion indicates that these impacts would not be substantial, that the affected area will be small (i.e. at most, the area of the downstream islands, about 0.3 square mile), and that there will be no detectable damage beyond the small affected area. Since, however, the extent of these impacts cannot be definitely determined at this time, the applicant will be required to expand his environmental surveillance program to include an assessment of the areas of potential effects identified in the preceding paragraph.

2. Chemical Effects

The chemical effluents are those resulting from the regeneration of the demineralizer, chlorination from condenser cleaning and service water, and sewage. These have been described in section II.B. (pp. 20-22).

Table 6 compares the chemical quantities from the demineralizer to drinking water standards, and to quantities of the same chemical already in the river and in drinking water. It can be seen from this comparison that the addition of chemical effluents from the station will not increase the concentrations in Pool 14 above existing levels. Furthermore, since the water gradients in the vicinity of the site are toward the river, no chemicals from the station are likely to enter the ground water supplies.

Sodium hypochlorite solution is added intermittently (40 minute periods, 3 times per day) to the condenser cooling water to reduce the growth of bacteria and other microorganisms in the piping and condensers. The concentrations of chlorine residual in the discharge canal may vary from as much as 250 ppb (0.25 ppm) at the condenser exit to something much less at the canal exit. The uncertainty in these numbers stems from the variability of the chlorine demand of the river water, and the uncertainty of the effect of the weir, and of the mixing in the canal. Operating experience must therefore be utilized to measure and understand the effects of chlorine residual on fish and other aquatic biota at levels of residual chlorine considerably below 1,000 ppb (1 ppm).

Chlorine is known to be toxic to aquatic life. Although the levels at which effects have been noted are subject to certain conditions (e.g., the nature of the receiving water, species of aquatic life, temperature, etc.), levels as low as 1 ppb have been shown to affect salmonid behavior[30] over long periods of time. More specifically, 12 days of continuous exposure at 10 ppb is lethal, and so is 4 days of continuous exposure at 100 ppb. Salmonids are capable of detecting and avoiding concentrations of 10 ppb. Thus, if residual chlorine concentrations were periodically (a few times per year) as high as 40 ppb, it seems likely that the fish exposed to these concentrations would be capable of avoidance reactions. While there are no salmonids in Pool 14, these data are indicative of the magnitude of the chlorine effect and may apply to some of the fish that live in Pool 14.

Our conclusion is that we expect no serious adverse effect on the aquatic biota in and around the discharge canal. However, due to the uncertainties enumerated above, monitoring of the chlorine residual will be required as indicated in Section II B.

Chlorine residual effects on fish in the river proper are the same as in the canal. However, by the time the chlorine residual has gone that distance, most of it has reacted with river water constituents and the levels are much lower. The effects will, therefore, be correspondingly lower. We have reviewed the literature (see discussion in II b 2) and observed measurements of chlorine residual at the station. The foregoing indicate to us that modern practices in chlorination, involving the mixing

Table 6

Chemical Content of Water (Parts Per Million)

	Quad Cities Condenser Discharge (a)	Pool[5,6] 14	Recommended Limits of Concentration in Drinking Water	Drinking Water in 100 Largest Cities[33] Median	Maximum
SO_4	≤ 2	28	250[32]	26	572
Mg	≤ 2	16	50[33]	6	120
Ca	≤ 2	39	75[33]	26	145

(a) These concentrations of the listed chemicals are discharged for short fractions of the day and are diluted by the River.

of chlorinated streams with larger volumes of unchlorinated water in the discharge system, lead to little or no chlorine discharge to the rivers and lakes providing the cooling water. However, there are no known published data which definitely establish this position. Because of the uncertainty involved and the potential adverse effects, the applicant will be required to monitor the residual chlorine and aquatic biota for chlorine effects so that remedial action may be taken early if necessary.

An additional amount of chlorine will be added to the discharge canal in the service water discharge. As indicated in Section II B 2, the service water is chlorinated for two 20-minute periods per day, during which the residual chlorine in the 67 cfs (30,000 gpm) discharge from the service water unit will be about 0.5 ppm (like the condenser cooling water, it is expected to vary in the range 0.2 to 0.7 ppm). Possible contribution to the river, during chlorination, is about one-tenth that of the condenser chlorination. This is not expected to add a measurable amount to the chlorine released from the condenser cleaning. In any event, it will also be included in the discharge water that is monitored.

