Final

environmental statement

related to construction of

DAVIS-BESSE NUCLEAR POWER STATION

TOLEDO EDISON COMPANY AND
CLEVELAND ELECTRIC ILLUMINATING COMPANY

DOCKET NO. 50-346

March 1973

UNITED STATES ATOMIC ENERGY COMMISSION

DIRECTORATE OF LICENSING

SUMMARY AND CONCLUSIONS

This Draft Environmental Statement was prepared by the U. S. Atomic Energy Commission, Directorate of Licensing.

1. This action is administrative.

2. The proposed action is the continuation of Construction Permit No. CPPR-80 of the Toledo Edison Company and the Cleveland Electric Illuminating Company for the construction of the Davis-Besse Nuclear Power Station located near Port Clinton in Ottawa County, Ohio (Docket No. 50-346).

   The Station will use a pressurized water reactor (PWR) to produce about 2633 megawatts thermal (MWt) to generate a net electrical output of 872 megawatts electrical (MWe). The Station may be capable of an ultimate output of 2772 MWt (906 MWe). The turbine steam condenser will be cooled by water circulated through a single hyperbolic natural-draft cooling tower. Makeup water for the cooling tower will be taken from Lake Erie.

3. Summary of environmental impacts and beneficial and adverse effects:

   a. The total site area is 954 acres of which 160 acres have been removed from production of grain crops and converted to industrial use. Approximately 600 acres of the area is marshland which will be maintained as a wildlife refuge.

   b. There will be temporary turbidity, silting, and destruction of bottom organisms due to disturbance of the lake shore and lake bottom during construction of the Station water intake and discharge pipes.

   c. Because of the location of the Station in a migratory bird flyway and close proximity to bird refuges, there is a possibility of occasional occurrences in which birds are killed by flying into the cooling tower structure.

   d. The cooling tower blowdown and service water which the Station discharges to Lake Erie, via a submerged jet, will be heated no more than 20°F above the ambient lake water temperature. Although some small fish and plankton in the discharge water plume will be disabled as a result of thermal shock, exposure to chlorine and buffeting, few adult fish will be affected. The thermal plume resulting from the maximum thermal discharge is calculated to have an area of less than one acre within the 3°F isotherm (above lake ambient).

e. The Station's natural-draft cooling tower will have a visual impact on the surrounding areas. There is a possibility that the cooling tower may augment natural fog (estimated to be 1 hour/year compared with 831 hours/year natural) within several miles of the Station - particularly in the winter months.

f. A total of 101 miles of transmission lines are being constructed, primarily over existing farmland, requiring about 1800 acres of land for the rights-of-way. Land use will essentially be unchanged since only the land required for construction of the towers is removed from production. Herbicides will not be used to maintain the rights-of-way.

g. It is calculated that the Station may discharge approximately 5 curies per year of mixed isotopes in liquid wastes and 1000 curies per year of tritium to Lake Erie. Approximately 3000 curies per year of gaseous radioactive wastes may be discharged to the atmosphere.

h. The risk associated with accidental radiation exposure is very low.

i. The Station will provide 6.1 billion kilowatt hours per year (at an average capacity factor of 80%) of the additional electrical power forecast to be required due to the continuing increases in population and industrial development in the region. An improvement in the local economy will result from Station operation and the additional taxes should benefit the State and local governments.

j. The meteorological, hydrological, biological and radiological monitoring programs initiated for the Station's vicinity will provide data on the impact of the plant and be of interest to the scientific community, particularly in regard to the ecology of Lake Erie.

4. The principal alternatives considered are:

   a. Alternative fuels
   b. Alternative sites
   c. Purchase of power
   d. Alternative cooling systems
   e. Auxiliary cooling for service water and blowdown effluent

5. The following Federal, State and local agencies were requested to to comment on the Draft Environmental Statement:

Advisory Council on Historic Preservation
Department of Agriculture
Department of the Army, Corps of Engineers
Department of Commerce
Department of Health, Education and Welfare
Department of Housing and Urban Development
Department of the Interior
Department of Transportation
Environmental Protection Agency
Federal Power Commission
Governor of the State of Ohio
Ohio Department of Development
Ohio Environmental Protection Agency
Ohio Department of Health
Ohio Department of Industrial Development
Ohio Department of Natural Resources

6. The Draft Environmental Statement was made available to the public, to the Council on Environmental Quality, and to the agencies noted above in November 1972.

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

Advisory Council on Historic Preservation
Department of Agriculture
Department of the Army, Corps of Engineers
Department of Commerce
Department of Health, Education and Welfare
Department of Transportation
Environmental Protection Agency
Federal Power Commission
Ohio Department of Development
Ohio Environmental Protection Agency
Toledo Edison Company

8. This Final Environmental Statement has considered the above-mentioned comments and is being made available to the public, to the Council on Environmental Quality, and to other agencies in March 1973.

9. On the basis of the analysis and evaluation set forth in this Statement, after weighing the environmental, economic, technical and other

benefits of the Davis-Besse Nuclear Power Station against environmental and other costs and considering available alternatives, it is concluded that the action called for under NEPA and Appendix D to 10 CFR Part 50 is the continuation of Construction Permit No. CPPR-80 subject to the following conditions for the protection of the environment:

a. A comprehensive, preoperational environmental monitoring program shall be established to provide an adequate baseline for measuring the operational impact of the Station. This program should be submitted for Regulatory approval within 90 days after issuance of the Final Environmental Statement.

b. The Applicant shall submit, during the time of the operating license review, proposed environmental Technical Specifications governing the operation of the facility which assure that the environmental impacts are not significantly different than those described in this statement.

c. A monitoring program shall be established to record any kills due to birds hitting the cooling tower and other Station structures, placing emphasis on observations during adverse weather conditions and during the spring and fall migratory seasons.

d. The objective of the Station design shall be such that by careful operation the total residual chlorine concentration in the Station effluent will be 0.1 ppm or less, not to exceed 2 hours/day.

e. If harmful effects or evidence of irreversible damage are detected by the monitoring programs, the Applicant will provide to the Staff an analysis of the problem and plan of action to be taken to eliminate or significantly reduce the detrimental effects or damage.

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FOREWORD

This draft statement on environmental considerations associated with the proposed continuation of Construction Permit No. CPPR-80 for the Davis-Besse Nuclear Power Station (Docket No. 50-346) was prepared by the U. S. Atomic Energy Commission, Directorate of Licensing (Staff) in accordance with the Commission's regulation, 10 CFR Part 50, Appendix D, implementing the requirements of the National Environmental Policy Act of 1969 (NEPA).

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

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

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

(i) The environmental impact of the proposed action,

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

(iii) alternatives to the proposed action,

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

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

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

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

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

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

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

Hugh L. Thompson, Jr. is the AEC Environmental Project Manager for this statement. (301-973-7731)

1. INTRODUCTION

1.1 STATUS OF PROJECT

The Toledo Edison Company (TEC) and the Cleveland Electric Illuminating Company (CEIC) are both privately owned public utility companies engaged in supplying electrical energy to the public. These two companies, hereafter referred to as the Applicant, will jointly own the Davis-Besse Nuclear Power Station (the Station) as tenants in common, with TEC having a 52.5% share of ownership and CEIC owning the remaining 47.5%. TEC is responsible for the design, construction and operation of the Station. Both companies are members of the Central Area Power Coordination Group (CAPCO), a group of four electric utilities in Ohio and Pennsylvania that pool their generating and transmission capabilities, to benefit from the economy and increased reliability of large-scale operation. Currently, CAPCO has an installed generating capacity of about 11,000 megawatts electric (MWe). The Davis-Besse Station is the fourth generating facility constructed under the CAPCO group agreement.

The Station is being constructed on a 954-acre tract, located in northwestern Ohio on the shore of Lake Erie in Ottawa County, about 21 miles east of Toledo, Ohio. The site terrain is relatively flat and contains about 600 acres of marshland, the remainder being, or having been, marginal farmland. The site has a 7500-foot frontage on Lake Erie, and is generally only slightly higher than the normal lake water level.

The Station will have a net electrical capacity of 872 MW and will utilize a pressurized water reactor (PWR) supplied by the Babcock & Wilcox Company. Most of the heat from the turbine steam condenser will be dissipated to the atmosphere by means of a natural-draft cooling tower, 493 feet high and 415 feet in diameter. Water for the Station will be drawn from Lake Erie via a submerged intake crib and a pipe buried under the lake bottom. Construction at the Station is now about 45% complete and the current schedule calls for start up by early 1975.

On August 1, 1969, the Applicant filed for all necessary AEC licenses to construct and operate the Station. On September 10, 1970, an AEC exemption was granted allowing the applicant to do below-grade work before issuance of the construction permit. The Advisory Committee on Reactor Safeguards (ACRS) reported favorably on the application on August 20, 1970, and the AEC completed the construction permit review and issued its formal Safety Evaluation Report on November 2, 1970. The construction permit stage public hearing before an Atomic Safety and Licensing Board (ASLB) was held on December 8-10, 1970. This hearing was contested and subsequent sessions were held, with the final one finishing on February 12, 1971. A favorable decision was reached by the ASLB on March 23, 1971, and Construction Permit No. CPPR-80 was issued by the AEC on March 24, 1971.

As required by the Commission's implementation of the National Environmental Policy Act (NEPA) outlined in 10 CFR 50, Appendix D, an Environmental Report (ER) was submitted on Aug. 3, 1970. On November 5, 1971, the Applicant submitted a two-volume Environmental Report Supplement as required under the amendments to 10 CFR 50. The Applicant has sent copies of the ER and Supplement to various state agencies. The Commission has received comments on the ER from a number of Federal Agencies.[1]

1.2 SITE SELECTION

When the Applicant began to seek a site for the Station, an option was acquired on an established privately owned game marsh (Darby Marsh) east of the present site, closer to Port Clinton. At the time, the U. S. Bureau of Sport Fisheries and Wildlife had recently acquired what is mostly the principal part of the marsh area of the present site, for development as a National Wildlife Refuge (Navarre Marsh). In order to provide a larger exclusion area for the Station (largely by acquisition of adjacent land, not owned by the Bureau, and available without relocation of the State highway) and to locate farther from Port Clinton, it was arranged to exchange the properties, but with a provision that the Bureau would have management under a long-term lease of the unused marsh areas at the Station as a wildlife refuge. The net result was the addition of over 500 acres to the area under Bureau management.

Three sites had previously been considered and rejected by the Applicant. These were: (1) Bayshore where the Applicant already has a fossil-fuel station (too close to Toledo for a nuclear station); (2) Darby Marsh (too close to Port Clinton for a nuclear station), which was exchanged for the present site, and (3) Erie Industrial Park (congested area not enough land available).

From the Applicant's point of view, the present site is acceptable for a nuclear station for a number of reasons: (1) the site is far enough from population centers to satisfy 10 CFR 100 siting requirements; (2) there is a readily available, steady supply of water - Lake Erie; (3) the site has acceptable geological and hydrological features for a nuclear station; (4) the location in the Applicant's service territory is favorable with respect to the load centers; and (5) the site is readily accessible by water, road, and rail transportation.

Rather extensive contact has been made by the Applicant with local citizens, primarily by means of newspaper articles and information booklets. The Ottawa County Planning Commission was consulted by the Applicant and informed of their plans to use the present site.

1.3 STATUS OF APPLICATIONS AND APPROVALS

The following is a history of the required federal, state, and local permits that have been applied for by the Applicant and which have either been received or are pending:

1.3.1 Federal

	Permit	Status
a.	U. S. Atomic Energy Commission Construction Permit No. CPPR-80.	Received on March 24, 1971
b.	Army Corps of Engineers permit for dredging a temporary barge channel	Received on Aug 4, 1972
c.	Army Corps of Engineers permit to construct offshore facilities (submerged water intake, intake pipe, discharge pipe, and rockfills) under the Rivers and Harbors Act of 1899.	Application filed on Aug 3, 1972
d.	Federal Aviation Administration approval for station (without cooling tower)	Received May 21, 1970
e.	Federal Aviation Administration approval for cooling tower.	Received August 11, 1971
f.	Permit for discharge of plant effluent.	Filed on August 3, 1972 with Army Corps of Engineers. Forwarded to EPA.

1.3.2 State of Ohio

	Permit	Status
a.	Ohio Department of Industrial Relations approval of plans and specifications and building permit.	Received October 20, 1970
b.	Ohio Department of Health permit for potable water supply to be used during construction period.	Received November 9, 1971
c.	Ohio Department of Health permit for sewage treatment plant for construction period, and also for completed station.	Received June 21, 1971
d.	Ohio Department of Health permit for installation of building sanitary and drain systems.	Received July 27, 1971
e.	State Water Quality Certification.	Received March 21, 1972
f.	Ohio Turnpike Commission permit for turnpike crossing with transmission line.	Received May 26, 1971
g.	Ohio State Highway Department permits for transmission line crossings of state highways.	Received March 3, 1971
h.	State Department of Highways permits for grade crossing of state highways for railroad spur.	Received August 3, 1971

1.3.3 Local

	Permit	Status
a.	Ottawa County building permit.	Received October 14, 1970
b.	Ottawa County Engineer permits for grade crossings of roads and highways for railroad spur.	Received August 30, 1971

c. City of Oregon building permit and certificate of occupancy for transmission lines.	Received January 19, 1973

1.3.4 Public Hearings

Hearing	Date
a. Atomic Safety and Licensing Board (ASLB) Construction permit hearings	Commenced December 8, 1970 - finished February 12, 1971
b. Ohio Water Pollution Control Board hearing.	July 28 & 29, 1971
c. Atomic Safety and Licensing Board (ASLB) hearings as to whether the construction of Davis-Besse should be suspended until the final NEPA review.	May 2-4, 1972
d. Atomic Safety and Licensing Board (ASLB) hearing re-opened to receive additional evidence relating to environmental effects that may occur subsequent to NEPA review and relating to environmental effects of operation of the plant.	July 7 & 8, 1972
e. Atomic Safety and Licensing Board decision that construction should not be suspended pending completion of the NEPA review.	July 13, 1972

REFERENCE

1. Detailed Statement on the Environmental Considerations by the Division of Reactor Licensing U.S. Atomic Energy Commission Related to the Proposed Construction of Davis-Besse Nuclear Power Station by the Toledo Edison Company and the Cleveland Electric Illuminating Company, Nov 20, 1970.

2. THE SITE

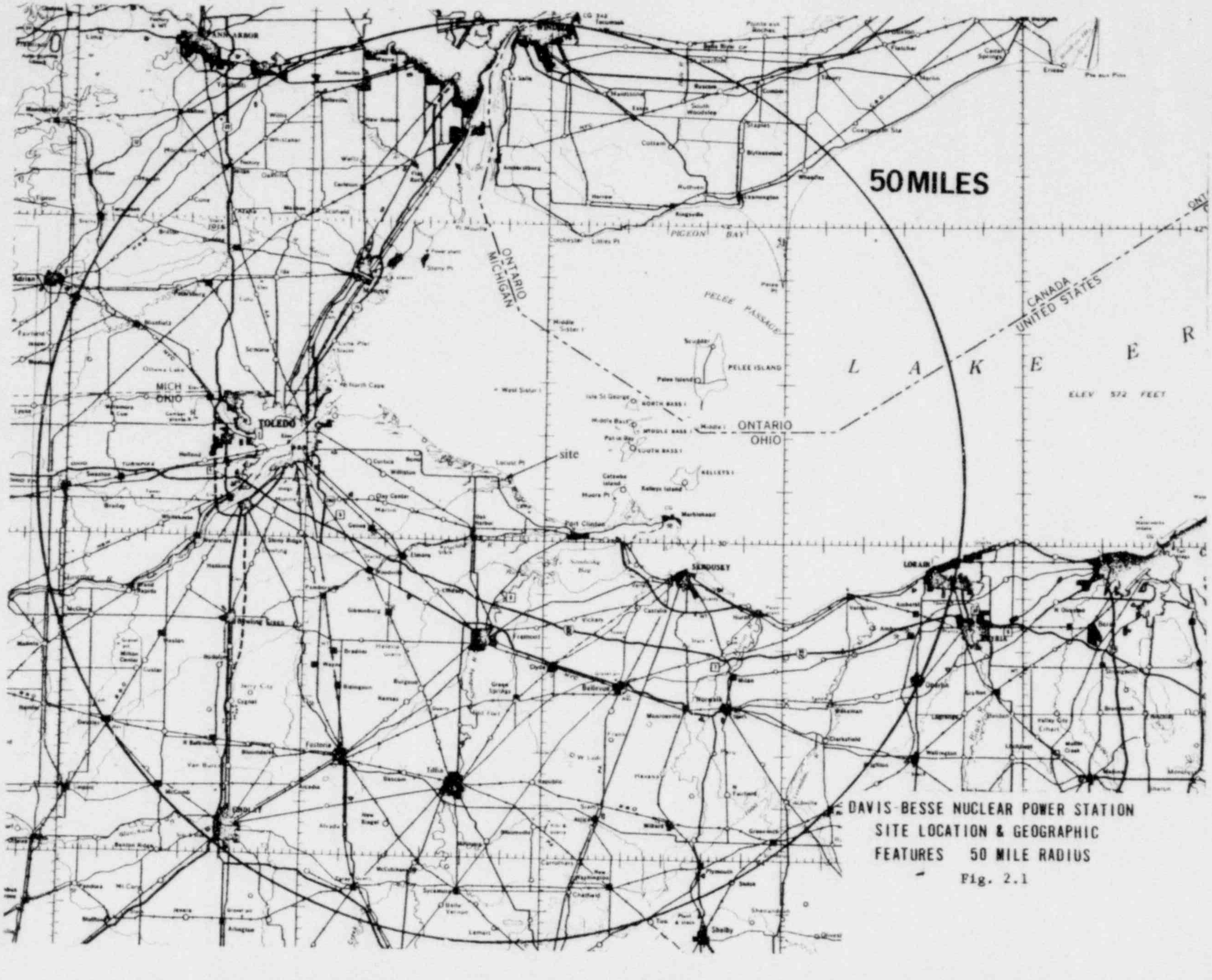
The Davis-Besse site is located in Ottawa County, Ohio, on the southwest shore of Lake Erie, about 21 miles east of Toledo. This section of Ohio, bordering Lake Erie from Toledo to Port Clinton, is flat and marshy with maximum elevations only a few feet above the lake level, and is quite sparsely populated. The area was originally swamp forest and marshland, rich in wildlife but useless for settlement and farming. During the 19th century the land was cleared and drained, and has since been farmed quite successfully. Growing awareness of the commercial value of the marsh wildlife, particularly the muskrat, and of the economic benefits to be derived from wildfowl hunting, led to the beginnings of marsh management early in this century, and resulted in the restoration and preservation of some marsh areas. Today the terrain consists of farmland with marshes extending in some places as far as two miles inland from the sandy lakeshore ridge. More than half the site area is marshland.

Although the farmland portion of the site is marginal, the marshes are part of a valuable ecological resource, providing breeding grounds for a variety of wildlife and a refuge for migratory wildfowl. Extensive nearby areas are now devoted to state and national wildlife refuges, public recreation areas and private hunting preserves. There are some residences along the lakeshore used mainly as summer homes, but the major resort area of the County is farther east, around Port Clinton, Sandusky, and the group of islands known as Put-in-Bay.

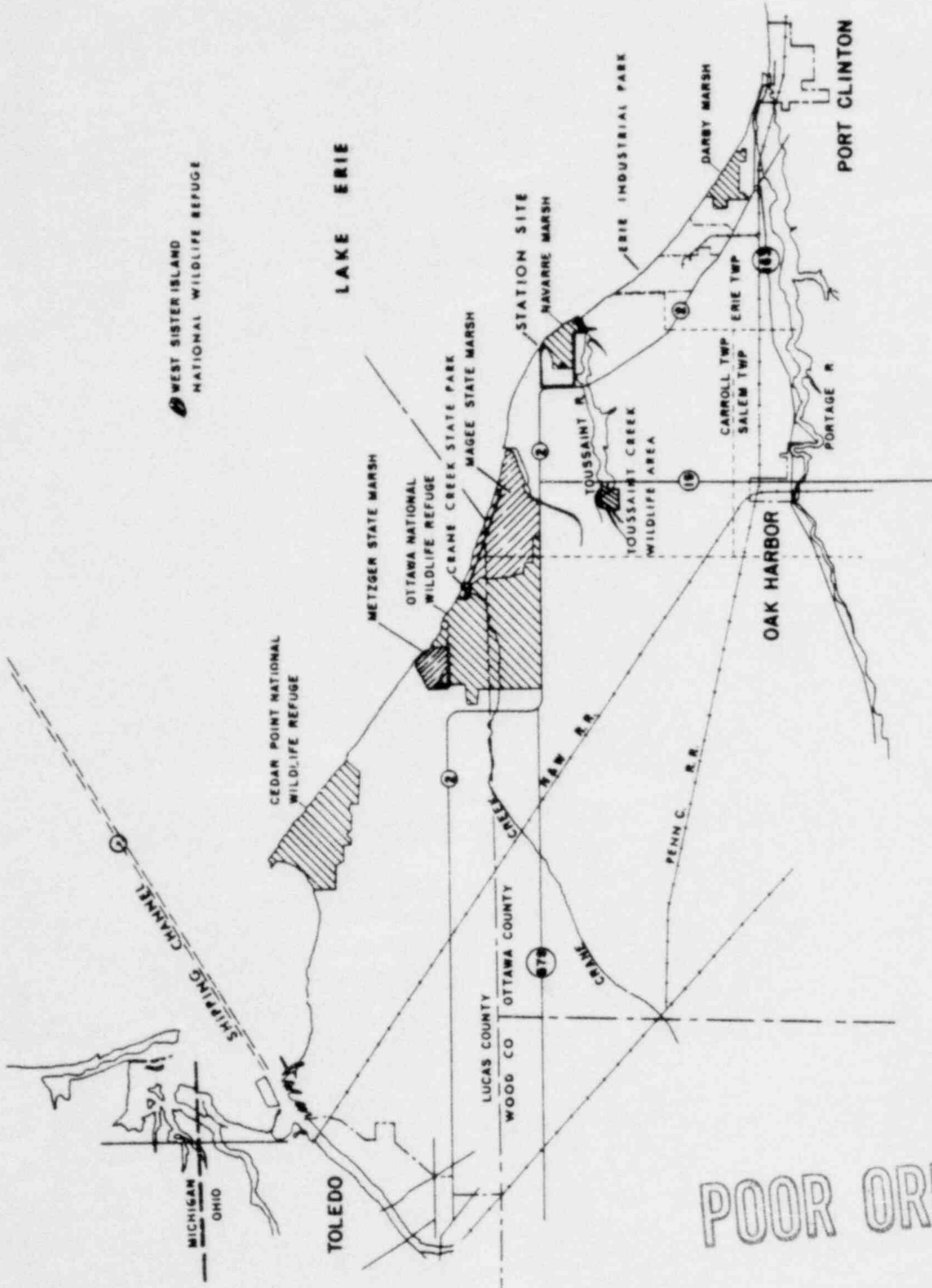
2.1 SITE LOCATION

Figure 2.1 is a map showing the location of the site with respect to nearby population centers, transportation facilities, and natural features. Fig. 2.2 is a local map showing the location of the site, nearby roads, railroads, conservation and recreation areas. Fig. 2.3 is an aerial photograph, taken early in construction, showing the site boundaries and marsh areas. Fig. 2.4 is a site plan showing the land acquisitions and future disposition of the various areas.

The 954-acre site is located in Carroll Township, Ottawa County, just north of the mouth of the Toussaint River and has a Lake Erie frontage of 7,250 feet. The coordinates of the cooling tower, as supplied by the Federal Aviation Administration, are 41° 35' 57" N and 83° 05' 28" W. The nearest population centers are Toledo, 21 miles WNW, and



DAVIS-BESSE NUCLEAR POWER STATION
SITE LOCATION & GEOGRAPHIC
FEATURES 50 MILE RADIUS
Fig. 2.1

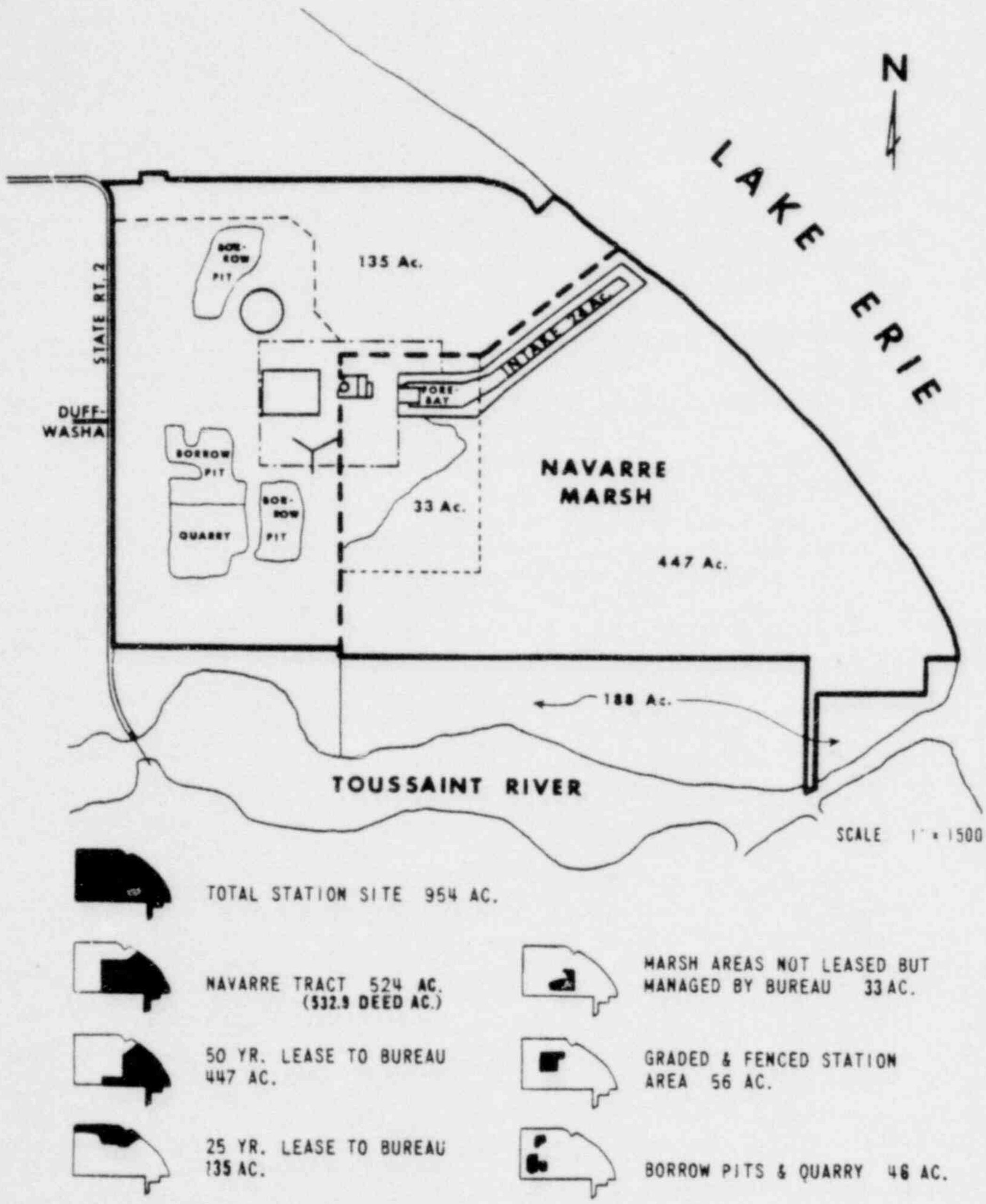


DAVIS-BESSE NUCLEAR POWER STATION
SITE LOCATION PLAN
Fig. 2.2

▮▮▮▮▮▮ SITE BOUNDARY

DAVIS-BESSE NUCLEAR POWER :TATION

AERIAL PHOTOGRAPH
AUGUST 3, 1971
Fig. 2.3



DAVIS-BESSE NUCLEAR POWER STATION
SITE AREAS
Fig. 2.4

Sandusky, 21 miles SE, of the site. The nearest incorporated communities are Port Clinton, 7 miles SE, Oak Harbor, 6 miles SW, and Rocky Ridge, 7 miles WSW of the site. There are groups of cottages known as Sand Beach and Long Beach, used mainly during the summer months, along the lakeshore from the northern boundary of the site to Locust Point, about 2 miles to the northwest. Beyond Locust Point is the nearest public recreational area, Crane Creek State Park. The western boundary of the site is Ohio Route 2, a two-lane paved highway at this point, and there is another group of cottages close to the southwest corner of the site, where this highway crosses the Toussaint River.

The site includes a tract known as Navarre Marsh (524 acres), mainly marshland, but including some upland where the main station structures are being built. This tract was acquired from the U.S. Bureau of Sport Fisheries and Wildlife, Department of Interior, in exchange for a similar marshland tract of about the same size known as Darby Marsh, on which the Applicant had an option. Darby Marsh is about 5 miles southeast, close to the western limits of the City of Port Clinton. A Memorandum of Understanding was signed on October 4, 1967, and a binding agreement was accepted by the U. S. Government on January 30, 1968. Under the terms of this agreement the Applicant undertook to lease back to the Bureau the unused portions (447 acres) of the original Navarre Tract. A 50-year lease was signed on November 1, 1968.

The remainder of the site was acquired from private owners in 13 parcels between December 1967 and July 1970. These acquisitions included 7 residences, and displaced a total of 25 people. A 135-acre marsh area, previously in private ownership, will be leased to the Bureau for 25 years. This lease agreement has been signed. In addition, the Bureau has been given management of a further 33 acres of marshhland without formal lease. These agreements will give the Bureau management of the entire marsh area of the site, with the exception of 24 acres used for the construction of the intake canal.

Under the terms of the agreements with the Bureau, the Applicant has constructed an earthen dike along the northern boundary of the property to separate the site from the adjoining privately owned marsh, and to provide seasonal water level control for better management of the marsh as a wildlife refuge. Similar measures are employed in the other Federal and State refuges in the area.

The 954 acres of the site property include a drainage canal right-of-way to the Toussaint River near its point of discharge into Lake Erie. This canal carries storm water from the site, and, as a temporary measure, groundwater pumped from the excavations during construction. In March 1971 the Applicant purchased the remaining property between the southern site boundary and the river, a total of 188 acres, to prevent further development close to the site boundary and as further protection for the wildlife habitat. This tract is not part of the site proper, and is leased to a private concern for wildfowl hunting.

Of the property retained by the Applicant, a total of 339 acres, the graded and fenced Station area, exclusive of the cooling tower, will occupy 56 acres. At present a further 46 acres are occupied by borrow pits and a quarry from which fill and crushed rock have been obtained during construction. Pumping of water from the excavations has been discontinued, and these pits filled with water to form ponds.

The Station buildings will be about 3000 feet from the lakeshore, and at least 2400 feet from any point on the site boundary. The various areas described above are shown in Fig. 2.4.

2.2 DEMOGRAPHY AND LAND USE

2.2.1 Residential

The area is sparsely populated; Ottawa County (county seat - Port Clinton) had a population of 35,323 in 1960, and this had increased to 37,099 by 1970 - an average population density of 146 persons per square mile. The population increased mainly in the western townships closest to the Toledo metropolitan area and in the resort areas around and to the east of Port Clinton, including the island communities of Put-in-Bay Township. The population of the rural townships in the middle of the county remained nearly stable or declined slightly in this ten-year period. Carroll Township, in which the site is situated, has the lowest population density of all the townships in the county (about 37 persons per square mile in]970) and its population is declining, as shown in Table 2.1.

Toledo and Sandusky, both about 21 miles from the site, had populations of 383,818 and 32,674, respectively, in 1970. Fremont, 17 miles south of the site, had a 1970 population of 18,490.

There are no incorporated communities in Carroll Township, or within 5 miles of the site, and there are only three communities within 10 miles: Port Clinton, Oak Harbor, and Rocky Ridge. Past population trends and projections] for the 8 incorporated communities in Ottawa County are given in Table 2.2.

TABLE 2.1. Population and Projections for Ottawa County by Townships[1]

Township	Population (Census)				Population (Projected)	
	1940	1950	1960	1970	1980	1990
Allen	2,196	2,563	2,755	2,829	3,000	3,500
Bay	552	1,432	1,716	1,798	1,950	2,250
Benton	1,977	2,116	2,366	2,340	2,400	2,750
Carroll	1,336	1,519	1,570	1,355	1,350	1,350
Catawba Is.	462	780	1,769	2,882	4,000	4,900
Clay	2,638	3,278	4,331	4,918	5,700	6,700
Danbury	2,483	3,222	3,526	3,760	4,100	4,800
Erie	835	1,145	1,566	1,470	1,500	1,000
Harris	2,067	2,273	2,675	2,784	3,000	3,400
Portage	6,113	7,013	8,111	7,948	8,200	9,300
Put-in-Bay	609	598	462	507	600	650
Salem	3,092	3,530	4,476	4,508	4,700	5,400
County Total	24,630	29,469	35,233	37,099	40,500	46,600

TABLE 2.2. Populations and Projections for Incorporated Communities in Ottawa County[1]

Community	Distance (miles) and Direction	Population (Census)				Population (Projected)	
		1940	1950	1960	1970	1980	1990
Clay Center	14 W	*	590	446	370	390	410
Elmore	13 SW	1,103	1,215	1,302	1,316	1,520	1,780
Genoa	15 WSW	1,455	1,723	1,957	2,139	2,800	3,290
Marblehead	14 ESE	915	867	858	726	1,100	1,290
Oak Harbor	6 SW	1,925	2,370	2,903	2,807	3,0[illegible]	3,490
Port Clinton	7 SE	4,505	5,541	6,870	7,202	7,450	8,430
Put-in-Bay	14 WNW	202	191	357	135**	160**	180**
Rocky Ridge	7 WSW	275	358	441	385	650	950

*Incorporated 1947.

**Note; The Planning Commission questions the 1970 census figure for Put-in-Bay Village, showing a large decrease between 1960 and 1970, and suggests that the 1970 figure should be 351. The Projections should be adjusted accordingly if this is so.

In addition to the permanent residents in the vicinity of the site, there is a small seasonal population in the cottages along the lakeshore and on the Toussaint River. The lakeshore cottages occupy the ridge between the lake and the marshes, and there is little space for further development. Figures 2.5 and 2.6 show the estimated populations within one-mile annuli from 0 to 5 miles from the site in winter and summer, respectively.[2] Figure 2.7 similarly shows the population distribution within 50 miles of the site according to the 1970 census. The 0-5 mile estimates were made by the Applicant in 1969 by counting residences and using an average number of persons per residence. Year-round occupancy was deduced by inspection of electricity meter records for the summer and winter months. These estimates are probably still valid, since there has been no new construction and the local population is declining.

2.2.2. Industrial Population and Land Use - Zoning

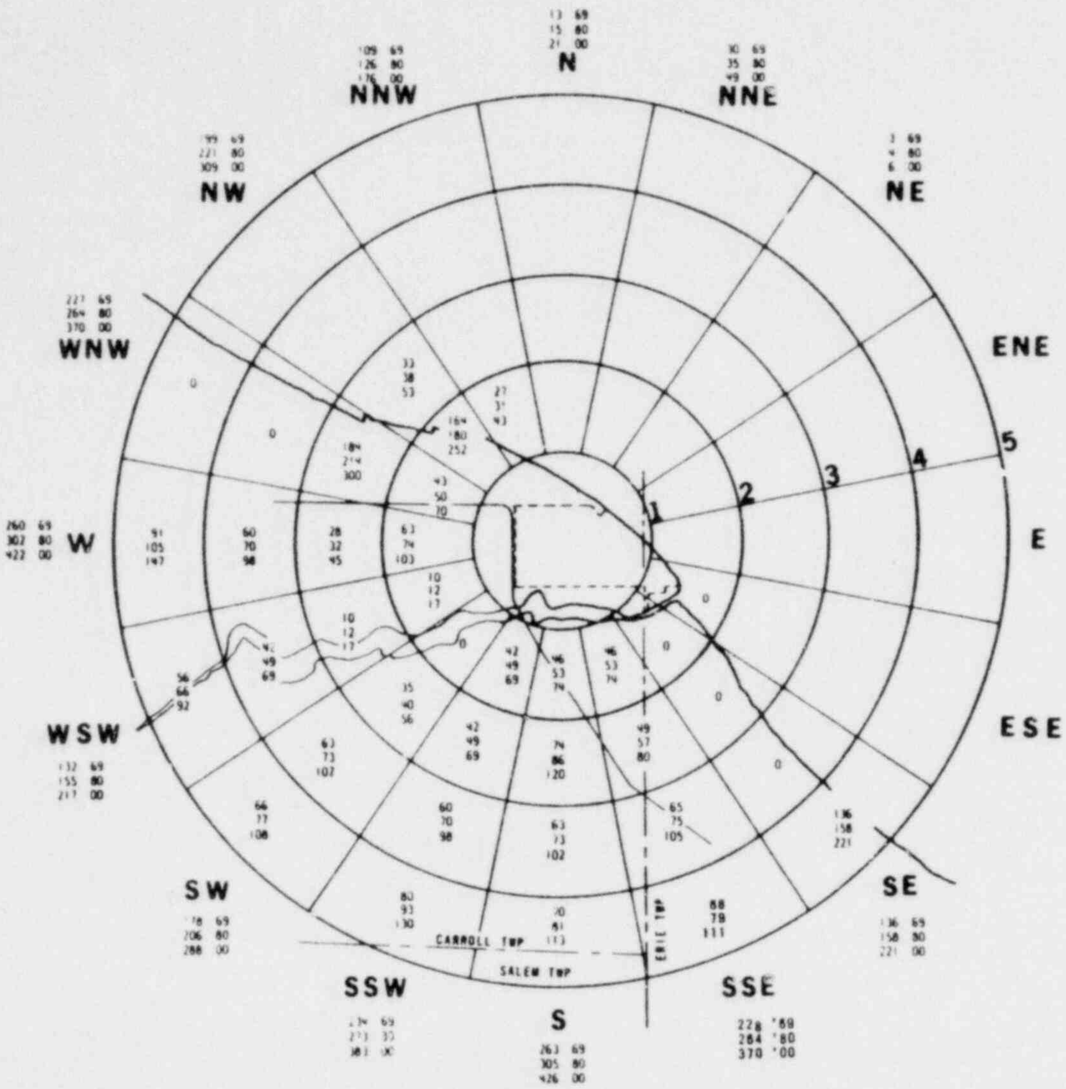
The only industries within 5 miles of the site are located in Erie Industrial Park, about 4 miles southeast. This property was known as the Erie Ordnance Depot until 1966 when the Army base was deactivated and sold to the Ottawa County Community Development Corporation, which in turn sold it to Uniroyal, Inc., on a lease-purchase agreement. Besides Uniroyal, several other industries lease property in the Park. These companies, their product or service, and number of employees, are listed in Table 2.3. The total employment in the Industrial Park is about 850.

Zoning is a township and community responsibility. At present, six of the twelve townships and six of the eight incorporated communities in Ottawa County have zoning ordinances, as shown in Fig. 2.8. In general, the townships and communities with zoning ordinances are those with increasing populations--the western townships closest to Toledo and the resort areas around Port Clinton. The only zoning ordinance in the three townships closest to the site (Carroll, Erie, Salem) is that in the village of Oak Harbor.

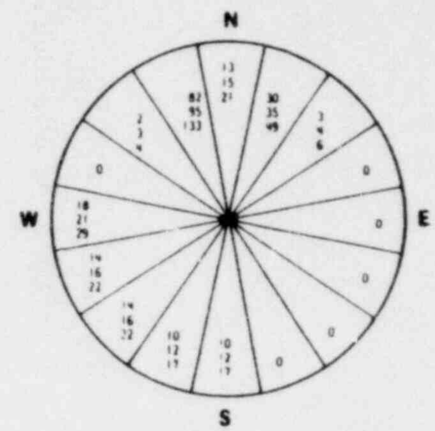
The County's Zoning Study (1972)[3] points out the desirability of zoning in Carroll and Erie Townships to control industrial development which may be attracted to the area by the presence of the Davis-Besse Station and its railroad link to the Norfolk and Western main line.

2.2.3 Agricultural Land Use

The soil at the site is classified as the Toledo soil association group, a silty-clay glacial lake sediment. This soil, which predominates in



1-5 MILES

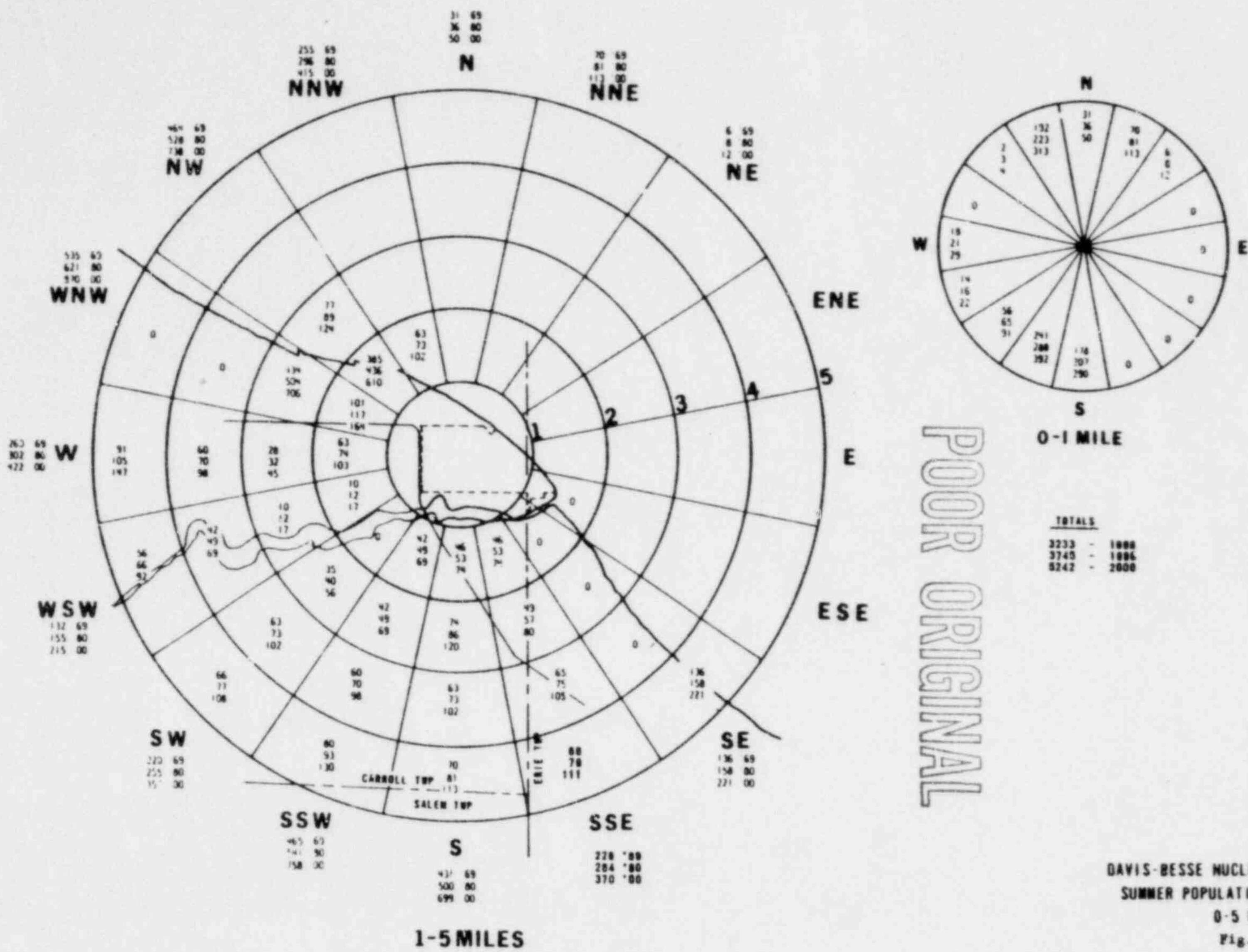


0-1 MILE

TOTALS

2012 - 1969
2328 - 1980
3258 - 2000

DAVIS-BESSE NUCLEAR POWER STATION
WINTER POPULATION DISTRIBUTION
0-5 MILES
Fig. 2.5

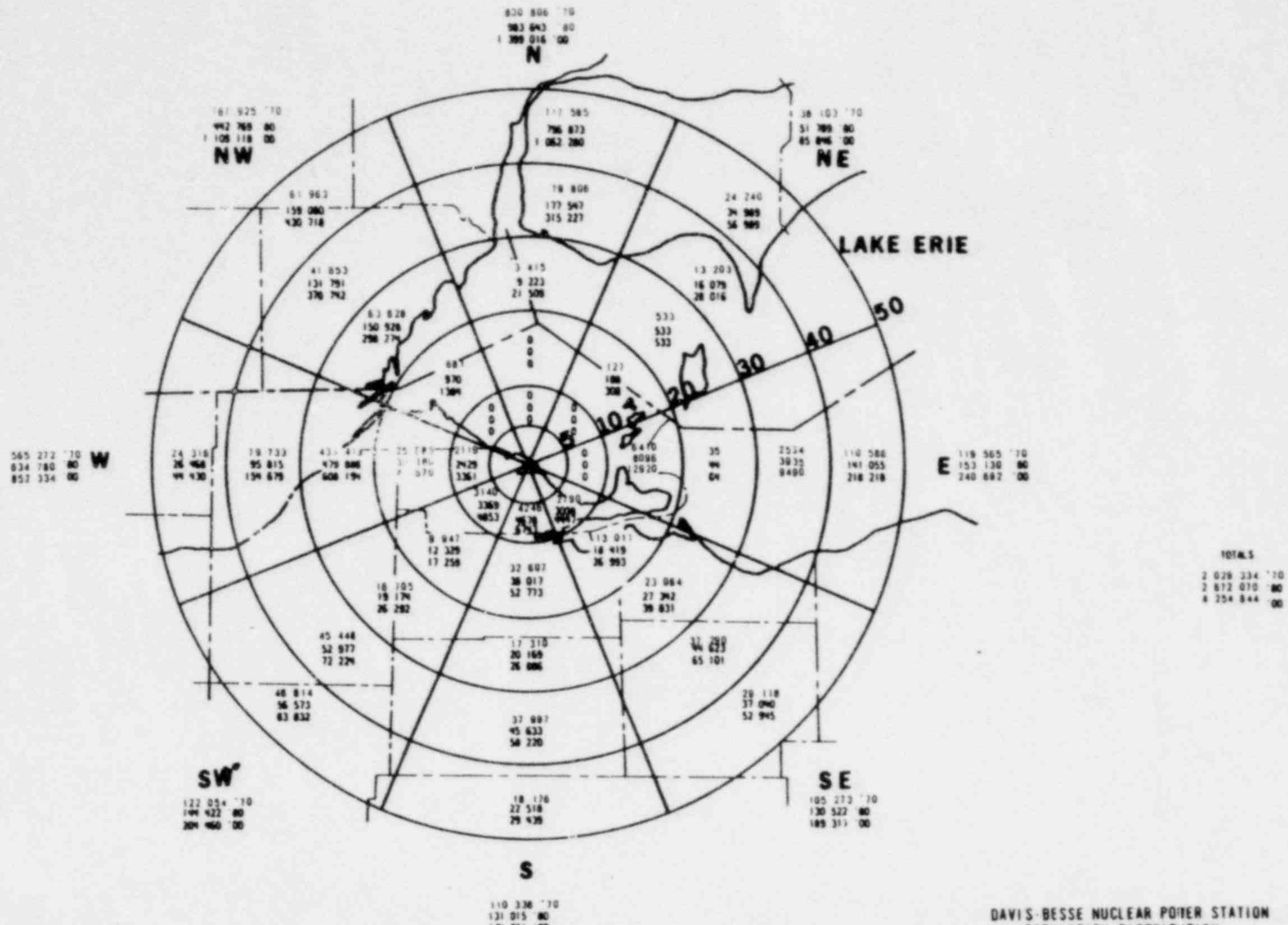


POOR ORIGINAL

TOTALS

3233	-	1969
3740	-	1980
5242	-	2000

DAVIS-BESSE NUCLEAR POWER STATION
SUMMER POPULATION DISTRIBUTION
0-5 MILES
Fig. 2.6



5-50 MILES

DAVIS-BESSE NUCLEAR POWER STATION
POPULATION DISTRIBUTION
5-50 MILES
Fig. 2.7

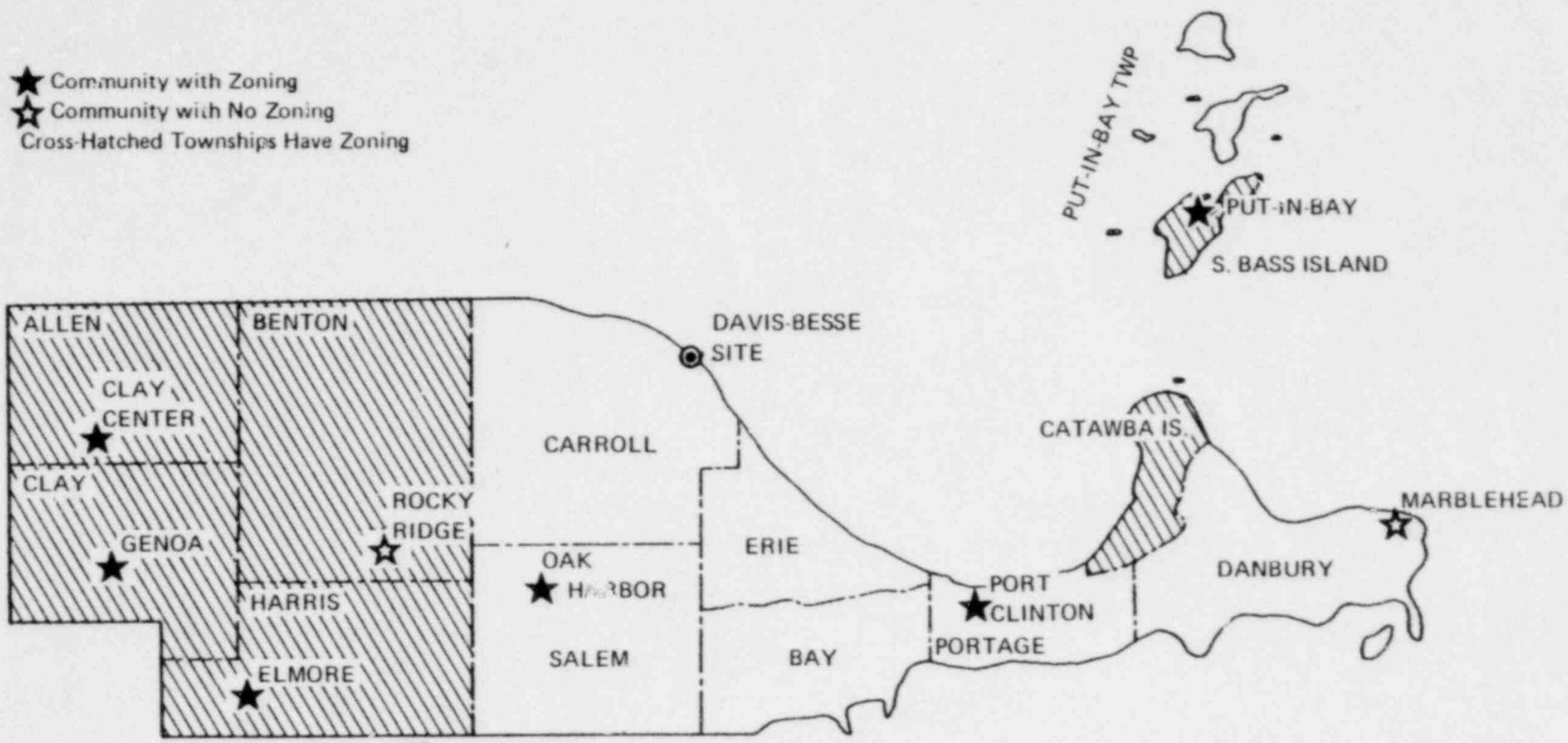


Fig. 2.8

OTTAWA COUNTY
TOWNSHIPS AND
INCORPORATED COMMUNITIES

TABLE 2.3. Companies in Erie Industrial Park

Company	Employment	Product or Service
Uniroyal Inc.	300	Coated Fabrics
USCO Services	250	Warehousing
Wilson Cabinets	80	Kitchen Cabinets
Ame Packaging	60	Plastic Bottles
DV Displays	50	Display Material
Snark Products	50	Styrofoam Boats
Milan Steel	30	Steel Buildings
Day Transportation	12	Local Cartage
Cadillac Gage	8	Military Testing
Bolus Trucking	4	Trucking

Ottawa County, has poor drainage characteristics due to its impervious, clayey consistency, and artificial drainage is often difficult because of the low elevation above lake level.[4] With adequate drainage, however, this soil can be highly productive. Diversified crops raised within 5 miles of the site include corn, wheat, soybeans, oats, hay, pumpkins, sugar beets, tomatoes, peaches, apples, and grapes.