The station has an operable sewage treatment plant which provides primary and secondary treatment. The maximum amount of effluent is 0.3 cfs. This is chlorinated to less than 1 ppm by State regulation, but the small amount of total effluent (0.3 cfs compared to 2,270 cfs) is unlikely to be a noticeable source of adverse effects. The plant is licensed by the State of Illinois and is under the supervision of a licensed sewage-treatment operator.

Based on the foregoing, we have concluded that there is not likely to be an adverse effect on the quality of the environment due to chemical effluents from operation of the station.

3. Radiological Effects

The staff estimate of the exposure that may be incurred by the general public from plant operation under the proposed license is based on operation of each unit at 20 percent power.

(a) Exposure from Radioactive Materials Released to the Atmosphere

The radioactive materials released to the atmosphere in gaseous effluents include the fission product noble gases (krypton and xenon), halogens (mostly iodines) and particulate material including both fission products and activated corrosion products.

The concentration of radioactive materials in the environment depends on the meteorological conditions during the period of release.

Release rate limits are defined by determining the average concentrations and dose rates to be expected at various locations outside the plant area where public access is not controlled by the applicant. The maximum release rate limit is established in accordance with 10 CFR Part 20. Conditions will be included in the Operating License to require the licensee to keep levels of radioactivity in effluents as low as practicable in accordance with 10 CFR Part 50.36a.

The maximum site release rate limit for noble gases for the station based on annual average meteorology has been determined to be 0.4 curie per second. This release rate would limit the annual exposure outdoors at any location on the site boundary to not more than 500 millirems per year.

Actual release rates will be substantially less than the maximum allowable release rates and are dependent on fuel element performance. Operation at 20 percent power is not expected to result in any significant fuel element failures. The actual release rate with new fuel is not expected to exceed about one percent of the maximum release rate limit. Under these conditions, the maximum exposure rate outdoors at the site boundary is expected to be no larger than 5 millirems per year. Actual exposures to individuals offsite, taking into account the distance individuals live from the site boundary and shielding from living part-time indoors, would not exceed 2.5 millirems per year.

The dose from iodine in the thyroid of a child was calculated to be about 0.5 mrem per year by assuming an intake of one liter of milk per day produced by cows grazing at the site of maximum deposition for the three months of spring.

In order to reduce the levels of gaseous radioactivity to the lowest practicable level, assuming that some fuel element failures will occur in the future at power levels higher than 20 percent, the Commission has informed the applicants that it will be necessary to install additional gaseous holdup equipment in the station. The applicants plan a modification of the offgas system, to be completed within 2-1/2 years. This modification will include on each unit a recombiner, a condenser, and an 8-charcoal-bed treatment system.

(b) <u>Exposures from Radioactivity Released in Liquid Effluents</u>

It is estimated, from staff calculations based on experience with similar operating reactors, that the total quantity of radioactivity in liquid effluents will be less than 6 curies per year of primarily corrosion products. The expected annual average concentration in the Mississippi River is expected to be 2×10^{-10} μCi/cc or less.

Below the station outfall, the annual dose to individuals who use the Mississippi River as their sole source of drinking water would be about 0.0003 mrem. The dose to an individual from consumption of 50 gm of fish per day (40 lbs per year) would amount to about 0.003 mrem per year.

(c) Doses to the Regional Population

In 1963, the total fish catch from the Mississippi River for Iowa, Illinois and Missouri was 9.3×10^6 lbs. This amount of fish would represent a potential dose from the Quad-Cities liquid effluents of 1 man-rem if consumed. The dose to the population within a 50-mile radius of the plant from drinking Mississippi River water will be about 0.2 man-rem, while the dose from gaseous effluents will be about 3 man-rem. Thus, based on our conservative estimates, the total man-rem dose from all pathways to the 600,000 persons who live within a 50-mile radius of the plant would be about 4 man-rem per year if the station is operated at 20 percent of full power. By comparison, the natural background dose of about 100 mrem per year per person results in an annual total of 60,000 man-rem for this same population.

(d) Radiation to Other Species

The average annual dose to fish, invertebrates, and plants living in the discharge canal would be less than 100 mrem per year. There is no evidence that dose rates of this magnitude will cause any detectable harm to these aquatic organisms.

(e) Conclusion

We therefore conclude that radioactive gaseous and liquid effluents resulting from operation at 20 percent of unit power are expected to be well within 10 CFR Part 20 and Technical Specification limits. In addition, we have concluded that operation of the facility will contribute only an extremely small increment to the dose that the area residents receive from natural background. Since fluctuations of the background dose may be expected to exceed this small increment, the dose will be immeasurable in itself and will constitute no meaningful risk.

4. Effects of Accident Releases

With each unit operating at 20 percent of rated power, the AEC staff believes the probability of an accident in the station that could have significant adverse effects is extremely small. This low probability results from conservatism in the design of the nuclear steam supply system, the reactor protection system and the engineered safety features that are included in the plant, as well as the reduced power operating level. The potential offsite consequences that could occur in the unlikely event of a major accident have been shown in the Quad-Cities Final Safety Analysis Report(19) and the AEC staff's Safety Evaluation(31) to be well within the guideline values established by the AEC regulations for the evaluation of power reactor sites when calculated by the very conservative methods used in such evaluations.

The environmental consequences of postulated accidents ranging from trivial to major have been evaluated for operation of each unit at 20 percent rated power. In making these evaluations, the guidance presented in the Commission document* entitled, "Scope of Applicants' Environmental Reports with Respect to Transportation, Transmission Lines, and Accidents," was followed. This document identified the nine classes of accidents shown in Table 7. In general, accidents in the high consequence end of the spectrum have a low occurrence rate, while those on the low consequence end of the spectrum have a higher occurrence rate. In contrast to the highly conservative assumptions and calculations used for safety evaluations, environmental consequences are determined in this report using assumptions as realistic as the state of technology permits. The staff's evaluation of these consequences in terms of population dose is shown in Table 8.

The environmental consequences of Class 1 and 2 events were evaluated by the staff and have been found to have trivial consequences. Furthermore, occurrences of Class 9 accidents are extremely unlikely in operation at 100 percent power.(31) They are even less likely at 20 percent of power. In addition, defense in depth (multiple physical barriers); quality assurance of design, manufacture, and operation; continued surveillance and testing; and conservative design are all applied to provide and maintain the required high degree of assurance that potential accidents in this class are, and will remain, sufficiently remote in probability of occurrence that the environmental risk is extremely low.

*Enclosure in the letter from H. L. Price to applicants dated September 3, 1971.

TABLE 7

CLASSIFICATION OF POSTULATED ACCIDENTS AND OCCURRENCES

No. of Class	Description	AEC Examples[a]	Applicants Design Analysis (Examples)
1	Trivial incidents	Routine releases	None
2	Small [illegible] outside containment	Steamline relief valves releases and small spills and leaks.	Reactor coolant leaks (below or just above Technical Specifications limits outside PC or RB.
3	Radwaste system failures	3.1 Equipment leakage or malfunction. 3.2 Release of waste gas storage tank contents. 3.3 Release of liquid waste storage tank contents.	Any single equipment failure or any single operator error.
4	Fission products to primary system	4.1 Fuel cladding defects. 4.2 Off-design transients that induce fuel failures above those expected.	Fuel failures during transients outside the normal range of plant variables but within expected range of protection equipment and other parameter operation.
5	Fission products to primary and secondary system (PWR)	Not applicable	Primary coolant loop to auxiliary cooling system secondary side of heat-exchanger leak.
6	Refueling accidents	6.1 Fuel bundle drop. 6.2 Heavy object drop onto fuel in core.	Dropping fuel assembly on reactor-core, spent fuel storage rack or against pool boundary; dropping spent fuel shipping cask in pool or outside pool.
7	Spent fuel handling accident	7.1 Fuel assembly drop in fuel storage pool. 7.2 Heavy object drop onto fuel rack. 7.3 Fuel cask drop.	Transportation incident involving spent fuel shipment on site but outside PC or RB.

a/ Numerical values of radiological releases shown in Table III

TABLE 7, (cont'd.)