Detailed agricultural statistics are only available on a county basis. The site is located centrally on the northern boundary of Ottawa County, and practically all the land within 10 miles of the site lies in this county. Table 2.4 gives the most recent statistics[5] for the major crops grown in Ottawa County in terms of acreage and yield, and also as percentages of the corresponding figures for the State of Ohio as a whole. Table 2.5 shows numbers of livestock in proportion to State totals, and Table 2.6 shows cash receipts from other farm products[6] on a similar basis. For comparison, Ottawa County represents 0.63% of the area of the State, and has 0.35% of the total State population. The major agricultural activities in the County are the raising of soybeans, wheat, oats, hay, fruit and vegetable crops. Livestock raising and dairy farming are not major activities.

The nearest dairy cattle and fruit orchards to the site are shown in Tables 2.7 and 2.8, respectively.

2.2.4 Recreation and Conservation Areas

Much of the lakeshore and marshland between Toledo and Port Clinton is devoted to recreation and conservation, under State or Federal management. These areas are shown in Fig. 2.2.

State Parks and Wildlife Areas

The State of Ohio, Department of Natural Resources, operates the following areas within 10 miles of the site.

The Magee Marsh and Turtle Creek areas lie between 3 and 6 miles northwest of the site and cover more than 2,000 acres. Magee Marsh is a wildlife preserve with a headquarters and visitor center north of Route 2, about 6 miles west of the site. The public is admitted for fishing, nature study, and controlled hunting in season. Turtle Creek, a wooded area at the southern end of Magee Marsh offers boating and fishing. The annual attendance at these areas is estimated at 48,000, with a peak daily attendance of about 1,500.

TABLE 2.4. Major Crops in Ottawa County, 1971[5]

Crop	Acreage: Ottawa County	Acreage: Ohio State	Acreage: % of State	Production: Ottawa County	Production: Ohio State	Production: Unit	Production: % of State	Yield per Acre: Ottawa County	Yield per Acre: Ohio State
Corn	15,000	3,526,000	0.43	1,050,000	313,814,000	Bu	0.33	70.0	89.0
Soybeans	41,800	2,494,000	1.68	1,223,000	76,067,000	Bu	1.62	29.5	30.5
Wheat	12,600	981,000	1.28	504,000	42,674,000	Bu	1.18	40.0	43.5
Oats	4,900	520,000	0.94	377,000	34,840,000	Bu	1.08	77.0	67.0
Hay	13,700	1,570,000	0.87	37,700	3,180,000	Tons	1.19	2.75	2.03

TABLE 2.5. Livestock in Ottawa County, January 1, 1972[5]
(head)

	Ottawa County	Ohio State	% of State
All cattle and calves	6,500	2,244,000	0.29
Milk cows and heifers that have calved	1,500	444,000	0.34
Hogs	5,900	2,611,000	0.23

TABLE 2.6. Cash Value (dollars) of Farm Products, Ottawa County, 1970[6]

	Ottawa County	Ohio State	% of State
Greenhouse & Nursery	64,000	50,481,000	1.27
Vegetables & Fruits*	2,751,000	84,420,000	1.27
Other Crops**	1,114,000	34,173,000	3.26
Dairy Products	920,000	255,507,000	0.36
Poultry***	742,000	89,193,000	0.83
Sheep & Wool	22,000	11,691,000	0.19
Other Livestock	15,000	8,055,000	0.19

*Includes fresh market, processing and greenhouse vegetables, potatoes, nuts and berries.

**Includes barley, rye, tobacco, sugar beets, maple products, seed crops, popcorn, forest products and miscellaneous crops.

***Includes broilers, farm chickens, chicken eggs and turkeys.

TABLE 2.7. Dairy Cattle within 5 Miles of Site

Distance (miles)	Direction	Head
2.5	WSW	65
3.5	SSW	52
4	S	35

TABLE 2.8. Fruit Orchards within 5 Miles of Site

Distance (miles)	Direction	Acres
1.5	WNW	6
1.5	S	19
2	S	3
2.5	WSW	80
3	WSW	10
3	S	7
3	SSE	20
3.5	S	20
4	SSW	22
5	S	10
5.5	SSE	60

Crane Creek State Park occupies the 2-1/2 mile stretch of lakeshore adjacent to Magee Marsh, a total area of 72 acres. It is a popular picnicking, swimming, and fishing area, and was used by about 230,000 visitors between July 1971 and June 1972. An average summer daily attendance is estimated at 2,500, with a possible peak of 5,000 on a very hot day.[7]

Toussaint Creek Wildlife Area (236 acres), about 4 miles WSW of the site, offers boating, fishing and hunting. The annual use is estimated at 5,220 user-days,[7] which probably indicates a peak daily attendance of between 100 and 200 people.

Federal Wildlife Refuges

The Wildlife Refuges operated by the U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, are managed solely for the conservation of wildlife with special emphasis on migratory wildfowl, and are not open to the public.

The Ottawa National Wildlife Refuge covers about 4,500 acres from 4 to 9 miles WNW of the site, immediately west of Magee Marsh. Darby Marsh, and the unused portions of Navarre Marsh at the site, will be managed as units of this National Refuge.

West Sister Island in Lake Erie, about 10 miles north of the Site, is also a National Wildlife Refuge.

Private Hunting Marshes

The marsh areas immediately north and west of the site, and also to the southeast between the site and the Erie Industrial Park, are privately owned and are used by private and institutional hunting clubs. During the 1971 season these marshes within 5 miles of the site were used by about 300 hunters who killed about 1200 wildfowl.

Campgrounds

The only campground within 10 miles is located about 2 miles southeast of the site, south of the Toussaint River. This campground, with 90 campsites, is operated by Kampgrounds of America Inc. (KOA), and is open from May 15 through October 15. It is reached from Route 2 via county route 223.

There are no summer camps for children in the area.

2.2.5 Hospitals, Schools, Military Installations

Hospitals

There are no hospitals within 5 miles of the site. The nearest hospitals are Magruder in Port Clinton with 134 beds and Memorial in Fremont with 240 beds.

Public Schools

The site is in the Benton-Carroll-Salem School District, and this is the only District to benefit from the increased tax base resulting from the construction of the Station. The only school within 5 miles of the site is Carroll Township Elementary, with a 1971 enrollment of 240, about 3-1/2 miles southwest. A 10-mile radius includes Erie Township and the Port Clinton area of Portage Township, which are in the City of Port Clinton School District. Enrollments for schools within a 10-mile radius are given in Table 2.9 for the 1960-61 and 1970-71 school years. On a county-wide basis, the Planning Commission Study[4] indicates that the population in the 5-9 year age group reached a minimum about 1970. This minimum will progress through the school grades, reaching the high school grades about 1980, and the total school enrollment is not expected to reach its 1970 value again before 1985. A new high school (capacity 1200) is planned for the Benton-Carroll-Salem District at Oak Harbor to reduce the present class size. By using the existing building for a middle school (grades 6, 7, 8), the District should have ample capacity to accommodate the projected increase in elementary school enrollment during the next 20 years.

Parochial and Private Schools

Saint Bonaife in Oak Harbor had a 1971 enrollment of 116 and the Immaculate Conception Elementary School in Port Clinton had a 1971 enrollment of 347. There are no parochial high schools in the area. Riverview school is a private school for retarded children with an enrollment of about 40. The school is situated on Ohio Rt. 163 east of Oak Harbor.

Higher Educational Institutions

There are no colleges or technical institutes within 10 miles of the site. Bowling Green University operates a branch at Fremont within a 1971-72 enrollment of 62 (full-time equivalent). The Ohio State University operates a summer school at Put-in-Bay, which had a 1971 enrollment of 55. Outside the 20-mile radius, the nearest large campus is The University of Toledo with about 13,000 students, and there are several small colleges and technical institutes in the Toledo metropolitan area with enrollments of less than 1,000. Bowling Green University has a branch at Sandusky with a 1971 enrollment of 433.

TABLE 2.9. School Enrollments within 10 miles of Site 1961 and 1971[4]

District	Township	School	Enrollment 1961	Enrollment 1971
	Benton	Graytown El.	287	279
Benton-	Benton	Rocky Ridge El.	149	215
Carroll-	Carroll	Carroll El.	315	240
Salem	Salem	R.C. Waters El.	754	725
	Salem	Oak Harbor High	647	809
	Salem	Saint Bonaife (Parochial)		116
	Salem	Riverview (Private)		40
	Erie	Erie El.	167	135
City of	Portage	Bataan El.	717	560
Port Clinton	Portage	Jefferson El.	600	550
	Portage	Portage El.	351	335
	Portage	Port Clinton Jr. High	-	600
	Portage	Port Clinton High	770	1,050
	Portage	Immaculate Conception (Parochial)		347

Military Installations and Activities

Camp Perry, an Ohio National Guard training center is located 4-1/2 miles southeast of the site, adjacent to the Erie Industrial Park. At present, about 200,000 man-days of week-end training are conducted at Camp Perry per year, and this training involves small arms firing into a restricted area of Lake Erie. Camp Perry is also the site of the National Rifle Competition, held in August each year, with an attendance of about 1,000 persons.

After the deactivation of the Erie Ordnance Depot, ordnance test firing was continued by the Jet and Ordnance Division of TRW Inc. This Company has now left the Industrial Park, and the small amount of testing which still continues is carried out by the Cadillac Gage Company. These tests involve automatic weapons and mortars, the maximum caliber shell being 120 mm. An estimate by an official of the Company was that about 50,000 rounds of machine gun and 100 rounds of mortar shells are fired annually, in testing sessions on Tuesdays and Thursdays. The restricted areas used by Camp Perry and the Cadillac Gage Co. are designated as Areas I and II on the U.S. Department of Commerce navigational maps of Lake Erie, and as restricted area R-5502 by the Federal Aviation Administration.

2.2.6 Transportation

Highways

Ohio State Route 2, which forms the western boundary of the site, follows the lakeshore from Toledo to Cleveland. At the site, it is a 2-lane paved highway, but farther east it has been widened to form a 4-lane restricted-access bypass around Port Clinton and Sandusky. The Ottawa County Planning Commission's Development Plan[4] calls for the extension of this 4-lane section westward towards Toledo, as a restricted-access highway passing about 3 miles south of the site. The Ohio Turnpike passes about 13 miles south of the site, with an interchange at Fremont for Port Clinton.

Railroads

The Penn-Central and Norfolk & Western Railroads both pass through Oak Harbor, about 6 miles southwest of the site. To facilitate delivery of materials to the site, the applicant has constructed a 7-1/2 mile railroad extension to the Norfolk and Western main line, joining the railroad about 5 miles northwest of the Oak Harbor. The route of this extension was chosen to follow a transmission right-of-way.

Airports

The nearest major airport is Toledo Express, with an 8700 foot runway, southwest of Toledo and about 36 miles west of the site. Smaller airports within 20 miles of the site are shown in Table 2.10. The Federal Airway designated V-232 takes a southeasterly course from Toledo and passes about 7 miles southwest of the Site. The airspace over Lake Erie in the vicinity of the Site is restricted (area R-5502) because of firing activities from Camp Perry and the Erie Industrial Park. (See Section 2.2.5).

2.3 HISTORIC AND NATURAL LANDMARKS

The nearest National Monument is the Perry's Victory and International Peace Memorial Monument on South Bass Island, Put-in-Bay, 14 miles east of the site. Also included in the National Register of Historic Places is the Jay Cooke Home on Gibraltar Island, Put-in-Bay.

The nearest natural landmark is Glacial Grooves State Memorial, about 20 miles east of the site, on Kelley's Island, in Erie County, off Marblehead.

According to the Ohio Historical Society, consulted by the applicant, there are no known deposits of archaeological or geological interest on the site.

2.4 GEOLOGY

A generalized geologic section taken from excavation at the site is shown in Fig. 2.9.[8] The sequence consists broadly of glacial deposits over Silurian dolomitic bedrock, but the stratigraphy is somewhat more complex.

Organic deposits 2 to 3 feet deep in the marshes, and wave-deposited sands along the lakefront cover two primary glacial strata. The glacial sediments - an upper glaciolacustrine and a lower till - were deposited about 10,000 years ago during fluctuations in the water levels of Lake Erie, between the Carey Port Huron interval and the Valders substage. These sediments are composed of silty clays which have a low permeability.

The Silurian bedrock strata (Tymochtee and Greenfield Formations) extend 3000 to 5000 feet under the glacial deposits. These horizontally bedded sedimentary rocks slope east to west. Lithologically, they are classed as pervious argillaceous dolomites with shale partings and variable

TABLE 2.10. Airports within 20 miles of Site

Name	Nearest Community	Distance (miles)	Direction	Longest Runway (feet)
Toledo	Toledo	20	W	4200
Chippewa	Williston (pvt)	12	W	2600
Haar	Elmore	13	SW	2600
Progress	Fremont	19	S	3500
Zimmerman	Fremont	16	S	2700
Slager	Fremont	19	S	2600
Jenkins	Fremont (pvt)	19	S	2800
Gibbs	Fremont (pvt)	13	SSE	2800
Keller	Port Clinton	13	SE	5000
Put-in-Bay	Put-in-Bay	13	E	2900

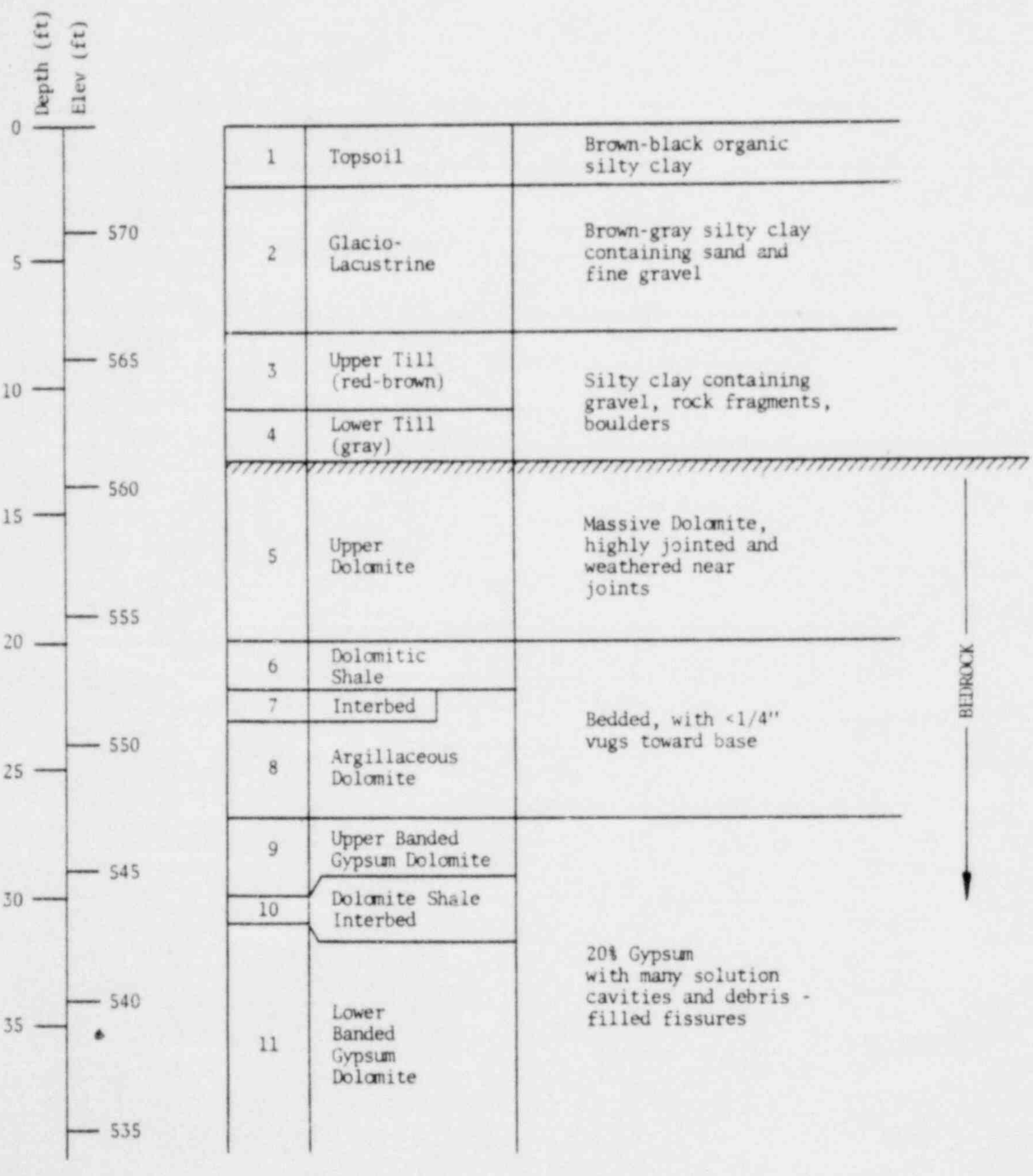


Fig. 2.9. Generalized Geologic Section at the Site.

amounts of gypsum and anhydrites. These strata are jointed extensively and contain many solution cavities (vugs). The fissures and vugs may be due to ground water dissolution of gypsum.[9] While most vugs are <0.25 inches in diameter, it is possible that there are some fissures 1 to 2 feet wide and cavities as large as several cubic yards in volume. The lower members of the Tymochtee-Greenfield Formations are described as a gypsiferous dolomite (20% gypsum) and have the most solution cavities. Some of the fissures are debris-filled, and this probably occurred due to collapse and filling of solution cavities as the Silurian sediments were being deposited.

The groundwater aquifers are in the vugs or solution cavities in the Silurian bedrock formations which begin about 10 feet below the surface. These water-bearing sediments are confined by the impervious glacial silty clay overburden. This situation produces an artesian head of about 10 feet above bedrock in the area of the site.

2.5 HYDROLOGY

2.5.1 Surface Waters

Lake Erie

The Station is located at Locust Point on the southern shore of the western basin of Lake Erie. The western basin is very shallow with a maximum depth of about 35 feet. A shallow epilimnion develops early during the season of natural heating in the spring, but since the basin is so shallow, wind action causes efficient vertical mixing and by June the water becomes vertically isothermal. During August the deeper waters occasionally have a thermocline for short periods.[10] The entire western basin freezes over early in the winter and stays frozen even during relatively mild winters.[11] Lake levels fluctuate both annually and over a period of many years. Yearly high levels occur in summer and lows in winter, with a total annual average fluctuation of 1.2 feet.[12] Local changes due to storm action, however, may be as great as 6 feet.[10]

The Detroit River, which empties into Lake Erie about 40 miles northwest of the site, provides 90% of the total inflow into the lake (188,000 cfs).[10] At Locust Point the Detroit River current, which crosses the western basin, diverges into eastern and western branches.[13,14] This provides a southeast drift of littoral sand from Locust Point to Port Clinton and a westward drift from Locust Point to Toledo. The presence of 3 or 4 sand bars parallel to the shore and close to the beach indicates a predominance of currents parallel to the beach.[13] Surface current velocities at Locust Point are about 2% of the wind velocity and vary with wind direction.[12]

The shoreline at Locust Point is very stable and is classified as a "non-critical erosion area, not protected."[15] The beach consists of sand and shell mixed. Immediately offshore, the underwater bottom consists of a shallow layer of sand with shell and clay intermixed which overlies stiff lake-clay. This sandy bottom varies from 3/16 to 1/8 mile wide, and beyond is a strip of stiff lake-clay exposed by wave action, which is 3/8 to 1/4 mile wide. About 9/16 miles offshore at the west edge of the property line, the bottom becomes sand again with increasing amounts of gravel as one goes further offshore. Eastward of the middle property line, the bottom becomes muddy sand.[13,14]

There have been measurable increases in total dissolved solids, calcium, chloride, sodium-potassium, sulfate, ammonia-nitrogen, and total nitrogen in Lake Erie over the past 50 years.[16] Water quality data are summarized in Table 2.11[17] and water temperatures in Table 2.11a.

Toussaint River

The Toussaint River is the largest tributary entering the lake near the site. The canal along the southern site boundary empties into the Toussaint River just before the river empties into Lake Erie. The river drains 143 square miles and has a slope of about 1 foot per mile.[18] Near its mouth, water levels are controlled mainly by the levels in Lake Erie.

2.5.2 Groundwater

At the site, the groundwater table elevation follows the lake levels. It is usually a few feet higher than the lake, and when the lake rises several feet during storms, the groundwater table elevation will rise commensurately. The groundwater table is relatively horizontal with a gradient of only 1 to 3 feet/mile (average of 2 feet/mile) toward the lake. During infrequent dry periods or when the lake is high, the groundwater flows away from the lake.[18] The rate of flow is similar to that in the local rivers and creeks.

The vugs and joints in the Silurian bedrock formations are the groundwater aquifers, but the impervious clayey soils and glacial deposits are not water-yielding sediments. Since the bedrock is at least 10 feet below the surface and overlaid by impervious deposits, the bedrock aquifer is under an artesian head of 10 feet above bedrock. These

TABLE 2.11. Lake Water Analysis

	Site Samples*	Toledo Intake**	
		Annual Average	Range
Calcium (Ca)	45	-	
Magnesium (Mg)	11	-	
Sodium (Na)	12	-	
Chloride (Cl)	22	20	(14-37)
Nitrate (NO_3)	12	-	
Sulphate (SO_4)	37	-	
Phosphate (PO_4)	1.5	-	
Silica (SiO_2)	2	-	
Alkalinity (as $CaCo_3$)	101	93	(76-181)
Turbidity (as SiO_2)	-	22	(2-220)
Suspended Solids	131	-	
Total Dissolved Solids	225	210	(191-248, Jan-Mar)
Dissolved Oxygen	10	-	
pH	8.1	8.3	(7.7-8.8)
Chlorine Demand	1.4	0.9	(0.1-2.7)
Arsenic	0.016	-	
Barium	0.1	-	
Boron	0.0	-	
Phosphorus	0.22	-	
Iron	0.31	-	
Manganese	0.07	-	
Mercury	0.001	-	
Nitrogen (N)	4	-	
Potassium	3	-	
Selenium	0.00	-	
Silicon	0.28	-	
Sulfur	14	-	
Zinc	0.03	-	

*Average of samples from November 1968 to October 1970 taken 50 to 100 feet from shore. Davis-Besse Nuclear Power Station, Supplement to Environmental Report, Volume 1, p. 4-37. Also from Answers to Questions, Site Visit, June 1972, p. 9-11.

**Average of monthly values reported in Lake Erie Ohio, Pennsylvania, New York Intake Water Quality Summary, 1970. Environmental Protection Agency, et al., August 1971. (Intake is 11,000 feet from shore at a depth of 10 feet in water which is 17 feet deep.)

General note: All values in parts per million except pH.

TABLE 2.11a. Monthly mean water temperatures in 10-35 feet in western Lake Erie

Month	No. of Stations	Weighted Mean Day of Month	Mean 10-foot Temperature	Mean Delta-T 10'-to-Surface	Mean Surface Temperature
January*	--	15th	32.0°F	0.0°F	32.0°F
February*	--	[illegible]th	32.0	0.0	32.0
March**	--	15th	37.0	0.0	37.0
April**	--	15th	46.0	0.0	46.0
May	32	14th	54.2	0.9	55.1
June	99	23rd	69.7	1.3	71.0
July	31	20th	75.9	0.5	76.4
August	6	21st	72.7	0.0	72.7
September	7	19th	69.7	0.4	70.1
October	45	17th	58.5	0.1	58.6
November	30	18th	45.4	0.0	45.4
December**	--	15th	36.0	0.0	36.0

*Ice presumed present.

**1966 data of Collins Park Water Treatment Plant, Toledo.

Temperature data taken from Davis-Besse Nuclear Power Station Environmental Report, August 1970, p. C-13.

waters are sulfurous (containing more than 5 ppm H_2S), hard and are not potable. However, they are used for farm and sanitary purposes. Bedrock wells are usually less than 100 feet deep and yield up to tens of gallons per minute. Some municipal wells in the Toussaint River Basin can, on the other hand, yield 100 gpm. No information is available about the precise chemistry of the groundwater. The Station's drinking water will be taken from Lake Erie. Some cottagers along the lake obtain their drinking water from shallow beach wells in the lake sands, and some south of the site truck in water from central cisterns.

2.6 METEOROLOGY

The Davis-Besse site has a climate typical of the Great Lakes region, classified as continental, with cold winters and warm, humid summers, but moderated by the proximity of Lake Erie. Because of its heat capacity, the lake remains cooler than the land in spring and early summer, and produces lake breezes which bring cool, humid air to the site, reducing afternoon temperatures and producing stable air conditions. Conversely, in fall and winter, when the lake is relatively warm, winds off the lake are warmed and humidified.

The passage of polar fronts and high and low pressure centers produces high average wind velocities and frequent changes of wind direction, which in the very flat terrain, produce adequate ventilation. In summer, the frequency of frontal passages is reduced, but convective showers in tropical air masses are common.

Meteorological observations with a 300-foot instrumented tower have been made at the site since October 1968. The data collected comprise wind speed, direction and variability at 20, 100 and 300-foot levels, and air temperatures at 5, 145 and 297-foot levels. No humidity or rainfall data are collected at the site. The duration of the temperature observations is too short to establish long-term averages, so data from Toledo Express Airport have been used. The airport is 36 miles west of the site and about 20 miles inland from Lake Erie.

2.6.1 Temperature

Table 2.12[19] gives the average monthly temperature statistics for Toledo over an 11-year period. The highest and lowest temperatures recorded at Toledo are 105°F (July 1936) and -17°F (January 1963).

2.6.2 Precipitation

Precipitation is moderate (31.4 inches annually at Toledo), and fairly

TABLE 2.12. Temperature (°F) Data for Toledo (11 Years of Record)[19]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Average Daily Max.	34	36	45	58	70	80	85	83	76	64	47	36	
Average Daily Min.	18	19	26	35	46	56	60	59	51	40	30	21	
Average Monthly	26	27	35	47	58	68	73	71	63	52	39	28	
Extreme Max.	62	68	80	87	95	97	96	98	95	91	76	65	98
Extreme Min.	-17	-10	-1	11	27	38	43	37	29	16	2	-11	-17
Degree-days	1200	1056	924	543	242	60	0	16	117	406	792	1108	6494
No. days T max. $\geq 90°$	0	0	0	0	1	4	5	4	1	*	0	0	16
No. days T min. $\leq 32°$	30	27	24	11	1	0	0	0	*	6	18	27	144

*More than 0 but less than 0.5 days.

evenly distributed throughout the year. Spring is the rainiest season (9.35 in. average) and fall the driest (6.87 in. average). The mean annual snowfall at Toledo is 38.0 inches, and on the average there are 11 days with snowfalls greater than 1.0 inch. As much as 9.8 inches of snow has fallen in a 24-hour period. Monthly average precipitation statistics are given in Table 2.13.

2.6.3 Wind

A complete tabulation of the wind data collected at the site for 20, 100 and 300-foot levels is given in the Applicant's Environmental Report. Figure 2.10 summarizes the data for the 300-foot level in the form of seasonal wind roses. On an annual basis, 62.3% of all winds are offshore (i.e. SE through S to WNW). The lowest proportion of offshore winds is in spring (54.6%), mainly because of the lake breeze effect.

2.6.4 Atmospheric Stability

The vertical mixing and turbulence of the atmosphere depends on hydrostatic stability as well as on wind velocity and surface topography. Hydrostatic stability is determined by the vertical temperature gradient, which is usually expressed as a lapse rate, the rate of decrease of temperature with height. An important value of this parameter is the rate at which a body of dry air cools adiabatically with increasing height. This adiabatic lapse rate corresponds to a decrease of 1.0°C per 100 meters or 5.5°F per 1000 feet. When the observed lapse rate is less than this value, the atmosphere is stable and vertical motions are damped, the extreme case being a negative lapse rate which occurs in a temperature inversion. When the lapse rate is greater than 1.0°C per 100 meters, the atmosphere is unstable and vertical mixing is rapid. When the humidity of the air approaches saturation, the adiabatic lapse rate is reduced because of the latent heat released in condensation. Observations of atmospheric stability at the site are made by comparing the temperatures at the 5- and 145-foot levels (1.5 and 46.0 meters). These observations are tabulated in the Applicant's Environmental Report and are summarized in Table 2.14. It should be noted that the stability classes are defined in terms of true temperature gradient (increase of temperature with height), so that unstable conditions correspond to negative temperature gradients.

2.7 ECOLOGY

2.7.1 Aquatic

Fish populations, bottom fauna, phytoplankton populations, and the

TABLE 2.13. Precipitation, Toledo, Ohio

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Ave. Precip in.**	1.95	2.58	2.79	3.18	3.30	2.90	2.91	2.59	2.31	2.30	2.26	2.22	31.37
Max. in 24 hrs, miles**	1.78	2.26	2.69	2.93	3.57	3.44	2.47	4.58	5.98	3.10	2.68	2.07	
Days with thunder-storms***	*	*	2	5	5	7	7	7	4	1	1	*	40
Ave. Monthly snow-fall, inches***	8.5	7.9	6.7	2.2	*	0	0	0	0	*	3.4	7.3	36.0

*Less than 0.5 but greater than 0.

**Period of record, 1871-1966.

***Period of record, 1956-1966.

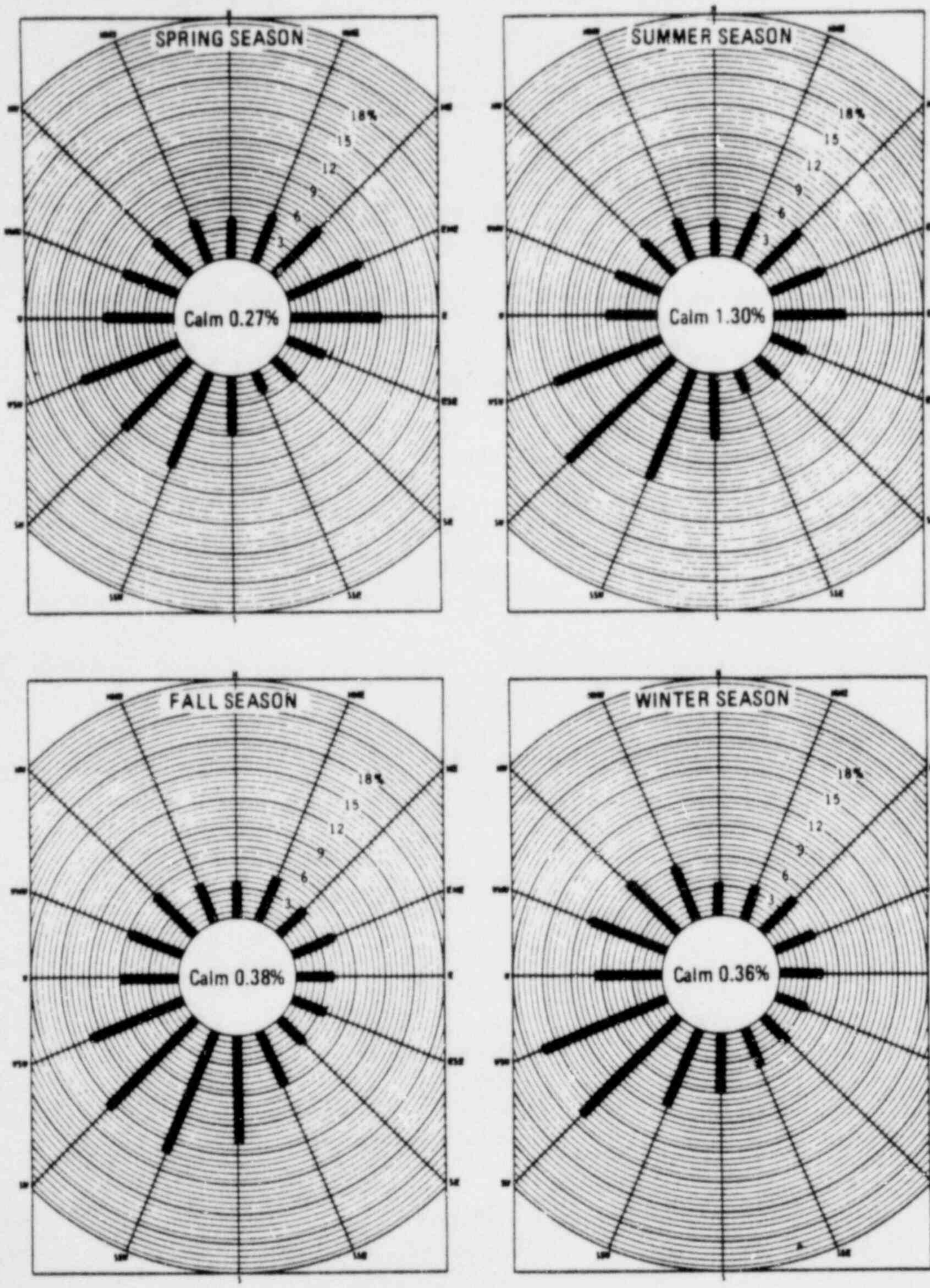


Fig. 2.10

SEASONAL WIND ROSES

DAVIS—BESSE – 300 FT. LEVEL

('68 – '70)

TABLE 2.14. Comparison of Stability Frequencies
(Percent of total hours)

Season	Mod. Stable	Slightly Stable	Neutral	Unstable
Fall	22.4	29.7	27.5	20.4
Winter	19.9	29.1	31.5	19.5
Spring	18.3	18.8	23.3	39.6
Summer	9.5	21.3	24.9	44.3

Stability classes defined as follows:*

Class	Temp. Gradient Range °C per 100 m
Unstable	<-1.5
Neutral	-1.5 to -0.5
Slightly Stable	-0.5 to +1.5
Moderately Stable	>+1.5

*Positive Temperature Gradient means increase of temperature with height.

chemical content of the waters of the western basin of Lake Erie have changed markedly in the past 50 years. Intensive agricultural activities and industrialization of the western basin's watershed have greatly increased the nutrient (and sediment) load, which has led to an acceleration of the eutrophication process in the lake. The biological and chemical changes indicating eutrophy (nutrient enrichment) in the western basin include: large oligochaete and midge larvae populations in the benthos; high plankton abundance with blooms of blue-green algae; warm water fish replacing characteristically cold water fish; and increases in total dissolved solids, calcium, chloride, sodium and potassium, sulphate, phosphorous, ammonia-nitrogen, and the degree and extent of oxygen depletion due to the increase in the oxygen demand of the sediments.[22,23]

Benthos

The bottom fauna of the western basin reflects the detrimental effects of heavy organic enrichment, siltation, and reduced dissolved oxygen levels. In summer, when quiescent warm periods often persist for several days, the bottom waters are prone to rapid oxygen depletion due to the high oxygen demand of the organically enriched sediments. The populations of pollution-sensitive organisms such as caddisfly larvae (Trichoptera) and burrowing mayfly nymphs (Ephemeroptera) have been greatly reduced. Prior to 1953, for example, mayflies dominated the benthos of western Lake Erie, but with the increased oxygen depletion of the bottom waters, the western basin populations have decreased to less than one percent of their former abundance.[24] On the other hand, the numbers of pollution-tolerant forms such as sludgeworms (Oligochaeta - Family Tubificidae) and midge larvae ("bloodworms" - Family Chironomidae = Tendipedidae) have increased greatly along the west side of the basin and in the island area. Organically-enriched environments characteristically support an unbalanced benthic community dominated by high numbers of sludgeworms.

Near the site at Locust Point chironomids and oligochaetes are the most abundant organisms in the benthos.[25,26,36] Snails (gastropods) are fairly abundant of depths greater than 10 feet. Mayfly nymphs and caddisflies are scarce. Other organisms present are scuds (amphipods), aquatic sowbugs (isopods), fingernail clams (sphaerids), hydra, planaria, and leeches (Hirudinea). The sandy, wavewashed sediments near shore, where the station discharge structure will be located, do not support a benthic community as large and diverse as areas further offshore. The greatest percentage of organisms is usually found between 10 and 15 feet and the greatest diversity at 10- and 12-foot sampling stations. At these depths wave action is diminished and bottom conditions are suitable for high populations.

Phytoplankton

In the western basin of Lake Erie, photosynthetic production is higher than in any other open water area of the Great Lakes.[27] Over the past 50 years phytoplankton abundance has increased almost threefold, the spring and fall maxima have lasted longer, the minima have become shorter and less pronounced, and there has been a shift in species dominance. Diatoms, which comprise 75 percent of the phytoplankton, dominate the spring and fall maxima. Melosira has replaced Asterionella as the dominant diatom in the spring, and the fall dominance has shifted from Synedra to Melosira to Fragillaria.[22,23,27] Certain species of Melosira and Fragillaria, as well as several other genera, often predominate in eutrophic lakes. Blue-green algae (which appear most often in nutrient enriched waters) and green algae have increased in abundance, particularly during the August-September peak. Blooms of blue-green algae, which float in mats on the water, begin to appear in late July or early August.

The Applicant's consultant, Dr. Ayers, has found the diatom Melosira, and to a lesser extent the diatoms Fragillaria and Diatoma, to be dominant in May at Locust Point.[26] Although phytoplankton was not rigorously counted in the State of Ohio's environmental evaluation F-41-R project,[25,36] notes were made on the dominant phytoplankters found while counting zooplankton. The spring phytoplankton bloom consisted largely of the diatoms Melosira, Fragillaria, Asterionella, and Tabellaria and the green alga Pediastrum. During the summer green algae, especially Pediastrum and Scenedesmus, were more abundant, and Staurastrum (green) and Ceratium (dinoflagellate) were more common than in other seasons. In the fall the blue greens Aphanizomenon and Microcystis were abundant and the diatoms were again prominent. Growths of attached nuisance algae, such as Cladophora, have not been noted near shore at the Station due to the lack of a suitable rocky substrate. (However, growths of Cladophora were found on buoys used in the 1972 studies[36].) So far, no fouling of beaches by algal mats blown ashore during storms has been reported for the Locust Point area, but blue-green blooms occur all over the western basin and have been noted in the open water near Locust Point.

Zooplankton

A considerable increase in the crustacean zooplankton population, dominated by copepods and cladocerans, has been observed in western Lake Erie.[27] The maximum number of copepods increased from 70,000 to 126,000 per cubic meter from 1939 to 1967. Calanoid copepods, particularly Diaptomus spp. (known primarily as an inhabitant of ponds and warm eutrophic waters) and Eurytemora affinis, are less abundant than cyclopoid copepods such as Cyclops or Mesocyclops. However, Eurytemora (a brackish water form) is more abundant in the western basin than in the rest of the lake. The dominant cladocerans are Daphnia spp. in late spring and Bosmia sp. in late August. Daphnia is particularly important in terms of numbers and biomass. A greater variety of rotifers occurs in the western basin than in the other basins.

Ayer's study at Locust Point found that cladocerans (Daphnia retrocurva and Bosmia sp.) and copepods (particularly the cyclopoids) are the dominant zooplankton. Rotifers and ostracods are also present, but many small organisms such as rotifers were probably missed due to the sampling method. Ohio's F-41-R study indicated that a seasonal pattern is evident for most zooplankters. Copepods (especially cyclopoids), cladocerans (Daphnia, Bosmia and Chydorus), and rotifers (several species) were dominant. All zooplankton reached peak densities in June, July and August. Sampling stations with the greatest zooplankton population showed no consistent correlation with depth or distance from shore.

Fish

In the past 25 years, the fish populations of Lake Erie have changed greatly. However, despite the elimination of high value species such as cisco, whitefish, sauger and blue pike, the decline of the walleye, and recent discoveries of high mercury levels (particularly in walleye and white bass), commercial fishery production has remained around 50 million pounds per year because of the increasing catch of carp, sheepshead, yellow perch, and smelt.[23,28] The changes in fish populations in Lake Erie cannot be attributed to the sea lamprey. It has never been an important predator since there are few tributaries offering suitable spawning conditions.[23] Although the trout fishing in Lake Erie was never important commercially, its long-term decline and eventual disappearance indicates the development of an unsuitable environment,[29] since trout are intolerant of polluted or eutrophic conditions. The year marking the beginning of major changes in the benthos, 1955, was also a key year in the changes in walleye and blue pike populations.

Fish surveys, using gill nets and seines, during most of the ice-free season for the past three years have shown carp and goldfish, followed by freshwater drum (sheepshead) and gizzard shad to be the most abundant fish off Locust Point.[25] The catch was greatest in May, June and October and lowest in August, indicating that the fish apparently move out to deeper water in the hottest summer months. The Ohio Department of Natural Resources has a Trawling Index Station (where numbers of young-of-year caught per hour of trawling is measured) near Crane Creek (about

4 miles northwest of the Davis-Besse). This index station ranks second for white bass and gizzard shad and third for walleye and alewife in relative lakewide abundance of young-of-the-year.[30] Examinations of fish stomachs indicate that the fish at Locust Point are actively feeding on the more abundant plankters and benthos in the area.[25] Chironomid larvae were the most common food items in most species in all months. Table 2.15 lists species, economic classification, spawning conditions and food preferences of fish found near the Station.

Ohio laws limit the commercial fishery in the Locust Point area to trotline, seine and trap net gear. Trap net and seine gear harvest the bulk of the fish.[30] Only seven major commercial trap-net fisherman utilize the area. Carp, catfish, walleye, white bass and perch are the major species harvested (by weight). However, recent discoveries of mercury contamination have led to a ban on the sale of all walleye and of white bass larger than 10-1/4 inches. The average annual monetary value of the fish caught by trap net in the area is estimated at $179,155. Three commercial seine fishermen utilize the area, but one seine catches the bulk of the fish, which are predominantly carp and catfish. The average annual monetary value of these species is estimated at $13,121. Therefore, the value of the commercial fishery off Locust Point is approximately $200,000 per year.[30]

Sport species most actively sought in the Locust Point area, particularly in the reef areas a few miles out, are walleye, white bass, catfish and perch. The estimated value of the boat angler utilization of Lake Erie within five miles of the site is $3.1 million.[30] There is also considerable value in the inland sport fishery (mainly for carp and channel catfish) within five miles of the site, particularly in the Turtle Creek and the Toussaint River. Commercial fishermen fish heavily for carp in these streams in the spring, but, since only a sport fishing license is required, no records of the amounts harvested are available.

2.7.2 Terrestrial

The site area is approximately 950 acres, of which over 600 acres is managed marshland and the balance is woodland, low grassland, and poorly drained marginal farmland. (See Section 2.1). Most of the farmland, formerly planted to wheat, has been removed from production due to construction of buildings, roads, parking lots, borrow pits, etc. Part of the remainder is lying fallow and part is planted to buckwheat during construction. Approximately 15 acres will be planted (probably to buckwheat) after completion of construction and farmed on a 3/4-1/4 basis (25% of the crop will be left on the fields for wildfowl forage).[31]

TABLE 2.15. Fish in the Vicinity of the Station

	Spawning: Time	Water Temp.	Place	Diet	Economic Classification
Walleye (Stizostedion vitreum vitreum)	Mid-April to early May	37-45°F	Shallow waters, clean, hard, rock bottom	Invertebrates, but mainly perch, minnows, suckers	Sport, commercial, fine food
Carp (Cyprinus carpio)	Late April to June	65-68°F (most active)	Migrate up streams	Browses on bottom vegetation aquatic insects, snails, copepods, cladocerans	Commercial, coarse food
Goldfish (Carassius auratus)	Spring	>60°F	Soft bottom	Phytoplankton, copepods, cladocerans, insects	Forage
Channel Catfish (Ictalurus punctatus)	April through August		Rapid waters of streams, holes in the banks	Omnivorous: aquatic insects, arthropods, fish, reptiles	Sport, commercial, fine food
Bullheads (Catfish) (Ictalurus spp.)	May to June or July	60-75°F	Less than 4 feet deep, protected from strong currents	Omnivorous: insects, entomostracans, plant debris, fish, frogs	Sport, fine food
White Bass (Roccus chrysops)	May to July		Shallows near shore	Prefer small fish (minnows), eat Daphnia, aquatic insects, plankton, crayfish	Sport, commercial, fine food
Yellow Perch (Perca flavescens)	Mid-April to May		3-8 feet deep	Zooplankton, aquatic insects, other fish	Sport, commercial fine food
Alewife (Alosa pseudoharengus)	Late May to June or July	55-72°F	6-12 inches deep	Small crustaceans, aquatic insects, plankton	Forage
Gizzard Shad (Dorosoma cepedianum)	Early June to early July	67-72°F	Shallow water	Algae from bottom mud, zooplankton, phytoplankton	Forage
Sheepshead (Freshwater Drum) (Aplodinotus grunniens)	May or June		Shallows, gravelly and sandy bottoms (planktonic eggs have been found in Lake Erie)	Mostly small fish & insect larvae, also molluscs, crustaceans, plankton, insects	Sport, fine food
Emerald Shiner (Notropis atherinoides)	June 25 - July 28 sometimes to August 15		Surface in open water	Microcrustacea, insects (aquatic and terrestrial)	Forage
Spottail Shiner (Notropis hudsonicus)	June 1 - 15 late June - early July	68°F	Clean sand	Fingernail clams, algae, insects, microcrustacea	Forage
Smelt (Osmerus eperlanus mordax)	May 1 - 15 sometimes also in late summer or early fall	37-54°F	Streams or lake shallows, sandy beaches	Plankton eater - Daphnia, Gammarus, fingernail clams, smelt young, shiners	Commercial, fine food
Quillback (Carpiodes cyprinus)					Commercial, fine food
Redhorse Sucker (Moxostoma spp.)	Spring		Shallows and in tributaries over gravel or stones	Bottom organisms	Coarse food
Crappies (Pomoxis spp.)	Late spring - early summer		Shallow waters		Sport, fine food

TABLE 2.15. (Contd.)