No. of Class	Description	AEC Examples[a]	Applicants Design Analysis (Examples)
8	Accident initiation events considered in design basis evaluation in the Safety Analysis Report	8.1 Loss of coolant accidents. 8.1 (a) Break in instrument line from primary system that penetrates the containment. 8.2 Rod drop accident. 8.3 Steamline breaks.	Reactivity transient, loss of reactor coolant inside or outside primary containment.
9	Hypothetical sequences of failures more severe than Class 8	See discussion on p. 37	See discussion on p. 37

a/ Numerical values of radiological releases shown in Table III

TABLE 8

QUAD-CITIES NUCLEAR POWER STATION (UNITS 1 & 2) AT 20% POWER

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

Class	Event	Estimated Fraction of 10 CFR Part 20 Limit at Site Boundary[a/]	Estimated Dose to Population in 50 mile Radius, man-rem
1.0	Trivial incidents	b/	b/
2.0	Small releases outside containment	b/	b/
3.0	Radwaste system failures		
3.1	Equipment leakage or malfunction	.002	0.13
3.2	Release of liquid waste storage tank contents	0.02	0.5
3.3	Release of liquid waste storage tank contents	Neg.	Neg.
4.0	Fission products to primary system		
4.1	Fuel cladding defects	b/	b/
4.2	Off-design transients that	0.007	0.17
5.0	Fission products to primary and secondary systems (PWR)	N.A.	N.A.
6.0	Refueling accidents		
6.1	Fuel bundle drop	~0	0.01
6.2	Heavy object drop onto fuel in core	~0	0.011
7.0	Spent fuel handling accident		
7.1	Fuel assembly drop in fuel storage pool	~0	0.01
7.2	Heavy object drop onto fuel rack	~0	0.004
7.3	Fuel cask drop	0.05	0.12

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

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

TABLE 8 (cont'd.)

Class	Event	Estimated Fraction of 10 CFR Part 20 Limit at Site Boundary[a]	Estimated Dose to Population in 50 mile Radius, man-rem
8.0	Accident initiation events considered in design basis evaluation in the safety analysis report		
8.1	Loss-of-coolant accidents		
	Small break	0	0.026
	Large break	0	0.15
8.1 (a)	Break in instrument line from primary system that penetrates the containment	0	0
8.2	Rod drop accident	0.01	0.18
8.3	Steamline breaks		
	Small break	0.006	0.14
	Large break	0.12	2.6
9.0	See discussion p. 37		

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

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

Events included in Class 3 through 8 are considered in the applicants' Safety Analysis Report and our Safety Evaluation. These events, especially those in Class 8, are used together with highly conservative assumptions and the design basis events to establish the performance requirements of engineered safety features. But these highly conservative assumptions and calculations are not suitable for environmental risk evaluation. The probabilities and potential consequences of events in these classes have therefore been reevaluated on a realistic basis.

In evaluating these accidents, an important consideration is that each facility will be operated at a fraction of full power. At low power levels, the potential consequences of accidents (e.g., the number of curies of radioactivity that could be released) are much less than at full power. As shown in Table 9, at 20 percent of full power and during typical operation (TO), the maximum fuel temperature is approximately 860°F (vs. 3470°F at full power) and the fuel rod heat transfer performance (average power per unit length) is 2.7 kW/ft (vs. 13.4 kW/ft at full power).

TABLE 9

CORE THERMAL CHARACTERISTICS

AT 20 PERCENT OF FULL POWER LEVEL OPERATION

CORE PARAMETER	BOL	TO	EC 1**
Maximum Power/Unit Length (kW/ft)	2.6	2.7	3.4
Power Density (kW/liter)	6.0	6.2	7.9
Maximum Fuel Rod Volumetric Average Temperature, °F	800	860	1010
Percent of Fission Gases Released from Fuel Pellets into Fuel Pin Gap*	<0.01	0.01	1

*APED-5756, "Analytic Methods for Evaluating the Radiological Aspects of the General Electric Boiling Water Reactor," dated March 1969.