Note: Other species found near the station include:

Trout-Perch (Percopis omiscomaycus)
Logperch (Perca caprodes)
Northern Pike (Esox lucius)
Bluegill (Lepomis macrochirus)
Johnny Darter (Etheostoma nigrum)
Coho Salmon (Oncorhynchus kisutch)
Sand Shiner (Notropis deliciousus)
White Sucker (Catostomus commersoni)
Spotted Sucker (Minytrema melanops)
Buffalo (Ictiobus spp.)
Bowfin (Amia calva)
Green Sunfish (Lepomis cyanellus)
Largemouth Bass (Micropterus s. salmoides)
Smallmouth Bass (Micropterus d. dolomieui)
Longnose Gar (Lepisosteus osseus)
Orangespotted Sunfish (Lepomis humillus)
Rock Bass (Ambloplites rupestris)
Silver Chub (Hybopsis storeriana)
Spotfin Shiner (Notropis spilopterus)
Stonecat (Noturus flavus)
Carp-Goldfish hybrids

Data compiled from the following:

1. Lagler, Karl F. Freshwater Fishery Biology. Wm. C. Brown Company: Dubuque, Iowa, 1964.
2. Carlander, K. D. Handbook of Freshwater Fishery Biology. Volume 1. Iowa State University Press: Ames, Iowa, 1969.
3. Tomkiewicy, Linda A. "Typical Fish Mortality Rates in Eastern Lake Erie." Lake Erie Environmental Studies, Technical Data Report No. 4, State University College, Fredonia, New York. April 1970.
4. Ohio Cooperative Fishery Unit. "Environmental Evaluation of a Nuclear Power Plant." Federal Aid Project F-41-R.
5. Davis-Besse Nuclear Power Station Environmental Report. The Toledo Edison Company.
6. Letter from Carl T. Baker, Jr., Lake Erie Fisheries Research Unit, State of Ohio, Department of Natural Resources, Division of Wildlife to Pamela Merry, Argonne National Laboratory, June 23, 1972.
7. Ohio Department of Natural Resources, Division of Wildlife, Publications Nos. 65, 123, 130, 141, 185: 1972.
8. Herdendorf, C. E. and E. M. Hair, "Aquatic Ecology of Lake Erie in the Vicinity of Locust Point, Ohio," Report to the Toledo Edison Company, Toledo, Ohio, October 1972. (Also submitted as Appendix 2B of the Final Safety Analysis Report.)

The southwest and west shore of Lake Erie includes 40,000 acres of marsh, most of which is owned by private clubs. Several marshes near the site, such as the State-owned Magee Marsh and the privately owned Winous Point Club ([illegible] miles southeast of the site) are under intensive management for increasing waterfowl breeding population. The Magee Marsh breeding population, for instance, was increased from 54 pairs in 1953 to 275 pairs in 1963.[32] Other marshes are managed primarily for attracting large populations of migrating birds.

Navarre Marsh is a natural lowland separated from Lake Erie by a stable beach ridge. The sandy beach is strewn with clam shells, small rocks, and pebbles washed ashore during storms. Several species of grasses, sandbar willow, staghorn sumac and several other low plants characterize the beach ridge plant community. Behind the beach ridge is a hardwood swamp zone. Cottonwood and black willow are in abundance and hackberry, sycamore, staghorn sumac and river-bank grape are common. The beach ridge and hardwood swamp are probably the most stable communities within the Navarre area. Severe storms can result in changes in the biota, but these changes are usually temporary.

The bulk of the area at Navarre is covered by a freshwater marsh which is surrounded and transected by earthern dikes. Cottonwood, black willow, rough leafed dogwood, staghorn sumac, river-bank grape and several grasses are common on the dikes. Wherever there is standing water throughout most of the year, cattail, softstem bulrush, white water lily, milfoil, sago pondweed and curly-leafed pondweed are abundant.

The plant communities on the dikes and in the marsh proper will probably change constantly as the dikes are repaired and the marsh is managed in the future. Waterfowl management is essentially control of plant succession based on the seasonal needs of waterfowl. Intensive and economical management is best achieved by control of water levels, since fluctuation of water levels has a marked influence on the succession of aquatic plants. Marsh managers in Ohio obtain the best results from drawdowns (by use of dikes and/or pumps) in May to create a nesting habitat for the summer, and reflooding in the fall to attract large numbers of fall migrants. Partial reduction of water levels (rather than complete drying of the soil) exposes knolls used for nesting and leads to an interspersion of suitable submerged, emergent and shoreline vegetation. For example, the northern section of the site marsh, which is temporarily connected with the privately owned section north of the dike, was partially drawn down this spring (1972). Dense growths of smartweed (a good waterfowl food) developed along the dike and other exposed areas. Partially flooded areas developed dense stands of emergents such as bulrush, watermilfoil, and spikerush. In the large southern section of the marsh, however, the water was not drawn down and less desirable waterlilies and arrowhead cover most of the formerly open water areas.

Manipulation of water levels often makes it easier to control troublesome animals such as snapping turtles, which attack ducklings, or carp, which can cause great damage to water plants while rooting around in the sediments for food.[32] Roiling of the water and destruction of waterfowl habitat is often associated with large populations of carp. In addition, large numbers of carp which obtain access to the marsh during their spring spawning runs are often left stranded by receding water levels. Their decaying carcasses cause noxious odors and often make the area unsuitable for nesting waterfowl.

Mallards, black ducks and blue-winged teal are the most abundant nesting waterfowl at the site. Artificial roosts are often used to attract wood ducks. The most abundant waterfowl during spring and fall migrations include mallards, widgeons, blue-winged teal, black ducks, Canada geese, wood ducks, shovelers, coot, green-winged teal, gadwalls, canvasbacks and redheads. The area is also used by whistling swans and large numbers of warblers. Other birds which are common during the summer are redwinged blackbirds, swallows, warblers, gulls, common egrets, mourning doves, wrens, starlings, black-night crowned heron and great blue heron. Pheasant might occasionally be found in upland areas. Endangered species which occasionally utilize the area are the Kirtland's warbler, bald eagle, sandhill crane, and peregrine falcon.

Other animals in the area are muskrat (very common), opossum, woodchuck, raccoon, skunk, weasel, mink, and red fox. Cottontail rabbits and fox squirrel are probably present, but in limited numbers. Several snakes, turtles, frogs, toads and salamanders live in the marsh. Fish which spawn in the marsh, in addition to carp, are bullheads, gizzard shad, and goldfish. Snails, spiders, and several insects such as horseflies, midges, damsel flies, mayflies, dragon flies, grasshoppers, bugs and beetles are common marsh inhabitants. Surveys in 1972 give more detailed lists and description of marsh biota.[37]

2.8 BACKGROUND RADIOLOGICAL CHARACTERISTICS

The radiological characteristics of the area surrounding the Station are not unusual. Natural and man-made background in the area is typical for Midwestern States, that is, 140 millirem per year.[33] Some 25 radiological monitoring stations have been active in the area for nearly two decades[34] so that a considerable backlog of data is available. A list of the major stations and their more recent reports is presented in Table 2.16. These stations have monitored not only Lake Erie, but also surface, ground, and tap waters in the area, as well as milk, dietary,

TABLE 2.16. Radiological Surveillance Locations in the Region of the Station

Location	Reporting Period	Measurement*	Range	Mean
Cleveland, Ohio	Sept 1970-Feb 1972	PM, Sr-90	6-11	9
Cleveland, Ohio (Cuyahoga River)	March 1971 and June 1971	SW gross alpha (d)	≤0.2-1	
		SW gross alpha (s)	2	2
		SW gross beta (d)	3-7	5
		SW gross beta (s)	4-39	21
Cleveland, Ohio (Lake Erie)	1971	TW gross alpha (d)	0	0
		TW gross alpha (s)	0	0
		TW gross beta (d)	≤5	5
		TW gross beta (s)	≤5	5
	July 1967-Dec 1971	DS, Sr-90	5-14	9
Painesville, Ohio	July 1969-Feb 1972	SA	0-8	1
		P	0-305	27
	Jan 1970-Dec 1971	TWT	0-0.6	0.2
Sandusky, Ohio	1967-1969	TW gross alpha (d)	0	0
		TW gross alpha (s)	0	0
		TW gross beta (d)	3	3
		TW gross beta (s)	7	7
Columbus, Ohio	July 1969-Feb 1972	SA	0-3	1
		P	0	0
		TWT	0-0.6	0.2
Youngstown, Ohio	1967-1969	TW gross alpha (d)	0	0
		TW gross alpha (s)	0	0
		TW gross beta (d)	3-8	5
		TW gross beta (s)	0	0
Lorain, Ohio	1967-1969	TW gross alpha (d)	0	0
		TW gross alpha (s)	0	0
		TW gross beta (d)	5	5
		TW gross beta (s)	0	0
Monroe, Michigan	Sept 1970-Feb 1972	PM, Sr-90	0-9	6
	Jan 1970-Dec 1971	TWT	0-0.6	0.2

TABLE 2.16. (Contd.)

Location	Reporting Period	Measurement*	Range	Mean
Detroit, Michigan	Sept 1970-Feb 1972	PM, Sr-90	7-8	8
	1967-1969	TW gross alpha (d)	0	0
		TW gross alpha (s)	0	0
		TW gross beta (d)	3	3
		TW gross beta (s)	0	0
Lansing, Michigan	Sept 1970-Feb 1972	PM, Sr-90	4-11	9
	July 1969-Feb 1972	SA	0-2	1
		P	1-20	9
	Jan 1970-Dec 1971	TWT	0	0
Erie, Pennsylvania	Sept 1970-Feb 1972	PM, Sr-90	0-25	10
Buffalo, New York	Sept 1970-Feb 1972	PM, Sr-90	5-10	7
	July 1969-Feb 1972	SA	0-1	1
Buffalo, New York (Lake Erie)	Mar-June 1971	SW gross alpha (d)	<0.2	<.2
		SW gross alpha (s)	<0.2	<.2
		SW gross beta (d)	2-3	3
		SW gross beta (s)	10-11	11
Windsor, Ontario, Canada	Sept 1970-Feb 1972	PM, Sr-90	4-12	5
	July 1969-Feb 1972	SA	0-0.4	0.1
		P	0.4-11.9	4

*PM - Pasteurized milk (pCi/l).
SW - Surface water (pCi/l).
TW - Tap water, gross alpha and beta (pCi/l).
TWT - Tap water, tritium (nCi/l).
SA - Surface air (pCi/m^3).
P - Precipitation (nCi/m^2).
DS - diet sampling (pCi/kg).
d - Dissolved.
s - Suspended.

and atmospheric concentrations. Thus, any changes introduced by the operation of the Station will have an extensive backlog of information for comparison.

A small-scale study of tritium has been reported for Lake Erie waters offshore of the Station.[35] This study gave values several-fold larger than the norm for Lake Erie or its western basin. In view of the methodology used in these studies and the normal variations in reported Lake Erie tritium values, it is more probable that the elevated values reported (range 350 - 1,800 pCi/l, mean about 1,100 pCi/l) are largely happenstance, and would not be observed in other studies.

REFERENCES

1. Ottawa County Comprehensive Planning Program: Vol. 1, Population and Economic Study, 1971.
2. Toledo Edison Company and Cleveland Electric Illuminating Company: Applicant's Environmental Report (ER) Supplement 3, Amendment 1, July 1972.
3. Ottawa County Planning Implementation: Zoning Study, 1972.
4. Ottawa County Comprehensive Planning Program: Vol. 2, Regional Development Plan, 1971.
5. Ohio Agricultural Statistics 1971: Ohio Crop Reporting Service, Annual Report, April 1972.
6. 1970 Ohio Farm Income: Ohio Agricultural Research and Development Center, Department Series ESM467, September 1971.
7. Ohio Dept. of Natural Resources, Division of Wildlife; letters from Carl L. Moseley, Admin. Asst. to John Milsted, Argonne National Laboratory, dated July 17 and July 20, 1972.
8. Applicant's Preliminary Safety Analysis Report (PSAR) Amendment No. 5, May 1970, Appendix 2C, pp 91-147.
9. PSAR Amendment No. 1. Dec 1969, Appendix 2C, pp 57-61.
10. International Joint Commission on the Pollution of Lake Erie, Lake Ontario and the International Section of the St. Lawrence River - Vol. 2 - Lake Erie. 1969
11. Rondy, Donald R. Great Lakes Ice Atlas. National Oceanic and Atmospheric Administration, Technical Memorandum NOS LSCR 1, U.S. Department of Commerce, September, 1971.
12. Davis-Besse Nuclear Power Station. PSAR. Amendment No. 5, Appendix 2D -17, May 12, 1970.
13. Herdendorf, Charles E. "Anticipated Environmental Effects of Dredging a Temporary Barge Channel at the Davis-Besse Nuclear Power Station." Center for Lake Erie Area Research, The Ohio State University, March, 1972.

14. Herdendorf, Charles E. "Anticipated Environmental Effects of Construction Water Intake and Discharge Pipelines in Lake Erie at the Davis-Besse Nuclear Power Station." Center for Lake Erie Area Research, The Ohio State University, July, 1972.

15. Corps of Engineers, Department of the Army. Great Lakes Region Inventory Report - National Shoreline Study. August, 1971.

16. Beeton, A. M. Special Report No. 11. Statement on Pollution and Eutrophication of the Great Lakes. Statement delivered to the U.S. Senate Subcommittee on Air and Water Pollution of the Committee on Public Works. May, 1970.

17. Davis-Besse Nuclear Power Station Supplement to Environmental Report, Vol. 1, pp. 4-37.

18. Davis-Besse Nuclear Power Station, PSAR Amendment No. 1, pp. 2-12, December 15, 1969.

19. Local Climatological Data, Annual Summary With Comparative Data, 1966, Toledo, Ohio, ESSA.

20. Climatological Data, National Summaries (1955-1959, 1964-1967), U. S. Weather Bureau.

21. Army, Navy and Air Force Manual, "Engineering Weather Data," TM-785, Department of the Army, April 1963.

22. Beeton, A. M. "Changes in the Environment and Biota of the Great Lakes." in Eutrophication: Causes, Consequences, and Correctives. Proc. of a Symposium, Nat. Acad. Sci., Washington, D.C. 1969. pp. 150-187.

23. Beeton, A. M. "Indices of Great Lakes Eutrophication." Publication #15, Great Lakes Research Division, The University of Michigan 1966.

24. Beeton, A. M. and D. C. Chandler. "The St. Lawrence Great Lakes." in Limnology in North America by David G. Frey. Madison, Wis. 1963.

25. Ohio Federal Aid Project F-41-R. "Environmental Evaluation of a Nuclear Power Plant." Job Progress Reports from 1970, 1971 and 1972; Job Completion Report - Research Completion Segment, 1972. Ohio Department of Natural Resources, Division of Wildlife.

26. Davis-Besse Nuclear Power Station. Environmental Report. Appendix C (also PSAR Am. #5, Sect 2D, p 87).

27. International Lake Erie Water Pollution Board and the International Lake Ontario-St. Lawrence River Water Pollution Board. "Report to the International Joint Commission on the Pollution of Lake Erie, Lake Ontario, and the International Section of the St. Lawrence River, Volume 2 - Lake Erie," 1969.

28. Parkhurst, Benjamin R. An Ecological Evaluation of a Thermal Discharge, Part V: "The Distribution and Growth of the Fish Populations along the Western Shore of Lake Erie at Monroe, Michigan during 1970." Technical Report No. 17, Thermal Discharge Series, Institute of Water Research, Michigan State University, Sept, 1971.

29. Beeton, A. M. "Special Report No. 11 - Statement on Pollution and Eutrophication of the Great Lakes" 1970 (Statement delivered to the U.S. Senate Subcommittee on Air and Water Pollution of the Committee on Public Works).

30. Letter from Carl T. Baker, Lake Erie Fisheries Research Unit, Sandusky, Ohio, State of Ohio Department of Natural Resources to Pamela Merry, Argonne National Laboratory. June 23, 1972.

31. Davis-Besse Nuclear Power Station, Environmental Report, Cost-Benefit Analysis.

32. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service. Waterfowl Tomorrow, Joseph P. Linduska, ed. U.S. Government Printing Office, Washington: 1964. L. C. card no. 65-60084.

33. Klement, A. W., L. Minx, B. Schleien et al., US E.P.A. Report ORP/CSD-72-1 (1972).

34. Environmental Protection Agency, Radiation Data and Reports, Vol. 1 - 13, (1972).

35. Davis-Besse Hearings, U.S.A.E.C , Cleveland, Ohio, July 1972, p. 2922.

36. Herdendorf, C. E. and E. M. Hair, "Aquatic Ecology of Lake Erie in the Vicinity of Locust Point, Ohio." Report to the Toledo Edison Company, Toledo, Ohio, October 1972.

37. Various memo from William B. Jackson (Bowling Green University) to Lowell Roe (Toledo Edison Company) August 1, 1962, December 1, 1972, January 29, 1973, February 1, 1973 regarding the Environmental Inventory at Davis-Besse.

3. THE STATION

3.1 EXTERNAL APPEARANCE

An architectural rendering of the completed Station as it will appear is presented in Fig. 3.1. A layout of the site and the Station is presented in Fig. 3.2. The plant, cooling tower, and switchyard are located in the west central portion of the site. Figure 3.3, a photograph of the Station during construction taken in September 1972, shows the various buildings and structures.

The rectangular turbine building, to be painted blue, is about 200 feet long, 150 feet wide and 104 feet high (above grade); the L-shaped auxiliary building, to be painted white, is roughly 200 feet long on each leg and 54 feet high; the containment building is a cylindrical, natural concrete structure about 140 feet in diameter and 225 feet high. The cooling tower, also natural concrete, will be 493 feet high and 415 feet in diameter at the base. The major visible structures will be the cooling tower, the containment building, the turbine building, and the auxiliary building.

In clear weather the cooling tower will probably be visible for more than ten miles on the flat terrain around the Station. During the daylight hours four high intensity flashing white (strobe) lights on the top of the tower will be operating. The nighttime lighting will be four flashing red lights at the top and midpoint, respectively, and four steady red lights at the three-quarter point. The other Station structures will be visible for perhaps two miles. The Applicant has stated that landscaping plans for the Station buildings will be formulated later.

3.2 REACTOR AND STEAM-ELECTRIC SYSTEM

The nuclear reactor for the Station will be of the pressurized water type (PWR) and will be supplied by the Babcock & Wilcox Company. Bechtel Company is the architect engineer and construction manager for the Station.

The reactor is designed for a power output of 2,633 megawatts thermal (MWt), the license application rating, corresponding to an approximate net Station output of 872 megawatts electrical (MWe). The reactor is expected to be capable of an ultimate output of 2,772 MWt, which corresponds to a turbine-generator rating of approximately 906 MWe.

Except for the nuclear steam supply system, the Station operates on the same principle as fossil-fueled power plants, namely by converting thermal

Fig. 3.1. Architectural Rendering of Completed Davis-Besse Nuclear Power Station.

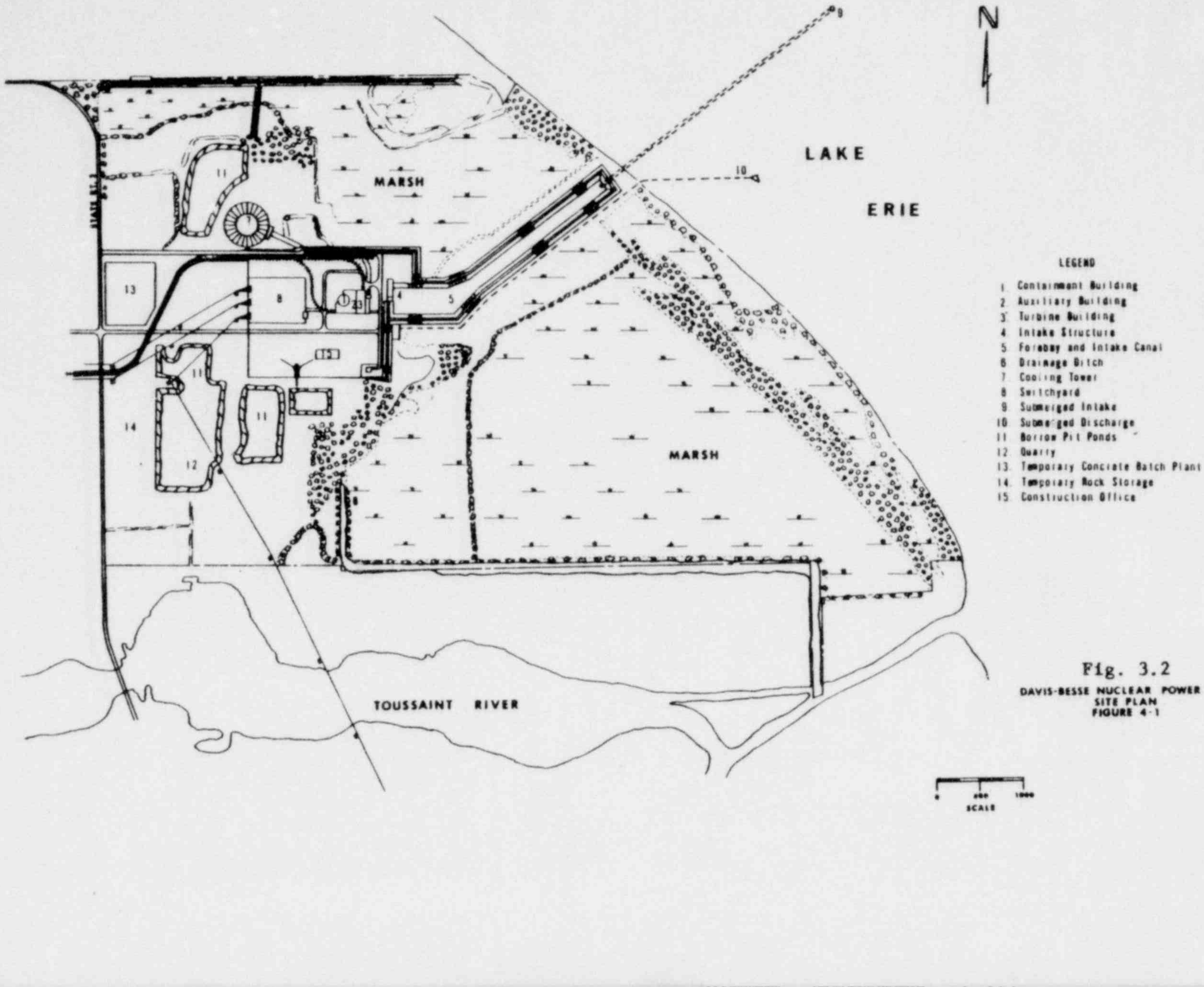


Fig. 3.2
DAVIS-BESSE NUCLEAR POWER STATION
SITE PLAN
FIGURE 4-1

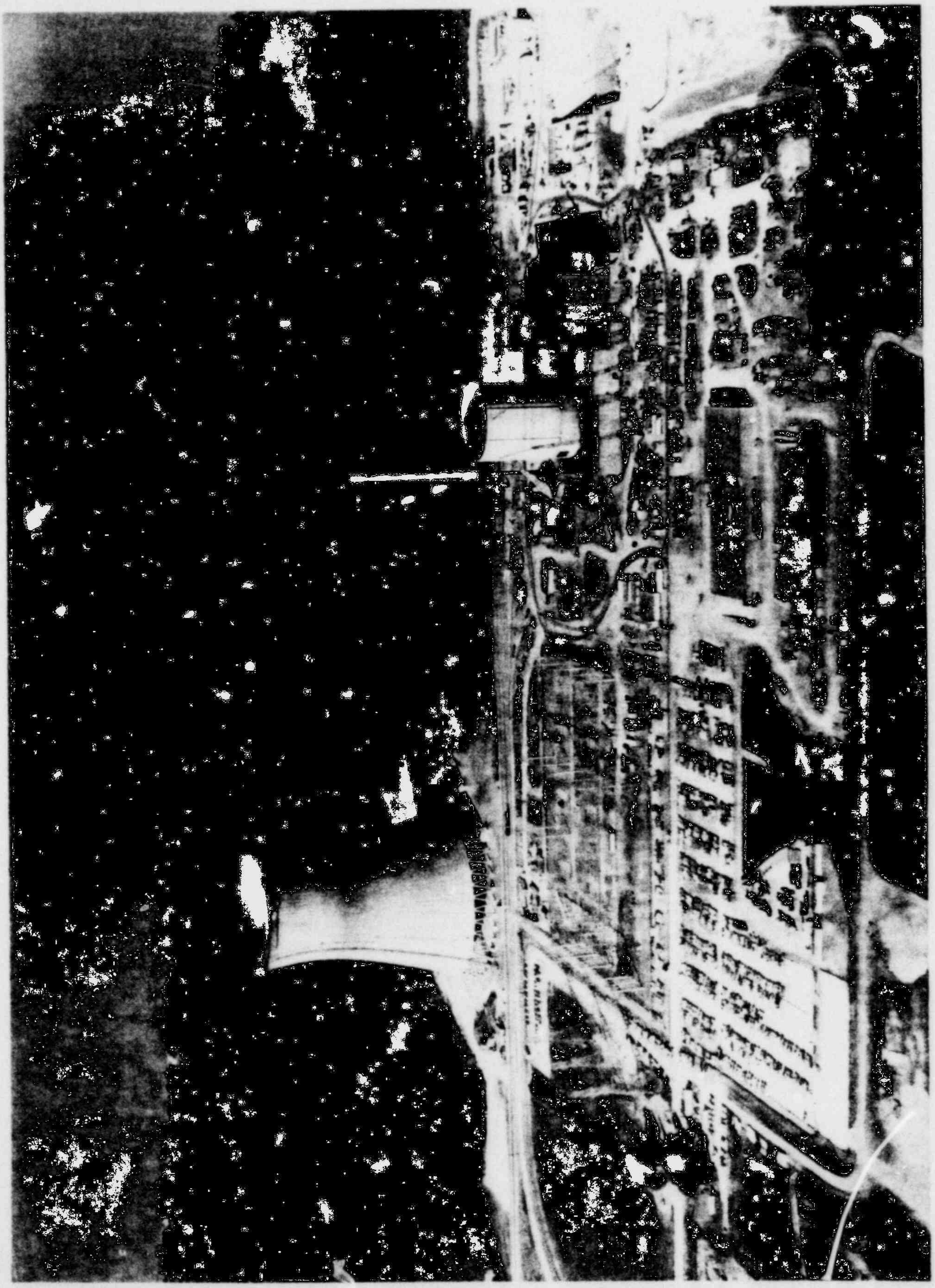


Fig. 3.3. View of Station during Construction

energy to electrical energy via a Rankine steam cycle. During operation, the uranium-235 in the slightly enriched uranium dioxide fuel elements undergoes fission and produces heat. The core reactivity is controlled by a combination of 49 control rod assemblies, and by a neutron absorber (boric acid) dissolved in the coolant-moderator. The control rods, used for short-term control, are cadmium-indium-silver alloy encapsulated in stainless steel tubes. Long-term reactivity is controlled by adjusting the concentration of boric acid in the coolant-moderator water.

Two outlet coolant loops are connected in parallel to the reactor vessel. Each loop contains one steam generator, two coolant pumps (there are two return lines from each steam generator), and the interconnecting piping. A pressurizer is connected to one of the loops. Heated reactor coolant water is pumped from the reactor outlet through the steam generator and back to the reactor inlet. The normal operating pressure for the reactor vessel is 2200 psia and the average coolant exit temperature is 608°F.

Heat generated in the reactor fuel elements is transferred by the pressurized water coolant-moderator to the steam generators. Each steam generator is a vertical straight tube-and-shell unit which produces steam at a shell-side operating pressure of 1065 psia.

Steam flows from the steam generator to an 1800 rpm tandem compound four-flow exhaust turbine operating in a closed condensing cycle with six stages of feedwater heating. The turbine drives a direct coupled electric generator. The turbine-generator is manufactured by the General Electric Co.

3.3 HEAT DISSIPATION SYSTEMS

3.3.1 Cooling Tower

A natural-draft counterflow cooling tower approximately 493 feet high and 415 feet in diameter at the base will be used to dissipate 98% of the total heat from the condenser (and other plant sources) to the atmosphere by means of evaporative cooling (see Fig. 3.4). The remaining 2% of the heat is discharged to Lake Erie in the blowdown from the cooling tower system. Condenser cooling water will be pumped through the cooling tower at the rate of 480,000 gpm, using four circulating pumps each with a capacity of 120,000 gpm. The condenser cooling water flows from these pumps to and through the condenser, through two 9-ft diameter buried pipes to the cooling tower, through the cooling tower, and through an open channel from the cooling tower back to the circulating pumps; the only water losses from this system are those due to evaporation, drift and blowdown. The temperature rise across the condenser and the drop through the cooling tower will be 26°F at full Station power, corresponding to a heat rejection to the atmosphere of 6.21×10^9 BTU per hour.

3.3.2 Other Cooling Water Systems

In addition to the major heat load from the turbine exhaust condensers, there are several other cooling systems (i.e., turbine room, component and containment) that transfer heat from other portions of the plant. These systems, which include the reactor decay heat (shutdown cooling) heat exchangers, the spent fuel pool heat exchangers, the closed loop component cooling water heat exchangers, the turbine plant recirculated cooling water heat exchangers, and the containment cooling heat exchangers, are supplied with cooling water by the service water system. A simplified flow diagram of the plant cooling and makeup water flow is shown in Fig. 3.5. The makeup water for cooling tower evaporation,, drift, and blowdown is obtained from the service water pumping system.

The average makeup flow is approximately 18,450 gpm, which includes an average 9,225 gpm evaporated from the cooling tower and 9,225 gpm average blowdown from the cooling tower pump discharges. The balance of the 20,730 gpm average intake flow is used to dilute the Station discharge to the lake (so that the maximum effluent temperature will not exceed 20°F above ambient) and to supply the operating water systems (demineralizer, Station potable water supply, etc.).

Intake Crib

All the water used in the Station is drawn from Lake Erie into a submerged intake crib about 3000 feet offshore; the intake orifice will be on a contour 11 ft below the Lake Erie low water datum (568.6 feet) at a current water depth of about 14 ft (see Figure 3.6). This intake consists of an octagonal crib made of timber with slots in the top so that water enters the crib downward through the slots. At the design intake flow of 42,000 gpm, the maximum intake velocity will be 0.5 ft/sec, but the actual intake velocity will be about 0.25 ft/sec at the nominal flow rate of ~21,000 gpm. The Applicant is planning to install a bubble screen to discourage fish from entering the crib.

Icing of the intake crib is not expected to occur, because similar wooden cribs currently operating on Lake Erie have not been troubled by icing.

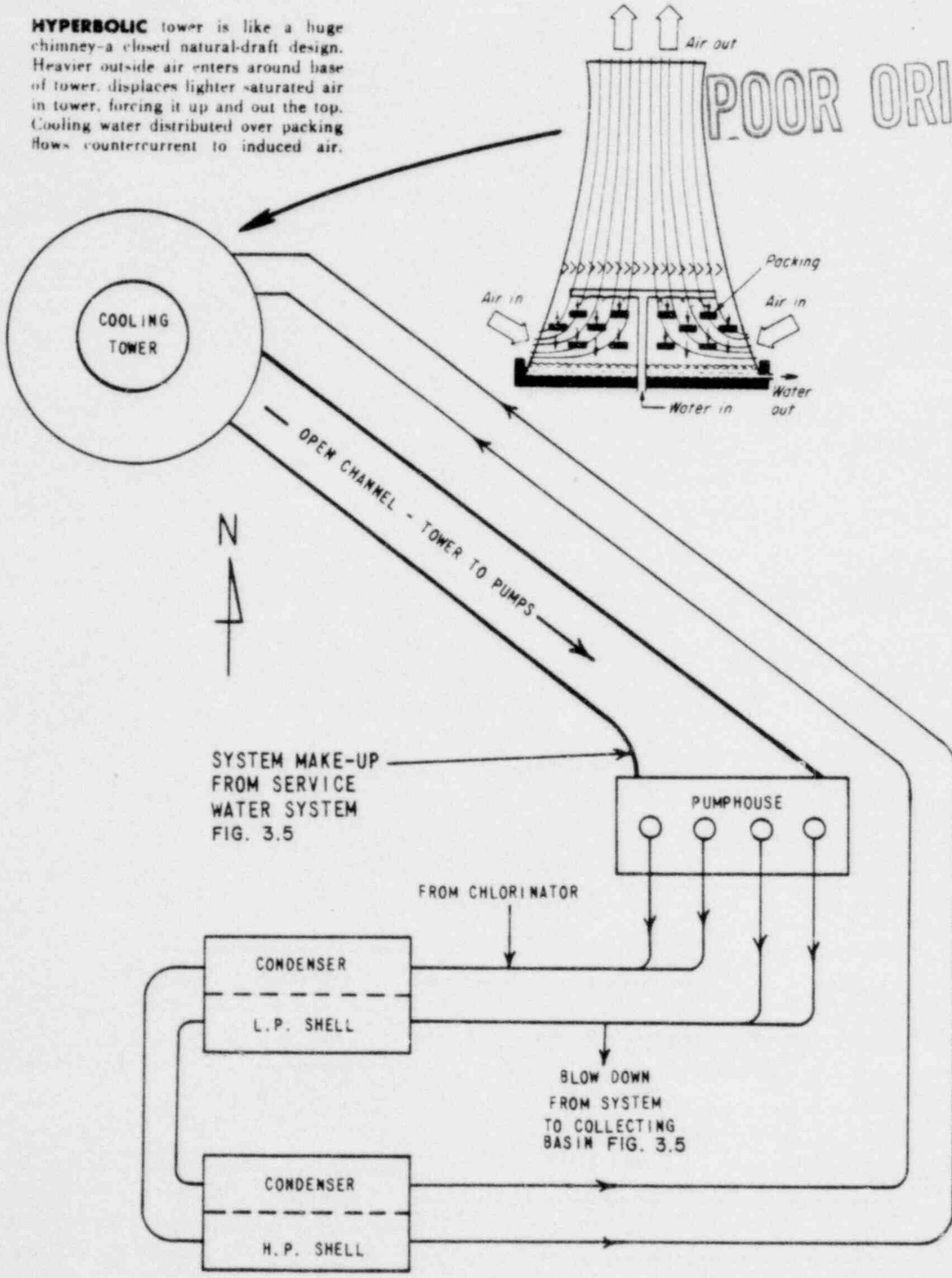


Fig. 3.4. Davis-Besse Nuclear Power Station Closed Condenser Cooling Water System Diagram.

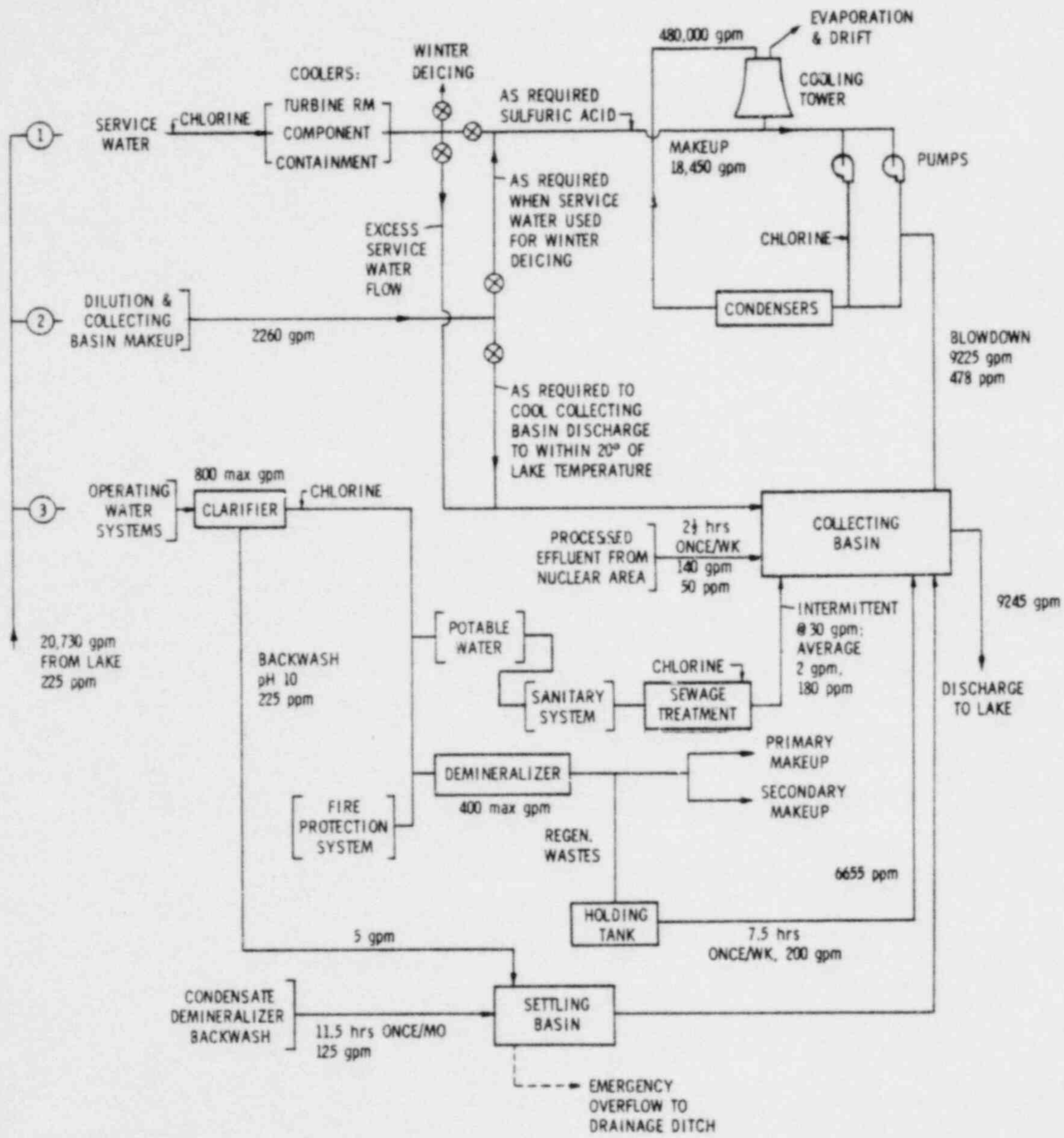


Fig. 3.5. Station Water Use Diagram.
(Schematic only - not piping diagram.)

If a heavy slab of ice should block the top of the crib, enough water to satisfy the Station's needs would enter through the porous rockfill surrounding it. The semicircular rockfill partially around the intake crib but spaced away from it has two purposes: (1) to prevent large chunks of ice from being driven into the crib by wind and wave action, and (2) to reduce the velocity of incoming water so that suspended sand settles out before it gets to the intake crib.

Water drawn into the crib enters an 8-ft diameter intake pipe buried beneath the lake bottom (Fig. 3.6). At the maximum intake flow of 42,000 gpm, the water velocity in the intake pipe will be about 1.8 ft/sec. This pipe brings the water to an intake canal which is separated from the lake by a beach and beachfront dike. The canal functions as a long reservoir where water is stored for Station use (See Figure 3.2). Water flows by gravity from the intake crib to the intake canal. The intake canal extends from the beachfront dike to the Station water intake structure; the canal widens into a forebay near the Station intake structure (See Fig. 3.7). At the design flow of 42,000 gpm, the water velocity in the intake canal is estimated to be about 0.11 ft/sec.

Intake pumps and screens

The three pumps, located in three bays in the intake structure, supply all the water used by the Station. However, before the water reaches these pumps, it passes through a trash rack (4 inch x 26 inch openings) and then through traveling screens with 1/4-inch square openings to prevent fish or small debris from entering the pump wells. The traveling screens have backwash sprays which remove entrained material, and the entrained material is sluiced through a trough to a holding basin with overflow weir discharge, so that debris or fish removed from the screens can be monitored and identified. From these pumps the water goes into the service and operating water systems, or is fed directly to the collecting basin for dilution purposes (See Fig. 3.5).

Discharge structure

All Station effluents (except storm water drainage, turbine building and non-radioactive auxiliary building drains, which go to the Toussaint River) will be mixed in the collecting basin prior to discharge into Lake Erie. Most of this mixture will be cooling tower blowdown and its associated dilution water. The collecting basin has a small volume compared with the flowrates into it, and therefore has no holdup capacity but merely serves to mix the various effluent streams. From the collecting basin a buried pipe, six feet in diameter, runs parallel to the intake

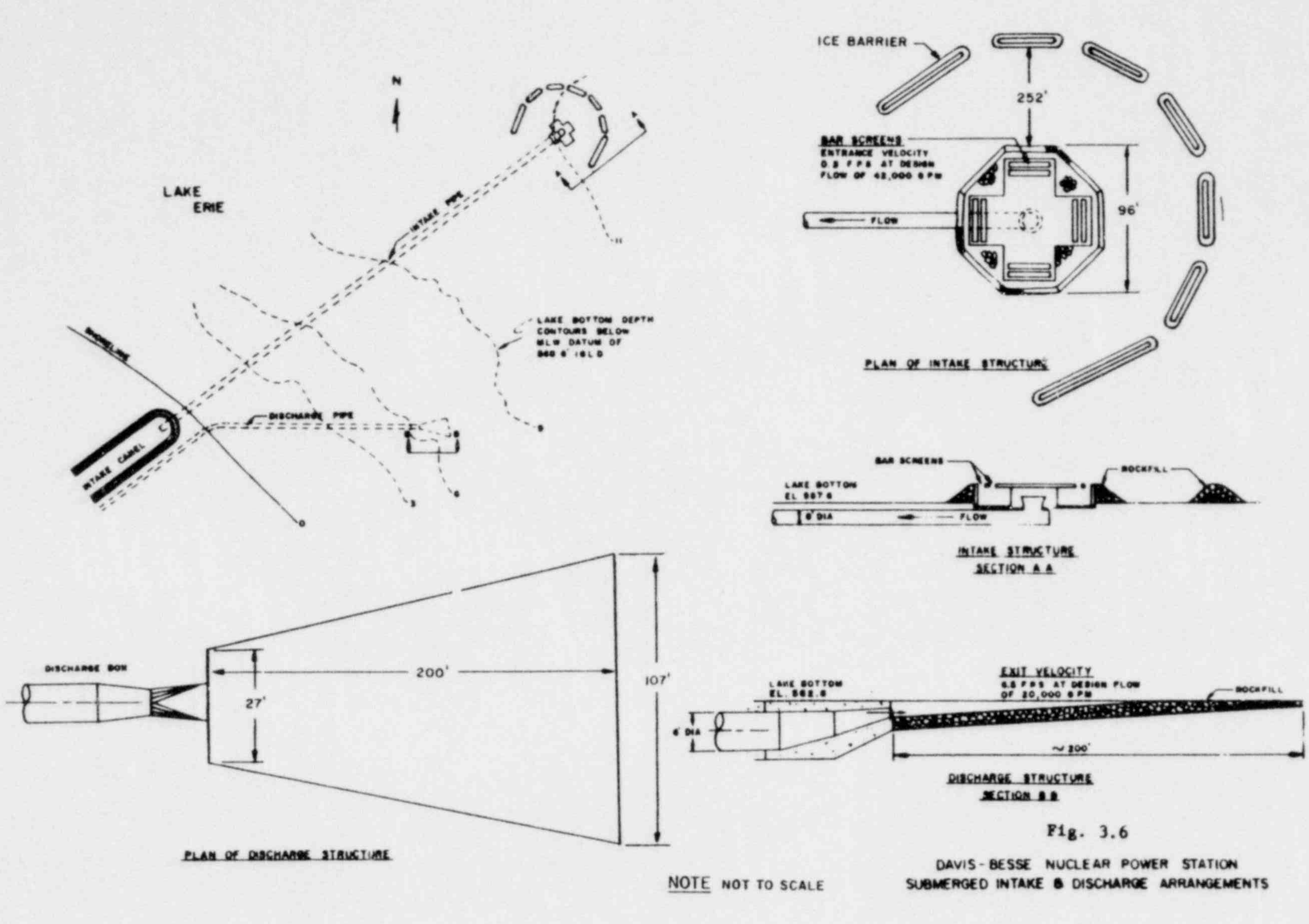


Fig. 3.6

DAVIS-BESSE NUCLEAR POWER STATION
SUBMERGED INTAKE & DISCHARGE ARRANGEMENTS

NOTE NOT TO SCALE

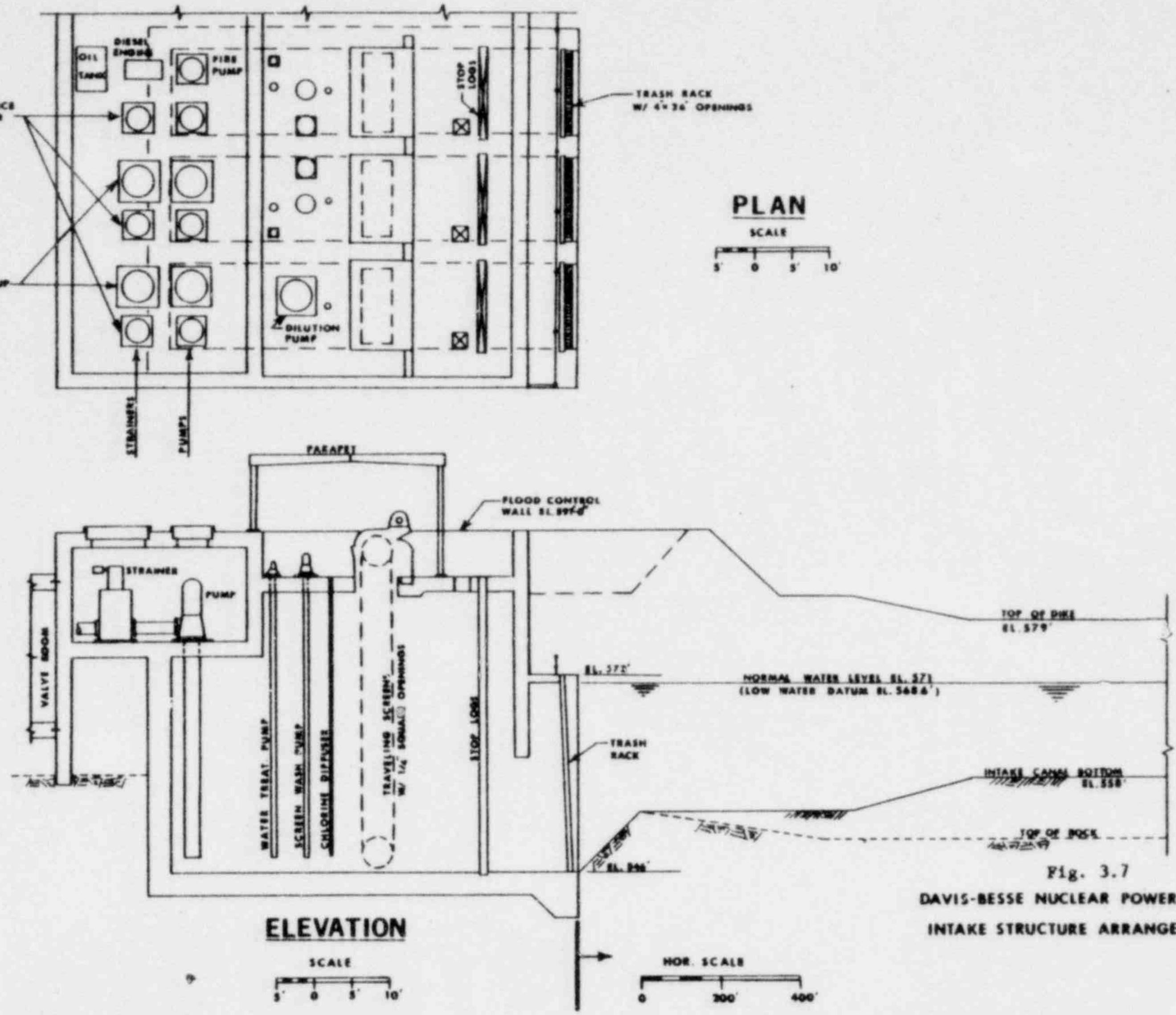


Fig. 3.7

DAVIS-BESSE NUCLEAR POWER STATION

INTAKE STRUCTURE ARRANGEMENT

canal on its eastern side and extends about 1300 feet eastward out under the lake, where it terminates with a 4.5 ft wide x 1.5 ft high slot-type jet discharge (See Figure 3.6). The discharge is located at a current water depth of about 9 ft (6 ft below the Lake Erie low water datum). The elevation of the collecting basin will provide the necessary head for discharge through the discharge pipe to the lake under all conditions of water level. The slot-type discharge will have an exit water velocity of about 6.5 ft/sec at the design maximum discharge flow of 20,000 gpm. The nominal water velocity will be 3.6 ft/sec at the expected discharge rate of 11,000 gpm, thus promoting rapid entrainment and mixing with the lake water. The lake bottom will be riprapped with rock for about 200 feet in front of the slot discharge to minimize scouring of the lake bottom and the water turbidity that would result.

3.3.3 Thermal Discharges to Lake Erie

Seasonal variations in Station water consumption and temperature of blowdown to the lake must be considered. The amount of local heating of the lake depends on the volume of blowdown and on the temperature difference between it and the lake. The cooling tower blowdown is taken from the cold water side of the loop and its temperature is dependent on the wet-bulb temperature of the air. Thus, the heat discharged to the lake depends on the difference between atmospheric wet-bulb temperature and lake temperature. This temperature difference varies considerably with the season of the year, as shown by the data in Table 3.1. Some lake water will be used to dilute the blowdown so that the effluent to the lake will never be more than 20°F above lake water temperature. A summary of quantities of cooling tower blowdown, dilution water, total discharge to the lake and heat added to the lake is presented in Table 3.2.

During winter months a portion of heated service water will be discharged to the intake canal forebay to prevent ice build-up at the Station intake structure.

Thermal Plume Analysis

The discharge of heated service water and cooling tower circulating water blowdown from the Station submerged discharge structure (1200 ft offshore) will generate a thermal plume in the lake. The Applicant's consultant, Dr. Pritchard, estimates the maximum area of this plume at the surface to be 0.21 acres (within the 3°F isotherm).[1] A detailed description of the computational model used to predict the discharge thermal plume is given in the paper presented by Dr. Pritchard at the Meeting of American Institute of Chemical Engineers in March 1971.[2]

TABLE 3.1. Temperature Difference between Station Cooling Tower Blowdown Water and Ambient Lake (°F)

	Minimum	Average	Maximum
January	-3	11.2	29
February	3	17.0	25
March	9	16.0	23
April	10	19.1	30
May	5	15.0	23
June	3	14.0	22
July	6	12.1	20
August	5	10.0	14
September	-5	5.0	14
October	6	17.0	23
November	7	17.1	30
December	8	18.2	30

Note
Atmospheric wet-bulb temperatures (taken at the onsite meteorology tower) were used to determine the cooling tower blowdown temperatures. The lake water temperatures were subtracted to obtain these numbers.

TABLE 3.2. Station Flow Rates and Heat Inputs to Lake Erie by Months

	Water Flow Rates (gpm)				Heat Input (10^6 BTU/hr.)	Temperature Rise Above Lake (°F)
	Cooling Tower Blowdown*	Process & Misc.	Dilution Water**	Combined Flow		
January	7,500	20	4,080	11,600	116	20.0
February	8,200	20	2,780	11,000	110	20.0
March	8,500	20	1,980	10,500	105	20.0
April	9,200	20	4,580	13,800	138	20.0
May	10,000	20	1,480	11,500	115	20.0
June	10,000	20	980	11,000	110	20.0
July	10,400	20	0	10,420	104	20.0
August	10,400	20	0	10,420	73	14.0
September	10,000	20	0	10,020	70	14.0
October	9,500	20	2,080	11,600	116	20.0
November	9,000	20	4,480	13,500	135	20.0
December	8,000	20	4,680	12,700	127	20.0

*The variation in cooling tower blowdown is due to the seasonal variation in evaporation from the tower. The tower is operated so that blowdown equals evaporation loss at all times.

**Dilution water flow is based on the quantity required to limit the maximum combined effluent discharge temperature to 20°F above Lake Erie temperature.

The Staff has written a computer program which codes the model equations specified in that reference. The inclusion of the vertical spreading phenomenon, which is only cursorily discussed in that paper, was done following the same technique Pritchard employed in his previous theoretical model studies of Zion and Waukegan.[3,4] The resulting program was run for Sub-Case-I-B and Sub-Case-II-B* featuring the current rectangular slot design. Our results and those reported by Dr. Pritchard differed. First, the distance from the orifice to the longitudinal position where the plume reaches the surface is predicted to be about 100 feet by Pritchard for all cases and subcases, but about 500 feet by our computer program. Employing the modified Koh and Fan analysis,[5] the circular jet of Cases I and II reaches the surface at 54 feet (the actual value should really be more than 54 feet since Koh and Fan assume no surface interference effects). The next, but related, question involves the quasi-two dimensionality of the Pritchard model. As represented in all his previous papers, the model yields constant temperatures and velocities with depth at any given surface location in the plume. Consequently, for distances beyond the plume intersection with the surface, the plume thickness should be a constant 8 feet, independent of surface temperature. This is not observed, however, in the tables on pages 25 and 27 of reference 1. Moreover, the vertical temperature isotherms sketched in Fig. 4-13 in the reference are not representative of a quasi-two-dimensional model such as Pitchard's. The plume predictions also do not represent or assess the partial spreading of the heated effluent in the directions opposite to the discharge direction, once the plume has reached the surface.

The major differences between our Pritchard code results and the results reported by Pritchard in reference 1 are in area and isotherm length-width predictions. For Sub-Case-I-B, the 3°F isotherm will have an area of 0.6 acres, a length of 347 feet and a width of 87 feet, according to our computer code, whereas Pritchard's results, in reference 1, show 0.16 acres, an isotherm length of 129 feet and a width of 62 feet. For Sub-Case-II-B, the values are 0.66 acres for the 3°F isotherm, a length of 336 feet and a width of 91 feet, according to the code; but 0.21 acres, 159 feet long and 66 feet wide, as predicted in reference 1. These differences are typical. The use in the program of Pritchard's own estimates for the distance of the plume to reach the surface yielded even larger differences when these new adjusted computer runs were made: the

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*Sub-Case-I-B is a heat discharge of 88 x 10^6 Btu/hr (volume flow rate of 9220 gpm at 19.1°F above lake temperature). Sub-Case-II-B is a heat discharge of 138 x 10^6 Btu/hr (volume flow rate of 13,800 gpm at 20°F above lake temperature).

areas and lengths given above are much smaller than those predicted in reference 1. One further point is of interest: the ratio of length to width to a given isotherm is equal to 4 as described in reference 2, yet this ratio varies in the results in reference 1.

The Staff estimates that the maximum surface area (within the 3°F isotherm) from the Station discharge of heated water, based on Pritchard's analytical model documented in reference 2, will be about 0.7 acres. This increase, however, does not change the conclusion that there will be negligible impact on the receiving waters.

3.4 RADIOACTIVE WASTE SYSTEMS

During the operation of the Davis-Besse Nuclear Power Station, radioactive material will be produced by fission and by neutron activation reactions of metals and material in the reactor coolant. Small amounts of gaseous and liquid radioactive wastes will enter the plant waste streams which will be processed and monitored within the plant to minimize the quantity of radionuclides released to the atmosphere and into Lake Erie under controlled conditions. The radioactivity that may be released during operation of the facility will be in accordance with the Commission's regulations as set forth in 10 CFR Part 20 and 10 CFR Part 50.

The waste handling and treatment systems for the plant are discussed in the Preliminary Safety Analysis Report and the Applicant's Environmental Report dated August 3, 1970, Supplement to Environmental Report dated November 5, 1971, and supplementary information dated April 21, 1972.

In these references, the Applicant has prepared an analysis of his treatment systems and has estimated the annual effluents. The following analysis is based on the Staff's model, adjusted to apply to this plant, and uses somewhat different operating conditions. The Staff's calculated effluents are, therefore, different from the Applicant's.

The waste treatment systems described in the following paragraphs are designed to collect and process on a batch basis the liquid, gaseous, and solid wastes that may contain radioactive materials. Samples of the radioactive gases or liquids will be collected at points within and at the end of the radwaste treatment systems and the wastes recirculated for additional decontamination if required. Instruments will monitor and record the radiation from controlled discharges and will activate alarms and control valves if the radiation is above a preset level. The principal assumptions and conditions the Staff used to determine the expected releases of radioactive materials in liquid and gaseous effluents are detailed in Table 3.3.

TABLE 3.3. Principal Conditions and Assumptions Used in Determining Releases of Radioactivity in Effluents from the Station

Thermal Power	2772 MWt
Plant Factor	0.8
Failed Fuel*	0.25%*
Total Steam Flow	11.8×10^6 lbs/hr
Number of Steam Generators	2
Weight of Steam - each Generator	5,100 lbs
Weight of Liquid - each Generator	49,900 lbs
Steam Generator Blowdown	0
Weight of Primary Coolant	525,400 lbs
Primary Coolant Volumes	
Degassed per year	12
Primary Coolant Gas Holdup Time	60 days
Containment Volume	2.86×10^6 ft^3
Containment Purges per year	4
Primary to Secondary Leak	20 gpd
Primary Coolant Leak to the Auxiliary Bldg.	20 gpd
Primary Coolant Leak to the Containment	40 gpd
Shimrod Bleed Flow Rate	0.37 gpm
Letdown Flow Rate	45 gpm
Partition Coefficients for Iodine gas/liquid	
Steam Generator Internal	1.0
Condenser Air Ejector	0.0005
Coolant Leak to Containment	0.1
Coolant Leak to Auxiliary Bldg.	0.005
Miscellaneous Waste Evaporator	0.01
Emergency Ventilation D.F.	100
Liquid Waste Holdup Time	
Clean Radioactive Wastes	36 days
Miscellaneous Radioactive Wastes	20.5 days

Total Decontamination Factors

	I	Cs,Rb	Y	Mo,Tc	Others
Shim Bleed	10^5	4×10^3	10^3	10^4	10^6
Clean Liquid Wastes	10^4	2×10^3	10^3	10^4	10^5
Miscellaneous Wastes	10^3	10^4	10^4	10^5	10^4

*This value is constant and corresponds to 0.25% of the operating power fission product source term.

3.4.1 Liquid Waste

The Davis-Besse design has four primary systems for collection and treatment of liquids. These are Make-Up and Purification, Clean Liquid Radioactive Waste (high purity), Miscellaneous Liquid Radioactive Waste (low purity), and Condensate Purification. The interrelationship of these systems is shown schematically in Figure 3.8.

The Make-Up and Purification System will maintain the water quality and boron concentration of the primary coolant. To control the radioactivity of the primary coolant during normal operation, a portion of the reactor coolant will be bled continuously through letdown coolers, a mixed-bed purification demineralizer (Li_3-BO_3 form) and filter, and then routed to the primary coolant make-up tank. A separate cation demineralizer will be used intermittently in conjunction with or in lieu of the mixed-bed demineralizer for cesium and lithium control. Near the end of the core life the primary coolant letdown will be processed through the purification demineralizer, filter, and deborating demineralizer back to the primary coolant make-up tank. Basically this closed system contributes only to the solid radioactive wastes of the station in the form of spent demineralizer resins.

For major boron control, an annual average shim bleed of 0.37 gpm will be diverted to the Clean Liquid Radioactive Waste System. The shim bleed may come from the purification demineralizers or from the make-up tank. The design basis process cycle will consist of passing the coolant through a degasifier, filter, and mixed-bed demineralizer (H^+-OH^- form) into a clean waste receiving tank. The waste will then be fed to a boric acid evaporator (15 gpm) with the distillate passing through a mixed-bed polishing demineralizer and filter into the clean waste monitoring tank. Based on the analytical data, the processed waste will be either diverted to the primary water storage tank, recycled or released to the mixing basin through a normally closed valve and monitoring station that automatically records, alarms, and closes the valve above a preset radiation level. The 70 gallons per minute discharge will be diluted with the ~21,000 gallon per minute discharge water. The Applicant assumed a 0.8 mixing factor for a dilution factor of 228 in the mixing basin before discharge to Lake Erie with which we agreed. The clean liquid radioactive waste system will also process primary coolant collected in the reactor coolant drain tank from the coolant system and pump seal drains, valve steam leaks and the chemical waste tank.

Concentrates from the boric acid evaporator will be fed through a mixed-bed demineralizer into a storage tank. From this tank the liquid will be

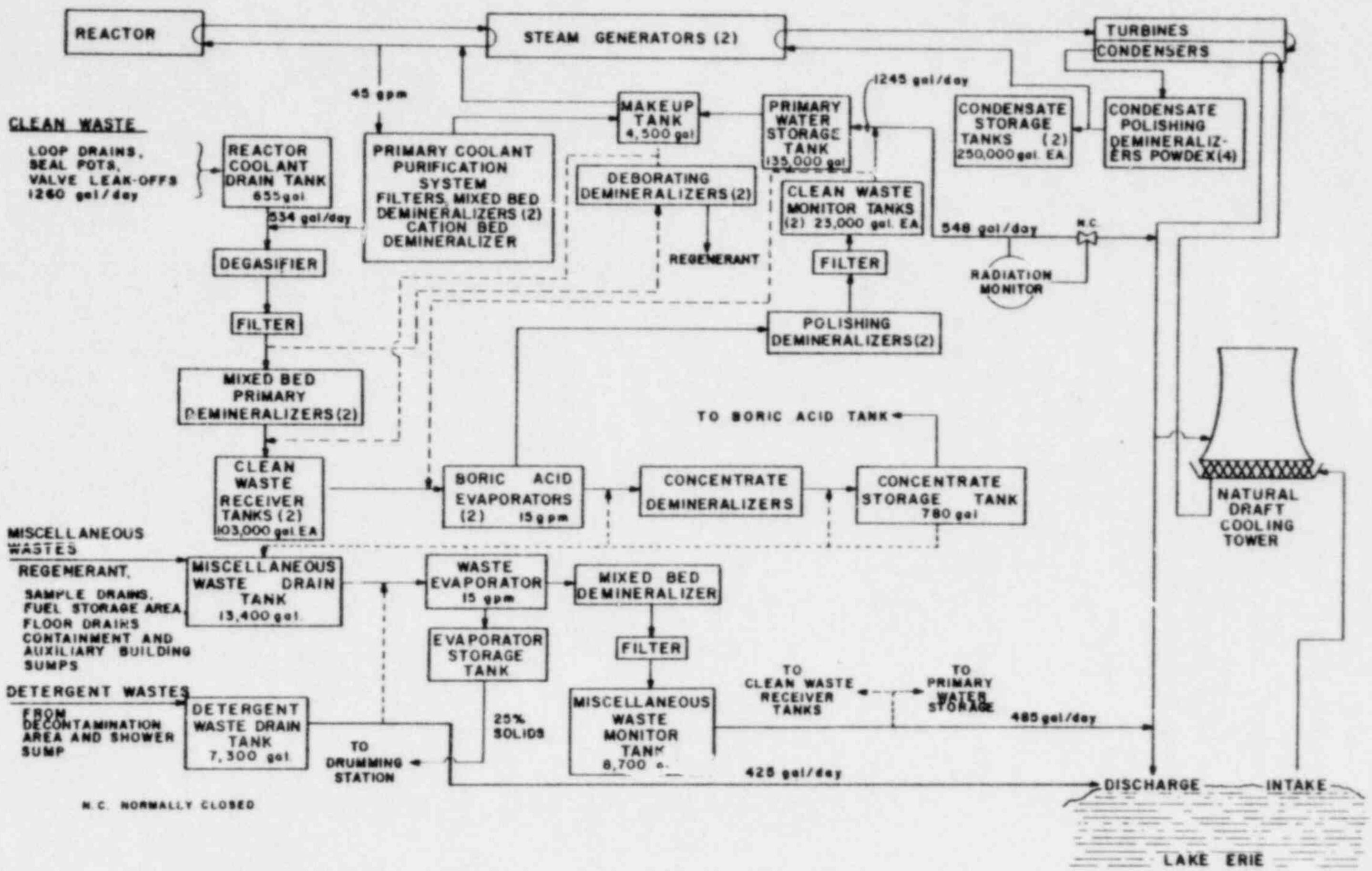


Fig. 3.8. Station Liquid Radwaste Systems

either sent to the boric acid storage tank, the solid waste drumming station or the Miscellaneous Liquid Radioactive Waste System described in the following paragraph. In our evaluation we assumed that 70 percent of the clean liquid radioactive waste stream will be reused and that 30 percent will be discharged to Lake Erie.

The Miscellaneous Liquid Radioactive Waste System (MLRW) is designed to process radioactive liquids collected in the miscellaneous waste drain tank and the detergent waste drain tank. Sources of the liquids stored in the miscellaneous drain tank for batch processing will be containment vessel and auxiliary building sumps, component cooling water relief valves, drains from the fuel storage area and laboratory, boric acid concentrate tank and the deborating demineralizer. These aerated non-detergent wastes will be fed to a 15 gpm evaporator with the distillate passing through a mixed-bed demineralizer and filter to a monitoring tank. Liquid from this tank will be either discharged to Lake Erie, recycled, or diverted to the primary water storage tank depending upon the purity. Evaporator concentrates will be mixed with a solidifying agent at the drumming station. The Applicant estimated an equivalent 48,000 gallons/year of primary coolant will be decontaminated in this system and discharged to Lake Erie through the discharge monitoring station. The Applicant also assumed 100% of all liquid waste from the miscellaneous liquid radioactive waste system would be discharged to Lake Erie. The Staff agrees with these assumptions and they were used in calculating release contributions from this system.

Detergent wastes from the hot shower sump, laundry and decontamination area will be collected in a tank, analyzed and handled accordingly. Normally, detergent wastes will be filtered and discharged to Lake Erie through the monitoring station without treatment. High specific activity wastes will be processed in the MLRW system before discharge. The activity of the potential detergent effluents was assumed to be a small fraction of the total discharge to the environment.

The Staff's estimated annual release of radioactivity in liquid wastes was calculated to be a fraction of the values shown in Table 3.4. However, to compensate for equipment downtime and expected operational occurrences the values have been normalized to 5 curies per year. Based on previous experience, the Staff has estimated the annual release of tritium will be approximately 1000 curies per year. The Applicant has estimated an annual release, exclusive of tritium, to be about 0.45 curie per year.

3.4.2 Gaseous Wastes

During power operation of the plant, radioactive materials released to the atmosphere in gaseous effluent will include low concentrations of

TABLE 3.4. Calculated Annual Radionuclide Release in Liquid Wastes from the Station*

Nuclide	Curies/yr	Nuclide	Curies/yr	Nuclide	Curies/yr
Rb-86	0.0012	Rh-103m	0.00008	Cs-136	0.16
Rb-88	0.0004	Rh-105	0.00001	Cs-137	0.58
Sr-89	0.0064	Rh-106	0.00003	Ba-137m	0.55
Sr-90	0.00002	Sb-127	0.000002	Ba-140	0.00052
Sr-91	0.00001	Te-125m	0.00007	La-140	0.00054
Y-90	0.00014	Te-127m	0.00057	Ce-141	0.00011
Y-91m	0.00001	Te-127	0.00058	Ce-143	0.00001
Y-91	0.045	Te-129m	0.0051	Ce-144	0.00008
Y-93	0.00002	Te-129	0.0032	Pr-143	0.00008
Zr-95	0.00011	Te-131m	0.00027	Pr-144	0.00008
Zr-97	0.000007	Te-131	0.00005	Nd-147	0.00003
Nb-95	0.00012	Te-132	0.001	Pm-147	0.00001
Nb-97m	0.000006	I-130	0.00049	Cr-51	0.000004
Nb-97	0.000006	I-131	2.37	Fe-55	0.000006
Mo-99	0.14	I-132	0.013	Co-58	0.00004
Tc-99m	0.13	I-133	0.25	Co-60	0.000004
Ru-103	0.00008	I-135	0.015	Np-239	0.000008
Ru-106	0.00003	Cs-134	0.72	Total	~5
				Tritium	~1000

*Radionuclides having a release rate less than 10^{-6} curies per year have not been listed.

fission product noble gases (krypton and xenon), halogens (mostly iodines), tritium contained in water vapor and particulate material including both fission products and activated corrosion products. The various systems for the processing of radioactive gaseous waste and ventilation paths are shown schematically in Figure 3.9.

The primary sources of gaseous waste will originate from the degassing of primary coolant discharged to the Clean Liquid Radioactive Waste system, displacement of nitrogen cover gas from liquid storage tanks, miscellaneous tank vents and the miscellaneous liquid waste evaporator. During reactor operation, vent valves on the Make-Up and Purification system will be closed and the system operated at a positive pressure. Thus the inventories of gaseous products, except krypton-85, will reach equilibrium levels which will tend to minimize the total yearly release of gaseous radioactivity. Normally, these gases, except those from the waste evaporator, will be collected in the waste gas surge tank, compressed into decay tanks, and held for 60 days decay. The contents of the tanks will be discharged through a high efficiency particulate air (HEPA) filter, a charcoal adsorber, and a radiation interlock monitoring system during a uniform release over a 30 day period. Due to the extended holdup time, Kr-85 becomes the major constituent released to the atmosphere from this system. The less contaminated cover gas may be tanked separately from other gases and recycled. The Applicant estimates that one of five tanks discharged in a year might require release after 30 days decay at which time only 2 percent of the initial activity will be present. In our evaluation, the Staff has assumed an average 60 day holdup time for all tanks discharged.

The miscellaneous liquid waste evaporator will be used for detergent wastes as well as non-detergent wastes if necessary and will be continuously vented through a charcoal adsorber to the Station vent. The Applicant estimates that 48,000 gal/yr. of primary coolant will be processed in the waste evaporator with a gas/liquid iodine partition coefficient of 0.001. The iodine releases for the waste evaporator, shown in Table 3.5, reflect the Staff's assumption of an iodine partition coefficient of 0.01 gas/liquid in the evaporator, a DF of 10 for the charcoal adsorber and a 20 day decay for accumulation time with two thirds of the source from containment leaks and one third from auxiliary building leaks.

Other sources of radioactive gases which are not considered sufficiently concentrated to warrant collection and storage originate from the containment building purges, primary coolant leaks to the auxiliary building, condenser air ejector exhaust contaminated by primary to secondary leakage when fuel cladding defects exist and steam leaks in the turbine building.

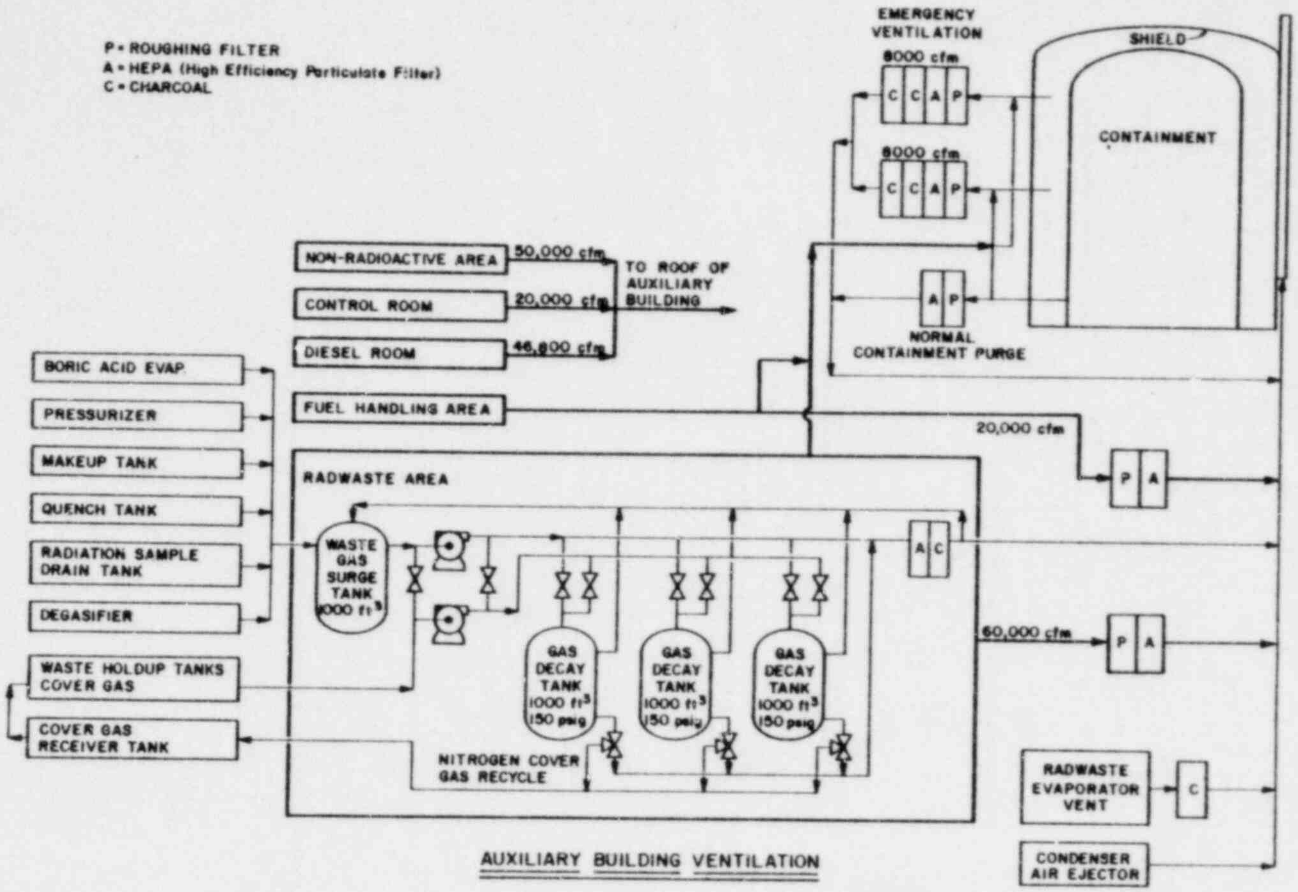


Fig. 3.9. Some Ventilation and Radioactive Gas Paths at the Station

Radioactive gases may be released inside the reactor containment building when the components of the primary system are opened to the building atmosphere for operational reasons or when minor leaks occur in the primary system. The containment building has no internal clean up system; however, before entry the containment atmosphere will be purged through a prefilter and high efficiency particulate filter (HEPA) to the station vent stack. The Applicant has stated in the PSAR that one of two parallel Emergency Ventilation Systems, consisting of a prefilter, HEPA filter and two charcoal adsorbers in series, will be used for normal containment purges if indicated by pre-purge analyses. In our evaluation we assumed that it will be necessary to purge the containment building 4 times per year through the Emergency Ventilation System.

The condenser air ejector exhaust will be discharged to the station vent stack without treatment. Air from the turbine building will exhaust through roof vents and auxiliary building air will be discharged to the Station vent stack through a prefilter and HEPA filter.

Additional sources of potentially contaminated air are the fuel storage area, penetration rooms, drumming station, and decontamination area. Normally, the ventilation air in these areas will be through a HEPA filter to the Station vent stack. A second Emergency Ventilation System identical to the one described for the containment building will be used to exhaust these areas when conditions warrant. The Staff assumed that under normal operating conditions the Emergency Ventilation System would not be used.

The plant will be provided with once-through steam generators and will be operated without blowdown.

The Staff's calculated releases from primary and secondary sources are shown in Table 3.5. The Applicant estimated an annual release of 1650 curies per year of noble gases and 0.005 curie per year of iodine. The Staff's calculated annual releases based on a 40 gallon per day leak to the containment and a 20 gallon per day leak to the auxiliary building were 2943 curies per year of noble gases, and 0.12 curie per year of I^{131}.

3.4.3 Solid Wastes

Solid wastes will consist of high level radioactive spent demineralizer resins, evaporator concentrates and filters and miscellaneous low activity level wastes such as clothing, plastic, paper, rags, glass, wood, metal, concrete and ceramics.

TABLE 3.5. Calculated Annual Release of Radioactive Materials in Gaseous Effluent from the Nuclear Power Station (curies per year)

Isotope	Containment* Purge	Auxiliary Building	Condenser Air Ejector	Waste Gas System 60 Day Holdup	Miscellaneous Waste Evaporator	Total
Kr-83m		1	1			2
Kr-85m		6	6			12
Kr-85	22	11	11	710		754
Kr-87		3	3			6
Kr-88		10	10			20
Xe-131m	2	6	6	5		19
Xe-133m	1	11	11	12		35
Xe-133	160	945	945	9		2059
Xe-135		16	16			32
Xe-138		2	2			4
Total						2943
I-131	0.004	0.08	0.008		0.02	0.12
I-133	0.0005	0.09	0.009			0.1

*Assumes single pass through 2 charcoal adsorbers of emergency vent system during purge.

The spent resins and evaporator concentrates will be stored in tanks for additional processing. Periodically, batches will be sent to the solid waste disposal drumming station located in the auxiliary building where the material will be mixed with a solidifying agent, drummed and stored for offsite burial.

All dry solid miscellaneous wastes will be hydraulically compacted into drums and stored for offsite burial. The non-compressibles will be sealed in the containers.

Based on operating experience at other plants and the capacity of the drumming station, the Applicant estimated 500 drums of high level and 150 drums of low level waste (4800 $ft.^3$) will be shipped annually to a licensed burial ground. All solid waste will be packaged and shipped in conformance with all applicable AEC and DOT regulations.

Staff's estimated annual disposal based on the operating experience of similar plants is 235 drums of high level wastes and 600 drums of dry compacted waste. The total activity after 180 days decay has been estimated at 2500 curies per year.

3.5 CHEMICAL AND BIOCIDES SYSTEMS

3.5.1 System Description

All plant water discharges are sent to a common collecting basin from which there is one discharge to Lake Erie. The pertinent water circuits are shown in Figure 3.5. In addition to the recirculating cooling water, carrying heat from the condensers to the cooling tower for discharge to the atmosphere, there are three pumping systems using lake water:

(1) Service water is pumped through systems from which heat must be removed. Since there are times when the service water flow rate will exceed the appropriate makeup rate for the recirculating cooling water, it has been made possible to discharge any excess into the collecting basin.

(2) A separate circuit is established for dilution and collecting basin makeup water. When the service water effluent is routed to the forebay area, this water is used for makeup to the recirculating cooling water system. As stated earlier, there are times when the temperature of the blowdown from the recirculating water system is greater than 20° above ambient lake temperature. At these times some water from the dilution and

collecting basin makeup system is pumped directly into the collecting basin in order to drop the temperature to 20° above lake temperature.

(3) Operating water is clarified, chlorinated, and used for several purposes. It provides potable and sanitary system water, maintains the level of the water in the fire protection system, and supplies the makeup water demineralizer, which provides makeup to the reactor primary and secondary water systems.

A settling basin is provided to contain the solids backwashed from the clarifier used in the operating water circuits and the solids from the secondary water-steam system condensate demineralizer backwash. The overflow from the settling basin is pumped into the collecting basin although there is an emergency overflow to the drainage ditch which leads to the Toussaint River. Various solutions from drains and other discharges in the nuclear waste monitor tanks (See Fig. 3.8) are checked for chemical content and radioactivity, then discharged occasionally into the collecting basin.

3.5.2 Chemicals Added

All the makeup to the recirculating system (cooling tower) is partially neutralized with sulfuric acid, releasing carbon dioxide, and thereby reducing the amount of scale formed in the condenser and the cooling tower. The Applicant's present plan is to operate at a pH of 7.3 (the pH of the lake water is about 8.1). The only other chemical added to the circuits is elemental chlorine. This is added as follows: 1) To the service water in four 30-minute periods per day (at a level required to maintain 0.5 ppm free residual chlorine) for defouling the heat exchangers; 2) To the recirculating cooling water system directly upstream of the condensers in four 30-minute periods per day (to maintain 0.5 ppm free residual chlorine); 3) To the operating water at the clarifier, where it gradually decays in the fire protection system, goes to the sewage treatment plant, or is removed in the makeup demineralizer; and 4) To the effluent from the sewage treatment system which is chlorinated continuously to maintain one ppm free residual chlorine.

3.5.3 Chemicals Discharged

The chemicals discharged to the lake are listed in Table 3.6.

<u>Cooling Tower Circuit</u>

The recirculating cooling water blowdown contains the major fraction of all chemicals discharged. Due to the evaporation of water in the cooling

TABLE 3.6 Summary of Chemicals Discharged to Lake Erie by the Station

Origin	Chemicals	Concentration at Origin (ppm)	Incremental Concentration in Discharge to Lake (ppm)	Total Quantity Discharged (Tons/Year)[a]
Recirculating cooling water blowdown	Normal Lake Erie dissolved excess produced by cooling tower evaporation. Predominantly carbonates, sulfates and chlorides of calcium and magnesium	202	202	8700
	chlorine: free	0.5	0.5[b]*	2.2[c]
	combined (chloramines)	0.07[d]	.03[e]*	0.1
Service water	chlorine: free	0.5	Unknown: depends on rates of excess flow directly to collecting basin at times of chlorination.	
	combined (chloramines)	0.9[f]		
Nuclear area effluent (Radwaste)	Miscellaneous non-toxic	50	0.8*	0.2
Sewage treatment system	Dissolved solids, reduction from that in lake	-45	-0.1*	-0.2
	chlorine: free	1	0.003*	0.004
	combined	Unknown		
Makeup demineralizer regeneration wastes	Normal lake solids concentrated in regenerant	2528	54.7*	49.3
	Sodium sulfate from neutralization of regenerant waste	2995	64.8*	58.4
Settling basin	Normal lake water from clarifier backwash; no excess	0	0	0
	condensate demineralizer backwash (pure water)	-225	-3*	-1.0

*While actually discharging.

TABLE 3.6 (Contd.)

Notes for Table 3.6

[a]Assuming 365 days per year operation (no reduction for load factor).

[b]Some free chlorine will be lost by reaction with organic growth and by sunlight-catalyzed decomposition before discharge to the lake. In the absence of knowledge of this amount, no reduction is made in the number in the table (See text).

[c]An allowance of 1.6 hours was made for full decay of chlorine in the recirculating water system. Each of the four daily chlorination periods was therefore assumed to discharge the equivalent of the full concentration for 1/2 hr during chlorination and 0.8 hour after chlorination. The calculated rate of discharge is believed to be greater than the actual amount that will be discharged by an unknown amount.

[d]This concentration calculated as steady-state value in the system during chlorination. Makeup water contains 0.37 ppm ammonia nitrogen; half of all chloramines in system assumed lost by evaporation for each pass through the cooling tower.

[e]Half the concentration entering the cooling tower is assumed to be lost in the tower.

[f]While actually discharging. Chlorine content of chloramines calculated equivalent to 0.37 ppm ammonia nitrogen in lake water.

tower the concentration of dissolved solids in the recirculating water is slightly less than double that in the lake (the concentration factor is not exactly 2X, even though the blowdown rate is equal to the evaporation rate, because of the addition of sulfuric acid and the loss of carbon dioxide). Except for the fact that the sulfate is slightly higher and the carbonate slightly lower, the ratios of the various chemicals are the same as in lake water.

The chlorine added for defouling the condensers and the cooling tower surfaces is sampled at a point just downstream of the condensers. Chloramines are produced by reaction of free chlorine (present as the hypochlorite ion and hypochlorous acid) with ammonia and organic amines present in the water and produced in the system by the growth of microorganisms. Some chloramines are quite volatile (notably $NHCl_2$)[7,8] so that they are lost by evaporation in the cooling tower, and to a slight extent in the return from the tower to the circulating pumps. Knowledge of this loss is needed to estimate the concentration of chloramines in the system during chlorination. Based on experience in other cooling towers it was decided to assume loss of one half of the chloramines in the system during flow of the total coolant through the cooling tower. With 0.37 ppm ammonia nitrogen continuously brought into the recirculating water system in the makeup 18,450 gpm (avg), the evaporative loss leads to a calculated steady state concentration (approximate concentration of chloramines when there is free chlorine present) of 0.07 ppm chloramines.

In the calculation of yearly discharges it was necessary to estimate the fraction of the time that chlorine would be discharged from the recirculating cooling water system. A calculation was made of the reduction in concentration of free chlorine by dilution in the makeup-blowdown operation, and by reaction with the chlorine demand (1.4 ppm) in the makeup water. The volume of water in the system was taken as 11.2 million gallons, the makeup rate 18,450 gpm, and the blowdown rate 9225 gpm. The calculation indicated that about 3.2 hours will be required for complete loss of free chlorine. Not included in the calculations was the loss expected in the cooling tower, and particularly in the open channel between the cooling tower and the recirculating pumps (Fig. 3.4). In the presence of sunlight, free chlorine is converted to dilute hydrochloric acid and oxygen, at a rate depending on light intensity and chlorine concentration. Under the conditions of the laboratory experiments of Hancil and Smith,[6] a 60-second exposure to the light would reduce free chlorine concentration more than 2000-fold. If because of limited penetration of the water by sunlight, local portions of dissolved chlorine in the return from the cooling tower received light at that intensity for 10% of the time there would be a factor of

2 reduction. There is no adequate method of estimating the loss of chlorine in passing through the cooling tower and in the return from the cooling tower due to reaction with bacterial and algal growth. In the only analogous case known to the Staff, chlorine has been said to be undetectable at the point of blowdown. With data so limited, it was decided to give no credit for such chlorine losses in the calculation of the amount released to the environment. An additional loss of free chlorine by depending upon system design, reaction with chlorine-demand constituents in dilution water could be expected in and just below the collecting basin at those times when dilution water is added to that point. This is seasonally variable (see Table 3.2), and would perhaps completely remove 0.5 ppm free chlorine before discharge in December, while not reducing its concentration at all in July, August, and September.

Because of these factors the calculated quantity of chlorine released (Table 3.6) will very probably be substantially in excess of the amount actually released. The quantity given in Table 3.6 for the tons/year discharge is based on a release of 0.5 ppm solution during each chlorination period (1/2 hour) and during half of the period of decreasing concentration following chlorination. The period of decreasing concentration was estimated to be half of the calculated 3.2 hours because of sunlight - catalized losses in the return from the cooling tower.

Excess Service Water

Some chlorine would be released to the lake from the service water that was diverted to the collecting basin during periods of service water chlorination. Flowrates at such periods are unknown; they are expected to be small, since service water flowrates are expected typically to be equal to the recirculating water makeup rate.

Sewage Treatment

The effluent from the sewage treatment system has a lower concentration of dissolved solids than the lake water. Negative numbers are used in Table 3.6 to reflect this.

Makeup Demineralizer Wastes

When the makeup demineralizer is regenerated, the salts previously removed from lake water are released in a neutralized solution, together with sodium sulfate that comes from the unused portions of the sodium hydroxide and sulfuric acid used in regeneration. Except for the sodium sulfate, the chemicals returned to the lake are those removed earlier.

Secondary System Blowdown

The secondary (turbine) system contains ammonia (1.2 mg/l), hydrazine (0.02 mg/l) and dissolved solids at a concentration less than 0.02 mg/l. There will be no blowdown from this system under normal operating conditions. If necessary, this system will be drained to the collecting basin.

Cooling Tower Drift

At the maximum anticipated drift, 0.01% (See Sec. 5.3.4), the cooling tower is expected to emit water droplets containing 247 pounds of dissolved solids per day. As the water evaporates, its solids will deposit on the land in the vicinity of the cooling tower. The estimated chemical composition of the drift and the solids deposited is shown in Table 3.7. For all constituents except sulfate and bicarbonate, concentrations were taken to be twice those in lake water. The sulfate level exceeds twice the lake concentration by an amount corresponding to the sulfuric acid added to reduce the alkalinity by 42 ppm ($CaCO_3$ equiv.). The bicarbonate concentration in the blowdown (and thus in the drift) depends on the initial bicarbonate concentration which is not quoted in the lake water analysis (Table 2.11). For the purpose of this calculation it was assumed to be 82.5 ppm, the quantity required to make the total dissolved solids add up to 225 ppm. This is a reasonable figure, but is less than the concentration (123 ppm) required to give the quoted alkalinity (101 ppm $CaCO_3$ equiv.). Addition of sulfuric acid will reduce this to 31 ppm in the treated water and 62 ppm in the blowdown.

The neutralization of bircarbonate alkalinity will produce about 2.0 tons of carbon dioxide per day, and most of this will probably be released from the cooling tower as carbon dioxide gas.

Also, chloramines will be lost by evaporation from the cooling tower. The quantities cannot be estimated accurately; however, the addition of chlorine to the 0.37 ppm ammonia nitrogen in the circulating water system makeup produces 0.86 ppm chlorine in the form of chloramines. If all except the steady state value of 0.07 ppm (See Table 3.6) is released to the atmosphere, the chlorine content of the mixed chloramines will be 15 pounds during the two hours each day that chlorine is added to the system.

3.6 SANITARY AND OTHER WASTE SYSTEMS

The secondary sewage treatment plant is designed to serve a total of 360 plant employees and visitors. About 3,000 gallons per day of treated effluent is expected to be discharged to the collecting basin (See

TABLE 3.7. Cooling Tower Salts Discharged in Drift

Constituent	Concentration in Drift (ppm)	Percentage of total	Deposits (pounds/day)
Total dissolved solids	427	100.0	247
Calcium	90	21.1	52.1
Magnesium	22	5.2	12.8
Sodium	24	5.6	13.8
Chloride	44	10.3	25.4
Nitrate	24	5.6	13.8
Sulfate	154	36.1	89.2
Phosphate	3	0.7	1.7
Silica	4	0.9	2.3
Bicarbonate	62	14.3	35.8

Figure 3.5). This effluent will be chlorinated continuously, so as to maintain 1 ppm residual free chlorine. It is the Staff's evaluation that the free chlorine discharged from the secondary sewage treatment plant (flow approximately 2 gpm average) will have an insignificant environmental impact since it is diluted with the cooling tower blowdown (flow approximately 9225 gpm) in the collecting basin.

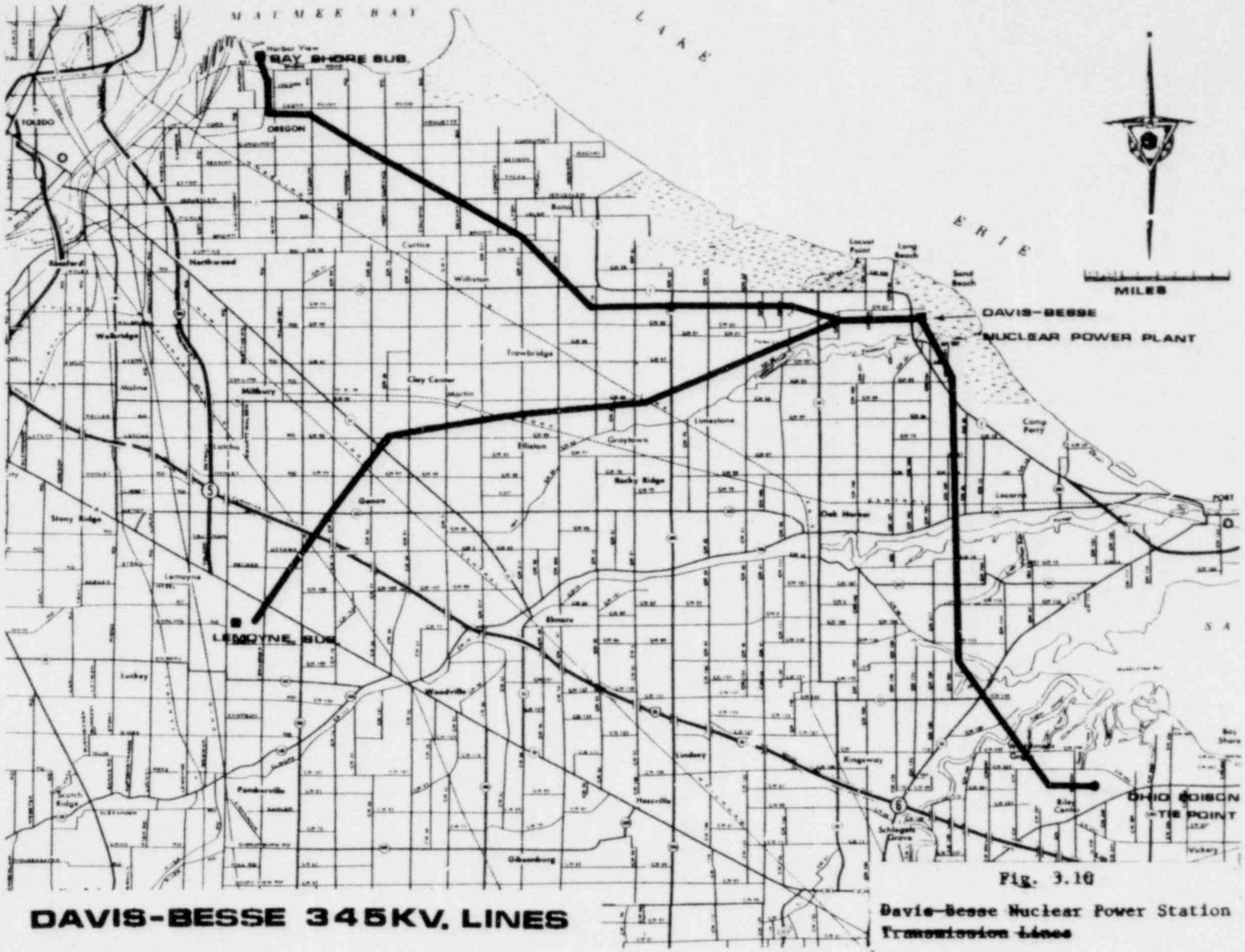
The trash from the water-intake screens and nonradioactive solids from the clarifier and condensate demineralizer will be packaged for commercial disposal.

3.7 TRANSMISSION LINES

Three new high voltage transmission lines are being built for the Station. Two of the lines will go to Toledo Edison substations and the third will go to an Ohio Edison substation (See Fig. 3.10). Power is generated at 25 kV by the Station generator and stepped up to 345 kV by the main power transformer in the Station switchyard. Each of the three 345 kV lines leaving the switchyard will be a single circuit bundle conductor line in vertical configuration with two shield wires on double-circuit towers. Double-circuit towers are being provided so that a second circuit can be added to each line if additional generating facilities are ever built at the site.

The transmission line towers are of the lattice steel type with tower heights varying from 120 to 190 feet (averaging about 150 feet). The base dimension of a typical tower is 40 ft x 40 ft. The towers were kept as low as possible by using high strength conductors to reduce line sags, thereby giving lower line profiles. The towers have a dull metallic finish.

The Bay Shore line will be about 21 miles long, extending from the Station switchyard west and then northwest to Toledo Edison's Bay Shore substation. The right of way is 150 feet except where it parallels the existing Bay Shore to Ottawa 138-kV line. In this region, the right of way is 145 feet, contiguous to the existing 100 feet for the 138 kV line. The Lemoyne line will be about 21 miles long, extending from the Station switchyard west and then southwest to Toledo Edison's Lemoyne substation with a 150 foot right-of-way. The Beaver line will be about 59 miles long, extending from the Station switchyard south and then southeast to Ohio Edison's Beaver substation (not shown on Fig. 3.10). The portion of the Beaver line under this project extends from the Station about 15 miles south and southeast to a tie point on the boundary between Toledo Edison and Ohio Edison. The remaining 44 miles, in Ohio Edison territory, are being constructed under a separate project. Approximately 1800 acres, primarily flat agricultural land, are required for the rights of way.



DAVIS-BESSE 345KV. LINES

Fig. 3.10

Davis-Besse Nuclear Power Station Transmission Lines

Effort was made in design of the transmission system to minimize the impact and optimize the compatibility of the transmission facility with the environment. The lines are routed to avoid paralleling existing major highways. Some paralleling of State Route 2 does occur near the Station, but here the Bay Shore line is located over one-half mile from the road and the Beaver line is approximately one-half mile away. At all major road crossings (state highways, U. S. highways, or interstate highways) the rights-of-way consist of either cultivated fields or orchards. The rights-of-way will be left natural at these road crossings. Efforts were made to avoid crossing the major highways at or near intersections. The Lemoyne line does cross State Route 163, 175 feet from the intersection of Billman Road, but this is the only exception.