** BOL - Beginning of core life (OMWD/T fuel exposure)
TO - Typical operation (7,350 MWD/T fuel exposure)
EC 1 - End of Cycle 1, Design Basis (11,650 MWD/T fuel exposure)

Under the above conditions, the probability of failures of the fuel cladding either in normal operation or as the result of an accident is greatly reduced. In addition, the fuel would be operating much of the time at lower temperatures than for full power and end of cycle 1, Design Basis (EC 1), conditions. Since the diffusion of fission products through the UO_2 fuel matrix into the gap between the fuel pellets and the fuel element cladding is strongly dependent upon the operating temperature, the fission products contained within the gap (and thus available for release in the event of cladding failure) will be less than 1 percent of that at full power. This combination of conditions (i.e., few, if any, cladding failures and low gap activity) means that the radioactive inventory within the main coolant system and in the radioactive waste systems will be very small. It will be due almost entirely to induced radioactivity of corrosion products. The corrosion resistance of the stainless steel systems involved will assure that this inventory is small. As a result, this staff evaluation of all accidents in Classes 3, 4, and 5 which involve releases of radioactivity from the radioactive waste system and/or the main coolant system indicated that the potential offsite radiological consequences are insignificant.

It is not anticipated that any irradiated fuel will be handled during the period of limited operation. However, if it is, the staff evaluation of the potential consequences of an accident during such handling (Class 6 and 7) indicates that these consequences would also be insignificant. The only radioactivity that could be released in such an accident would be the radioactivity that had previously been released from the UO_2 fuel into the fuel element gap, and this has been found to be small for the reasons discussed in the previous paragraph. When this source term is used in conjunction with realistic evaluations of the effects of decontamination from the water and steam within which the irradiated fuel elements are always submerged, the confinement and filtration systems provided, and meteorological diffusion factors, the calculated potential offsite radiological doses from these classes of accidents are less than one millirem to the whole body and the thyroid. These doses were, therefore, also found to be insignificant.

Class 8 events, which are considered in the applicants' Safety Analysis Report and the staff's Safety Evaluation, are used together with highly conservative assumptions as the design-basis events to establish the performance requirements for engineered safety features. The highly conservative assumptions and calculations legitimately used for safety evaluations are not suitable for environmental risk evaluation because the probability of occurrence is so low for the unfavorable combination of circumstances used. For this reason, Class 8 events are evaluated realistically and would have consequences predicted in this way that are far less severe than those given for the same events described in Section 4.0 of our Safety Evaluation[31]. For example, the staff evaluation of environmental effects of a Class 8 event, assuming a postulated loss-of-coolant accident, results in a calculated 2-hour thyroid dose at the site boundary of less than 1 rem, in contrast to the 150 rem given in Table 4.0 of our Safety Evaluation.

It is therefore concluded that no accident during the limited operations up to 20 percent of rated power would result in an ad·-se radiological impact on the environment.

III. FORECLOSURE OF ALTERNATIVES IN FACILITY DESIGN OR OPERATION

The station has already been constructed on a particular site. Consequently, there are no reasonable or practical alternatives as to plant type or location.

Major changes in the condition of the station which could result from authorizing the operation of Units 1 and 2 up to 20 percent of full power would, for the period involved, be the discharge effluents, the consumption of enriched uranium and the production of small quantities of fission products. However, such effluent discharges, consumption and fission product production would not foreclose the adoption of alternatives in plant design or operation of the type that may result from the ongoing full NEPA review.

While, as earlier indicated (p. 36), radioactive gaseous and liquid effluents resulting from operation are expected to be well within 10 CFR Part 20 and Technical Specification limits, the applicants further plan to install a modified waste system to reduce radioactive effluents to levels meeting the requirements of the "as low as practicable" amendments to 10 CFR Parts 20 and 50. This is to be effected within the period provided in the amended regulations.