In an effort to reduce the number of utility corridors across the countryside, the Bay Shore line is located adjacent to the existing Bay Shore-to-Ottawa line for about 11.6 miles and parallels the Lemoyne line for about 2.2 miles upon entering the Station. In addition, the railroad spur that serves the Station and interconnects with the Norfolk and Western Railroad is installed on the Lemoyne line right-of-way for about 7.8 miles.

Although the "Environmental Criteria for Electric Transmission Systems" (by Departments of Interior and Agriculture) was published well after the design and planning of the Station transmission lines was started, the applicant states good design practices followed were consistent with the Criteria. Herbicides will not be used to maintain the rights-of-way.

REFERENCES

1. "Davis-Besse Nuclear Power Station, Supplement to Environmental Report," Vol. 1, Appendix 4B.

2. Pritchard, D. W., "Design and Siting Criteria for Once-Through Cooling Systems," Chesapeake Bay Institute, The Johns Hopkins University, March 1971.

3. Pritchard, D. W., "Predictions of the Distribution of Excess Temperature in Lake Michigan Resulting from the Discharge of Condenser Cooling Water from the Zion Nuclear Power Station," April 1970.

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

5. Shirazi, M. A. and L. R. Davis, "Workbook of Thermal Plume Prediction, Volume 1, Submerged Di--har ," National Environmental Research Center, Corvallis, Oregon, April 972.

6. Hancil, V. and J. M. Smith, Ind. Eng. Chem. Process Design Develop. 10, 515-523 (1971).

7. Laubusch, E. J., Chapter 5 of The Water Quality and Treatment Handbook. Third Edition. American Waterworks Association. 1971. pgs. 186, 187, 206, 207.

8. Griffin, A. E. and R. J. Baker. "The Break-Point Process for Free Residual Chlorine." Journal of the New England Water Works Association, September 1959.

4. ENVIRONMENTAL EFFECTS OF SITE PREPARATION AND STATION AND TRANSMISSION LINE CONSTRUCTION

4.1 EFFECT ON LAND USE

The Station structures include the reactor containment building, turbine building, auxiliary building, and cooling tower, as shown in the Station layout in Figure 3.2. The Station, not including cooling tower, will occupy 56 acres of the 954-acre site. In addition, there will be almost 46 acres of ponds resulting from filling of the borrow pits.* The Station facilities, including the borrow pits and quarry, were constructed on farmland, requiring removal of very few trees. At the time construction began, 160 acres were classified as agricultural. Currently 15 acres remain under cultivation in the southwest portion of the site. The main Station area was graded up to an elevation 6 to 12 feet above the original grade. The marsh area was disturbed only for construction of the intake canal. The discharge pipe will be buried along the edge of the intake canal and the marsh will not be further disturbed by its installation.

Off-site transmission facilities are constructed largely over flat farmland; only about 4.7 miles of wooded area will require clearing out of a total of 57 miles** of right-of-way. Routes were selected to minimize conflict with present uses of the land. The rights-of-way were selected to avoid unnecessary removal of homes or other usable buildings, disturbance of forested areas, interference with radio and television facilities, or traversal through towns, villages, cemeteries, schools, playgrounds, manufacturing facilities, parks, or other recreational facilities. Marshland, creeks and rivers were avoided where possible because they are areas of wildlife concentrations. The Bay Shore transmission line was routed south of State Highway 2 to bypass Metzger Marsh, Ottawa National Wildlife Refuge, Magee Marsh and the open expanses of water at the mouth of Turtle Creek. The Lemoyne line was routed north of Toussaint River and Creek to avoid crossing that stream and to bypass Toussaint Creek Wildlife area. The Beaver line was routed west and south of Sandusky Bay to avoid the marsh areas and coves located along the edge of the bay. Therefore no government-designated marsh areas or wildlife refuges were crossed.

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*A small portion of one of the borrow pits is being used as a landfill during construction.

**Does not include the 44-mile extension of the Beaver line being constructed by Ohio Edison (See Section 3.7).

The routes selected do not pass near any natural or historic landmarks. The only government-designated scenic area crossed is that section of State Highway 163 where it parallels the Portage River. The Beaver line crossing of this area was selected at a point where the Scenic Highway was not adjacent to the Portage River and at one of the narrow points of the river to reduce the crossing span and adjacent tower heights.

During construction, excess excavated materials is being graded around the base of each tower to conform with the existing lay of the land. Construction areas will be filled or leveled to minimize erosion and to leave the entire right of way in as close to natural condition as possible.

4.2 EFFECT ON WATER USE

4.2.1 Temporary Barge Channel

The Applicant's method of delivery of the reactor pressure vessel to the site was by barge. This required dredging of a temporary barge channel in Lake Erie connecting with the intake water canal. Accordingly, the Applicant applied to the U. S. Army Corps of Engineers for a permit to dredge and maintain a temporary (100 days, from beginning of dredging to completion of backfilling) barge channel to a depth of 3.6 feet below the Lake Erie low water datum (LWD) of 568.6 feet MSL at the site, to connect to the existing intake water canal (Figure 4.1). The channel was approximately 650 feet long, 50 feet wide and 1.8 feet deep (average), and required the removal of approximately 3300 cubic yards of material (75% sand-25% hard (glaciolacustrine) clay) from the lake bottom. The removed material was stored at the edge of the channel and replaced on the lake bottom after delivery of the reactor vessel.

An earlier dredging plan submitted by the Applicant, which involved dredging a deeper channel and removal of about 34,000 cubic yards of sand and clay,[1] was opposed by local property owners. The opposition centered on alleged erosion damage to the beach and inland marsh areas, increased turbidity of the lake water, and introduction of pollutants (dissolved from the dredgings). The Applicant modified the plans to take advantage of the currently high water level of the lake* and, as described above, requiring a greatly reduced amount of dredging. A new application was submitted to the Corps of Engineers[2] and the permit was issued on Aug 4, 1972, dredging commenced on October 12, 1972 and refilling of the channel was completed on January 12, 1973.

*The lake level is currently averaging ~3 feet above the LWD.

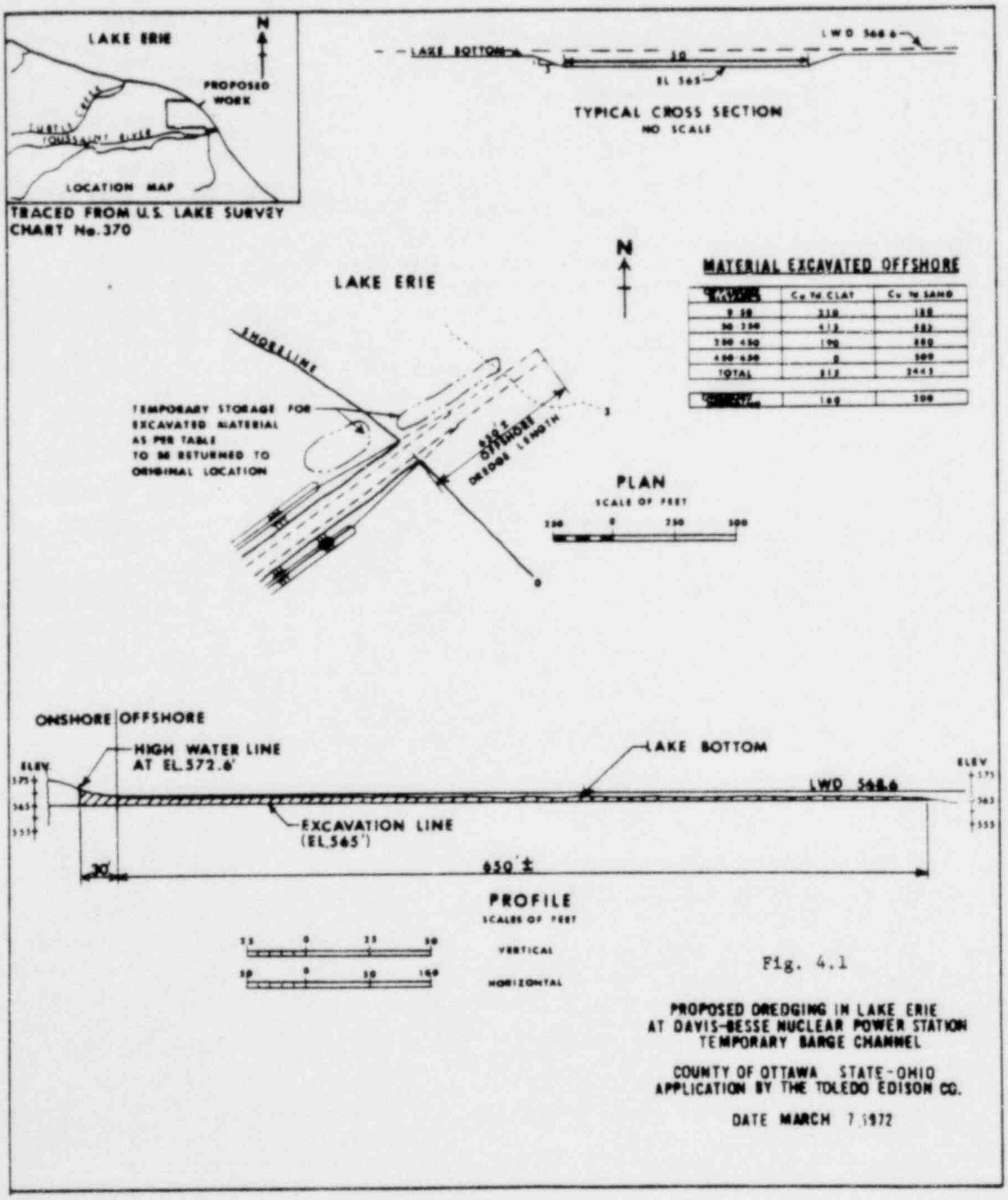

Fig. 4.1

PROPOSED DREDGING IN LAKE ERIE
AT DAVIS-BESSE NUCLEAR POWER STATION
TEMPORARY BARGE CHANNEL

COUNTY OF OTTAWA STATE-OHIO
APPLICATION BY THE TOLEDO EDISON CO.

DATE MARCH 7 1972

A study by the Applicant's consultant, Dr. Herdendorf,[3] concluded that there would be no lasting adverse environmental effects from the proposed dredging and that the time proposed for the operation (beginning in the third quarter of 1972) is optimal, since the lake storms are less severe during this period. He also concludes that the dredging will not cause shoreline erosion because of the rather unusual lake current situation at Locust Point, wherein the sand transported to the east and west by littoral drift is replenished by sand carried in from the offshore lake bottom. A recent study by the Corps of Engineers[4] also lists the Lake Erie shoreline around Locust Point as a non-critical erosion area. Dr. Herdendorf further states that water turbidity will be minimal and that the chemical nature of the sediments, mainly ancient lake and glacial clays, means that they are unpolluted, in contrast to materials dredged from harbors. Because of the low chemical oxygen demand of the sediments, they will not cause measurable oxygen depletion when placed in suspension temporarily.

The Ohio Department of Natural Resources and the Ohio Department of Health have provided the water quality certification required before the Corps of Engineers can issue a permit. The state certification gives approval to the project and lists some procedures, primarily aimed at reducing water turbidity and restoring the shoreline to its original condition, which the Applicant should follow.[5] All the beach areas and the lake bottom will be restored to their natural condition after backfilling of the barge channel.

It was the Staff's evaluation that dredging operations for the temporary barge channel would produce some slight short-term damage to aquatic life in the immediate vicinity, but no lasting effects on the aquatic environment was expected.

4.2.2 Intake and Discharge Pipelines

Dredging and backfilling of the trenches for the intake and discharge piping present potential impacts of the same nature as those discussed above for the dredging of the temporary barge channel. However, in the case of the pipeline the trenches will be deeper, resulting in the removal of underlying glacial till (a hard clay containing some sand and gravel) in addition to the sand and glaciolacustrine clay which will be removed for the barge channel. In this case, also, Dr. Herdendorf concludes that the proposed construction will result in no lasting damage.[6] His conclusion is based on an analysis similar to that for the barge channel and experience with similiar projects on Lake Erie. All beach areas and the lake bottom will be restored to their natural condition after installation of the piping.

The pipeline construction will require 4 to 5 months to complete and will cover the period from late spring to early fall 1973. Accordingly, The Ohio State University Center for Lake Erie Research (CLEAR) has started to conduct a monitoring program to assess the effects of the temporary barge channel construction, which will be completed before the pipeline construction starts.[6] The data from this program will presumably aid in developing procedures to further minimize the impact of the pipeline construction. The Applicant filed a permit application with the Corps of Engineers for this construction on Aug 1, 1972.

It is the Staff's evaluation that dredging operations for the permanent water intake will produce some slight short-term damage to aquatic life in the immediate vicinity, but no lasting effect on the aquatic environment is expected.

4.2.3 Ground Water and Storm Water Drainage Systems

The main Station area storm drain system prevents storm run-off from the construction area from entering the marsh. All exposed earth surfaces drain into the borrow pits, thus preventing silt from reaching any waterway.

All the ground water which was pumped out of the excavations during construction was eventually discharged to the Toussaint River, after passing through an aeration pond and the drainage ditch connecting it to the river. The aeration pond provided for reduction of the H_2S content (naturally about 5ppm in the ground water) of the effluent to less than 0.1 ppm. It was not desirable for water with this high a concentration of H_2S to enter the river. The pumping and discharge of ground water ceased when the construction of foundations was completed.

Artesian pressure in the rock aquifer forces water to flow into the excavations for foundations in the bedrock. Since these excavations must be kept dry they were continually pumped; however, the resulting water flow leads to a reduction of the rock aquifer water table. Reduction of the water table level off-site was minimized by grouting the upper bedrock layer at the perimeter of the excavations, thereby reducing the water flow into the excavations. Upon completion of the foundations the excavations were backfilled and pumping was no longer necessary. The water table then returned naturally to the normal level. The small (temporary) change in the water table has not affected the wells in the vicinity of the site.

4.3 EFFECTS ON SITE ECOLOGY

As the result of an exchange arrangement and long-term lease agreement with the Bureau of Sport Fisheries and Wildlife, there has been a net addition of more than 500 acres of marsh under Bureau management to serve as a wildlife refuge. The arrangement with the Bureau of Sport Fisheries and Wildlife has resulted in the following actions to enhance the area as a wildlife refuge. 1.) A dike was constructed through the marsh (Figure 2.4) at the northern edge of the site boundary in late summer of 1971; this season was chosen to avoid interference with nesting and migratory wildfowl. The dike separates the site refuge area from an adjoining private marsh, permitting water level control for improved marsh management. 2.) Existing dikes on the Navarre Marsh were in poor repair when the site was acquired; these are being repaired and maintained. The banks of the intake canal have also been seeded and planted to prevent erosion. 3.) The Applicant will install permanent water pumps to control water levels for operation by the Bureau as part of the marsh management program. 4.) Construction workers have been kept out of the marsh areas.

Operation of on-site borrow pits, the quarry, and the concrete batch plant have eliminated major sources of heavy truck traffic frequently associated with large construction projects. In cooperation with the Ohio Department of Highways, State Route 2 was widened at the construction road entrance to provide turning and passing lanes, as a means of expediting traffic flow in and out of the site. On-site parking is provided for all construction workers. The dirt roads on the site are wet down during dry periods to reduce dust.

After construction is completed, the quarry and borrow pit areas will be allowed to fill with water and the surrounding areas will be landscaped.

4.4 EFFECTS ON THE COMMUNITY

Site preparation at the Station began in May 1970 and construction started in September 1970, after receipt of an exemption from the Commission. Construction has proceeded in accordance with applicable federal, state, and local regulations, and necessary approvals, certifications, and licenses have been obtained in accordance with those requirements (see Section 1.3). The state of major construction at the Station as of September, 1972 is shown in the photograph of Figure 3.3. Overall, construction is about 45% complete and commercial operation is scheduled for spring 1975. This is based on the following timetable:

Completion of containment building - fourth quarter, 1972.
Delivery and installation of reactor vessel and steam generators - fourth quarter, 1972, and first quarter of 1973.
Installation of piping - 1972 and 1973.
Delivery of turbine - second quarter, 1973.

The status of transmission line construction, as of February 1, 1973, is as follows:

Activity	Bay Shore Line	Lemoyne Line	Beaver Line*
Right-of-way secured	100%	100%	68%
Tree clearing completed	100%	100%	20%
Tower foundations	100%	100%	5%
Tower erection	100%	99%	5%
Cable installation	99%	0%	0%

Currently, there is a construction force of approximately 1100 at the site; however, the construction force will peak at approximately 1600-1700 workers during 1973. Most of the workers come from Port Clinton, Toledo, Fremont, and Sandusky. However, since this local area will not be able to supply the total peak anticipated work force, workers from outside the area will move into communities in the vicinity of the Station during the peak construction period. At the present employment level of 1100, the monthly payroll is approximately $2,200,000 and it will vary roughly in proportion to the work force. There is no present or anticipated strain on the school systems or housing in the area. To date, the work at the Station has taken up the slack caused by lower than normal construction activity in the area.

*Tie to Ohio Edison.

Section 4. References

1. Application by Toledo Edison Company to the Corps of Engineers for Construction of an Off-shore Barge Channel in Lake Erie - Davis-Besse Nuclear Power Station, Aug 19, 1971.

2. Application by Toledo Edison Company to the Corps of Engineers for Proposed Dredging in Lake Erie at Davis-Besse Nuclear Power Station - Temporary Barge Channel, March 7, 1972.

3. Herdendorf, C. E., "Anticipated Environmental Effects of Dredging a Temporary Barge Channel at the Davis-Besse Nuclear Power Station," a report to the Toledo Edison Company, March, 1972.

4. Great Lakes Region Inventory Report, National Shoreline Study, Department of the Army, Corps of Engineers North Central Division, August 1971.

5. Letter, W. B. Nye, Director, Ohio Department of Natural Resources to Col. M. B. Snoke, Detroit District Engineer, U. S. Army Corps of Engineers, June 19, 1972.

6. Herdendorf, C. E., "Anticipated Environmental Effects of Constructing Water Intake and Discharge Pipeline in Lake Erie at the Davis-Besse Nuclear Power Station," a report to the Toledo Edison Company, July, 1972.

5. ENVIRONMENTAL EFFECTS OF STATION OPERATION

5.1 EFFECT ON LAND USE

Operation of the Station will produce a very small effect on land use. The marsh areas within the site boundaries originally totalled about 640 acres, and of this, only the 24 acres excavated for the intake canal will be permanently altered. The remaining marsh areas, more than 600 acres, will be preserved as a National Wildlife Refuge and the water level control measures provided by the Applicant will enhance the value of these areas. Further, the 188 acres of marsh between the site and the Toussaint River have been protected against undesirable development through acquisition by the Applicant.

Of the remaining non-marsh area, about 100 acres remain in their original state as woodland and low grassland, and about 230 acres are upland of which 160 acres were formerly classified as agricultural, formerly used for farming. Most of this farmland will be occupied by Station structures, ponds formed by filling of the borrow pits and quarry, and paved or landscaped areas around and between these features. A small area (about 15 acres), adjacent to Route 2 will be farmed by a custodial employee, and a quarter of the crop will be left as food for wildfowl.

The presence of the Station will not affect access to the lake, lakeshore, or surrounding land areas. Prior to acquisition by the Applicant, the site area was privately or Federally owned, and the public had no access to the lakeshore. Sand Beach and Long Beach cottage communities are reached by a side road from Route 2, about a mile northwest of the site entrance, and this has not been affected.

The Station, with its large concrete cooling tower and vapor plume, in spite of whatever architectural merit it may possess, will inevitably be regarded by most people as an extraneous feature of the landscape. Its visual impact will be felt particularly by observers on Route 2, on the lake, and in the Sand Beach and Toussaint River cottage areas. The Applicant has stated that all possible efforts will be made to improve the appearance of the Station by landscaping, but a landscaping consultant has not yet been retained. The nearest public recreational areas are Crane Creek State Park and the Toussaint Creek Area, about 3 and 4 miles away, respectively. Owing to the very flat terrain, the cooling tower will be visible in clear weather for 10 miles or more. Except for periods of lake breeze, the prevailing winds will most frequently carry the vapor plume over Lake Erie.

5.2 EFFECT ON WATER USE

5.2.1 Water Flow Plan

All water used at the Station is drawn from Lake Erie. The supply is used for:

1. Service water system,
2. Dilution and cooling tower makeup system, and
3. Operating water system.*

The major streams discharged from the plant to a collecting basin and thence to the lake are:

1. Cooling tower blowdown,
2. Sanitary sewage, and
3. Industrial waste (includes treated radwaste).

Storm water runoff goes to the Toussaint River via the drainage ditch (see Section 3). The storm drain system also carries drainage (resulting from nonradioactive equipment leaks) from the turbine and auxiliary buildings. Storm water runoff and building drainage passes through an oil interceptor before reaching the drainage ditch.

5.2.2 Water Consumption

The only significant consumptive use of water is the evaporative and spray loss from the cooling tower, which varies between 7500 and 10,400 gpm (average rate of 9225 gpm, 21 cfs), depending upon climatic conditions. This is about 0.1 percent of the lake average natural evaporation rate of 25,000 cfs** and, thus, does not have a significant impact on the overall water balance.

*The operating water system is the source of: potable water, sanitary system water, demineralized water supply for primary and secondary system make-up, and fire protection system water.

**Report to the International Commission on the Pollution of Lake Erie, Lake Ontario and the International Section of the St. Lawrence River - Volume 2. Lake Erie, 1969.

5.2.3 Thermal Discharges

Approximately 98% of the waste heat produced by the Station is discharged to the atmosphere via the cooling tower. The remaining 2% is discharged to Lake Erie with the cooling tower blowdown. The resulting maximum heat load to the lake is 138 million BTU/hr (13,800 gpm at a temperature 20°F above ambient lake temperature). The maximum load will occur during April (Table 3.2).

Applicable water quality criteria for Lake Erie have not yet been completely resolved. The Ohio Department of Health, Water Pollution Control Board, first defined these criteria on April 11, 1967 by applying existing stream water criteria as the minimum standards for Lake Erie waters in Ohio. These stream water criteria were revised in October 1967 and submitted to the Secretary of the Interior for approval (this was before the establishment of the U. S. Environmental Protection Agency). With the exception of the temperature and dissolved oxygen criteria, these amended criteria were approved by the Department of Interior on March 4, 1968. On April 14, 1970 the Ohio Water Pollution Control Board issued new stream water criteria, defining Aquatic A (warm water fish population) criteria as applicable to Lake Erie. These criteria are reproduced in Appendix A. They established stricter standards for dissolved oxygen, pH, and temperature, specifying a maximum temperature rise of 5°F at any point, but were qualified by the phrase "except for areas necessary for the admixture of waste effluents with stream water," thus acknowledging the necessity for a mixing zone.

On April 8, 1971 the Applicant applied to the Water Pollution Control Board for certification for the purposes of Section 21(b) of the Federal Water Pollution Control Act, and submitted a report and plan covering the proposed discharges to Lake Erie. This report and plan was amended in July 1971, and includes the thermal plume calculations made by Dr. Pritchard, the Applicant's consultant. These calculations are discussed in Section 3. On March 21, 1972, certification was received from the Board. The Staff's independent calculations, also discussed in Section 3, predict that the thermal plume will be larger (0.7 vs 0.2 acres) than indicated by Dr. Pritchard's calculations, however this does not qualitatively change the conclusions regarding negligible impact on the receiving waters.

Just before this certification was issued, on March 14, 1972, the Water Pollution Control Board adopted amended stream water criteria, stating in the preamble that certain changes were made in response to recommendations of the EPA. This latest resolution removes Lake Erie from the list of waters to which the criteria apply, but does not change the criteria for warm water fisheries.

5.2.4 Scouring of Lake Bottom

The Station's liquid effluents are discharged from a submerged jet at a maximum exit velocity of 6.5 feet/sec to promote rapid mixing and dilution. Since the lake bottom for about 200 feet downstream of the exit is lined with rockfill, the Staff does not expect any scouring of the sandy bottom with attendant turbidity during normal operation. However, there will probably be some turbidity for short periods after start up, due to materials which have settled in front ofthe discharge during shut down.

5.2.5 Chemical Effluents

The major chemical wastes (exclusive of liquid radioactive wastes and treated sewage) are a neutralized solution of sodium sulfate and other salts (originally removed from lake water) from the makeup demineralizer regeneration and residual chlorine from treatment of condenser cooling and service water. The Applicant states that he does not plan to use any corrosion inhibitor.

Water will be discharged to Lake Erie from the collecting basin. The concentration of dissolved solids in the effluent will be controlled at approximately twice that of Lake water by adjustment of the flow rates to maintain the blowdown rate equal to the rate ofevaporation. The average concentration of dissolved solids in the effluent is expected to be about 427 ppm. The pH will be lower than the lake water, that is, 7.3 compared to 8.1.

The composition of the waste resulting from demineralizer regeneration is given in Table 3.6. This stream is mixed with cooling tower blowdown so that its contribution to the effluent dissolved solids concentration is about 143 ppm during the approximately 4% of the time it discharging.

The condenser cooling system will be chlorinated four times a day for 30-minute intervals. Using the Applicant's effluent concentration of about 0.5 ppm residual free chlorine, the total quantity discharged is 2.3 tons/year. (See Section 5.5.3 for the Staff's recommended effluent level for chlorine.) Cooling tower aeration the increases the dissolved oxygen concentration of the effluent over that of lake water.

5.2.6 Treated Sewage Effluent

The sewage treatment plant provides primary and secondary treatment for sanitary wastes. All effluents are chlorinated. Chlorine content will be 1 ppm. The effluent will have no coliform bacteria and a B.O.D. of about 14 ppm.

5.2.7 Summary of Liquid Wastes

The composition of the liquid effluent is summarized in Table 3.6. It will contain about 427 ppm of nontoxic chemicals, not differing greatly in composition from the 225 ppm of dissolved solids normally present in the inshore lake water (Table 2.11). The effluent will conform to the State chemical and biological criteria quoted in Appendix A.

The temperature of the effluent may be as much as 20°F above the ambient lake temperature, and will produce a thermal plume in the lake. Although estimates of the size of this plume by the Staff and by the Applicant's consultant differ, the area of the 3°F isotherm is less than one acre in either case.

The Staff considers that the effluent will have no detectable effect on human uses of the lake (e.g., for potable water supplies and recreational purposes). Effects on aquatic biota are considered in Section 5.5.

5.3 COOLING TOWER EFFECTS

5.3.1 Choice of Cooling System

It has been decided to use a single large natural-draft cooling tower in a closed-circuit cooling system to dissipate nearly all the condenser heat directly to the atmosphere rather than to Lake Erie as originally planned. Although this decision alleviates concern regarding the effects of the additional thermal load on Lake Erie, a closed-circuit system involves some loss of thermal efficiency and may have undesirable meteorological effects.[1,2,3] Since this will be one of the first natural-draft cooling towers to be operated on the shores of the Great Lakes, there is no closely related experience on which to base predictions.

Natural draft cooling towers rely primarily on evaporation of water for their cooling effect and transfer large quantities of water vapor and heat to the atmosphere at high rates, from a small area. Before this moisture and heat can be completely dissipated by mixing with large volumes of ambient air, condensation is likely to occur and to produce a visible vapor plume. Apart from the shading of sunshine by a visible plume, possible additional adverse effects include increased incidence of ground-level fog and icing conditions, an increase of cloudiness and increased precipitation downwind. Theoretical approaches to the complex situations involved are not yet adequate to permit accurate predictions to be made, but practical experience indicates that of the available alternatives (spray ponds and canals, and mechanical-draft cooling towers), hyperbolic natural-draft towers are least apt to create ground-level fogging and icing. The reason for this is that the moist air is discharged at a considerably greater height (nearly 500 feet for the Station tower) where wind speeds are normally higher, turbulence is less, and moisture deficits are greater than at ground level. Further, a natural-draft tower releases the warm, moist air as a nonturbulent upward stream with considerable momentum and buoyancy, which under most conditions continues to rise well above the top of the tower before it becomes diffused and is carried horizontally by the wind.

5.3.2 Possible Atmospheric Effects

The air leaving the top of the tower is practically saturated with water vapor, and, as it rises, it carries along and mixes with a considerable volume of cooler, unsaturated ambient air. Since the saturation vapor pressure decreases rapidly and nonlinearly with decreasing temperature, the mixed effluent usually becomes supersaturated as soon as it leaves the tower, and minute droplets condense out to form a visible plume - the primary atmospheric impact. The latent heat released by condensation adds to the buoyancy of the plume so that it continues to rise and mix with more ambient air until it dissipates by evaporation, merges with existing cloud cover, or reaches a maximum height depending on temperature, humidity, wind velocity and atmospheric stability. In the latter case, as the plume is carried downwind, further mixing and dispersion take place, reducing buoyancy, and eddies may also cause local downward movement. However, mixing with unsaturated air and adiabatic heating on descent cause evaporation of the droplets, and under normal conditions, in reasonably flat country, the visible plume eventually dissipates without returning to ground level.[1-7] The length of the visible plume will depend on Station load and meteorological conditions but will be greater at lower temperatures in winter, because of the reduced capability of air to hold water vapor.

After the visible plume has evaporated, a region of slightly higher humidity remains, and it has been suggested that this humid air may diffuse downwards and produce surface fog or augment natural fog. It has also been suggested that a small amount of water, carried out of the tower as droplets rather than vapor, may descend to ground level and evaporate into nearly saturated air to cause fog. These droplets, or drift, have been reduced to a very small proportion of the water throughput in modern tower designs. It may further be predicted that if fogging conditions exist and the temperature at ground level is below 32°F, ice will be deposited on the ground. As far as the Staff knows there have been no reports of icing from natural draft cooling tower plumes.

A further possible meteorological effect is that the plume will develop into a cumulus cloud while still visible or as a result of changes in meteorological conditions after it evaporates to invisibility. The increased cloudiness in the downwind area might increase precipitation or even trigger storms. Precipitation, particularly snowfall, might also be increased by falling through the humid air layer left by the plume.

The most thorough review of the effects of cooling towers on local fog, cloud, and precipitation is in the recent paper by Huff et al.[1] Additional relevant articles are those by Decker[2] and Zeller et al.[3]

Finally, the drift loss, due to entrained water droplets, contains appreciable quantities of dissolved solids which must eventually be deposited on the ground.

5.3.3 Experience with Natural-Draft Cooling Towers

The possible adverse effects are listed above without regard to actual experience. In fact, although well-documented data on cooling-tower effects are limited, the available information suggests that most of these postulated effects do not occur sufficiently frequently to be attributed definitely to cooling-tower operation.

Large natural-draft cooling towers have only been in operation in the U. S. for about 10 years. However, in Western Europe, particularly in Great Britain, such towers have been in operation for several decades. In an unpublished report, dated June 1968, the British Central Electricity Generating Board reported its findings on the environmental effects of cooling towers, and stated that although visible plumes sometimes persist for several miles downwind, altering sunshine in the area, no measurable changes in relative humidity at ground level have been detected. Cumulus clouds have sometimes been formed, but no cases of showers or increased precipitation have been definitely attributed to the cooling-tower plumes. These observations are particularly relevant in view of the fact that Great Britain has a cool, humid climate with frequent fog.

Most of the available information on operating natural-draft towers in the U. S. is derived from observations at the Paradise (Kentucky) Steam Plant and at the Keystone (Pennsylvania) Power Plant (1800 MWe). Observations have been made at Paradise[4,5] for two years and at Keystone[6,7,8] for four years. At Paradise, plumes as long as 10 miles have been observed, and at Keystone, Hosler[6] has reported the only observation of a plume descending to the ground.

At Keystone, plumes from the 325-ft towers were photographed daily for six months from January through July 1969.[7] The photographs were taken in early morning, normally the time of maximum plume length. On 81.5% of all days, complete evaporation of the plume was observed. On 16.5% of the days the plume merged with existing cloud cover, and plumes on the remaining days (2.0%) were classified as "special cases," such as cloud building. Of the cases where complete evaporation was observed, the plume length was nearly always less than 5 tower heights (1625 ft), and only exceeded 15 tower heights (4875 ft) on 2.6% of these days. These reports plus observations reported elsewhere[1,2,38] show that the visible plumes from natural-draft cooling towers almost always evaporate completely before reaching ground level, and thus fogging and icing are not problems.

5.3.4 Predictions for the Station Cooling Tower

Plume Lengths

The Applicant's consultant has developed an analytical model to predict the extent and behavior of the visible plume from the cooling tower.[9]

This model consists of three main sections: (a) initial state of the plume (exit velocity, temperature and humidity of the effluent, ambient air temperature, humidity and wind velocity), (b) a buoyant plume rise formula to predict the rise and growth of the plume, and (c) standard dispersion calculations of the downwind transport and dilution of the plume. It is stated that hour-by-hour calculations were made, using five years of meteorological information gathered at Toledo Express Airport, but the detailed results of these calculations are not presented. It is concluded that the average length of visible plume will be 1.5 miles and that plumes longer than 5 miles will occur about 3% of the time. Experience with operating cooling towers[1,2,5,7,8] suggests that these predictions are probably conservative (i.e., that the visible plumes will probably be shorter than predicted). The prevailing winds at the site are offshore, especially during the winter season when the longest plumes would be expected (See Section 2.6), indicating that the plume will frequently be over the lake.

Ground-Level Fog and Icing

Lake breezes and temperature inversions are common at the site, especially in spring and early summer when Lake Erie is cold compared to the land. Under these conditions, a deep (up to 3,000 ft) inversion forms over the lake and the plume could be trapped and carried downwind for many miles with little mixing or evaporation. The base of the plume would be 500 to 600 feet above ground level as it moved inland. As the layer of stable air moves inland, surface heating by solar radiation creates a layer of turbulence and mixing which grows thicker and would eventually reach the height of the plume.[10,11] In this region, portions of the plume descending towards the ground would evaporate rapidly by mixing with warmer, drier air and by adiabatic compression. Isolated sections of visible plume could be brought to the ground by eddies, but these evaporating puffs should not greatly impair visibility. However, since there are no cooling towers operating in areas subject to lake breezes there are no data for predicting the frequency of fog at the Station.

Another mechanism by which surface fog could be formed by the cooling tower is by means of the downward dispersion of water vapor into a nearly saturated surface air layer. The Applicant's consultant has considered this and the analytical model predicts a very small increase in the incidence of fog; less than 1 hour per year, compared to an average of 831 hours of natural fog.[9] Natural fogs are fairly frequent close to lakes and rivers where cooling towers are usually located, and are generally associated with surface cooling and stable lapse rates. These conditions would tend to keep vertical dispersion to very low levels. Photographs taken at cooling tower installations[8] often show the plume leaving the tower and rising, completely separated from the natural surface fog which is caused by surface cooling. Thus it seems unlikely that fogs caused by downward dispersion of water vapor will be produced by operation of the Station. Also the drift losses from the Station cooling tower will be too small to create surface fog.

Using the conservative assumption that icing will occur whenever induced fogging conditions exist with air temperature below 32°F, the Applicant has concluded that additional icing at a given location will be less than 1 minute per year.[9] The Staff believes that this is a reasonable conclusion.

Cloud Formation and Increase of Precipitation

Aynsley[8] has reported that cooling-tower plumes can create cumulus clouds under certain meteorological conditions. He concludes that this is a "rare occurrence" and that these man-made clouds only precede natural cloud formation. It is not now possible to predict whether or not cooling tower plumes can cause any increase in rainfall amounts.[1,6,13,14,15]

There are at least three reported occurrences of snow showers or ice crystals being generated by cooling towers.[12] In all three, the amounts of precipitation were very small.

Drift

The Applicant assumes a maximum value of 0.01% for the drift loss from the cooling tower. In view of recent measurements of drift losses from others towers with drift eliminators (where drift was only 0.001 to 0.005% of the circulating water),[16] the actual value will probably be considerably less than this. Under most weather conditions the drift droplets will be carried along with the visible plume and evaporate completely, leaving their solid residue as extremely small particles which will remain airborne and disperse over a very large area before being carried to to the ground by precipitation. For this reason, deposition of salts close to the Station will probably be much less than the estimated maximum given in Section 3.5. This is supported by a recent theoretical and observational study of drift from a salt-water cooling tower.[17]

5.4 EFFECT ON TERRESTRIAL ENVIRONMENT

No measurable changes in the terrestrial biota are expected from increased fogging, icing and precipitation, from decreased solar radiation reaching the ground or from the drift fallout. It is doubtful that the increases in fogging, icing and precipitation, for example, will be measurable. Based on conservative estimates of 0.01% drift and deposition of all dissolved solids in the drift within 5 miles of the tower, yearly deposition of chemicals such as chlorides, sulfate, nitrate, calcium and sodium will be less than a few percent of the normal deposition of these substances in rainwater.[18,19] The total deposition of trace elements, such as zinc, over the lifetime of the plant will be several orders of magnitude less than the amount normally contained in the upper millimeter of soil.[20,21]

The site is within a flyway for migatory birds, songbirds as well as waterfowl. The cooling tower and transmission lines are potential obstructions to migrating birds, who might be killed or wounded by flying into these structures when they are forced by adverse weather to fly under low clouds. Several accounts of nocturnal migrant mortality at television towers, tall buildings or monuments, and airport ceilometers* have been reported in the literature.[22-30] Major kills (several thousand in one night) are generally associated with peak periods of migrations (particularly in the fall, when total numbers of migrating birds are much larger than in the spring), where the birds started migrating under favorable weather conditions with good tail winds, encountered a weather front with low, deep cloud cover, possibly with fog or mist, and were forced to fly low. Ceilometer lights or the navigational lights on tall (generally about 1000 feet) television towers apparently attract the

*A ceilometer is a device used for measuring the cloud-cover depth and height by beaming a collimated light vertically and using triangulation to obtain the distance above ground.

birds, who become confused and fly into the ground, buildings, or, in particular, the guy wires of television towers. From an extensive study by Stoddard at a TV tower in Florida, it appears that intervals between major kills will average several years.[28] Small losses, however, can occur intermittently during peak periods of migration,[27] even on clear nights with good visibility.[28]

The cooling tower at the Station is not as tall as the television towers or other buildings that have major mortalities, nor does it have guy wires, which are, apparently, particularly lethal. At Eau Claire, Wisconsin, for instance, there was no evidence of bird casualties at an old 500-foot pyramidal type tower. Shortly after a new 1000-foot guy-wired tower was built, the first heavy mortality occurred.[25] Transmission lines have horizontal wires, or course, but they are much lower than the television towers. Therefore, major kills of nocturnal migrants are not expected to occur. Occasional mortalities may occur, but these are not expected to be significant compared to the numbers that die from other migrational hazards.*

The transmission lines are not expected to be an electrical hazard to birds, either. Studies of bird electrocutions on power lines[31-33] indicate that the lower voltage distribution lines (under 60 kV), particularly the three-phase, 4-carrier lines with spacing less than 6 feet between the phase conductors and ground wire, are the lines involved in bird electrocutions, not the higher voltage transmission lines.

5.5 EFFECTS ON AQUATIC ENVIRONMENT

The major environmental impacts on the aquatic ecosystem will be mechanical, thermal and chemical effects resulting from the intake of water from Lake Erie, passage through the Station, and discharge back into the lake.

5.5.1 Intake Effects

The water intake crib will be about 3,000 feet from shore in 11-15 feet of water (depending on lake level). Since the vertical downflow through the slots in the intake crib will be a maximum of 0.5 feet/second, entrainment of fish has been reduced. Experience at the Indian Point Power Plant on the Hudson River indicates that the number of entrained small fish remains relatively constant at intake velocities up to about 1.0 feet/second, at which point the number of increases

* Preliminary observations were made at irregular intervals during the fall migratory season.[48] It was concluded that birds killed by tower collosion probably number in the dozens (only about 12 were actually counted) and that the impact on migratory birds is insignificant.

greatly.[34] Adult fish should be able to avoid being drawn into the intake, although young fish or weak adults swimming too near the intake will probably be entrained.[35,36] Trawling catches of young-of-the-year near Crane Creek (6 miles northwest of the station)[37] and seine surveys[45,49] indicate that gizzard shad, alewife, drum, white bass and shiners are likely to be the most abundant young fish near the intake crib. It is questionable whether the bubble screen the Applicant proposes to install at the intake will be effective in deflecting fish away from the intake.[34,38] Most fish that are entrained in the intake water will be impinged on the traveling screens located in the intake structure at the end of the intake canal.

5.5.2 Station Passage Effects

Planktonic organisms contained in the intake water and fish fry and eggs small enough to pass the 1/4-inch openings in the traveling screens will be subjected to mechanical, thermal and chemical damage during passage through the Station. On the average an organism will spend about 20 hours in the Station, during which time it will go through periods of chlorination (which alone will probably cause 100% mortality) and several trips through condensers and pumps where it will be subjected to mechanical abrasion and thermal shock. We estimate that the probability of an organism leaving the cooling tower circulating water system after only one pass is only 2%. Therefore, practically every organism entrained in the intake water will be killed.

5.5.3 Discharge Effects

Water from the Station's collecting basin will be discharged into Lake Erie. This water will generally be warmer than Lake Erie (except for a few days in the fall when it will probably be a few degrees cooler) and will contain the same dissolved solids as normal in Lake Erie water, but at approximately twice the concentrations. Dissolved oxygen concentrations will be near lake levels.

Approximately one half acre of the bottom near the discharge in Lake Erie will be covered with riprap and the benthic community in the area will be altered. There should be no increase in turbidity.

Under the present plans for chlorination, the Station will discharge chlorinated water for 4 periods each day. During each period up to 0.5 ppm free chlorine could be discharged for about 1/2 hour and continuously decreasing amounts for about 1.6 hours thereafter. The 0.5 ppm level of chlorine (either free or combined) is probably toxic to most aquatic organisms, including fish.[39,40] For intermittent discharges, the EPA recommended criteria call for total residual chlorine in receiving waters of no more than 0.1 ppm chlorine, not to exceed 30 minutes per day, or 0.05 ppm, not to exceed 2 hours per day.[39]

The Applicant indicated that he intended to discharge effluent with .5 ppm total residual chlorine. The Staff estimates that this level could produce a toxic zone within 50 feet of the discharge. The "fast acting" chlorine demand of the lake water reduces the chlorine to nontoxic substance.* The Applicant, however, has not provided the Staff with sufficient data to justify exceeding EPA recommendations; therefore, the Staff recommends that all practicable means be employed to maintain the total residual chlorine in the discharge at or below 0.1 ppm. Some methods of reducing the chlorine concentration in the discharge, not necessarily all practicable, are reducing the concentration of free chlorine at the condenser during chlorination, reducing the duration of chlorination periods, adding significant quantities of dilution water to the collecting basin continuously rather than intermittently, using intermittent rather than continuous blowdown (see Appendix B), enlarging the mixing basin so it can serve as a retention pond for chlorine decomposition, adding dechlorination chemicals (e.g., sodium sulfite) to the blowdown as required. Only if all practicable methods have failed should the Applicant determine the size of the zone in the lake within which EPA or other pertinent criteria are exceeded, and request approval for the discharge of a solution of chlorine in excess of 0.1 ppm.

Under conditions of maximum heat discharge (138×10^6 BTU/hr), the plume of water warmer than 3°F above ambient will cover about 0.7 acres and of water warmer than 1°F above ambient will cover less than 4 acres (Staff estimates using Pritchard's model, see Section 3). Plankton and small fish in the lake water entrained into the plume could be damaged by thermal stress or buffeting or exposure to toxic levels of chlorine. Their residence time in the plume will be short

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* The formation of chloramines by reaction of residual free chlorine with ammonia in the lake also occurs rapidly, but less rapidly than chemical reduction of chlorine by reducing ions in the lake water. It is estimated by the Staff that the concentrations of chloramines formed in this way will always be below the EPA recommended criteria. The approximation that half of the chlorine demand is "fast acting", made by the Staff in the absence of specific information, is based on experience in other waters. To establish the applicability of the approximation, measurements would have to be made with Davis-Besse water.

(less than 15 minutes to the 1°F isotherm)* and it is doubtful that any measurable increases in biological activities such as photosynthesis or rates of decay will take place during this short period.

During the winter and early spring, the warm water plume may be expected to attract fish. It is unlikely that these fish would be subjected to cold shock if the Station shut down suddenly, as fish are not likely to reside too close to the discharge (where the higher temperatures are) due to the high velocity of discharge. Most of the plume area where fish would congregate will be only a few degrees above ambient lake temperatures, and a sudden drop to ambient temperatures would not be enough to cold shock the fish. Likewise, no adult fish should be subjected to sudden toxic concentrations of chlorine as fish are not likely to be found close to the discharge where such toxic concentrations might occur.

5.5.4 Summary

It is unlikely that there will be major adverse biological effects due to the intake of lake water and discharge of heated, sometimes chlorinated, water. Any organisms (e.g., plankton) killed during passage through the Station or in the discharge plume in the lake will not be lost to the ecosystem. They will be fed upon by fish living near the plume, or they will go through the decay processes and be recycled. It is doubtful that the number of fish killed as a result of Station operation will have any effect on the fish population as a whole.

5.6 RADIOLOGICAL EFFECTS ON BIOTA OTHER THAN MAN

During normal operation of the Station, small quantities of radioactive materials will be released to the environment. The maximum rates of release that will probably be permitted the Station have been covered in Section 3. These releases were used as the basis for the dose computations below, using the ARIP program package.[42]

Dose rates have been included in Table 5.1 for all of the biota in the vicinity of the Station. These include phytoplankton, zooplankton, benthic organisms, terrestrial and aquatic plants, and local and migratory birds and mammals. Other terrestrial organisms will receive doses intermediate between those of terrestrial plants and birds. Doses at the effluent outlet, or in the western basin of Lake Erie, are applicable only to aquatic forms. Navarre Marsh has been chosen to represent

* Based on Staff estimates of plume size and Pritchard's formula for temperature-time exposure relationships.[41]

TABLE 5.1. Doses to Biota in the Vicinity of the Station

Organism	Dose Rates, mrem/yr			Reference Organisms
	Effluent	Lake Erie W. Basin	Navarre Marsh	
Aquatic Plants	58	5.1 (-3)	11	Pediastrum, spp.
Aquatic Invertebrates	187	2.6 (-2)	37	Ephemeroptera, spp.
Aquatic Vertebrates	211	3.0 (-2)	41	Stizostedion vitreum
Terrestrial Plants	-	-	5.6	Persicaria hydropiper
Terrestrial Invertebrates	-	-	5.6	Pelaecyopoda, spp.
Birds	-	-	1.0	Anatida, spp.
Mammals	-	-	0.8	Ondatra zibethicus

the maximum doses to be expected on land, or at the aquatic-terrestrial interface. Doses in all other terrestrial areas will be lower than those given for Navarre Marsh. In each case the doses are given for the species that are critical for this particular area, e.g., by reason of showing the maximum bioaccumulation effects, because of key position in the local trophic chains, etc. Inspection of the table shows that these doses are, in fact, quite low for all of the biota in the area. At these dose levels no deleterious effects are anticipated for any of the biota in the area.[43,44]

A diagrammatic representation of some of the pathways utilized in this evaluation is included in Figure 5.1. In addition, equilibration between geosphere, hydrosphere and atmosphere was considered, as well as the various trophic levels to and from birds, mammals, etc. in the biosphere.

5.7 RADIOLOGICAL EFFECTS ON MAN

The methodology above was then extended to man. Figure 5.2 presents some of the pathways to man. Direct doses to the human population via atmospheric dispersion of Station releases extending to 50 miles are given in Table 5.2. These are the combined, critical organ doses attendant on releases of halogens and particulates (e.g., I-131), and of noble gases (e.g., Kr-85). These are given because they represent the limiting cases of human hazard (e.g., carcinogenesis). Genetically significant doses, for example, will be one to two orders of magnitude lower.

The maximum airborne doses are found in the northeast sector at, or near, the boundary. This sector is also inhabited, so that the maximum value, 0.04 mrem/yr, represents an actual dose which may be received. Direct doses in all sectors are completely dominated by the noble gas component. Hunters, anglers, park and marsh visitors, and other persons in the area temporarily will receive doses at this rate or less, with an annual dose markedly less than 0.04 mrem. The annual, population-integrated, commitment over the 50-mile radius will be 0.4 man-rem.

The nearest dairy herd is pastured about two miles to the south, and this also represents the nearest probable pasturage. Annual dose to a child's thyroid via the air-cow-milk iodine pathway will be less than 1.3 mrem.

Direct and indirect doses to man via waterborne radionuclides are given in Table 5.3. These include doses to permanent residents of the area (e.g., via public water supplies at distances up to 50 miles from the

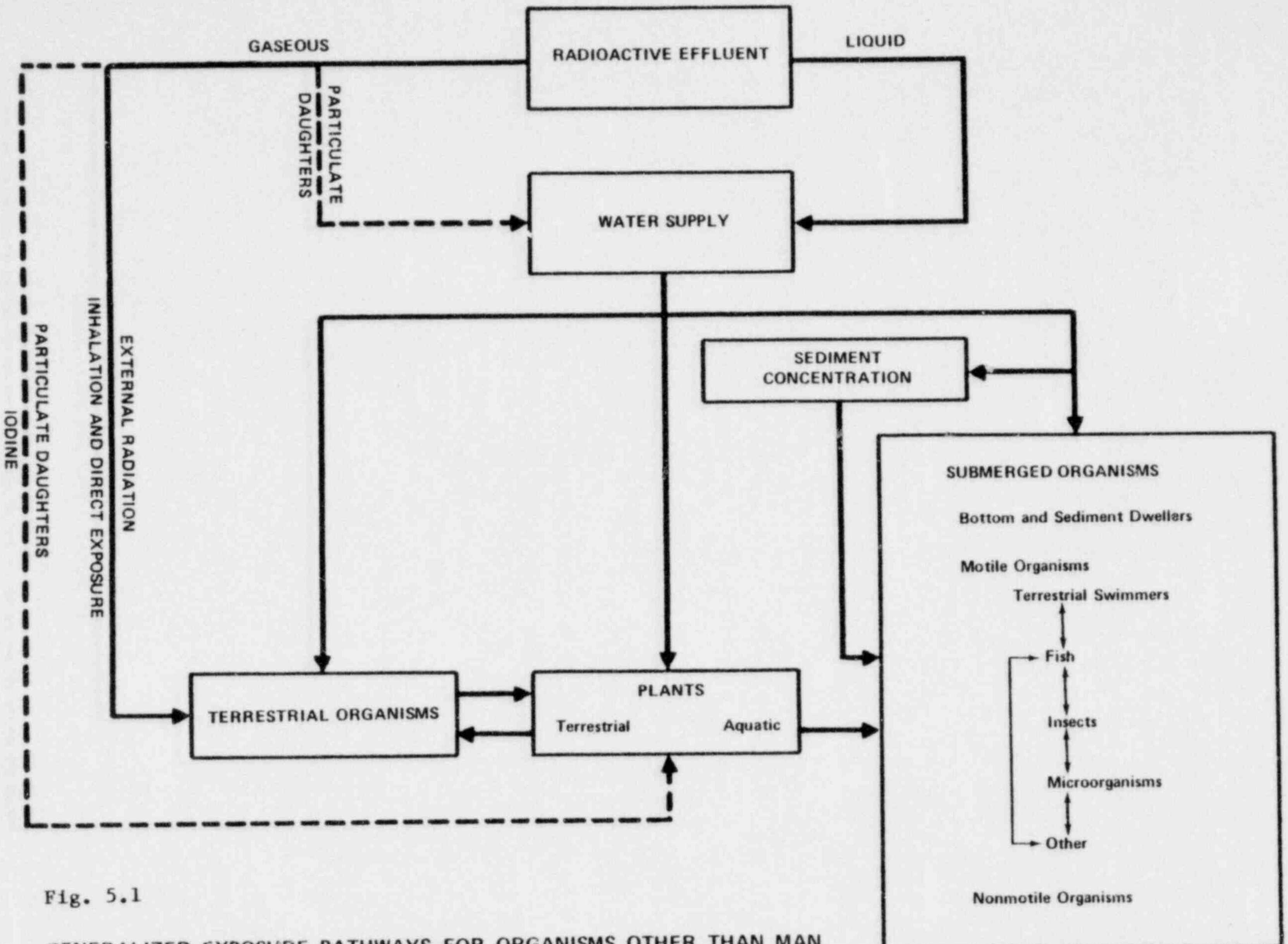

Fig. 5.1

GENERALIZED EXPOSURE PATHWAYS FOR ORGANISMS OTHER THAN MAN

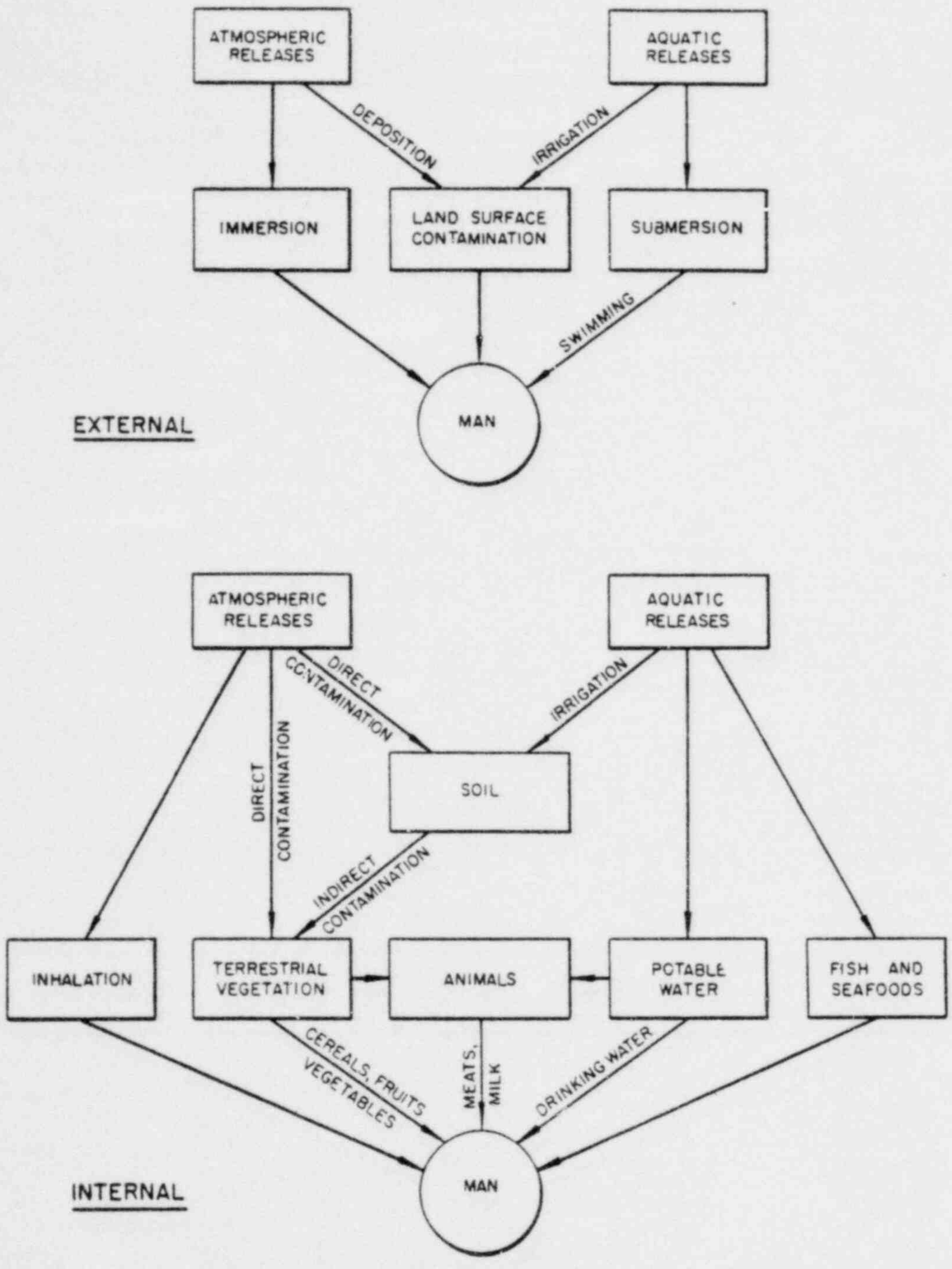

Fig. 5.2. Pathways for External and Internal Exposure of Man from Atmospheric and Aquatic Releases of Radioactive Effluents.

Table 5.2

Cumulative Population, Cumulative Annual Dose, and Average Dose Due to Airborne Releases from the Station

Radius (miles)	Cumulative Population	Cumulative Dose* (man-rem/year) 1	2	Average Annual Dose (millirem/year)
1	808	.012	.0011	.0142
2	1,564	.016	.0016	.0102
3	2,313	.018	.0018	.0080
4	2,666	.019	.0019	.0073
5	3,097	.020	.0020	.0065
10	15,390	.032	.0032	.0021
20	103,900	.065	.0064	.00063
30	672,000	.18	.0017	.00026
40	1,020,000	.23	.023	.00023
50	2,052,000	.40	.039	.00019

*Dose in column 1 is from noble gases and the dose in column 2 is from particulates.

Table 5.3 Population Doses due to Liquid Releases from the Station

Pathway	Population Type	Dilution[1]	Population at risk, Man years/yr	Dose, Mrem/yr Whole Body	G.I. Tract	Thyroid	Bone	Critical Organ
Tap Water	Camp Perry	857	5.5(+2)	8.4(-3)	3.8(-4)	1.4(-1)	2.6(-3)	0.14
Tap Water	Port Clinton	2419	7.2(+3)	3.0(-3)	1.3(-4)	4.8(-2)	9.4(-4)	0.05
Tap Water	Sandusky	6254	3.3(+4)	1.1(-3)	5.2(-5)	1.9(-2)	3.7(-4)	0.02
Tap Water	Toledo Area[2]	6254	4.0(+5)	1.1(-3)	5.2(-5)	1.9(-2)	3.7(-4)	0.02
Tap Water	Monroe	10,800	2.4(+3)	6.7(-4)	3.0(-5)	1.1(-2)	2.1(-4)	0.01
Tap Water	Pte. Aux Peaux	11,370	2.0(+2)	6.3(-4)	2.9(-5)	1.0(-2)	2.0(-4)	0.01
Tap Water	Lorraine	13,350	7.9(+2)	5.4(-4)	2.4(-5)	8.7(-3)	1.7(-4)	0.009
Tap Water	Local Wells	-	3.0(+2)	2.4(-2)	1.1(-3)	4.1(-1)	7.1(-3)	0.41
Tap Water risk, Manrem/yr				0.56	0.03	9.1	0.18	9.7
Dietary	Commercial	-	2.1(+6)	2.8(-3)	2.0(-4)	1.9(-4)	3.5(-3)	3.5(-3)
Dietary	Sport	-	7.6(+2)	3.2(+0)	2.4(-1)	2.2(-1)	4.1(+0)	4.1(+0)
Direct	Recreational	-	5.5(+2)	1.9(+0)	1.8(+0)	3.5(-3)	1.8(+0)	1.9(+0)
Immersion	Recreational	-	2.4(+2)	3.2(-3)	0	0	0	3.2(-3)
Inhalation	Recreational	-	3.0(+2)	4.3(-3)	3.2(-3)	1.4(-3)	1.7(-3)	4.3(-3)
Dietary/recreation risk, manrem/yr				9.4	1.6	0.57	11.4	11.5
Total risk, manrem/yr				10.0	1.6	9.7	11.6	21.2

[1]Ratio of concentration at effluent to concentration at intake. Dashes used where this ratio is not applicable.
[2]Both Toledo and Oregon intakes.

Station), to temporary residents, hunters, anglers, boaters, swimmers, etc., and to consumers of foods produced in the area. The maximum, cumulative, annual dose received by any member of the permanent population, via normal liquid releases from the Station, would be less than 3 mrem. The corresponding population dose would be 21.2 manrem/yr.

Direct dose rates from radioactive fuel and/or radionuclides stored at or released from the Station will be less than one mrem/yr at the closest approach to the Station. This dose drops off very rapidly with distance, however, so that the total annual population dose from this source will be less than one manrem. This source is independent of Station releases.

In summary, the radiological characteristics of the Station and its environs are such as to limit human doses and dose rates to a very small fraction of the natural background (140 mrem/yr). The fraction is less than 3% in nearby sectors, and much less than that at a distance.

5.8 EFFECTS ON THE COMMUNITY

The Station's full-time operating staff will number 89. Most of these workers will be recruited from outside the immediate area of the Station, and they will probably live in the Toledo area, or in the local communities of Oak Harbor and Port Clinton. This small number of workers and their families, dispersed among several communities, is unlikely to impose a noticeable load on hospitals, schools, or other community services, and their incomes will not significantly affect the local economy.

The Benton-Carroll-Salem school district will benefit greatly from the increased tax base produced by the Station. Property taxes on the Station will amount to about $4,100,000 annually, of which the greater part, about $3,450,000, will go to the school district. The present annual revenue of the school district is about $800,000. Carroll Township general fund will receive about $287,000, and Ottawa County about $385,000 annually. In addition, the Ohio State excise tax will amount to about $4,300,000 annually.

There is a possibility that the presence of the Station and its railroad link may attract new industry to the area with more significant social and economic effects. The area possesses the main requisites (except plentiful power and transportation) for heavy industry and manufacturing. The land is flat, with good foundation stability, isolated and downwind from residential areas, yet reasonably close to large population centers. These are, in fact, some of the characteristics which made the area suitable for the construction of the Station. There are at present no zoning regulations in the area, and the extent to which such development should be permitted or controlled will be the responsibility of the local authorities.

5.9 EFFECTS OF TRANSPORTATION OF NUCLEAR FUEL AND SOLID RADIOACTIVE WASTE

The nuclear fuel for the Station is slightly enriched uranium in the form of sintered uranium oxide pellets encapsulated in zircaloy fuel rods. Each year in normal operation, about 59 fuel elements are replaced.

5.9.1 Transport of New Fuel

The Applicant has indicated that new fuel will be shipped by truck in AEC-DOT approved containers which hold two fuel elements per container. About 5 truckloads of 6 containers each will be required each year for replacement fuel and about 15 truckloads for the initial loading. The Applicant has not identified the source of the fuel.

5.9.2 Transport of Irradiated Fuel

Fuel elements removed from the reactor will be unchanged in appearance and will contain some of the original U-235 (which is recoverable). As a result of the irradiation and fissioning of the uranium, the fuel element will contain large amounts of fission products and some plutonium. As the radioactivity decays, it produces radiation and "decay heat." The amount of radioactivity remaining in the fuel varies according to the length of time after discharge from the reactor. After discharge from a reactor, the fuel elements are placed under water in a storage pool for cooling prior to being loaded into a cask for transport.

The Applicant has not identified the site to which the irradiated fuel will be sent for reprocessing. For calculating purposes, the Staff estimates the shipping distance to be 700 miles.

Although the specific cask design has not been identified, the Applicant states that the irradiated fuel elements will be shipped by rail in approved casks. The cask will weigh perhaps 70 to 100 tons. To transport the irradiated fuel, the Applicant estimates 6 shipments per year with 10 fuel elements per cask and 1 cask per carload. An equal number of shipments will be required to return the empty casks.

5.9.3 Transport of Solid Radioactive Wastes

The Applicant has not identified where the waste will be shipped for disposal. For calculating purposes, the Staff has assumed a shipping distance of 300 miles.

The Applicant estimates that about 1800 cu. ft. of waste to be mixed with concrete and 900 cu. ft. of low level waste to be compacted will be generated by the operation of the reactor. The solidified and compacted wastes will be replaced in drums for shipment and disposal. The Applicant estimates about 9 truckloads of waste in drums will be shipped from the plant each year.

5.9.4 Principles of Safety in Transport

The transportation of radioactive material is regulated by the Department of Transportation and the Atomic Energy Commission. The regulations provide protection of the public and transport workers from radiation. This protection is achieved by a combination of standards and requirements applicable to packaging, limitations on the contents of packages and radiation levels from packages, and procedures to limit the exposure of persons under normal and accident conditions.

Primary reliance for safety in transport of radioactive material is placed on the packaging. The packaging must meet regulatory standards[46] established according to the type and form of material for containment, shielding, nuclear criticality safety, and heat dissipation. The standards provide that the packaging shall prevent the loss or dispersal of the radioactive contents, retain shielding efficiency, assure nuclear criticality safety, and provide adequate heat dissipation under normal conditions of transport and under specified accident damage test conditions. The contents of packages not designed to withstand accidents are limited, thereby limiting the risk from releases which could occur in an accident. The contents of the package also must be limited so that the standards for external radiation levels, temperature, pressure, and containment are met.

Procedures applicable to the shipment of packages of radioactive material require that the package be labeled with a unique radioactive materials label. In transport the carrier is required to exercise control over radioactive material packages including loading and storage in areas separated from persons and limitations on aggregations of packages to limit the exposure of persons under normal conditions. The procedures carriers must follow in case of accident include segregation of damaged and leaking packages from people and notification of the shipper and the Department of Transportation. Radiological assistance teams are available through an inter-Governmental program to provide equipment and trained personnel, if necessary, in such emergencies.

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

Safety in transportation is provided by the package design and limitations on the contents and external radiation levels and does not depend on controls over routing. Although the regulations require all carriers of hazardous materials to avoid congested areas[47] wherever practical to do so, in general, carriers choose the most direct and fastest route. Routing restrictions which require use of secondary highways or other than the most direct route may increase the overall environmental impact of transportation as a result of increased accident frequency or severity. Any attempt to specify routing would involve continued analysis of routes in view of the changing local conditions as well as changing of sources of material and delivery points.

5.9.5 Exposures During Normal (No Accident) Conditions

New Fuel

Since the nuclear radiations and heat emitted by new fuel are small, there will be essentially no effect on the environment during transport under normal conditions. Exposure of individual transport workers is estimated to be less than 1 millirem (mrem) per shipment. For the 5 shipments, with two drivers for each vehicle, the annual cumulative dose would be about 0.01 man-rem per year. The radiation level associated with each truckload of cold fuel will be less than 0.1 mrem/hr at 6 feet from the truck. A member of the general public who spends 3 minutes at an average distance of 3 feet from the truck might receive a dose of about 0.005 mrem per shipment. The dose to other persons along the shipping route would be extremely small.

Irradiated Fuel

Based on actual radiation levels associated with shipments of irradiated fuel elements, we estimate the radiation level at 3 feet from the rail car will be about 25 mrem/hr.

Train brakemen might spend a few minutes in the vicinity of the car at an average distance of 3 feet, for an average exposure of about 0.5 millirem per shipment. With 10 different brakemen involved along the route, the annual cumulative dose for 6 shipments during the year is estimated to be about 0.03 man-rem.

A member of the general public who spends 3 minutes at an average distance of 3 feet from the rail car, might receive a dose of as much as 1.3 mrem. If 10 persons were so exposed per shipment, the annual cumulative dose would be about 0.08 man-rem. Approximately 210,000 persons who reside along the 700-mile route over which the irradiated fuel is transported might receive an annual cumulative dose of about 0.04 man-rem. The regulatory radiation level limit of 10 mrem/hr at a distance of 6 feet from the vehicle was used to calculate the integrated dose to persons in an area between 100 feet and 1/2 mile on both sides of the shipping route. It was assumed that the shipment would travel 200 miles per day and the population density would average 330 persons per square mile along the route.

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

Solid Radioactive Wastes

Under normal conditions, the average radiation dose to the individual truck driver is estimated to be about 10 mrem per shipment. If the same driver were to drive 15 truckloads in a year, he could receive an estimated dose of about 150 mrem during the year. The annual cumulative dose to all drivers for 9 shipments during the year, assuming 2 drivers per vehicle, would be about 0.2 man-rem.

A member of the general public who spends 3 minutes at an average distance of 3 feet from the truck might receive a dose of as much as 1.3

mrem. If 10 persons were so exposed per shipment, the annual cumulative dose would be about 0.1 man-rem. Approximately 90,000 persons who reside along the 300-mile route over which the solid radioactive waste is transported might receive an annual cumulative dose of about 0.02 man-rem. These doses were calculated for persons in an area between 100 feet and 1/2 mile on either side of the shipping route, assuming 330 persons per square mile, 10 mrem/hr at 6 feet from the vehicle, and the shipment traveling 200 miles per day.

REFERENCES

1. F. A. Huff, R. C. Beebe, D. M. A. Jones, G. M. Morgan, and R. G. Semonin, "Effect of Cooling Tower Effluents on Atmospheric Conditions in Northeastern Illinois," Illinois State Water Survey, Urbana, Circ. 100, 1971, 37 pp.

2. F. W. Decker, "Report on Cooling Towers and Weather," FWPCA, Corvallis, Oregon, 1969, 26 pp.

3. R. W. Zeller, H. E. Simison, E. J. Weathersbee, H. Patterson, G. Hansen, and P. Hildebrandt, "Report on Trip to Seven Thermal Power Plants," prepared for Pollution Control Council, Pacific Northwest Area, 1969, 49 pp.

4. W. C. Colbaugh, TVA Muscle Shoals Alabama, personal communication.

5. W. C. Colbaugh, J. . Blackwell, and J. M. Leavitt, "Interim Report on Investigation of Cooling Tower Plume Behavior," T.V.A. Muscle Shoals, Paper presented at the Amer. Inst. Chem. Engineers Cooling Tower Symposium, Houston, Texas (March 3, 1971).

6. C. L. Hosler, "Wet Cooling Tower Plume Behavior," Paper presented at the Amer. Inst. Chem. Engineers Cooling Tower Symposium, Houston, Texas (March 2, 1971).

7. G. F. Bierman, A. Kundler, J. F. Sebald, and R. F. Visbisky, "Characteristics, Classification and Incident of Plumes from Large Natural Draft Cooling Towers, Proc. Amer. Power Conf., 33, 535-545 (1971).

8. E. Aynsley, "Cooling-Tower Effects: Studies Abound," Electrical World, 42-43 (May 11, 1970).

9. NUS Corporation, "Evaluation of Environmental Effects of a Natural Draft Cooling Tower at the Davis-Besse Nuclear Power Station," NUS-799, July 1971, Appendix 7F of Applicant's Environmental Report.

10. M. S. Hirt et al., "A Study of the Meteorological Conditions which Developed into a Classic 'Fumigation' from a Large Lake Shoreline Source," Paper presented at the 64th Annual Meeting of the Air Pollution Control Assoc., Atlantic City, June 27-July 2, 1971, 31 pp.

11. W. A. Lyons and H. S. Cole, "Fumigation and Plume Trapping. Aspects of Mesonale Dispersion on the Shores of Lake Michigan in Summer During Periods of Stable Onshore Flow," Conference on Air Pollution Meteorology, Raleigh, N. C., April 5-9, 1971.

12. J. E. Carson, "The Atmospheric Effects of Thermal Discharges into a Large Lake," J. Air Poll. Cont. Assoc., Vol. 22, 523-528, 1972.

13. E. P. Lowry, "Environmental Effects of Nuclear Cooling Facilities," Bull. Amer. Meteor. Soc., 51, 23-24 (1970).

14. E. W. Hewson, "Moisture Pollution of the Atmosphere by Cooling Towers and Cooling Ponds," Bull. Amer. Meteor. Soc., 51, 21-22 (1970).

15. EG&G, Inc., "Potential Environmental Modifications Produced by Large Evaporative Cooling Towers," EPA WQO, Water Pollution Control Research Series, Report No. 16130 DNH 01/71, 76 pp. (1970).

16. F. M. Shofner and C. O. Thomas, "Development and Demonstration of Low-Level Drift Instrumentation," E.P.A. Report 16130 GNK 10/71, Water Poll. Cont. Research Series, October 1971, 56 pp.

17. R. A. Burns et al., "Program to Investigate Feasibility of Natural Draft Salt Water Cooling Towers," Appendix 5 to Fork River Nuclear Power Plant Environmental Report, January 1972, 50 pp. plus Appendixes.

18. Fried, M. and H. Broeshart, The Soil-Plant System. Academic Press, New York and London, 1967, 358 pp.

19. Carroll, Dorothy, "Rainwater as a chemical agent of geologic processes - a review." Geological Survey Water-Supply Paper, 1535 G, 1962.

20. Bowen, H. J. M., Trace Elements in Biochemistry. Academic Press: London and New York, 1966.

21. Davis-Besse, Answers to Questions on Site Visit, June, 1972, page 10.

22. Cochran, W. W. and R. R. Graber. "Attraction of nocturnal migrants by lights on a television tower." Wilson Bulletin. Vol. 70, 1958, p. 378.

23. Brewer, R. and J. A. Ellis. "An analysis of migrating birds killed at a television tower in east-central Illinois, September 1955 - May 1957." Auk, Vol. 75, 1958, p. 400.

24. Tordoff, H. B. and R. M. Mengel. "Studies of birds killed in nocturnal migration." University of Kansas Publications, Museum of Natural History, Vol. 10, No. 1, pp. 1-44.

25. Kemper, C. A. "A tower for TV - 30,000 dead birds." Audubon, March-April, 1964.

26. Howell, J. C. et al., "Bird Mortality at Airport Ceilometers." Wilson Bulletin, Vol. 66, 1954-55, p. 207.

27. Northern Prairie Wildlife Research Center, Jamestown, North Dakota. "Investigation of Bird Migration and Bird Mortality at the Omega Navigation Station, Lamoure, North Dakota, 1971." December, 1971.

28. Stoddard, H. L., Sr. and R. A. Norris. "Bird Casualties at a Leon County, Florida TV Tower: An Eleven-year Study." Bulletin of the Tall Timbers Research Station, No. 8, June 1967.

29. Terres, J. K. "Death in the night." Audubon, January - February, 1956.

30. Bub, H. "Observations on the autumn migration in the area between the Sea of Azov and the Caspian." Ibis, Vol. 97, 1955, p. 25.

31. Arend, Philip H. "The Ecological Impacts of Transmission Lines on the Wildlife of San Francisco Bay." Pacific Gas and Electric Company, Report, August, 1970.

32. Sverdrup & Parcel, Consulting Engineers. Letter to Mr. G. E. Huber, Toledo Edison Company, May 17, 1972.

33. Boeker, E. L. "Powerlines and bird electrocutions." Department of the Interior, Bureau of Sport Fisheries and Wildlife.

34. Indian Point - Unit 3 - Environmental Report, Appendix S, Consolidated Edison.

35. Hynes, H. B. The Ecology of Running Waters. University of Toronto Press, 1970.

36. Laurence, Geoffrey C. "Comparative swimming abilities of fed and starved larval largemouth bass (Micropterus salmoides)." J. Fish. Biol. (1972) 4, 73-78.

37. Letter from Carl T. Baker, Lake Erie Fisheries Research Unit, to Pamela Merry, Argonne National Laboratory, June 23, 1972.

38. Bates, Daniel W. "The Horizontal Traveling Screen." In Engineering Aspects of Thermal Pollution, ed. Frank L. Parker and Peter A. Krenkel, Vanderbilt University Press, 1969.

39. National Water Quality Laboratory, Duluth, Minnesota. "Water Quality Criteria for Residual Chlorine in Receiving Waters for the Protection of Freshwater Aquatic Life." 1971.

40. Brungs, W. A. "Literature Review of the Effects of Residual Chlorine on Aquatic Life." U.S. EPA, National Water Quality Laboratory, Duluth, Minnesota, 1972 (to be published in the Journal Water Pollution Control Federation).

41. Pritchard, D. W. "Design and Siting Criteria for Once-Through Cooling Systems." Chesapeake Bay Institute, The Johns Hopkins University, March 1971.

42. N. A. Frigerio, 1972, "The Argonne Radiological Impact Programs," Argonne National Laboratory, in preparation.

43. S. I. Auerbach, 1971, "Ecological Considerations in Siting Nuclear Power Plants: The Long-Term Biotic Effects Problem," Nuclear Safety, Vol. 12, No. 1.

44. A. H. Sparrow, A. G. Underbrink, and R. C. Sparrow, 1967 "Chromosomes and Cellular Radiosensitivity," Rad. Res. 32, 915 (1967).

45. Ohio Federal Aid Project F-41-R. "Environmental Evaluation of a Nuclear Power Plant." Job Progress Reports from 1970, 1971, and 1972, Job Completion Report 1972. Ohio Department of Natural Resources, Division of Wild Life.

46. 10 CFR Part 71; 49 CFR Parts 173 and 178.

47. 49 CFR § 397.1(d).

48. Memo from W. B. Jackson (Bowling Green U.) to L. Roe (Toledo Edison Co.) "Bird Observations: Davis-Besse Tower Fall 1972", February 1, 1973.

49. Herdendorf, C. E. and E. M. Hair, "Aquatic Ecology of Lake Erie in the Vicinity of Locust Point, Ohio." Report to the Toledo Edison Co. October 1972.

6. EFFLUENT AND ENVIRONMENTAL MEASUREMENT AND MONITORING PROGRAMS

6.1 OPERATIONAL EFFLUENT MONITORING PROGRAM

6.1.1 Chemical Effluents

The objectives of monitoring chemical effluents are to ensure that planned chemical discharges are not exceeded, to develop data that can be used in the design of new operational procedures, and to aid in the interpretation of the results of other studies such as the biological monitoring program. The Applicant has indicated that samples of the collecting basin effluent, which is discharged to Lake Erie, will be taken for analysis on the following schedule:[1]

Weekly

1. pH
2. Suspended Solids
3. Total Volatile Solids
4. Dissolved Solids
5. Total Solids
6. Conductivity
7. Turbidity
8. Phosphorus (as P)
9. Oxygen

Monthly

1. B.O.D.
2. C.O.D.
3. Ammonia (as N)
4. Kjeldahl Nitrogen
5. Organic Nitrogen
6. Total Coliform
7. Oil & Grease
8. Mercury
9. Arsenic
10. Nitrate (as N)
11. Alkalinity (as $CaCO_3$)
12. Zinc
13. Sulfate
14. Color
15. Total Hardness
16. Calcium
17. Magnesium
18. Sodium
19. Potassium
20. Manganese
21. Iron
22. Chromium
23. Chlorides

In addition, we suggest that residual chlorine in the collecting basin effluent be monitored during chlorination and for short periods thereafter.

Since the effluents from certain station drains are diverted into the Toussaint River together with storm water runoff, we recommend additional routine monitoring of the drainage ditch outflow for turbidity and of the storm drain discharge to ensure that no significant quantity of toxic (or otherwise objectionable) chemicals is discharged.

6.1.2 Radioactive Effluents

A continuous record of the Station's radioactive releases will be provided by monitoring the radioactive effluent streams. The detailed specifications for the monitoring system will be prepared by the Applicant in the Technical Specifications for the Station.

6.2 ENVIRONMENTAL MONITORING PROGRAMS

6.2.1 Terrestrial Monitoring Program

The Applicant is sponsoring a preoperational terrestrial plant and animal survey. Work began this summer (1972) and will continue into next year with a survey of spring flowers, migratory birds, etc.[2,3,9] This survey is simply an inventory -- not an ecological study. While useful in obtaining a picture of the types of organisms present (which is helpful to any further ecological study), simple preoperational, and presumably also operational, inventories are not sufficient to determine Station effects on the terrestrial ecosystem.

A terrestrial monitoring program should be developed. As previously stated, no discernible effects due to the operation of the cooling tower are expected. However, the long-term additive effect of increases in atmospheric moisture, for example, could have a localized effect on soil moisture content, on insect populations or on fungal growths. A terrestrial study, carried out over a period of several years, could include the establishment of permanent sample plots on the beach ridge and hardwood swamp at the Station, and control plots at one of the other preserved marshes along that section of Lake Erie. Seasonal surveys on the sample and control plots could be taken. These studies should be started as soon as possible in order to obtain a good record of normal variations before the Station begins operating. In addition, a program should be developed to determine whether the predictions of lack of meteorological effects from operation of the cooling tower are accurate.

Finally, since no definite conclusions on bird mortality at the cooling tower can be reached based solely on experience at TV towers and airport ceilometers (see Section 5.4), the Applicant is sponsoring a program for intensive monitoring of the cooling tower area during both the spring (mid-April to late May) and fall (late August to early October) song-bird migrations.[4] The program will involve daily inspection and collection of dead birds and all-night monitoring when adverse weather conditions are predicted. Consideration will be given to devices or techniques (sonic devices, lighting, etc.) to reduce the probability of bird strikes should they be found to occur. This study, which should be continued for more than just one year, should indicate whether or not the cooling tower presents a hazard to migratory birds, and if it is a hazard, what corrective measures can be taken. (Results of preliminary investigations are summarized in Section 5.4).

6.2.2 Aquatic Monitoring Program

Aquatic preoperational and operational studies (completed and proposed) are summarized in Table 6.1. The 6-year F-41-R project[5,6] should provide a good picture of seasonal variations and trends prior to Station operation and any gross changes after the Station begins operation. Studies of the benthic and zooplankton communities should offer a good chance of distinguishing Station effects from normal variations. Also, by studying fish, and particularly the food items in their stomachs, one could hope to detect changes in their feeding habits and/or changes in the food chain relationships in the area. The most recent report on the F-41-R project recommends that in the future phytoplankton should be sampled to determine seasonal variations before the Station begins operation. If it is found that phytoplankton show a patchy distribution (as Ayers has indicated), sampling would probably have to be much more intensive than once a month.

Since the Station will go on line May 1975 and the F-41-R project is scheduled through June 1972, there are presently no plans for operational monitoring. A comprehensive operational study, similar to the preoperational study, should be continued for at least two years after the Station begins operation. Based on the preoperational and operational studies, a monitoring program should be developed which would involve sampling of those parameters which show the most promise of being indicators of Station effects. Statistical analyses of variance could conceivably justify reducing frequency and numbers of samples.

The Applicant should develop a program to periodically monitor the numbers, size and species of fish trapped on the traveling screens. Plankton contained in the intake water should also be monitored. Diurnal, as well as seasonal variations, should be taken into consideration.

TABLE 6.1. Aquatic Preoperational and Operational Studies at the Station (Completed and Proposed)

	Phytoplankton	Zooplankton	Benthos	Fish*	Physical and Chemical	Hydrographic
John C. Ayers, *et al.* Great Lakes Research Division, The University of Michigan	May & October 1969	May & October 1969	May & October 1969			October 1968
Project F-41-R (U.S. Bureau of Sport Fisheries and Wildlife, Ohio Department of Natural Resources, The Ohio State University	(-----1969-1975-----) [spans Phytoplankton and Zooplankton]		(1969-1975)	(1969-1975)		
	Notes made during course of counting zooplankton	June thru October 1969	April & May 1967 thru 1969 (egg pump on reefs)	June thru October 1969 (monthly)	July & August 1970 (Oxygen & temperature)	1972 (4-5 times)
		May thru October 1970 (monthly)	June thru October 1969 (monthly)	May thru October, 1970 (monthly)	1972 (approximately monthly)**	
		April & May 1971	May thru October, 1970 (monthly) April & May 1971	April, May 1971 1972 (monthly)		
	1972 -----(monthly)----- [spans Phytoplankton and Zooplankton]		1972 (monthly)			

*Includes analysis of food items in fish stomachs.

**Measurement parameters included: chloride ions, specific conductance, current (velocity and direction), dissolved oxygen, pH, temperature (air and water) transparency, turbidity, wind and waves.

Notes: 1) Water current measurements were taken by Dr. Ayers in July, August and September 1968.
2) Sediment information has been obtained from U.S. Geological Survey. Also, sediments will be sampled during the hydrographic surveys.
3) A continuous recording water level gage was installed at the site in 1972.

In the absence of precise data on the effects of residual chlorine discharges, it is recommended that the Applicant monitor the concentration of total residual chlorine in the Station effluent during and following chlorination. If the concentration in the effluent is greater than 0.1 ppm, the Applicant should use all practicable means to reduce the concentrations of total residual chlorine so that it will always be less than 0.1 ppm. Should efforts to reduce to 0.1 ppm fail, the Applicant should determine the extent of the zone in the lake within which total residual chlorine exceeds the EPA recommended criteria.[7]

6.2.3 Radiological Monitoring Program

The radiological monitoring program for the Station began in July 1972 under a plan elaborated by the NUS Corp. of Rockville, Md.[8] and implemented by Industrial Biotest Laboratories of Northbrook, Illinois. This starting date should assure about two years of preoperational monitoring with the full complement of 25 sampling locations (Fig. 6.1). In addition, about 25 sampling stations have been operational, within a 150-mile radius of the Station, for up to 20 years (Section 2.8). Also, several environmental research efforts have been conducted in the immediate area of the Station within recent years making preliminary measurements of tritium and fission radionuclides, and at least one of these will be going on into the post-operational period. Thus, the adequacy of baseline data for future comparisons seems assured.

The State of Ohio has no sampling program in the immediate vicinity of the Station at this time, but there are plans to undertake sampling in this area in the future. Thus, even if the planned Ohio program is not in operation by Station startup, it will provide valuable operational data.

The Station radiological monitoring program is outlined in Table 6.2 (and the sampling locations are shown in Figure 6.1). It would be difficult to fault this program, and it appears to be well designed for the proper monitoring of levels in all of the significant man/biota exposure pathways. We would suggest, however, that some system of prompt notice be set up between the in-plant monitoring network and both the environmental monitoring program and the Environmental Protection Agency of the State of Ohio. In this way abnormal Station operation or noteworthy incidents can promptly be brought to their attention, to enable them to document fully the consequent trail of environmental impact, if any.

FIGURE 6.1 – DAVIS–BESSE NUCLEAR POWER STATION
ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM
SAMPLING LOCATIONS

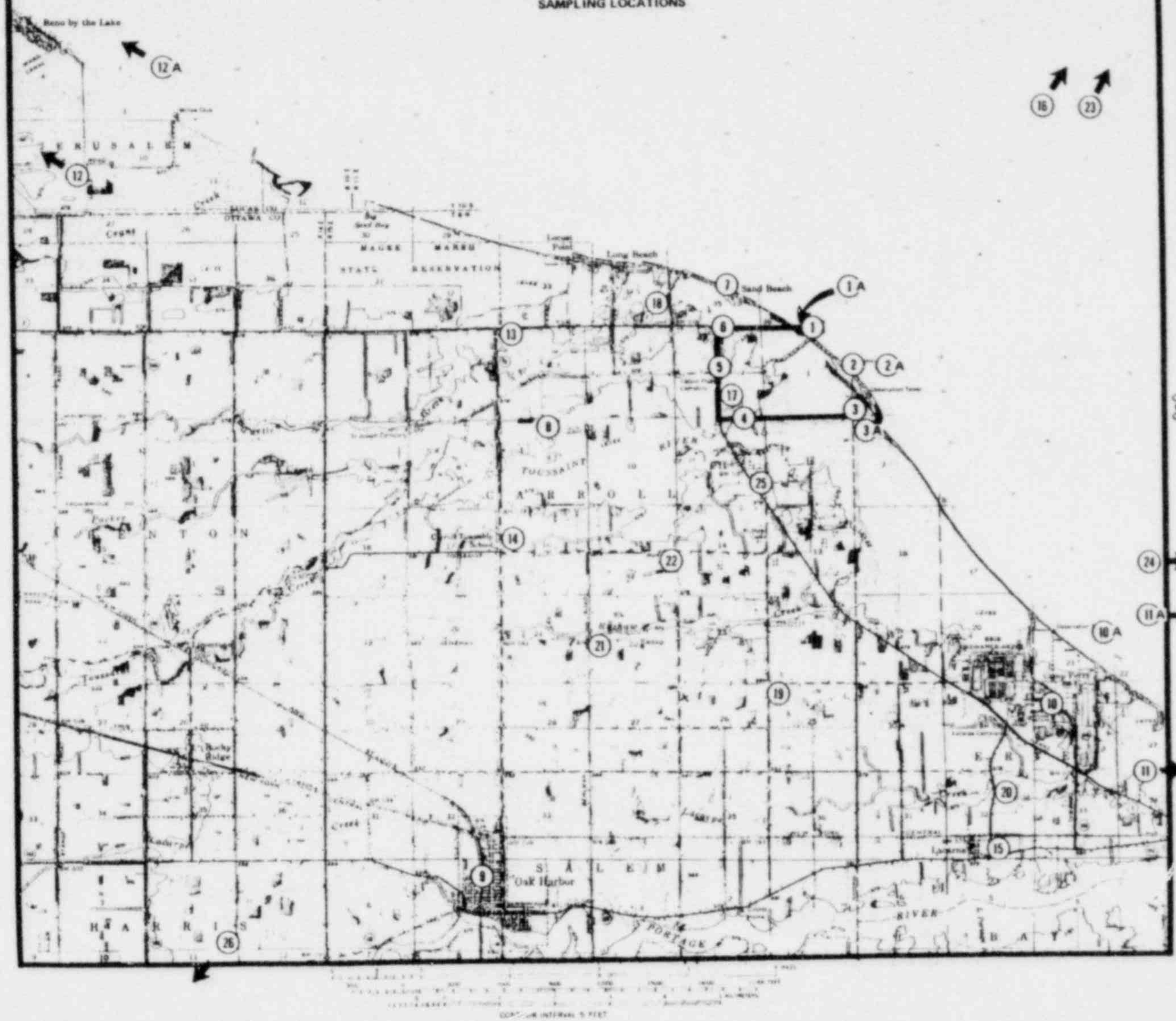

TABLE 6.2. Radiological Monitoring Program

Sample Type	No. of Sampling Stations	Sampling Location (Fig 6.1)	Sampling Frequency	Analyses
Air, particulates	11	1-4, 7-12, 23	W	GA, GB, SA, Sr-90
Air, halogens	13	1-12, 23	W	I-131, SA
Ambient radiation	16	1-15, 23	M	D
Surface water, raw	6	1a, 2a, 3a, 10a, 11a, 12a	W	GA, GB, SA, tritium, Ra, Sr-90
Ground water	5	4, 7, 13, 17, 18	Q	GA, GB, SA, tritium, Ra, Sr-90
Precipitation	2	1, 23	M	GB, tritium
Lake River sediments	3	1a, 2a, 3a	Q	GA, GB, SA, Sr-90
Fish	Various	Lake, 30	Q	GB, SA, Sr-90, K-40, Cs-137
Clams	Various	Lake, 30	Q	GB, SA, Sr-90, K-40, Cs-137
Crops and vegetation	4	8, 16, 19, 25	BA	GA, GB, SA, K-40, I-131, Cs-137
Milk	5	12,20, 21, 24	M	GB, SA, Sr-89/90, Ba/La-140, I-131, Cs-137
Domestic meat	1	22	BA	GB, SA, thyroid I-131, K-40
Wildlife	Various	Site	BA	GB, SA, Sr-90, thyroid I-131, K-40
Soil	4	1, 8, 19, 20	BA	GB, SA, K-40
Tap water	3	10, 11. 12	W	GA, GB, SA, tritium, Sr-90, Ra

Type of analysis: GB = gross beta, GA = gross alpha, SA = gamma spectral analysis,
D = dose of gamma + hard beta.

Frequency: W = Weekly, Q = Quarterly, BA = twice yearly.

REFERENCES

1. Davis-Besse Supplement to the Environmental Report, Amendment 1, July 13, 1972.

2. Personal communication, Dr. William Jackson, Environmental Studies Center, Bowling Green State University.

3. Personal communication, Lowell Roe, Toledo Edison.

4. Memo from Dr. William B. Jackson, Environmental Studies Center, Bowling Green State University to Toledo Edison re. Cooling Tower - Bird Hazard Observations, May 16, 1972.

5. Ohio Federal Aid Project F-41-R, "Environmental Evaluation of a Nuclear Power Plant." Job Progress Reports from 1970, 1971 and 1972; Job Completion Report - Research Completion Segment, 1972.

6. Letter from Charles E. Herdendorf, Ohio State University Center for Lake Erie Area Research, to P. Merry, ANL, July 3, 1972.

7. "Water Quality Criteria Recommendations for Total Residual Chlorine in Receiving Waters for the Protection of Fresh Water Aquatic Life", Staff of National Water Quality Laboratory, Duluth, Minn., July 1972.

8. L. K. Cohen, "Environmental Radiological Monitoring Program for the Davis-Besse Nuclear Power Station", NUS-886, January 1972. (contained in Ref. 1 above).

9. Various memos from William B. Jackson (Bowling Green University) to Lowell Roe (Toledo Edison Company), August 1, 1972, December 1, 1972, January 29, 1973, February 1, 1973, Regarding Environmental Inventory at Davis-Besse.

7. ENVIRONMENTAL EFFECTS OF ACCIDENTS

7.1 PLANT ACCIDENTS

A high degree of protection against the occurrence of postulated accidents in the Station is provided through correct design, manufacture, and operation, and the quality assurance program used to establish the necessary high integrity of the reactor system, as considered in the Commission's Safety Evaluation for the Station, dated November 2, 1970. Deviations that may occur are handled by protective systems to place and hold the plant in a safe condition. Notwithstanding this, the conservative postulate is made that serious accidents might occur, in spite of the fact that they are extremely unlikely; and engineered safety features are installed to mitigate the consequences of these postulated events.

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

The Commission issued guidance to the Applicants on September 1, 1971, requiring the consideration of a spectrum of accidents with assumptions as realistic as the state of knowledge permits. The Applicant's response was contained in the "Davis-Besse Nuclear Power Station Supplement to Environmental Report," dated November 5, 1971.

The Applicant's report has been evaluated, using the standard accident assumptions and guidance issued as a proposed amendment to Appendix D of 10 CFR Part 50 by the Commission on December 1, 1971. Nine classes of postulated accidents and occurrences ranging in severity from trivial to very serious were identified by the Commission. In general, accidents in the high potential consequence end of the spectrum have a low occurrence rate, and those on the low potential consequence end have a higher occurrence rate. The examples selected by the Applicant are presented in Table 7.1 and are reasonably homogeneous in terms of probability within each class, although we consider the rupture of the waste gas decay tank as more appropriately in Class 3 and the steam generator tube rupture as more appropriately in Class 5. Certain assumptions made by

TABLE 7.1. Classification of Postulated Accidents and Occurrences

Classes	AEC Description	Applicant's Example (s)
1	Trivial incidents	Not considered
2	Miscellaneous small releases outside containment	Spills or leakage of reactor coolant
3	Radwaste system failures	Heat exchanger leaks, uncontrolled release of contents of a gas decay tank, failure of pumps to shut off
4	Events that release radioactivity into the primary system (BWR)	Fuel cladding defects
5	Events that release radioactivity into primary and secondary systems (PWR)	Fuel cladding defects and steam generator leak
6	Refueling accidents inside containment	Dropped spent fuel assembly
7	Accidents to spent fuel outside containment	Dropped spent fuel assembly
8	Accident initiation events considered in design basis evaluation in the Safety Analysis Report	Steamline break accident, steam generator tube rupture, waste gas decay tank rupture, loss-of-coolant accident, various reactivity accidents, various reactor coolant releases
9	Hypothetical sequences of failures more severe than Class 8	Not considered

the Applicant do not exactly agree with those in the proposed Annex to Appendix D, but the use of alternative assumptions does not significantly affect overall environmental risks.

Commission estimates of the dose which might be received by an assumed individual standing at the site boundary in the downwind direction, using the assumptions in the proposed Annex to Appendix D, are presented in Table 7.2. Estimates of the integrated exposure that might be delivered to the population within 50 miles of the site are also presented in Table 7.2. The man-rem estimate was based on the projected population areound the site for the year 2000. (The projected population was based on 1960 census data.)

To rigorously establish a realistic annual risk, the calculated doses in Table 7.2 would have to be multiplied by estimated probabilities. The events in Classes 1 and 2 represent occurrences which are anticipated during Station operation and their consequences, which are very small, are considered within the framework of routine effluents from the Station. Except for a limited amount of fuel failures and some steam generator leakage, the events in Classes 3 through 5 are not anticipated during plant operation; but events of this type could occur sometime during the 40 year Station lifetime. Accidents in Classes 6 and 7 and small accidents in Class 8 are of similar or lower probability than accidents in Classes 3 through 5 but are still possible. The probability of occurrence of large Class 8 accidents is very small. Therefore, when the consequences indicated in Table 7.2 are weighted by probabilities, the environmental risk is very low. The postulated occurrences in Class 9 involve sequences of successive failures more severe than those required to be considered in the design basis of protection systems and engineered safety features. Their consequences could be severe. However, the probability of their occurrence is so small that their environmental risk is extremely low. Defense in depth (multiple physical barriers), quality assurance for design, manufacture, and operation, continued surveillance and testing, and conservative design are all applied to provide and maintain the required high degree of assurance that potential accidents in this class are, and will remain, sufficiently small in probability that the environmental risk is extremely low.