As earlier discussed (p. 16), the applicants have also adopted or agreed to adopt (for the operational period beyond June 1, 1972) additional methods of limiting the effects of thermal discharges. Civil works have been initiated and components have been procured to build a pipe with diffuser nozzles for dispersion of heated condenser cooling water near the bottom of the Mississippi River channel. This system is expected to reduce the thermal effects of the discharged water. Present operation will not foreclose these changes; nor will it preclude any additional changes to accommodate requirements that may be imposed by the Commission as a result of its complete NEPA review.

IV. EFFECTS OF DELAY IN FACILITY OPERATION UPON THE PUBLIC INTEREST

A. POWER NEEDS

The applicants have stated, with supporting submissions, that electric service in Chicago, Northern Illinois, and all of Iowa will be seriously jeopardized if the Quad-Cities generating capacity is not available to meet the 1972 summer peak load. In addition, the Commonwealth Edison Company states that its 75 percent share (1,214 MW) of Units 1 and 2 is needed prior to the summer season in order to schedule urgent maintenance of existing units. The importance of such maintenance is indicated by the loss of 1,664 MW in generating capacity that the applicant experienced on a peak load day in 1970 as a result of forced outages and restrictions. During a similar peak load in 1971, there was a loss of 2,239 MW, and the situation, according to the applicants' submission, is likely to be worse in 1972 unless deferred maintenance is performed.

For the summer of 1972, the Commonwealth Edison Company estimates its peak load will be 12,520 MW. This is subject to an increase of up to 440 MW if the summer is hotter than average. Without either of the 809 MW Quad-Cities units or Zion 1 (a 1,050 MWe nuclear unit for which an operating license is also pending), this applicant's system capacity will be 13,189 MW, including firm purchases from other utilities. The reserve capacity would thus be 669 MW, only 5.4 percent more than the estimated peak load. This is far below the applicant's normal target of 14 percent reserve and further below the 20 percent reserve generally recommended by the Federal Power Commission (FPC).

Iowa-Illinois Gas and Electric Company has forecast a 1972 summer peak load on its system of 714 MW, which exceeds its dependable capacity of 568 MW. Instead of a reserve, this applicant will, therefore, have a deficiency of 146 MW without its 404 MW share of Quad-Cities Units 1 and 2. The Iowa Pool, of which the applicant is a member, indicates that its reserve margin without Quad-Cities will be a negative 45 MW. With 4C4 MW from Quad-Cities, the pool's reserve would be 359 MW, which is 11.5 percent of its predicted peak load.

The situation which faces the applicants is the subject of a staff report by the FPC's Bureau of Power which was transmitted to the Atomic Energy Commission on December 10, 1971. In its report, the FPC views the situation as a potential power supply shortage throughout the midwest and concludes with the following: "The factors examined indicate that there is an emergency need for interim operation of the Quad-Cities Units 1 and 2, assuming that the AEC can concurrently deal appropriately with environmental issues involved in such operation." A copy of the FPC report is appended to this document.

The Illinois Commerce Commission emphasized the urgent need for additional generating capacity in a recent letter to the AEC*, which stated: "It is apparent that Illinois must put into operation some of the capacity now under construction before next summer or face the certainty of power outages. The units most able to contribute to the required capacity are Edison's Quad-Cities 1 and 2, because they are ready for testing and operation."

There is no way to assure availability of the Quad-Cities units for the summer peak load demand unless the applicants' power operation test program is undertaken and completed in advance of that time. Additional time should be allotted to remedy any deficiencies discovered during the test program. The applicants have indicated that testing one unit will require 8 weeks at the minimum, or 72 days for both units with some overlap in effort. However, they estimate that 32 additional days will eventually be required for testing each unit to full power if operation to only 20 percent of full power is authorized at this time. Taking all of this into account we conclude that authorizing operation at 20 percent of full power of the Quad-Cities units at this time will save the applicants' about 2 months in the time it would otherwise take to start and complete the power operation test program subsequent to the completion of our ongoing NEPA review.

From this discussion it should be noted that there is a critical need for power from the Quad-Cities units to help meet the area's summer peak load. Complete testing of the units and the 100 hour warranty run at full power must be completed prior to the July-September peak load months. However, even this would not be of help to meet the peak load demand unless operations up to 20 percent of full power were authorized now so that the fuel loading for Unit 2 and the test program for both units could begin.