Table 7.2 indicates that the realistically estimated radiological consequences of the postulated accidents would result in exposures of an assumed individual at the site boundary to concentrations of radioactive materials within the Maximum Permissible Concentrations (MPC) of Table II of 10 CFR Part 20. The table also shows that the estimated integrated

TABLE 7.2. Summary of Radiological Consequences of Postulated Accidents

Class	Event	Estimated Fraction of 10 CFR Part 20 at Site Boundary*	Estimated Dose to Population in 50 Mile Radius (man-rem)
1.0	Trivial incidents	**	**
2.0	Small releases outside containment	**	**
3.0	Radwaste system failures		
3.1	Equipment leakage or malfunction	0.052	7.2
3.2	Release of waste gas storage tank contents	0.20	29
3.3	Release of liquid waste storage tank contents	0.006	0.8
4.0	Fission products to primary system (BWR)	N.A.	N.A.
5.0	Fission products to primary and secondary systems (PWR)		
5.1	Fuel cladding defects and steam generator leaks	**	**
5.2	Off-design transients that induce fuel failure above those expected and steam generator leak	0.001	0.17
5.3	Steam generator tube rupture	0.068	9.5

TABLE 7.2 (Cont'd)

Class	Event	Estimated Fraction of 10 CFR Part 20 at Site Boundary*	Estimated Dose to Population in 50 Mile Radius (man-rem)
6.0	Refueling accidents		
6.1	Fuel bundle drop	0.011	1.5
6.2	Heavy object drop onto fuel in core	0.19	26
7.0	Spent fuel handling accident		
7.1	Fuel assembly drop in fuel storage pool	0.007	0.95
7.2	Heavy object drop onto fuel rack	0.027	3.8
7.3	Fuel cask drop	N.A.	N.A.
8.0	Accident initiation events considered in design basis evaluation in the Safety Analysis Report		
8.1	Loss-of-coolant accidents		
	Small break	0.1	29
	Large break	0.1	51
8.1(a)	Break in instrument line from primary system that penetrates the containment	N.A.	N.A.
8.2(a)	Rod ejection accident (PWR)	0.01	5.1

TABLE 7.2 (Cont'd)

Class	Event	Estimated Fraction of 10 CFR Part 20 at Site Boundary*	Estimated Dose to Population in 50 Mile Radius (man-rem)
8.2(b)	Rod drop accident (BWR)	N.A.	N.A.
8.3(a)	Steamline breaks (PWR's outside containment)		
	Small break	<0.001	<0.1
	Large break	<0.001	<0.1
8.3(b)	Steamline breaks (BWR)	N.A.	N.A.

* Represents the calculated fraction of a whole body dose of 500 mrem or the equivalent dose to an organ.

** These releases are expected to be in accord with proposed Appendix I for routine effluents (i.e., 5 mrem/yr to an individual from all sources).

exposure of the population within 50 miles of the plant from each postulated accident would be orders of magnitude smaller than that from naturally occurring radioactivity. The exposure from naturally occurring radioactivity corresponds to approximately 730 man-rem/year within 5 miles and approximately 290,000 man-rem/year within 50 miles of the site. These estimates are based on a natural background level of 0.14 rem/yr. When considered with the probability of occurrence, the annual potential radiation exposure of the population from all postulated accidents is an even smaller fraction of the exposure from natural background radiation and, in fact, is well within naturally occurring variations in the natural background. It is concluded from the results of the realistic analysis that the environmental risks due to postulated radiological accidents are exceedingly small.

7.2 TRANSPORTATION ACCIDENTS

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

7.2.1 New Fuel

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

The packaging is designed to prevent criticality under normal and severe accident conditions. To release a number of fuel assemblies under conditions that could lead to accidental criticality would require severe damage or destruction of more than one package, which is unlikely to happen in other than an extremely severe accident.

The probability that an accident could occur under conditions that could result in accidental criticality is extremely remote. If criticality were to occur in transport, persons within a radius of about 100 feet from the accident might receive a serious exposure but beyond that distance, no detectable radiation effects would be likely. Persons within a few feet of the accident could receive fatal or near-fatal exposures unless shielded by intervening material. Although there would be no nuclear explosion, heat generated in the reaction would probably separate the fuel elements so that the reaction would stop. The reaction would not be expected to continue for more than a few seconds and normally would not recur. Residual radiation levels due to induced radioactivity in the fuel elements might reach a few roentgens per hour at 3 feet. There would be very little dispersion of radioactive material.

7.2.2 Irradiated Fuel

Effects on the environment from accidental releases of radioactive materials during shipment of irradiated fuel have been estimated for the situation where contaminated coolant is released and the situation where gases and coolant are released.

Leakage of contaminated coolant resulting from improper closing of the cask is possible as a result of human error, even though the shipper is required to follow specific procedures which include tests and examination of the closed container prior to each shipment. Such an accident is highly unlikely during the 40-year life of the plant.

Leakage of liquid at a rate of 0.001 cc per second or about 80 drops/hour is about the smallest amount of leakage that can be detected by visual observation of a large container. If undetected leakage of contaminated liquid coolant were to occur, the amount would be so small that the individual exposure would not exceed a few mrem and only a very few people would receive such exposures.

Release of gases and coolant is an extremely remote possibility. In the improbable event that a cask is involved in an extremely severe accident such that the cask containment is breached and the cladding of the fuel assemblies penetrated, some of the coolant and some of the noble gases might be released from the cask.

In such an accident, the amount of radioactive material released would be limited to the available fraction of the noble gases in the void spaces in the fuel pins and some fraction of the low level contamination in the coolant. Persons would not be expected to remain near the accident due to the severe conditions which would be involved, including a major fire. If releases occurred, they would be expected to take place in a short period of time. Only a limited area would be affected. Persons in the downwind region and within 100 feet or so of the accident might receive doses as high as a few hundred millirem. Under average weather conditions, a few hundred square feet might be contaminated to the extent that it would require decontamination (that is, Range I contamination levels) according to the standards[3] of the Environmental Protection Agency.

7.2.3 Solid Radioactive Wastes

It is unlikely that a shipment of solid radioactive waste will be involved in a severe accident during the 40-year life of the plant. If a shipment of low-level waste (in drums) becomes involved in a severe accident, some release of waste might occur but the specific activity of the waste will be so low that the exposure of personnel would not be expected to be significant. Other solid radioactive wastes will be shipped in Type B packages. The probability of release from a Type B package, in even a very severe accident, is sufficiently small that, considering the solid form of the waste and the very remote probability that a shipment of such waste would be involved in a very severe accident, the likelihood of significant exposure would be extremely small.

In either case, spread of the contamination beyond the immediate area is unlikely and, although local clean-up might be required, no significant exposure to the general public would be expected to result.

7.2.4 Severity of Postulated Transportation Accidents

The events postulated in this analysis are unlikely but possible. More severe accidents than those analyzed can be postulated and their consequences could be severe. Quality assurance for design, manufacture, and use of the packages, continued surveillance and testing of packages and transport conditions, and conservative design of packages ensure that the probability of accidents of this latter potential is sufficiently small that the environmental risk is extremely low. For those reasons, more severe accidents have not been included in the analysis.

Section 7. References

1. Federal Highway Administration, "1960 Accidents of Large Motor Carriers of Property," December 1970; Federal Railroad Administration Accident Bulletin No. 138, "Summary and Analysis of Accidents on Railroads in the U.S.," 1969; U.S. Coast Guard, "Statistical Summary of Casualties to Commercial Vessels," December 1970.

2. 49 CFR §§ 171.15, 174.566, 177.861.

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

8. EVALUATION OF THE PROPOSED ACTION

8.1 THE NEED FOR POWER

As stated, the Toledo Edison Company (TEC) and the Cleveland Electric Illuminating Company (CEIC) will own the Station as tenants in common and will share in the expenditures for the construction, operation, and in the energy produced in the ratio 52.5%, TEC; 47.5%, CEIC. Both TEC and CEIC are members of the Central Area Power Coordination Group (CAPCO). CAPCO is a power pool consisting of TEC, CEIC, Duquesne Light, and Ohio Edison, along with its subsidiary, Pennsylvania Power. The total CAPCO service territory (Figure 8.1) includes about 7.2 million people in a 14,000 square mile area; CAPCO serves about 2 million customers. The CAPCO companies share generation and transmission facilities and function as though they were one single system, and there are plans to establish a common load dispatching center in the near future. The Davis-Besse Unit will be the fourth generating unit to be installed under the CAPCO agreement, and it will be the second nuclear unit (Beaver Valley Unit 1 will be the first). The Davis-Besse Unit will become part of the CAPCO pool generating capacity; and consequently, during its initial period of operation, its output will be distributed as follows:

Ohio Edison	280 MW
CEIC	314 MW
TEC	277 MW

Subsequently, however, the entire Station capacity will be allotted to TEC and CEIC.

TEC has a service territory of about 2500 square miles in northwestern Ohio (Figure 8.1). This service territory includes a population of about 720,000 people (1971). At the end of 1971, TEC served 208,448 residential customers, 20,708 commercial customers, and a group of 4239 customers including industrials, other utilities, and municipalities. A breakdown of the actual 1971 load is: residential, 23.3%; commerical, 12.7%; industrial, 50.0%; other utilities, 4.9%; all others, 9.1%. Total 1971 sales were approximately 5879 million kilowatt hours.

CEIC has a service territory of about 1700 square miles in northeastern Ohio (Figure 8.1). This service territory includes a population of about 2.1 million people (1971). At the end of 1971, CEIC served 505,889 residential customers; 50,285 commerical customers; 7122 industrial customers; and 453 miscellaneous customers. A breakdown of CEIC's actual 1971 load is: residential, 25.1%; commercial, 22.3%; industrial, 48.5%; all other customers 4.1%. Total 1971 sales were approximately 14,065 million kilowatt hours.

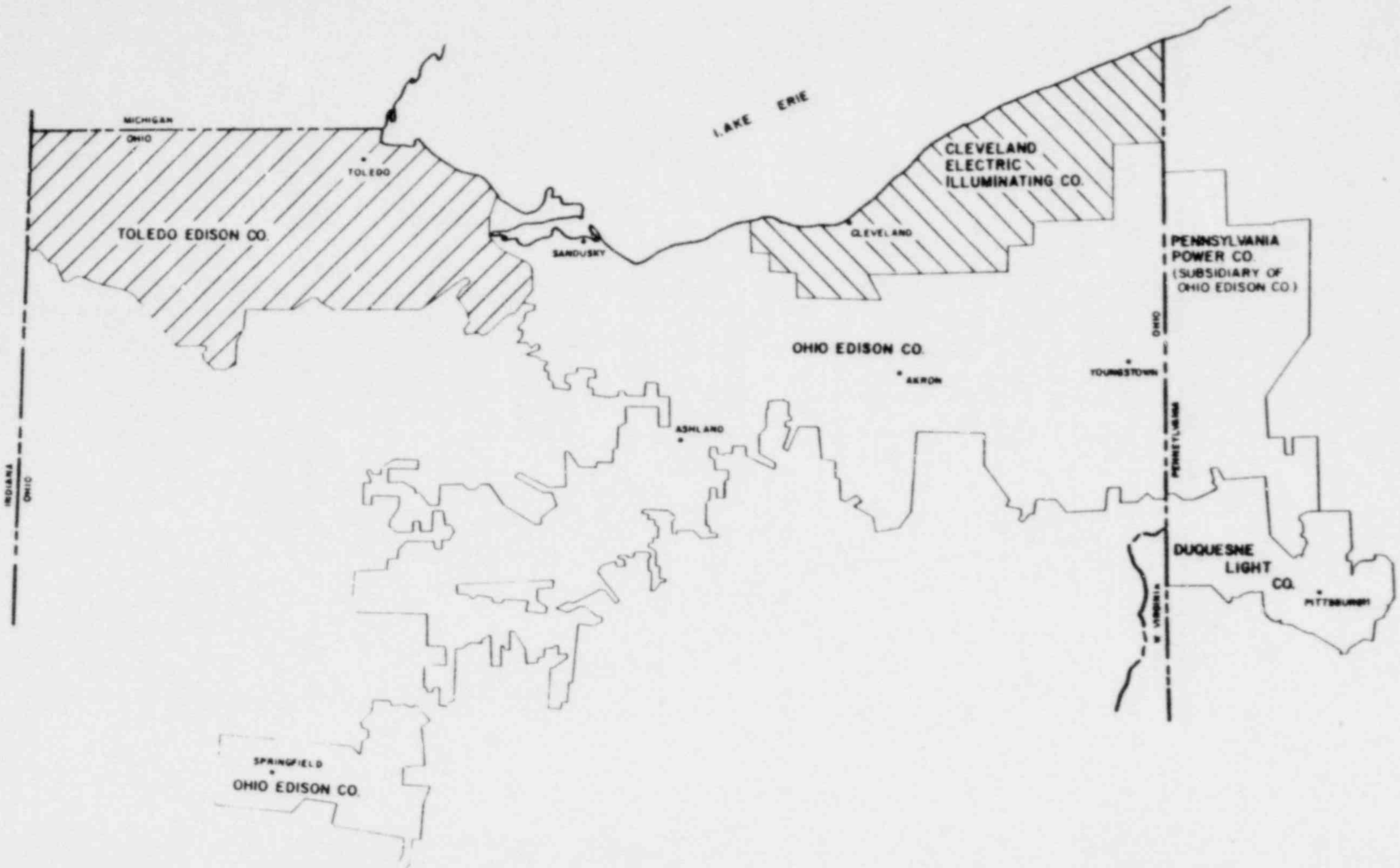

Fig. 8.1. Service Territory of CAPCO and Member Companies.

The projected system summer peak loads and generating capacities for TEC and CEIC through 1976 are presented in Tables 8.1 and 8.2, respectively. Although it is difficult to present a meaningful picture of the reserves situation for each of the companies individually, because CAPCO operates almost as a single utility system in meeting the load demand, the data in the Tables do indicate some trends. As shown by the last column in each Table, both companies have percentage reserves below the Federal Power Commission's (FPC) recommended guideline of 20%, even if all the projected capacity increases come on line as scheduled. Since both companies experience peak loads in summer, their winter reserve situation will presumably be better than that shown in the Tables. The projected TEC load growth rate, reflected by the data in Table 8.1 is 7.5%. This compares with a growth rate for the Toledo area, TEC's load center, of 6.7%, projected by the Federal Power Commission (FPC).[7] Similarly, the load growth data for CEIC in Table 8.2 correspond to a rate of 6.2%, which compares with the FPC projected value of 5.9% for the Cleveland, Ashtabula load center.[7] Therefore it appears that the load growth projections for CEIC and TEC are slightly in excess of, but in rough agreement with, the FPC estimates.

A more meaningful picture of the reserves situation with and without Davis-Besse is presented in Table 8.3, which gives CAPCO load and capacity data through 1980. The CAPCO projected summer peak* given in the Table reflects a growth rate of about 6%. This compares with the FPC estimate of 6.7% for the East Central region, power supply area 9, which includes most of the CAPCO service territory.[7]

Therefore, it appears that the CAPCO load growth projections are reasonable. As shown by the reserve capacity percentages in the last column, the most critical period for CAPCO is the summer of 1974 when the reserves are only 5.6%. Since Davis-Besse is not scheduled to come on line until the following winter, the earliest time when it will likely be available will be for the summer 1975 peak. As shown by the data in the table, 1975 summer reserves will be 17.0% and 9.6%, respectively, with and without Davis-Besse, assuming all the other units come on line as scheduled. Thus it appears that CAPCO is critically dependent upon Davis-Besse, Beaver Valley-1, and Mansfield-1 for meeting the summer 1975, and thereafter, peak loads.

The CAPCO companies are all members of the East Central Area Reliability coordination agreement (ECAR). ECAR is one of the nine regional power groups that make up the National Electric Reliability Council. ECAR is made up of 26 utilities located in eight east-central states, with a

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* As with TEC and CEIC, CAPCO experiences its peak loads in summer.

TABLE 8.1 Projected TEC System Load and Generating Capacity*

Year	Projected Peak Summer Load (MWE)	Scheduled Dependable Capacity (MWe)	Projected Net Power Purchases (MWe)	Available Capacity (MWe)	Projected Reserves (MWe)	Reserve Capacity (%)
1971	1054 (actual)	1013	165	1178	124	11.8
1972	1160	1103	153	1256	96	8.3
1973	1246	1203	153	1356	110	8.8
1974	1334	1215**	219	1434	100	7.5
1975	1389	1441	147	1614	225	16.2
1976	1503	1609	129	1738	235	15.6

* Data for this table taken from References 1, 2, and 3.

** Davis-Besse-1 (Nuclear) on line (December); the initial share allotted to TEC is 277 MWe, although this increases in subsequent years.

TABLE 8.2. Projected CEIC System Load and Generating Capacity*

Year	Projected Peak Summer Load (MWe)	Scheduled Dependable Capacity (MWe)	Projected Net Power Purchases or (Sales) (MWe)	Available Capacity (MWe)	Projected Reserves (MWe)	Reserve Capacity (%)
1971	2750 (actual)	3235	**	3235	485	17.6
1972	2930	3400	**	3400	470	16.1
1973	3120	3597	**	3597	477	15.3
1974	3310	3710***	18	3728	418	12.6
1975	3500	4140	(41)	4099	599	17.1
1976	3700	4430	**	4430	730	19.7

* Data for this table taken from References 4 and 5.

** Data unavailable.

*** Davis-Besse-1 (Nuclear) on line (December); the initial share allotted to CEIC is 314 MWe, although this increases in subsequent years.

TABLE 8.3. Projected CAPCO System Loads and Generating Capacity[i]

Year	Projected Peak Summer Load (MWe)	Scheduled Dependable Capacity (MWe)	Projected Net Power Purchases (MWe)	Available Capacity (MWe)	Projected Reserves (MWe)	Reserve Capacity (%) With Davis-Besse	Reserve Capacity (%) Without Davis-Besse
1971	8,747 (actual)	10,422	*	10,422	1675	–	19.1
1972	9,693	11,060[a]	439	11,499	1806	–	18.6
1973	10,353	10,960[b]	445	11,405	1052	–	10.2
1974	11,071	11,046[c]	646	11,692	621	–	5.6
1975	11,804	13,489[d]	324	13,813	2009	17.0	9.6
1976	12,527	14,429[e]	291	14,720	2193	17.5	10.6
1977	13,285	14,429	293	14,722	1437	10.8	4.3
1978	14,086	15,305[f]	241	15,276	1190	8.4	2.3
1979	14,941	16,186[g]	195	16,381	1440	9.6	3.8
1980	15,840	17,066[h]	200	17,266	1426	9.0	3.5

* Data unavailable.

[a] Eastlake - 5 (Coal) on line (August) + 650 MWe.

[b] Various peaking units on line (October), + MWe.

[c] Beaver Valley - 1 (Nuclear) on line (October), + 856 MWe; Davis-Besse-1 (Nuclear) on line, (December), + 872 MWe.

[d] Mansfield - 1 (Coal) on line (April), + 825 MWe.

[e] Mansfield - 2 (Coal) on line (April), + 825 MWe.

[f] Beaver Valley - 2 (Nuclear) on line (January), + 880 MWe.

[g] Undetermined, + 880 MWe.

[h] Undetermined, + 880 MWe.

[i] Data for this table taken from References 3 and 6.

combined capacity of about 56,000 MWe (Dec. 1971), serving about 32 million people in an area of about 194,000 square miles. The stated objectives of ECAR are: (1) to assure an adequate supply of electric energy to meet present and future needs; (2) to achieve maximum reliability and continuity of service; and (3) to accomplish these objectives while protecting and preserving the environment.

The feasibility of the alternative of purchasing the power which would be supplied by the Davis-Besse Station from within the ECAR territory is discussed in Section 9.

A comparison of the Applicant's load projections vs. actual historic load demand is available to the Staff for the time period of 1960 to 1970. This load projection for the ten year period was made in mid 1960 and was intended to anticipate load growth up to 1970.

Throughout this time period (1960-1970) the projections were from 13.9% to 8.3% above the actual experienced demand. The Applicant did not make yearly corrections of his projections to bring them into closer conformity to experienced historic load demand. This information is presented as a graph (Fig. 10-1) in the Applicant's Supplement to Environmental Report, Vol. 2. It is difficult to determine whether the Applicants' high projections are due to the fact that yearly projection corrections were not made or are due to conservatism. There is a near parallelism between the projection and the historic demand which implies that the Applicant's projection method was reliable.

A historic comparison of the same kind for CAPCO is not available to the Staff and would be of little value since CAPCO was formed in 1967 and thus only a few years' comparison would be made-this would be of limited value because of year-to-year fluctuations between projected load and historic load demand.

8.2 ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

The following is a listing of the major items which comprise the total environmental impact of the Station operating as currently designed. The impacts are categorized under the major headings of land, aquatic, and radiological effects.

8.2.1 Land Effects

Construction of the Station has removed 160 acres of marginal farmland from production of grain crops for the forseeable future. On the other hand, by virtue of the agreements between the applicant and the Bureau of Sport Fisheries and Wildlife, about 500 acres of marshland have been placed under management as an additional wildlife refuge area. The lakeshore along the site property was privately owned and, hence, access was restricted prior to construction of the Station and will remain so in the future; therefore, there is no change in land access because of the Station presence. Construction of the temporary barge channel and the Station water intake and discharge piping will, however, temporarily disturb the lake shore and lake bottom at the site. While this will cause some disruption of the beach and temporary water turbidity for a few months, permanent effects are very unlikely. An additional 1800 acres, primarily farmland, are directly affected by the construction of the off-site transmission lines for the Station, although the land use is not changed substantially since only that needed for construction of the towers themselves is removed from farm production.

The presence of the Station, particularly the cooling tower, will change the appearance of the lake front and marshland. The addition of the approximately 493 foot high natural draft cooling tower and visible vapor plume will affect the view for recreational boaters on Lake Erie, the few local residents with summer homes along the lake shore, and persons using the nearby recreational areas and campgrounds. In addition, the following environmental effects of the cooling tower effluent are possible.

1. Increased natural fog within one to five miles inland may be expected whenever onshore circulation of cool air from Lake Erie creates an inversion layer during spring and summer months (lake effect) that inhibits the rise of the moisture plume from the cooling tower. This is not expected to occur more than a few hours per year.

2. Slight additional snowfall in the immediate area of the Station may be expected from the growth of snowflakes during their fall through the cooling tower moisture plume.

It is improbable that major mortalities of nocturnal migrants (mainly songbirds), such as have occurred at airport ceilometers or television towers, will occur at the Station cooling tower. However, under certain adverse weather conditions during major migrations, such kills are possible, and certainly occasional mortalities of a few birds may occur. No quantitative estimate of mortalities can be made due to lack of experience with tall cooling towers and, in particular, in combination with the unique situation of a cooling tower situated on a large lake within a migratory bird flyway.

8.2.2 Aquatic Effects

Essentially all the organisms (plankton, fish eggs, very small fish) which are drawn into the Station intake will be killed. However, because of the low water velocity at the intake crib, very few adult fish will be drawn in. Also, some small fish and plankton entrained in the discharge water plume will be disabled as a result of buffeting, thermal shock, or exposure to chlorine. There may be some loss in reproduction potential of the scuds (amphipods) in the immediate area due to sublethal effects of chlorine, but since scuds do not form an important food organism here, there is a negligible impact.

There is a net consumption of water from Lake Erie, due to evaporation of water in the Station cooling tower, which amounts to 0.1% of the total natural evaporation from the surface of the lake.

8.2.3 Evaluation of Radiological Effects

Some perspective may be gained by comparing the doses attributable to this Station with those from the natural background and from medical diagnostic radiation. The natural-radiation background includes contributions from cosmic rays, cosmic-ray-produced tritium and carbon-14 in air and water, uranium- and thorium-bearing soils, and radioactive potassium within the human body. These sources contribute about 140 millirem/yr per individual in Ohio. However, it is quite variable from place to place depending mainly on altitude above sea level and the nature of the local soil. In the U. S., it ranges from about 60 to about 250 millirem/year. For the 2,052,000 people living within 50 miles of the Davis-Besse Station (1970), this amounts to a total population dose of about 290,000 man-rem/yr. The results of a Public Health Service survey made in 1964 indicated that the dose to the population averaged about 55 millirem per year per individual from diagnostic radiation. This would contribute about 13,000 man-rem/yr to the population considered here. Thus, the total population dose attributed to the routine operation of this Station (22 man-rem/yr) is very small compared with the doses from natural background and medical diagnostic radiation.

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

The marshlands along the Lake Erie shore are a valuable ecological resource that should be conserved. The use of the site for a generating station will not conflict with this goal. In fact, the arrangements which have been made between the applicant and the U. S. Bureau of Sport Fisheries and Wildlife will further the interests of conservation by increasing the extent and improving the quality of the marshland available as a wildlife refuge.

The removal of about 160 acres of marginal farmland from cultivation will have an insignificant effect on the agricultural productivity of the area, and this land could conceivably be restored to its original condition, at considerable expense, for use as farmland or for some other purpose such as public recreation. However, the expenditure of many millions of dollars for this purpose seems unlikely, even after the end of the useful life of the present equipment, if the need for power still demands the existence of a large generating station in this area. The Applicant points out that, historically, boilers become obsolescent before turbine generators. Advances in technology will undoubtedly produce more efficient nuclear generators during the design life of the present equipment (30 years) and the Applicant's tentative prediction is that the present reactor and steam generators will be replaced by an advanced design, operating at higher temperature and pressure, and driving a high pressure topping type turbine ahead of the existing turbine generator. Such improvements could extend the life of the Station to 75 years or more. In that case, the following present-day estimates of decommissioning procedures and costs may be of doubtful validity.

8.3.1 Decommissioning Station After Operating Life

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

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

There are several alternatives which can be and have been used in the decommissioning of reactors: (1) Remove the fuel (possibly followed by decontamination procedures); seal and cap the pipes; and establish an exclusion area around the facility. The Piqua decommissioning operation was typical of this approach. (2) In addition to the steps outlined in (1), remove the superstructure and encase in concrete all radioactive portions which remain above ground. The Hallam decommissioning operation was of this type. (3) Remove the fuel, all superstructure, the reactor vessel and all contaminated equipment and facilities, and finally fill all cavities with clean rubble topped with earth to grade level. This last procedure is being applied in decommissioning the Elk River Reactor. Alternative decommissioning procedures (1) and (2) would require long-term surveillance of the reactor site. After a final check to assure that all reactor-produced radioactivity has been removed, alternative (3) would not require any subsequent surveillance. Possible effect of erosion or flooding will be included in these considerations.

For Type 3 decommissioning of the plant the Staff estimates the cost of $30 million (1972 dollars). This figure is based on adjustment to a single unit of the estimate prepared by the Staff for the Consumer Power Co. Midland Plant Units 1 & 2.[8] The Midland estimate was made by careful scaling of the detailed estimates for the Elk River reactor.

The Staff concludes that the benefits derived from the Station in serving the electrical needs of the area outweigh the short term uses of the environment in its vicinity.

8.4 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

As mentioned in Section 8.3, the arrangements involved in the acquisition of the site will enhance rather than detract from the ecological resources of the marshland. With the exception of the work on the intake canal, already completed, the construction work has not disturbed the marsh areas, and there is no evidence of any undesirable effects on the wildfowl population. Dredging operations for the temporary barge channel and the permanent water intake are expected to produce some slight short-term damage to aquatic life in the immediate vicinity, but no lasting effect on the aquatic environment is expected.

As in any large industrial project, considerable mineral resources in the form of steel and concrete are committed to the construction of the Station. The concrete is irretrievable, but with the exception of the reactor vessel, much of the metal can be recovered as scrap for re-use at the end of the Station's useful life. The uranium-235 consumed during operation will be irretrievable, but some uranium-238 in the fuel will be converted to fissionable plutonium-239. Of this plutonium, a small fraction will be consumed by fission in the reactor reducing slightly the consumption of uranium-235, while the remainder will be recovered during fuel reprocessing and will contribute to the general reserves of fissionable material. The Staff calculates that about 30 metric tons of uranium will be consumed during the 40 years of plant operations.

The water evaporated by the cooling tower (about 10,000 gpm) represents an insignificant loss from Lake Erie. Some of this water will eventually return to the Great Lakes system as precipitation over the watersheds of rivers flowing into the lakes, while the remainder will find its way into the Atlantic Ocean.

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

REFERENCES

1. Davis-Besse PSAR, Amendment No. 12, Appendix C.

2. Toledo Edison Co., Annual Report - 1971.

3. Davis-Besse Nuclear Power Station - Testimony on Behalf of the Toledo Edison Company and Cleveland Electric Illuminating Company, April 4, 1972.

4. Davis-Besse PSAR, Amendment No. 12, Appendix D.

5. Cleveland Electric Illuminating Co., Annual Report - 1971.

6. Report by ECAR Bulk Power Members to the Federal Power Commission, Volume I, Load Projections and Resource Planning, April 1972.

7. The 1970 National Power Survey, Part II, Federal Power Commission, December 1971, pp. II-2-15 and II-2-16.

8. Transcript of the ASLB Hearing June 12, 1972, in the matter of Consumers Power Co. (Midland Plant Units 1 and 2), pp. 7822-7836.

9. ALTERNATIVE ENERGY SOURCES AND SITES

The need for additional power within the service areas of the Applicant and the CAPCO pool was discussed in Section 8.1. It is shown there that additional power equal to the 872 MWe expected from the Station will be needed to maintain adequate generating reserve from 1974 on. Alternative sources of power are considered in this section:

1. The purchase of power from other companies;
2. The construction of a generating plant at a different site;
3. The construction of a non-nuclear plant at the Station site.

Full acceptance of any one of these alternatives would imply that the proposed Station should be abandoned. In that event, little of the sunk economic costs (money already spent or irrevocably committed) could be salvaged. According to the Applicant,[1] the estimated loss if the Station were abandoned at year-end 1972 is about $118 million. Similarly, most of the environmental impacts associated with construction (but not operation) of the Station are "sunk" because they have already occurred.

9.1 PURCHASE OF POWER

The purchase of power by the Applicant and/or other CAPCO members from other Power Companies would be a reasonable alternative to completion and operation of the Station only if (1) sufficiently firm long-term commitments for power could be achieved to ,allow adequate system reliability for CAPCO and if (2) the vendor companies had no need to construct additional generating plants, since such construction would merely transfer environmental impacts to other localities.

The major producers of power (including CAPCO) within the East-Central region are members of ECAR, a fact-gathering and coordinating organization. As shown in Table 9.1, ECAR members as a group face a continuing need for additional generating capacity comparable to that of CAPCO. It may be seen that the projected annual peak load increases exceed 6.5 percent and that the projected net additions to generating capacity exceed 5.4 percent or 4900 MWe for each year in this period.

The 19 corporately independent ECAR members form 12 systems or pools for which ECAR maintains peak load and generating capacity projections. Of these, Ohio Valley Electrical Company (OVEC) is exceptional in that it serves a single customer, the U.S. Atomic Energy Commission Gaseous Diffusion Center near Portsmouth, Ohio. OVEC's load is essentially

TABLE 9.1. Projected ECAR Load and Generating Capacity

Year	Summer Peak Load (MWe)	Increase		Year End Capacity (MWe)	Increase	
		MW	(Percent)		MW	(Percent)
1972	48,561			61,425	5184	9.2
1973	52,584	4023	8.3	68,491	7066	11.5
1974	56,531	4247	8.1	73,497	5006	7.3
1975	61,404	4573	8.0	79,426	5929	8.1
1976	66,052	4648	7.6	85,288	5862	7.4
1977	70,694	4642	7.0	90,656	5368	6.3
1978	75,984	5290	7.5	95,573	4917	5.4
1979	81,462	5478	7.2	101,678	6105	6.4
1980	87,010	5548	6.8	108,566	6888	6.8
1981	92,782	5772	6.6	115,331	6765	6.2

Based on ECAR Bulk Power Members Report to the Federal Power Commission Pursuant to Docket R-362, Order 383-2, April 1972

TABLE 9.2. Five Year Projections for ECAR Pools

Pool or Company	Year	Projected Peak Load (MWe)		Five Year Increase (Percent)		Projected Capacity As of January 1 (MWe)	Five Year Increase (Percent)	Projected Obsolete Capacity Removed (MWe)
		Summer	Winter	Summer	Winter			
A.P.S.	1972	3,675	4,140			4,735		270
	1977	5,275	5,860	44	42	6,430	36	270
A.E.P.	1972	9,412	10,521			12,573		
	1977	13,438	14,540	43	38	19,739	57	424
CAPCO	1972	9,693	9,421			10,622		
	1977	13,285	12,648	37	34	14,668	38	405
C.G.E.	1972	2,400	1,940			2,354		
	1977	3,580	3,030	49	56	3,951	68	0
C.S.O.E.	1972	1,567	1,282			1,563		
	1977	2,488	2,010	59	57	2,719	74	86
D.P.L.	1972	1,670	1,575			1,717		
	1977	2,565	2,510	54	59	2,631	53	19
K.I.P.	1972	5,641	5,292			5,946		
	1977	8,712	8,146	54	54	9,187	55	4
L.G.E.	1972	1,456	1,007			1,571		
	1977	2,134	1,342	47	33	2,381	52	0
M.P.	1972	10,305	10,055			10,866		
	1977	14,845	14,045	44	40	18,033	66	1,112
N.I.P.S.	1972	1,856	1,795			1,400		
	1977	2,851	2,658	43	48	2,400	57	0
S.I.G.E.	1972	530	345			495		
	1977	765	510	44	48	750	52	0

Based on ECAR Bulk Power Members Report to the Federal Power Commission Pursuant to Docket R-362, Order 383-2, April 1972

TABLE 9.2. (Contd.)

Explanation of abbreviations: A.P.S.-Allegheny Power System; A.E.P.-American Electric Power System; CAPCO-Central Area Power Coordination Group (Cleveland Electric Illuminating Co., Duquesne Light Co., Ohio Edison Co., Toledo Edison Co.); C.G.E.-Cincinnati Gas and Electric Co.; C.S.O.E.-Columbus and Southern Ohio Electric Co., D.P.L.-Dayton Power and Light Co.; K.I.P.-Kentucky-Indiana Pool (East Kentucky Power Cooperative, Kentucky Utilities Co., Indianapolis Power and Light Co., Public Service of Indiana, Inc.); L.G.E.-Louisville Gas and Electric Co.; M.P.-Michigan Pool (Consumers Power Co., Detroit Edison Co.); N.I.P.S.-Northern Indiana Public Service Co.; S.I.G.E.-Southern Indiana Gas and Electric Co.

constant, with rare changes which are scheduled years in advance. Each of the other 11 ECAR reporting entities projects annual peak-load growth of not less than 5.8 percent for each of the years 1972-1981. As shown in Table 9.2 for the five years 1972-1976, none of the 11 systems or pools projects gross new generating capacity of less than 36 percent of its 1971 year-end capacity. In the aggregate, 31,367 MWe of new capacity is projected with the retirement of 2590 MWe of obsolescent capacity (chiefly coal-fired plants) for a net increase in capacity over the years 1972-1976 of 29,047 MWe or 54 percent of the ECAR-less-OVEC capacity at year-end 1971. (OVEC capacity is projected as unchanged through 1981.) The absence of exceptions other than OVEC and the homogeneity of the projections over the 11 distinct systems or pools make it clear that if the expected generating capacity of the Station were replaced by purchases from other power companies within the ECAR region, the consequence would be augmented construction elsewhere or delay of the retirement of obsolete coal-fired plants within the region. Since the environmental impact of either consequence compares with that expected from the Station, we conclude that the purchase of power is not a reasonable alternative to the completion and operation of the Station.

9.2 ALTERNATIVE SITES

The applicant's study of possible sites in 1967, described in Section 1.2, assumed that the contemplated plant would use once-through cooling and therefore was limited to the area near the Lake Erie shoreline. Only two sites, the Darby Marsh and the Navarre Marsh, were identified as possibly available and as meeting the AEC criteria for nuclear-plant sites. During the study, the U.S. Government acquired the Navarre Marsh. Consequently, the Applicant acquired an option on the 489-acre Darby Marsh tract. However, the Navarre Marsh appe ed the better site and the Applicant and the U.S. Bureau of Sport Fisheries and Wildlife negotiated an exchange agreement in early 1968. Under the agreement, the Government acquired the Darby Marsh as a National Wildlife Refuge and the Applicant received the Navarre Marsh tract. However, the Government also received the use and control, as a wildlife refuge, of over 500 acres at the Navarre Marsh site. The Applicant also agreed to construct one dike, to repair others, and to install pumps so that the marsh water level may be controlled. The high ground portion of the Navarre Marsh site is being used for construction of the Station.

The later decision by the Applicant (July 1970) to change the Station design to closed-cycle cooling greatly reduced the needed water supply. In principle, many other site possibilities could then have been considered. However, in order to avoid delaying completion of the plant and because the Navarre Marsh site appeared generally satisfactory, the Applicant did not reopen the study of possible sites.

Most environmental impacts expected to result from construction and operation of the Station would arise from a similar plant located anywhere in the Applicant's service area. For example, the evaporative consumption of water and the discharge of a warm blowdown stream would have greater impact on a river or a lake smaller than Lake Erie. The visual impact of a natural-draft cooling tower sized for an 872 MWe plant would reach a comparable number of viewers from almost any location in Northern Ohio. Respect for public opinion and, for a nuclear plant, conformance to AEC siting requirements would probably place any alternative site away from urban or suburban areas: in that case, either farmland or wildlife habitat would be converted to industrial use, just as at the reference site.

The only impact which appears to be specific to the reference site is the risk of occasional occurrences in which migratory birds may collide with the cooling tower and be killed (see Section 5.4). The risk, which is estimated to be small, arises from the location of the reference site within an important flyway for migratory birds. However, the same feature of the location makes particularly valuable the creation of more than 600 acres of additional Government managed wildlife refuge.

The Staff thus concludes that any environmental advantage which might have resulted from thorough reconsideration by the applicant in 1970 of possible alternative sites would have been small, at best. Choice of a different site at that time would have delayed the plant by a period of one to several years, with a consequent threat to reliability and adequate power supply within the CAPCO service area for 1975 and following years (see Table 8.3).

Were the reference (Navarre Marsh) site to be abandoned at a time near the end of the NEPA review, say January 1, 1973, a greater delay would result. Almost certainly, the delay would be not less than four years (the Applicant estimates 6 years[4]) since the Applicant's posture would be "reset" to that of early 1969 with respect to site selection and construction. All of the environmental and economic costs associated with construction at the reference site would be sunk and could not be recovered. Since site-preparation work and conventional construction are well advanced, the sunk cost would be not less than $160 million as the overall economic penalty if a <u>similar</u> plant were to be constructed at another site.

It appears unlikely that the achievable environmental gain with respect to operation of the Station at a conceivable alternative site could outweigh the doubled environmental impact due to construction first at the reference site and then at the hypothesized alternative site.

Considering as well the 4 to 6 years of marked reduction in reliability within the CAPCO service area and the severe economic penalty to the Applicant (all or much of which would ultimately be borne by the public) the Staff concludes that the case for completion of the Station at the reference site is very strong.

9.3 ALTERNATIVE MEANS OF POWER GENERATION

Potential hydroelectric capacity approaching 872 MWe does not exist within the CAPCO service area. Natural gas is not available in the area in adequate quantity for large generating stations. For base-load (24 hours per day) operation fuel costs for an oil-fired steam plant would be about double those for a coal-fired plant. Fuel costs for oil-fueled gas turbines would be even higher. The remaining commercially practicable alternative to the proposed nuclear steam-turbine plant is a coal-fired steam-turbine plant. Most present generating plants in the East Central area are of this type.

Two environmental impacts associated with nuclear plants are substantially reduced for coal-fired plants. Because of higher thermodynamic efficiency and because some of the heat passes up the stack with other combustion products, fossil-fuel plants release only about 60 percent as much waste heat to the plant condenser cooling water as do nuclear plants of the same electrical output capacity. Also, although the release of radioactivity from current nuclear plants leads only to minor increments to the natural radiation levels, coal-fired plants release even less and oil-fired plants release virtually none.

Coal-fired plants, however, produce combustion products including dust, sulfur dioxide, and oxides of nitrogen in substantial amounts and these are a significant source of air pollution. The comparative environmental impacts expected for the reference plant and for a coal-fired plant of the same generating capacity are given in Table 9.3. Combustion products are estimated on the basis that the coal-fired plant just meets the Environmental Protection Agency standards for new plants.[2]

The estimated economic costs associated with the reference plant and with an alternative coal-fired plant of the same capacity are presented in Table 9.4. Capital costs of coal-fired capacity is estimated at

TABLE 9.3. Comparative Environmental Impacts for Reference and Coal-fired Plants

Category	Reference: 872 MWe Nuclear Plant	872 MWe Coal-fired Plant with Cooling Tower
Land use:		
Plant	75 acres	Similar to reference
Fuel storage	minor	15 acres
Total plant	150 acres (without exclusion area)	150 acres
Releases to air:		
Radioactivity	2943 curies/yr.	small
Dust	none	7.3 tons/day
Sulphur dioxide	none	87.5 tons/day
Nitrogen oxides	none	51 tons/day
Releases to water:		
Heat	2.65 billion BTU/day*	1.59 billion BTU/day*
Radioactivity:		
tritium	1000 curies/year	none
other	5 curies/year	none
Chemical:		
chlorine	13 lbs/day	13 lbs/day
salts	700 lbs/day	450 lbs/day**
Water consumed	10 million gal/day	6 million gal/day
Fuel:		
consumed	26 tons/year	2.5 million tons/year
transported	5 truckloads/year	350 trainloads/year
Wastes	6 carloads/year	250,000 tons/year
Aesthetic	Inoffensive except for 493-ft cooling tower	Similar to reference plus 15 acre coal pile, 300 ft stack.

* Assumes 80% load factor.

** This chemical discharge could be increased about tenfold if ash-sluicing effluent is discharged.

TABLE 9.4. Comparative Economic Costs for Reference and Alternative Plants (in Millions of Dollars)

	872 MWe Reference (Nuclear) Plant-First Operation January 1, 1975		872 MWe Coal-Fired Plant-First Operation January 1, 1979	
Construction Cost:				
Total	$321		$174	
Sunk	193		0	
Incremental	128		174	
Salvage Allowance	0		-75	
Net Incremental	128		99	
Present Worth of Net Incremental Cost		$128		$70
Allowance for Loss of Power		12		165
Annual Operating Cost:				
Fuel	8.3		24	
Other	2.1		2	
Total	10.4		26	
Present Worth of Capitalized Operating Cost		105		273
Decommissioning Allowance	30		5	
Present Worth		2		0
Present Worth of Incremental Life-of-Plant Cost		247		508
Present Worth of Total Life-of-Plant Cost		440		508
Annualized Equivalent of Life-of-Plant Cost				
Incremental		23.5		48.4
Total		41.9		48.4

\$200 per KWe and coal costs at \$0.45 per 10^6 BTU.* In order to achieve comparability among costs which would be incurred at different times, all costs are reduced to present worth** at the assumed time of first operation, January 1, 1975. The discount rate used is 8.75 percent which is representative of the overall before-Federal-income-tax rate required for payment of interest on bonds and stock dividends by investor-owned power companies. Estimated construction costs for the reference plant are those provided by the Applicant. These figures normally include compounded "interest during construction" so no present-worth adjustment need be made. To compute the present worth of the stream of payments for fuel and other operating costs, a life of 30 years is postulated.

In order to assess the comparative costs of completing the reference plant or constructing the alternative coal-fired plant, only the costs incurred after the hypothetical time of decision should be considered; i.e., the sunk prior costs are "water over the dam." Costs that would be incurred after the assumed decision point, January 1, 1973, are labeled incremental costs in the table.

Since the alternative plant could not be operational until about January 1, 1979, the cost of providing power for four years from other sources should be charged against it. An estimated rate of 8 mills per kilowatt hour is used. However, the postulated combination of four years purchase and 30 years plant life provides power for 34 years. To place the reference plant on a comparable basis, the purchase of power for four years after 30 years of plant life is postulated.

It may be seen from Table 9.3 that the estimated economic penalty for the hypothesized change to a coal-fired plant is about \$261 million or 59 percent of the total life-of-plant cost of the reference plant. These figures are present worths as of January 1, 1975. On an annualized basis, the penalty is about \$25 million per year during the postulated 30 years of operation.

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* The estimates come from another applicant in the East Central area. They appear reasonable in relation to estimates published by the Federal Power Commission[3] when the latter are corrected for inflation and the rapid increase in minehead coal prices during recent years.

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

The coal-fired plant would discharge less heat to Lake Erie and less radioactivity to the atmosphere than the reference plant. However, as assessed in Sections 5 and 8, the impacts of these discharges are very small for the reference plant. We judge their effect to be clearly outweighed by the air pollution intrinsic to the coal-fired plant and therefore consider the reference plant to be, on balance, the better with respect to environmental impact. Considering the loss of reliability to the CAPCO pool during the four-year delay and the large economic penalty to the applicant, which is ultimately paid by the public, there is no doubt that the reference plant is the preferred alternative.

9.4 SUMMARY

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

REFERENCES

1. Benefit-Cost Discription of Alternative Designs for the Davis-Besse Nuclear Station, July, 1972 (supplement to the Applicant's Environmental Report).

2. Environmental Protection Agency Regulations on Standards of Performance for New Stationary Sources (40 CFR 60; 36 FR 24876; December 23, 1971).

3. Federal Power Commission, The 1970 National Power Survey. See Table 19.3, p. I-19-4 for plant costs; Table 4.2, p. I-4-3, and Fig. 4.9, p. I-4-28 for coal costs.

4. Davis-Besse Nuclear Power Station, Reasons for Non-suspension of Construction Permit No. CPPR-80, April 27, 1972. (p. 26-27.)

10. PLANT DESIGN ALTERNATIVES

In this section we consider possible modifications to the reference design which might change significantly the balance between economic and environmental costs.

10.1 COOLING SYSTEM ALTERNATIVE

Thermal electric generating plants require the removal of from 5300 to 7100 BTU waste heat for each kilowatt hour of electrical energy generated, the higher figure being typical of current nuclear plants.* The best established methods of large-scale cooling involve either (a) the transfer of water (as vapor) and heat to the atmosphere by direct evaporation in "wet" cooling towers, spray ponds or canals or (b) the warming of a stream or lake. In the latter case, the heat is eventually transferred to the atmosphere, chiefly by evaporation although radiative and convective processes play some part. Another means of heat transfer, the "dry" cooling tower, serves to transfer heat directly to the atmosphere without evaporation of coolant (in the same manner as an automobile radiator). Dry towers have been used for relatively small thermal electric plants in arid regions, particularly abroad, but the high coolant-return temperature in hot weather results in condenser back-pressure which is too high for any large (over 300 MWe) steam turbines currently available.[1]

The preliminary design of the Station was based on once-through cooling with Lake Erie water, and the Navarre Marsh site was acquired on that assumption. The Applicant's later decision to incorporate a closed-cycle cooling system because of uncertainty as to the regulatory standards which might apply at the time of completion of the Station (discussed in Section 5) was made on the basis that the Navarre Marsh site would continue to be used, since any change of site might have delayed the plant for several years.

Among the closed-cycle alternatives, the Applicant's choice appears to have been based on the expectation that the probability of fog and icing, particularly at the Station itself and at the nearby State Highway 2, would be least for a natural-draft tower (because the moisture release occurs 500 ft. above ground level). The estimated economic costs did not differ greatly for the several closed-cycle choices, as shown in Table 10.1. Although aesthetic impact is greatest for the natural-draft tower because of its great size, the Staff concur in the applicant's choice among closed-cycle means.

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* A lower value would hold for high-temperature gas-cooled reactor plants, a few of which are coming into service.

TABLE 10.1. Comparative Economic Costs for Alternative Cooling Systems (Millions of Dollars)

	Once-Through	Natural-Draft Tower	Mechanical-Draft Towers	Spray Canal	Cooling Pond
Incremental construction cost if chosen in 1970:					
Direct	base	6.77	5.1	4.1	10.75
IEC* at 33%	base	2.23	1.7	1.5	3.55
Total	base	9.0	6.8	5.6	14.3
If chosen in 1972:					
Direct	9.2	base	6.1	5.6	11.6
IEC* at 33%	3.0	base	2.0	1.9	3.8
Total	12.2	base	8.1	7.9	15.4
Lost-capacity allowance ($250/kW)	base	6.25	7.35	8.53	base
Incremental maintenance cost-capitalized (8.75%, 30 years)	base	-.21	.32	.58	.42
Gross incremental cost					
If chosen in 1970	base	15.0	14.5	14.7	14.8
If chosen in 1972	6.2	base	9.8	17.0	15.8

Based on Table B.1, p. B-17, Benefit-Cost Description of Alternative Designs for the Davis-Besse Nuclear Power Station (supplement to the Environmental Report).

*Interest during construction, escalation, and contingency.