B. <u>AVAILABLE ALTERNATE SOURCES</u>

To make up their power supply deficiencies, the applicants would attempt to purchase the required capacity and energy from neighboring utilities. However, it is uncertain whether power will be available from adjacent systems, as noted in the FPC report which states, "Within the time available, there are no known alternate additions of generating capacity which could be substituted for the Quad-Cities Units.... Delays in commercial operation of both fossil and nuclear units are likely prospects in adjoining regions; therefore, it would not be realistic to depend upon imported replacement power in this instance."

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* Letter dated October 26, 1971 to James R. Schlesinger, Chairman of the AEC from the Illinois Commerce Commission (copy attached).

C. DELAY COSTS

For each week the Quad-Cities Station is not operating, the applicants estimate the full cost of replacement power at $1,200,000. The FPC report verifies this estimate as reasonable. Operation of both units at 20 percent or less would reduce this cost by an amount approximately in proportion to the percentage of rated output obtained.

D. OTHER EFFECTS OF DELAY

The applicants state that every megawatt not produced at Quad-Cities, which can be replaced, will have to be produced by the oldest, most inefficient coal-fired units on the applicants' systems. Such generation is estimated to result in adding about 70 pounds of sulfur dioxide and 3 pounds of particulates per megawatt-hour to the environment. The Illinois Pollution Control Board, in granting a variance from air particulate regulations for operation of several coal-fired units which are to be retired upon completion of Quad-Cities Unit 1, stated, "The present petition underlines the importance of placing Quad-Cities in use at the earliest possible date." (See PCB 71-165; Opinion of the Board, September 16, 1971.)

V. CONCLUSION

We have completed our radiological health and safety review of the operation of the station up to full power under the authority of the Atomic Energy Act of 1954, as amended, and are prepared to make all the necessary findings pursuant to the provisions of 10 CFR 50.57(a) for operation of the station at 20 percent of full power. The results of the radiological health and safety review are set forth in the AEC regulatory Staff Safety Evaluation(31) dated August 25, 1971.

We have reviewed the matter of 20 percent operation of Units 1 and 2 during the period ending June 1, 1972 in the context of the following factors specified in 10 CFR Part 50, Appendix D, Section D.2:

"(a) Whether it is likely that limited operation during the prospective review period will give rise to a significant, adverse impact on the environment; the nature and extent of such impact, if any; and whether redress of any such adverse environmental impact can reasonably be effected should modification or termination of the limited license result from the ongoing NEPA review.

"(b) Whether limited operation during the prospective review period would foreclose subsequent adoption of alternatives in facility design or operation of the type that could result from the ongoing NEPA environmental review.

"(c) The effect of delay in facility operation upon the public interest. Of primary importance under this criterion are the power needs to be served by the facility; the availability of alternative sources, if any, to meet those needs on a timely basis; and delay costs to the licensee and to consumers."

Based on our evaluation of the data and analyses referred to, we have determined that:

a. Operation of both units at power levels up to 20 percent of rated power each, during the period ending about June 1, 1972, will likely give rise to only a minimal impact on the environment. As discussed above, this potential impact is due to chemicals, particularly chlorine and chlorine derivatives, and heat added to the condenser cooling water. This impact would be localized and is not likely to have a measureable effect on the overall aquatic population of Pool 14. Furthermore, should this proposed operation be terminated, recovery of the aquatic biota in Pool 14 would be good and probably complete.

b. Operation of the station, at the 20 percent power level will not foreclose subsequent adoption of alternatives in the facility design or operation of the type that could be required as a result of the ongoing supplemental NEPA environmental review.

c. There will be an adverse effect upon the public interest as a result of delay in facility operation. The Federal Power Commission, in its December 20, 1971 letter, has stated that it is essential that these units be available for power generation by this summer. Their letter and supporting data confirms the applicants' contentions (with supporting submission) that an emergency situation exists with regard to the public need for power.

In accordance with Section D.2 of Appendix D of 10 CFR Part 50, we therefore conclude that, authorization of interim operation at a power level up to 20 percent during the period ending June 1, 1972, should be granted.

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