The choice between once-through and closed-cycle cooling was made by the Applicant in 1970 primarily on the basis of economic contingencies which do not appear in Table 10.1, namely the risk of serious delay in operation of the Station or the later imposition of a requirement to backfit the plant with a closed-cycle cooling system. One or both of these contingencies might have arisen because of changing Federal or State regulations or because of the vigorous opposition by a segment of the public to once-through cooling anywhere on the Great Lakes (which indeed is the subject of an unresolved controversy within and among Federal regulatory agencies).

Because much of the construction cost for the closed-cycle system is now sunk, there would now be an economic penalty estimated at $6.2 million (see Table 10.1) attached to a change to once-through cooling, apart from the risks feared by the applicant. The environmental balance between the alternatives appears nearly even. In our judgement, the damage to Lake Erie ecology from a well designed once-through system would probably be small in terms of aquatic populations and species balance. On the other hand, enhancement of fog and ice by the natural-draft tower will probably be undetectable, and the danger of high mortality among migratory birds through collision with the tower appears to be small. The cooling tower will have a considerable visual impact, which may be regarded as adverse by some members of the public. On balance, and mainly because of the uncertainty in predictions about lake ecology, the Staff judges the closed-cycle system to have the smaller probable impact and we therefore support the Applicant's choice.

10.2 INTAKE SYSTEM ALTERNATIVES

In the original Station design, flow velocity at the water intake in Lake Erie was 1.5 feet per second under maximum flow conditions. At this velocity a relatively large fraction of the fishes present in the area might be swept into the intake and destroyed on the traveling screens. The Applicant has recently considered and adopted an alternative design for which the intake velocity will be no more than 0.5 feet per second at maximum flow.[2] At the lower velocity, only the small (young) fishes will be vulnerable to entrainment. An air-bubble screen will also be added, tending further to reduce the risk to small fishes, although doubt exists as to the effectiveness of the air screen (see Section 5.4). These modifications will certainly reduce the impact on fishes and are therefore desirable.

10.3 DISCHARGE SYSTEM ALTERNATIVES

In the reference design, as much as 13,800 gallons per minute of diluted blowdown water will be discharged to Lake Erie, at a temperature no more than 20°F above that of the lake. The resulting thermal plume will have an estimated area within the 3°F isotherm of 0.21 acres according to the Applicant's estimate, although our calculation using the model of the Applicant's consultant gave a higher figure (0.7 acre). Since the discharge orifice is 5000 feet from the mouth of the Toussaint River and 16,250 feet from the nearest reef that is believed to be a fish-spawning area, no detectable effect on aquatic life is expected.

The Applicant has considered the possibility of cooling the blowdown stream by a mechanical-draft tower, spray canal, or small cooling pond.[3] The maximum heat discharge and plume area would be reduced by 50 percent for the tower or spray canal, by 20 percent for the pond. Estimated costs are $1.025, $1.115, $0.735 million, respectively (including allowance for maintenance expense and loss of capacity). The Staff judgement is that the environmental advantage of further reducing the already small heat discharge (about 2% of the total condenser heat) is outweighed by the cost of the modifications and the possible terrestrial effects, however small, of the auxiliary cooling system.

10.4 CHEMICAL DISCHARGE SYSTEMS

The only appreciable discharges of chemicals from the reference design plant will be about 13 pounds per day of chlorine and 700 pounds per day of sodium, calcium, and magnesium sulfates and carbonates. According to the evaluation in Section 5, the environmental effects of the chlorine will be confined to a very small area within about 50 feet of the discharge jet. No detectable effect on the lake ecology is expected. However, a procedure which might greatly reduce or even eliminate the discharge of chlorine is suggested in Appendix B. The salt discharge consists essentially of chemicals already present in Lake Erie, at only about twice their lake concentrations.

Since the environmental impacts of these releases are insignificant, we judge that consideration of alternatives (other than that suggested in Appendix B) is not warranted.

10.5 BIOCIDE SYSTEM

Chlorine is the only biocide that will be used in the Station. Its contribution to the chemical waste has been discussed in Section 10.3

above. As an anti-fouling water treatment, chlorine performs very well at quite low concentrations, and its use for this purpose is well-established. No suitable alternative treatment can be suggested. An alternative method of operation designed to minimize the discharge of chlorine is described in Appendix B.

10.6 SANITARY WASTE SYSTEM

The sanitary waste system is of sound, modern design. It has been approved by the Ohio State Department of Health, and permits for its construction and operation have been obtained. We consider that its impact on lake water quality will be negligible, and that no alternatives need be considered.

10.7 TRANSMISSION SYSTEM

Overhead transmission lines are an adjunct of large generating stations. The height and spacing of the conductors, and of the towers required to support them, are determined by the transmission voltage, which in turn is chosen by balancing economic costs of conductors, towers, and land acquisition against transmission losses. The Applicant's choice of 345 kV follows accepted practice for the load capacity required. Three transmission routes were selected to connect the Station with the Applicant's distribution system and with the other utilities of the CAPCO group. The total length of lines to be constructed in the Applicant's service area is about 57 miles. The design of the system and the choice of routes are described in Section 3.7 and in Appendix 4A of the Applicant's Environmental Report Supplement. All applicable local, state, and federal standards and guidelines have been complied with, and the necessary approvals and permits have been obtained (Section 1.3).

The Staff considers that, in the design of towers and choice of routes, the Applicant has taken account of aesthetic, social and environmental values by avoiding as far as is feasible the removal of dwellings, proximity to communities or community services (e.g., schools, parks, radio and television transmitters), following of highways, disturbance of forested areas, and interference with public enjoyment of recreational, conservational, and scenic areas, although some impact on these amenities is inevitable. We judge that no feasible alternatives would produce sufficient benefit to outweigh the costs already expended or committed.

REFERENCES

1. J. P. Rossie, E. A. Cecil, and R. O. Young, Cost Comparison of Dry-Type and Conventional Cooling Systems for Representative Nuclear Generating Plants, USAEC Report TID-26007. Appendix B, p. 110.

2. Benefit-Cost Description of Alternative Designs for the Davis-Besse Nuclear Station, July, 1972 (supplement to the Applicant's Environmental Report), p. 47.

3. Reference 2, p. 45.

11. BENEFIT-COST SUMMARY

11.1 BENEFITS

The primary benefits from completion and operation of the Station will be the generation of about 6.1 billion kilowatt hours per year of electrical energy and increased reliability within the CAPCO pool because of 872 MWe additional generating capacity. About 51 percent of the power will be sold to industrial users, 19 percent to commercial users, and 25 percent to residential users.

Indirect local and regional benefits will include a revenue of about $4 million per year in taxes to local governmental bodies and a similar amount to the State of Ohio. Some 89 persons will be employed in the operation of the Station. The preservation and improvement of all marsh areas on the site for wildlife and the addition to the National Wildlife Refuge System of over 500 acres of prime waterfowl habitat is another indirect benefit of some importance.

11.2 ENVIRONMENTAL COSTS

11.2.1 Land Use

A total of 160 acres of farmland has been removed from use by construction of the Station. Access to the lakeshore at the site was restricted by private ownership in the past and will remain so. Construction of the Station intake and discharge piping and of the temporary barge channel will disturb the lakeshore and bottom; however, the applicant will restore the shore and bottom grade and, so far as possible, the soil character so that long-term effects are unlikely. Although 1800 acres of off-site land, mainly farmland, will be used for transmission lines, only that required for the towers themselves will be removed from farm use.

The 493-foot natural-draft cooling tower and vapor plume of the Station will be conspicuous on the lakeshore landscape. A small increase (probably undetectable) in the duration of naturally occurring fog inland of the Station may occur. Similarly total snowfall in the vicinity of the Station may be slightly increased.

11.2.2 Water Use

The net consumption of Lake Erie water by the Station (as evaporation from the cooling tower) will be about 5 billion gallons per year. Natural evaporation from the lake surface is 1000-fold greater so that no detectable change in the lake level will result. About 900 billion BTU per year of waste heat will pass to Lake Erie with the blowdown water; the effects will be undetectable outside of a very few acres of thermal plume.

11.2.3 Biological Effects

Virtually all of the organisms drawn into the Station intake will be killed. These will include plankton, fish eggs, and very small fish but almost no adult fish. Since the rate of water intake at the Station will be only about 0.015 percent of the flow through the lake, and the annual intake will only be about 0.006 percent of the lake volume, no detectable effect on aquatic populations or species balance is expected. While some birds will almost certainly be killed from time to time by collision with the cooling tower, it is unlikely that major bird kills will occur.

11.2.4 Radiological Effects

The total dose from operation of the Station to the entire population within 50 miles is estimated to be 22 man-rem per year, distributed among about 2 million people who live within this area. The dose to individuals in areas near the plant will be less than 3 percent of that due to natural background radioactivity; in more distant areas it will be much less.

11.3 BENEFIT-COST BALANCE

The identified benefits and environmental costs associated with completion and operation of the Station have been described and evaluated in this Environmental Statement. They are listed in Table 11-1.

The overall impact on the environment of Station construction and operation is expected to be small. On balance, the Staff concludes that the benefits will substantially outweigh the environmental and economic costs.

TABLE 11-1. Benefit-Cost Summary for Davis-Besse Nuclear Station

Benefits	
Primary benefits:	
Electrical energy to be generated	6.11 billion kilowatt-hours per year
Generating capacity contributing to reliability of electrical power in the CAPCO service area	872,000 kilowatts
Secondary local benefits:	
Employment of operating staff	89 persons
State and local taxes paid	$8 million per year
Conservation	Over 500 acres of water fowl habitat
Environmental Costs	
Land Use:	
Farmland for station	160 acres
Transmission line right-of-way	1800 acres
Water Use:	
Water evaporated	9000 gallons per minute (average)
Lake Erie surface area within 3°F excess isotherm of thermal plume	0.7 acres
Chemicals discharged to lake	13 pounds per day of chlorine; 700 pounds per day of salts occurring naturally in lake water
Radiological Impact:	
Normal operation:	
Cumulative population dose (50-mile radius)	22 man-rem per year
Whole-body dose to nearby residents	Less than 1 percent of natural background
Biological Impact:	Small destruction of aquatic life--no significant effect on Lake Erie ecology; possible lethal collisions of night-flying migrant birds with 500-ft. cooling tower--expected to be rare.

12. DISCUSSION OF COMMENTS RECEIVED ON THE DRAFT ENVIRONMENTAL STATEMENT

Comments on the Draft Environmental Statement were received by the Staff from the following:

Advisory Council on Historic Preservation
Department of Agriculture
Department of the Army, Corps of Engineers
Department of Commerce
Department of Health, Education and Welfare
Department of Transportation
Environmental Protection Agency
Federal Power Commission
Ohio Department of Development
Ohio Environmental Protection Agency
Toledo Edison Company

These letters are reproduced in their entirety in Appendices C through M. The Staff [illegible]ewed these comments. The issues raised in these letters are a[illegible] in the following listing of comments and responses.

A. ADVISORY COUNCIL ON HISTORIC PRESERVATION, December 18, 1972

Response: This agency comment does not raise any substantive issues requiring a response.

B. DEPARTMENT OF AGRICULTURE, January 11, 1973.

1. ECONOMIC RESEARCH SERVICE

Comment: (1) Inasmuch as the production of electricity consumes natural resources and results in environmental change, we feel that the statement should include a discussion of measures that the Applicant and the regional power network of which it is a member have under consideration to encourage more efficient utilization of electricity.

Response: The Staff has been informed by the Applicants that they have taken the following measures to encourage more efficient utilization of electricity:

With respect to residential rate structure, the Applicants are using, or have proposed by filings with the State regulatory commission, residential rates which require medium and large residential customers to pay higher rates during the summer peak load months than during the winter months. The Applicants' rate structures also provide for demand metering of sales to commercial and industrial customers so that those customers pay a charge for their peak demand in addition to an energy charge according to KWH consumed.

Toledo Edison currently has an advertising program which is designed to promote efficiency in the use of energy in all-electric homes. Toledo Edison does not advertise the sale of any appliance that would add to the peak demand on its system. Cleveland Electric has a program directed to the promotion of the efficient use by its customers of their electrical appliances. The members of the regional power network have made available to their customers booklets promoting efficient use of electricity.

2. SOIL CONSERVATION SERVICE

Comment: (1) There should be a statement concerning what methods and procedures are being used to prevent erosion and sediment damage during construction of the nuclear plant.

Response: The Applicant states that during site preparation the fill was compacted and uniformly placed to minimize erosion due to rain runoff. The yard drainage system was completed shortly after the fill was completed which allows for drainage of the site area from several points to reduce heavy runoff. Where possible, embankment areas were seeded. In addition, the drainage from the borrow pit area was into the borrow pits, which reduced runoff into adjacent areas.

Comment: (2) It is stated in Chapter 2 on page 23 that the Applicant has constructed a 7-1/2 mile railroad extension to the Norfolk and Western main line. A statement specifying what erosion and sediment control measures were implemented should be included.

Response: The Applicant states that, by working closely with both State and local agencies, in particular the Oak Harbor Soil Conservation Office, the areas adjacent to the railroad have usually experienced superior sediment and erosion control. The railroad construction incorporated the existing farm field tile system either into new properly sloped ditches or into new tile collecting headers which parallel the railroad. Where Soil Conservation plans indicated the need for future tile crossings under the railroad right-of-way, the crossings were installed and capped. The ditch banks and earthened formations were promptly seeded.

<u>Comment</u>: (3) The loss of 150 [160] acres of agricultural land in the proposed project site will have an impact on the area. The degree and magnitude of this impact should be so stated.

<u>Response</u>: Column 1 of Table 2.4 shows a total of 88,000 acres were under cultivation in 1971 in Ottawa County. Thus the loss of 160 agriculture acres will result in less than a 0.2% decrease in farm land and this loss is <u>de minimus</u>.

<u>Comment</u>: (4) There should be a statement in regard to what affect the proposed site will have on natural drainage patterns of other properties in the area.

<u>Response</u>: The Applicant states that a lift station was installed to maintain the previously existing drainage pattern from along State Route 2 in the northern area of the site. Other offsite areas are not affected by the site.

3. FOREST SERVICE

<u>Comment</u>: (1) This impact description does not recognize other forest values which must be realized in this area for hunting, other forms of recreation, aesthetics, and other amenities. No part of the evaluation of impact is carried over into the draft statement.

<u>Response</u>: The forest which once covered this portion of northern Ohio has been largely cleared for agricultural land use; the remaining wooded areas consist of small, widely scattered wood-lots which occupy less than 5 percent of the land area in Ottawa County, and are nearly all located on private land. While these wooded areas are of considerable aesthetic value in breaking the monotony of the flat landscape, they are too small to qualify for the description of forests as the term is generally understood; private ownership further limits their recreational value. As a result, the clearing necessary for transmission line rights-of-way has had very little impact on recreational values. On the other hand, the scattered woodlots suffer the visual impact of the transmission lines in the very flat terrain. The limited amount of clearing may have a beneficial effect on some forms of wildlife by providing a low plant and shrub habitat not available in densely wooded areas or on agricultural land.

C. <u>DEPARTMENT OF THE ARMY</u>, January 3, 1973

<u>Comment</u>: (1) Section 1.3.1.d. of the draft statement should be revised since the Corps of Engineers no longer issues permits governing the

discharge of plant effluents. Any such discharge will require separate authorization by the Environmental Protection Agency under Public Law 92-500 enacted by Congress recently.

Response: Section 1.3.1.d. has been revised.

D. DEPARTMENT OF COMMERCE, January 4, 1973

Comment: (1) Section 3.3.2 - Discharge Structure, Page 3-9: This paragraph indicates that the volume of the collecting basin is small in comparison with flow rates into it. The possibility of enlarging the capacity of this basin to increase hold-up time, in order to reduce the discharge of toxic materials to the lake, should be included in the final environmental impact statement.

Response: The Station collecting box for liquid effluents is a reinforced concrete box measuring approximately 10 ft by 20 ft by 9 ft deep. As indicated in the Environmental Statement it does not provide holdup time for the liquid effluents which pass through it. The only toxic chemical being discharged from the Station which could potentially be reduced by an increased holding time is chlorine. The Staff believes that the Applicant can meet EPA recommended total residual chlorine levels in the receiving waters by careful operating procedures with the current Station design. Therefore, the great increase in size of the size of the collecting basin (in effect converting it to a retention pond) which would be required to achieve any discernable reduction of residual chlorine levels, does not appear to be necessary.

Comment: (2) Section 4.2.2 - Intake and Discharge Pipelines, Page 4-5, first paragraph: The construction of this pipeline during the spring and summer of 1973 for a 4 to 5 month period could cause problems for spawning fish; a discussion of protective measures that will be used should be presented.

Response: The F-41-R project studies and other available data (Baker, Carl. "Lake Erie fish population trawling survey," Ohio Department of Natural Resources, Division of Wildlife Progress Report R-35-R-7 (3), 1969, 32 pp.) indicate that the area is not a spawning site. The closest spawning grounds are on the reefs (3 miles offshore), the nearby marshes, and the Toussaint River. The only fish eggs which have been encountered in the F-41-R sampling have been a few perch eggs (probably washed in by rough weather), a very few shiner eggs, and a few pelagic (open water) eggs of the freshwater drum. Also, other than diurnal onshore-offshore movements of fish and a general movement of some species (e.g., carp) into streams, marshes, etc. in the spring, there are no major "migrations" through the area. Hence, neither the construction of the intake,structure, discharge structure and related pipelines, nor the presence of the completed structures should cause problems for spawning fish. It must be kept in mind, however, that the construction will disrupt the benthos and may affect local populations of fish food organisms. This is expected to be a temporary situation as benthic organisms should reinvade the disturbed areas once construction is complete. (Ref. Section 4.2.2)

Comment: (3) Section 5.2.3 - Thermal Discharges, Page 5-3, first paragraph: Since the maximum heat loading to the lake occurs during April, increased water temperature might affect the spawning activities of Perch and Walleye that also take place at this time. In addition, it should be pointed out that Perch require a period of 6 months or more at temperatures of 39°F or below for successful maturation of gonads and normal reproductive success.

Response: Although 6 months at 39°F may be the optimum condition for reproductive success of Lake Erie perch, it is the Staff's opinion that in actuality this duration is not required to maintain a large stable population of Perch. In fall the Perch are very abundant in the western basin and support a large commercial fishery although they only have a period of 4 months when the lake temperature is 39°F or below and by April the mean 10 foot temperature is 46°F. (Ref. Table 2.11a in text. See response to next comment).

Comment: (4) The statement should discuss the possibility that these species [walleye and sauger] of fish will become resident in a warm water area, thus suffering reproductive decline. There is a distinct possibility that this will occur, the statement should also discuss what steps will be taken to alleviate the expected adverse impact upon these populations.

Response: The Staff believes it unlikely that walleye and sauger will become resident in the thermal plume in the winter. Studies by the Ohio Department of Natural Resources, Division of Wildlife indicate that walleye are not in the area during the winter. Also, sauger are extremely rare in the area. Therefore, walleye and sauger will generally not be around to be affected by the thermal plume during the winter. (See response to Commerce Comment 3.)

Comment: (5) Section 5.5.3 - Discharge Effects, Page 5-13: Recent research on the toxic effects of chlorine on fish and other aquatic life has indicated that levels as low as .003 ppm have reduced reproductive potential of scuds (amphipods); an important food organism present in the area (page 2-37). Since there is a common effluent collecting basin, the potential impact of chlorine in the sewage effluent (page 505, Section 5.2.6) should also be considered.

Response: The Staff did not conclude that the scud is an important food organism at the Davis Besse site. Moreover it is doubtful that numbers abundant enough to influence food chain dynamics will even be exposed to the plume. Such exposure that does occur will be intermittent, not chronic; therefore long term, sublethal effects are not expected. It is the opinion of the Staff than an intermittent discharge of effluent of 0.1 ppm total residual chlorine will not result in detectable alteration of the biota in the region of the site. The Staff's evaluation of the chlorine in the sewage effluent is in Sections 3.6 and 10.6.

Comment: (6) The statement should discuss the possibility that congregation of fish in the area of the heated discharge plume, even if it is only a few degrees above ambient, could cause reproductive problems.

Response: A few fish will probably be attracted to the thermal plume in the winter. However, most fish apparently leave the area during the winter, and the plume area is small (0.7 acres within the 3°F isotherm). It is the Staff's evaluation that there will be no fish reproductive problems due to the thermal plume. See responses to Comments Nos. 3 and 4.

Comment: (7) Section 6.2.3 - Radiological Monitoring Program, Pages 6-5 through 6-7: Analyses of aquatic plants were omitted from the radiological monitoring program (Table 6.2). Also, the map showing sampling locations (Fig. 6-1) is a poor reproduction and does not indicate which type of sample is collected at which location; that is, the station numbers seem unrelated to material in the text and tables. These deficiencies should be remedied in the final statement.

Response: See New Figure 6-1 and Table 12.1. The Staff agrees with the comment that aquatic plants are part of the food chain and that they should be monitored, particularly in the marsh. The Staff recommends monitoring the smartweed in the marsh area. The Applicant has been advised of this requirement.

TABLE 12.1

ENVIRONMENTAL MONITORING PROGRAM

Type of Sample	Locations and Sampling Points	Sample Frequency	Analyses
AIRBORNE PARTICULATES	#1 Site boundary near inlet canal and Sand Beach NE direction	Weekly	Gross alpha Gross beta
	#2 Site boundary beach east end of site		Note: Gamma spectral analysis if beta activity > $10pCi/m^3$
	#3 Site boundary Toussaint River and storm drainage pt. outfall		on quarterly composite of all filters
	#4 Locust Point and Toussaint River		Gamma spectral analysis Sr-90
	#7 Sand Beach		
	#8 Earl Moore Farm - W-WSW		
	#9 Oak Harbor		
	#10 Erie Industrial Park		
	#11 Port Clinton		
	#12 Toledo		
	#23 Put-in-Bay		
AIRBORNE IODINE	#1 Site boundary near inlet canal and Sand Beach NE direction	Weekly	Gamma spectral analysis on charcoal canister for Iodine-131
	#2 Site boundary beach east end of site		
	#3 Site boundary Toussaint River and storm drainage pt. outfall		
	#4 Locust Point and Toussaint River		
	#7 Sand Beach		
	#8 Earl Moore Farm - W-WSW		
	#9 Oak Harbor		
	#10 Erie Industrial Park		
	#11 Port Clinton		
	#12 Toledo		
	#23 Put-in-Bay		
AMBIENT RADIATION LEVELS	#1	Monthly, Quarterly and Annually	Beta and gamma dose
	#2		
	#3		
	#4		
	#5 Main entrance to site		
	#6 North west corner of site boundary		

TABLE 12.1 cont'd

Type of Sample	Locations and Sampling Points	Sampling Frequency	Analyses
AMBIENT RADIATION LEVELS (Continued)	#7 #8 #9 #10 #11 #12 #13 State roadside park #14 Township School #15 Larcarne #23 Put-in-Bay #24 Sandusky #26 Fostoria	Monthly, Quarterly, and Annually (same as above)	Beta and gamma dose (same as above)
SURFACE WATER UNTREATED	#1a Water from plant intake-in lake opposite Location 1 #2a In lake opposite Location 2 #3a In river opposite Location 3 - (storm drainage outfall in river #10a Erie Industrial Park water intake #11a Port Clinton water intake #12a Toledo water intake	Weekly Grab Composited Monthly	Gross alpha Gross beta in dissolved and suspended fractions Tritium Note: Gamma spectral analysis if gross beta > 10 pCi/l Radium determination if gross alpha > 3 pCi/l On quarterly composite Sr-90, gamma spectral analysis
SURFACE WATER TREATED	#10 Erie Industrial Park tapwater #11 Port Clinton tapwater #12 Toledo tapwater	Weekly	Gross alpha Gross beta Tritium Note: Gamma spectral analysis if gross beta >10 pCi/l Radium determination if gross alpha >3 pCi/l On quarterly composite Sr-90, gamma spectral analysis
GROUND WATER	#7 Beach well-sand beach #4 Locust Point #17 Irv Fick's well on-site #13 State roadside park #18 Well off main road leading to sand beach	Quarterly	Gross alpha Gross beta in dissolved and suspended fractions Tritium Sr-90 Note: Gamma spectral analysis if gross beta >10 pCi/l Radium determination if gross alpha >3 pCi/l
PRECIPITATION	#1 #23	Monthly Composite	Gross beta Tritium Note: gamma spectral analysis if gross beta >10 pCi/l

TABLE 12.1 cont'd

Type of Sample	Locations and Sampling Points	Sampling Frequency	Analyses
BOTTOM SEDIMENTS	#1a #2a #3a	Quarterly	Gross beta Gross alpha Sr-90 Gamma spectral analysis for Cs-137, K-40, etc.
FISH AND FRESHWATER CLAMS (three species of fish, min.)	Lake Erie in vicinity of site #3a Toussaint River near storm drain outfall	Quarterly	Flesh - Gross beta Gamma spectral analysis for K-40 and Cs-137 Bone - Sr-90
FOOD CROPS AND VEGETATION	#8 #16 #25 Winter Farm #19 Miller Farm	Semi-Annually	Edible portion Gross beta Gross alpha Gamma spectral analysis for I-131, Cs-137
MILK	#8 #20 Daup Farm #21 Haynes Farm #12 Toledo (milk processing plants) #24 Sandusky (milk processing plant)	Monthly	Gross beta Sr-89 Sr-90 Ba-La-140 Gamma spectral analysis for I-131, Cs-137 Calcium
DOMESTIC MEAT	#22 Peter Farm	Semi-Annually	Flesh - Gross beta Gamma spectral analysis for K-40, Cs-137 Thyroid - I-131
WILDLIFE (min. of three species)	On-site	Semi-Annually	Flesh - Gross beta Gamma spectral analysis Thyroid - I-131 (rabbit or muskrat) Bone - Sr-90
SOILS	#8 #20 #19 #1 Beach sand	Semi-Annually	Gross beta Gamma spectral analysis for K-40, etc.

Comment: (8) Section 8.2.2 - Aquatic Effects, Page 8-8: As indicated in the comments on Page 5-13, Section 5.5.3, chlorine in small sub-lethal amounts may have a pronounced adverse effect on the aquatic system; this effect should also be considered in this section.

Response: Section 8.2.2 has been revised to include the Staff's evaluation of this impact. (See response to Commerce comment number 5).

Comment: (9) Section 10.3 - Discharge System Alternatives, Page 10-4: The possibility of using the high velocity discharge in winter (when fry are at a minimum) to minimize the sinking plume effect and winter residence by fish (with the possibility of cold kill during shutdown and the possibility of reduced reproductive rates) should be considered. On the other hand, during other times of the year when the receiving water is warmer than 4°C (39°F) and the plume would not sink and contact the bottom of the lake, a low velocity surface release could be used, thus reducing entrainment into the plume of fry and plankters and permitting more rapid loss of the waste heat to the atmosphere than would be obtained with a submerged jet-type discharge.

Response: The Applicant did consider the use of a low velocity surface discharge as a possible alternative to the submerged high velocity discharge, but chose the high velocity discharge as the best compromise for minimizing environmental impact with a structure that will operate satisfactorily under all lake conditions. In particular, a dual discharge structure which would also release the heated water at a low velocity on the surface would require a structure which would be an obstacle to boating and would be difficult to maintain because of the ice conditions that are experienced in this area.

It appears to the Staff that there is essentially no difference in environmental impact between a low velocity surface and a high velocity submerged discharge. Rapid mixing exposes a larger number of organisms to lower temperatures while a low velocity (surface) release exposes fewer organisms to somewhat higher temperatures. Also, the Staff does not believe there will be problems with cold kills of fish with either alternative.

Comment: (10) Section 10.5 - Biocide System, Page 10-4: The use of mechanical cleaners for the condenser should be explored.

Response: The comment suggests that mechanical condenser cleaning should be considered as an alternative to the use of chlorine. While mechanical cleaning systems are available for condensers, there is no mechanical cleaning system available for the cooling towers. Therefore, a biocide, such as chlorine, is required for cleaning the cooling tower.

Comment: (11) The Staff does not indicate the meteorological data used and the resulting average relative concentration which we need to make a quantitative evaluation. If the releases are from roof top vents, then the wind data presented in figure 2.10 for the 300-ft. level would not be appropriate without modification.

Response: All Station radiation gas releases are from a 84 meters high stack on top of the reactor building, consequently the 300 ft meterological data are appropriate. The mistaken impression that they were released from a roof vent may have arisen from the terminology in Section 3.4 of the DES wherein reference is made to the "Station vent" when talking about the station vent stack.

E. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE, February 5, 1973

Response: This agency comment does not raise any substantial issue requiring a response.

F. DEPARTMENT OF TRANSPORTATION, January 9, 1973

Comment: While not stated in the draft environmental impact statement, there appears a strong possibility for electrical interference effects with railroad signal and communication circuits. The transmission of EHV power can cause extraneous voltages by metallic cross or ground potential and electric or magnetic induction. Aside from the obvious personal safety hazard, it should be noted that these currents can destroy the integrity of railroad signal and communication systems and therefore create the potential for serious accident. We suggest that this problem be addressed in the final environmental impact statement.

Response: The Applicant is aware of the problems that have been reported in the recent issues of "Railway System Controls" (June 72 and Dec. 72). The Applicant states that these transmission lines will be constructed in accordance with the National Electric Safety Code requirements 6th Edition and should not constitute a problem. Each railroad crossing must be approved by the railroad company.

G. UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, January 25, 1973

Comment: (1) We noted in our review that this draft statement has been submitted in support of two proposed actions: (1) the continuation of Construction Permit No. CPPR-80 and (2) the issuance of an operating license. It is expected that substantial additional information, which will enable a more accurate assessment of the environmental impact to be conducted, will be developed by the time the plant is ready for licensing. This additional information is expected to include final system design details, operating experience at similar large nuclear power reactors, and results of environmental studies. While the current review should be adequate for consideration of the continuation of CPPR-80, prior to plant operation the AEC should assess the best information then available to determine if the conclusions reached during the current review are still valid, and to determine whether a supplemental environmental review is necessary.

Response: In accordance with Appendix D to 10 CFR 50 the Applicant is required to submit with his application to operate the Station a separate document entitled "Applicant's Environmental Report - Operating License Stage." This document discusses the same environmental considerations that were discussed in the environmental report previously submitted at the construction permit stage, but only to the extent that they differ. The Staff, after analyzing this report, will prepare a draft detailed statement and forward a copy of the Applicant environmental report and a copy of draft statement to appropriate Federal, State, and local agencies requesting comments, but only as to environmental matters that differ from those previously considered. This procedure will be followed for this Station.

Comment: (2) The final statement should consider alternative treatment systems to provide further reductions of chlorine and total dissolved solids in the effluent being discharged to Lake Erie.

Response: In the Draft Statement the total dissolved solids (TDS) concentration in the effluent was given as 478 ppm, the value originally quoted in the Applicant's Environmental Report. Subsequently, calculations were made by the Applicant on the basis of a specified reduction in bicarbonate content equivalent to a reduction of 42 ppm in the methyl orange alkalinity required to prevent condenser scaling. These calculations indicated that loss of carbon dioxide and replacement of bicarbonate ion by sulfate would produce a net reduction in TDS. Thus, although evaporation in the cooling tower produces a concentration factor of 2, the TDS concentration in the blowdown will actually be about 430 ppm, less than twice the TDS content of the lake water. The values quoted for chemical discharges in Amendment No. 1 to the

Applicant's Environmental Report are based on these newer calculations, and the corresponding values quoted in Sections 3 and 5 of this Final Statement have been revised accordingly.

It should be noted that the demineralizer regenerant waste represents only a small fraction of the TDS discharged, and that even with this addition, the total weight of solid returned to the lake will be less than that withdrawn. Thus, the overall effect of Station operation will be a local loss of water from the lake and a slight reduction in TDS. As stated in Section 5.2.2, this water loss represents only about 0.1 percent of the natural lake evaporation rate. Operation of the Station will therefore produce no detectable change in TDS in Lake Erie.

There are at present no practicable desalination methods applicable on the scale required to produce a significant reduction in effluent TDS. Complete elimination of the regenerant waste would produce only a slight reduction in TDS of the effluent. As previously stated, the quantity of solids returned to the lake will actually be less than the quantity withdrawn from the lake.

Although the Staff does not consider further reduction of chlorine (below 0.1 ppm) necessary for the protection of the environment, Section 5.5.3 has been modified to present some alternate treatment systems for chlorine.

Comment: (3) There is little information regarding this disposition of the condensate polishing demineralizer sluice water, or the frequency, volumes, and concentrations of radioactivity involved, and it is not possible to estimate the environmental consequences of the possible discharges from this source. The final statement should contain an analysis of the discharge pathway including, (1) a description of the waste management techniques to be used to control the environmental impact, (2) the annual discharge volumes and quantities of radionuclides, and (3) the resulting radioactive dose.

Response: Our evaluation of the miscellaneous waste system includes the radioactive waste liquids generated by the backwashing of the condensate polishing demineralizers. We assumed a primary to secondary leak of 20 gpd and a yearly backwash liquid volume of 2900 gallons at 1% of primary coolant activity. This liquid waste was assumed to be processed through the miscellaneous waste system along with the other wastes from other sources contributory to the system. The radionuclide contribution from this system is reflected in the releases given in Table 3.4, and the dose contribution is reflected in Table 5.3. The Applicant states that if there is significant radioactivity in the secondary system resulting from a primary to secondary coolant system leak, the condensate and resin sluice from the condensate polishing demineralizers will be routed to holdup tanks. The decanted condensate in these tanks can then be processed by the Miscellaneous Liquid Radwaste System if required. The spent resin slurry can then be processed by the solid waste disposal system where the resin is drummed and solidified for off-site disposal.

Comment: (4) In evaluating the effluent release source terms, the AEC assumed a partition factor of 100 for iodine in the steam generators. Since the steam generators are of the "once-through" design, in which approximately one-half the steam generator tube surface area is covered by secondary coolant, it is not justifiable to assume a partition factor greater than 1.0.

Response: The partition coefficient for iodine for the steam generator in Table 3.3 was not correct. The value should have been 1.0 since the steam generator is a once-through design. A partition coefficient of 1.0, however, was used in our evaluation.

Comment: (5) Since dilution pumping to reduce the blowdown temperature to a 20°F temperature differential prior to discharge may cause increased mechanical damage to aquatic organisms, we suggest that alternatives to dilution pumping be presented in the final statement. Because lake water is involved in both dilution pumping and lake mixing, consideration might be given to dilution to a lower temperature to take place in the lake and thereby avert mechanical damage to organisms. The final statement should compare the environmental effects and benefits to dilution with the effects and benefits of keeping the discharge at a 20°F temperature differential.

Response: The Applicant has considered the use of an auxiliary mechanical draft cooling tower, a spray pond, and a cooling pond to further cool the blowdown.[1] A summary of these studies is presented in Section 10.3. As shown, the estimated cost (equipment and operating expense) for reducing the blowdown temperature by 10°F is about $1 million. In addition, these alternatives have an environmental impact since all give low level releases of moisture which would lead to some fogging and icing.

As shown in Table 3.2, the dilution water will vary seasonally from zero to about 50% of the blowdown flow and averages 25% on an annual basis. The Staff concludes that the slight additional aquatic impact, due to the pumping of dilution water approximately balances the slight additional adverse terrestrial impact on the marsh areas due to fogging and icing caused by a blowdown cooling system. Since the impacts are nearly equal and the costs for auxiliary cooling would be greater, a cost-benefit balance favors the present Station design with dilution pumping.

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[1] Benefit-Cost Description of Alternative Designs for the Davis-Besse Nuclear Station, July 1972 (Supplement to the Applicant's Environmental Report).

Comment: (6) We believe this discrepancy [between the Staff's thermal plume calculations and Prichard's calculations] should be resolved.

Response: The Staff's calculations of the thermal plume area for a 3° isotherm resulted in an area less than one acre. It is the Staff's evaluation that this impact is negligible (Section 5.2.3). In response to the above comment, additional information was obtained.

As conjectured in the Draft Environmental Statement (DES), the discrepancy between Dr. Pritchard's results for Sub-Cases I-B and II-B with those calculated using his published model was due to several changes in the model that were not documented in Reference 2. First, Dr. Pritchard included a new trajectory determination based primarily upon the acceleration term in the vertical equation of motion. Second, a short-cut method was used to determine the rate of change in plume depth: Dr. Pritchard simply used the same rate of growth he calculated for the Zion discharge plume[1] and scaled the result to Davis-Besse by the ratio of water depth to orifice vertical dimension. Third, an approximation was made in calculating surface isotherm areas from the longitudinal isotherm distance and maximum isotherm width. Finally, Dr. Pritchard employed a new numerical procedure based on mean velocities from isotherm-to-isotherm to derive maximum time of exposure of organisms to excess temperatures (Table 3, p. 22 of Ref.2).

These modifications do not appear to be in conflict with the general state-of-the art literature in thermal plume modeling and additional Staff calculations using that approach would result in a smaller environmental impact which would not change the Staff's evaluation.

Comment: (7) Temperature standards for Lake Erie are presently under consideration, and if possible, the final statement should discuss the capability of the plant to meet those proposed standards.

Response: The Staff's evaluation of negligible environmental impact was based on the present state standards. If new temperature standards for Lake Erie (presently under consideration) are adopted, and if they are applicable to the Station's effluent. The Applicant will be required to meet the new standards. (See response to EPA Comment 15.)

[1] D. W. Pritchard, "Predictions of the Distribution of Excess Temperature in Lake Michigan Resulting from the Discharge of Condenser Cooling Water from the Zion Nuclear Power Station," April 1970. Appendix to Zion Environmental Report, Commonwealth Edison Company.

[2] "Davis Besse Nuclear Power Station, Supplement to the Environmental Report," Vol. 1, Appendix 4B.

Comment: (8) Public Law 92-500 provides that cooling water intake structures should reflect the "best technology available." The final statement should discuss those factors considered in the design of the intake and how the present design meets the requirements of "best technology available" for minimizing adverse environmental effects.

Response: The Staff believes that the design of the intake structure will not trap large numbers of fish (thereby mininizing adverse effects) and thus reflects the "best technology available." Features of the intake structure design directed toward achieving this end are: (1) a low intake flow velocity (0.5 ft/sec) and (2) the installation of a bubble screen around the intake ports. Bubble screens are one of the techniques currently under development to deter fish from entering intake structures.

With the present state of the art there is no clear cut superiority of any of the alternatives being tested (eg, electric screens, bubble screens, bypass systems). Furthermore there are indications that the effectiveness of a given technique may be site dependent, implying that various mathods must be tested at a given site to determine the best one. The Staff and the Applicant must keep abreast of the development in this field in order to take corrective measures, if needed.

Comment: (9) It appears that excessive numbers of fish may be drawn into the intake because of the vertical current created by the upward direction of the intake structure. Experiments at the Monroe Plant (which has an intake structure similar to the one proposed) indicate that large numbers of fish are drawn into the intake structure even when a bubble curtain is employed. The possibility of a similar situation occurring at Davis-Besse should be discussed in the final statement.

Response: The Staff is aware that fish apparently have little resistance to vertical currents and that experiences with vertical flow intakes have shown that problems with entraining large numbers of fish were substantially alleviated when velocity caps were installed over the intakes (thereby changing to a horizontal flow). The Staff has also further investigated the effectiveness of bubble screens and still maintains that at best it is questionable whether or not the bubble screen at Davis-Besse will be effective in deflecting fish away from the intake. The intake design at the Monroe plant is not similar to the Davis-Besse intake in that the intake is an open channel connecting to a river, the intake velocity is 1-2 ft/sec at the traveling screens, and the intake flow is horizontal. The design velocity at the Davis-Besse intake (0.5 fps) is less than the velocity at the intakes which have had problems (approximately 1 fps) but it is greater than the vertical flow velocity intakes for the Cities of Oregon and Port Clinton, Ohio where there have been no problems with fish entrainment (design velocity of 0.25 fps and have operated at about 1/4 design velocity). Although it is difficult to say with certainty that fish will not be entrained at Davis-Besse, it can be said that the Station will operate at about half design flow velocity, or about 0.25 fps, and that the intake is not in a spawning or nursery area where large congregations of juvenile fish might be found and that both conditions are consistent with negligible impact.

Comment: (10) In the final statement, estimates should also be presented for different seasons as to the kinds and numbers of fish per acre in this area, their mobility, and the effects of artificial reef structures on their distribution, since the intake will be an artificial "reef." The biological habitat at the site with respect to fish migratory paths, spawning grounds, and nursery areas should also be carefully delineated. It is recommended that a program be devised to determine the significance of fish egg and larvae passage through the power plant.

Response: Walleye might use the rip rap near the intake for spawning. (See Table 2.15) However, the rip-rapped area is less than 0.006 percent of the natural reef areas offshore. The Staff judges the potential impact of the intake area becoming a so-called "artificial 'reef' " to be insignificant and that there is no need to devise a program to monitor fish eggs and larvae. (See Section 2.7.1 for the fish in this area.)

Comment: (11) If operated as planned, the Davis-Besse Nuclear Power Station will probably meet existing Ohio water quality standards. However, the State of Ohio is now revising the Ohio water quality standards as they apply to Lake Erie and other waters, and is also developing effluent standards. These final standards will probably be available soon. The AEC and the Applicant should be aware of these changes, and if possible, should explicitly compare the proposed effluent composition with the state standards in the final statement.

Response: See Response to EPA comments number 7 and 15.

Comment: (12) The draft statement indicates that the use of an orthophosphate corrosion inhibitor at a concentration of about 2 milligrams per liter will be considered at a later date. Since Lake Erie needs no further enrichment, it is suggested that the use of orthophosphate for this purpose be very carefully detailed in the final statement.

Response: The Applicant states that he does not intend to use any corrosion inhibitor. The environmental Technical Specifications will reflect this fact. If in the future, it becomes necessary to use any corrosion inhibitor the environmental impact must be justified before any change to the environmental Technical Specifications is approved.

Comment: (13) The disposal of detergents as described in the draft statement should also be revaluated for similar reasons.

Response: As shown in Figure 3.8, there will be an estimated 425 gallons per day of detergent waste discharged to the lake. This water originates in the hot shower, the laundry, and the decontamination area. The Applicant has stated that he intends to use a low phosphate or no phosphate detergent such as TURCO DECON 4324 (Low Foam). Since the detergents are only a small fraction of the discharges and their discharge is diluted by the Station blowdown of $\sim$ 15,840,000 gpd, the Staff concludes that the small phosphates additions to the lake due to the detergent waste will have negligible effect on lake eutrophication.

Comment: (14) The Station plans to discharge 0.5 ppm chlorinated water for four periods per day, each period being about 2.1 hours in duration. The 0.5 ppm level of either free or combined chlorine is expected to be toxic to most aquatic organisms, including fish. For intermittent discharges EPA recommended a total residual chlorine discharge of no more than 0.1 ppm chlorine for 30 minutes per day or less; or 0.005 ppm chlorine not to exceed two hours per day. The final statement should present the Applicant's program to reduce the discharge of chlorine to the levels recommended by EPA.

Response: The Staff agrees that the estimated maximum discharges of chlorine (0.5 ppm) given on page 5-13 might be excessive and should not be permitted in view of the sensitivity of fishes to chlorine and the recommended EPA criteria. See response to EPA Comment 2 and response to Toledo Edison Comment 1.

Comment: (15) The specific water quality objectives outlined in the International Joint Agreement on the Great Lakes for Lake Erie, and the practicability of reducing total dissolved solids to a lower level, in keeping with the non-degradation clause applicable to Lake Erie, should be addressed in the final statement.

<u>Response</u>: The specific water quality objectives referred to by EPA are as follows:

(a) <u>Microbiology</u>. The geometric mean of not less than five samples taken over not more than a thirty-day period should not exceed 1,000/100 millilitres total coliform, nor 200/100 millilitres fecal coliforms. Waters used for body contact recreation activities should be substantially free from bacteria, fungi, or viruses that may produce enteric disorders or eye, ear, nose, throat and skin infections or other human diseases and infections.

(b) <u>Dissolved Oxygen</u>. In the Connecting Channels and in the upper waters of the Lakes, the dissolved oxygen level should be not less than 6.0 milligrams per litre at any time; in hypolimnetic waters, it should be not less than necessary for the support of fishlife, particularly cold water species.

(c) <u>Total Dissolved Solids</u>. In Lake Erie, Lake Ontario and the International Section of the St. Lawrence River, the level of total dissolved solids should not exceed 200 milligrams per litre. In the St. Clair River, Lake St. Clair, the Detroit River and the Niagara River, the level should be consistent with maintaining the levels of total dissolved solids in Lake Erie and Lake Ontario at not to exceed 200 milligrams per litre. In the remaining boundary waters, pending further study, the level of total dissolved solids should not exceed present levels.

(d) <u>Taste and Odour</u>. Phenols and other objectionable taste and odour producing substances should be substantially absent.

(e) <u>pH</u>. Values should not be outside the range of 6.7 to 8.5.

(f) <u>Iron (Fe)</u>. Levels should not exceed 0.3 milligrams per litre.

(g) Phosphorus (P). Concentrations should be limited to the extent necessary to prevent nuisance growths of algae, weeds and slimes that are or may become injurious to any beneficial water use.

(h) Radioactivity. Radioactivity should be kept at the lowest practicable levels and in any event should be controlled to the extent necessary to prevent harmful effects on health.

In connection with the objectives lettered (b), (c), (e), and (f), it should be noted that Francis T. Mayo, the Regional Administrator of Region V (which includes Ohio) of the EPA, wrote a letter to Governor John J. Gilligan of Ohio concerning the states water quality standards. It contained the conclusion that "to meed the requirements of the 1972 Amendments [of the Federal Water Pollution Control Act (PL 92-500)] noted changes to Ohio water quality standards must be adopted as shown - [in the following attachment]....

To satisfy the requirements of the Great Lakes Agreement the following criteria must be adopted:

Dissolved Oxygen	- 6 mg/1 (minimum)
Hydrogen Ion Concentration (pH)	- 6.7 - 8.5
Iron	- 0.3 mg/1
Total Dissolved Solids (TDS)	- 200 mg/1 "

The Staff has learned that the State of Ohio has initiated procedures to bring its water quality provisions into conformity with these four criteria. Whenever these criteria are in fact adopted pursuant to the provisions of the Federal Water Pollution Control Act Amendments of 1972, they will be applicable to the effluent discharges from the Station into Lake Erie.

With regard to these criteria, the effects of Station operation may be summarized as follows:

(a) Dissolved Oxygen. Because of aeration in the cooling tower, the effluent will generally have a dissolved oxygen (DO) content greater than that of the lake, but never less than 7 mg/1. (See Response to Ohio EPA Comment 2.)

(b) Total Dissolved Solids. The existing total dissolved solids (TDS) of the inshore lake water is slightly greater than the 200 mg/1 objective for Lake Erie. Opertation of the Station will result in a net removal of dissolved solids and a concentration of the residual solids by a factor of less than 2 through loss of water by evaporation in the cooling tower. A small zone of higher TDS concentration will therefore exist close to the discharge, but no significant effects on human use or on aquatic life from this cause are expected (5.2.7 and 5.5.3). Some of the evaporated water will return to the lake through precipitation over tributary watersheds, but even if the water loss is considered irretrievable, the effect on TDS content of the lake as a whole will be undetectable. The TDS content of the Station effluent will be entirely dependent on the TDS of the intake water which controls not only the blowdown concentration but also the amounts of impurities to be removed by the demineralizers. Any future reduction in lake TDS by control measures taken elsewhere would thus produce a corresponding decrease in Station blowdown TDS and also in demineralizer regenerant waste. (See response to EPA comment 2.)

c. pH. Neutralization of the blowdown to a pH 7.3 from the natural lake value of 8.1 will have a small but beneficial effect.

d. Iron. The lake water already contains about 0.3 mg/l of Fe. The foregoing discussion of total dissolved solids is equally applicable to iron content.

With regard to the non-degradation clause of the Agreement (paragraph 3 of Annex 1) the Staff concludes that the Applicant has taken all reasonable and practicable measures (Subject to meeting the Staff's restriction on total residual chlorine) to maintain existing water quality levels.

Comment: (16) It is of interest that the AEC recommended in the final statement for the Point Beach Nuclear Plant (Page iii) that the applicant should determine a method of substantially reducing the discharge of demineralizer regenerant waste to Lake Michigan. This treatment method may be equally applicable to the Davis-Besse plant.

Response: See response to EPA question number 2.

Comment: (17) In the final statement, the effectiveness of the oil interceptor system should be estimated together with the organic content of the waste. The possibility of non-nuclear, accidental spills at the site and contingency plans should be considered in this evaluation.

Response: Liquids from the Station floor drains go to a sump pump, through an oil interceptor, and then combine with the Station yard drain. The combined drainage goes into a 1-1/2 mile long drainage ditch which empties into the Toussaint River.

The liquid from the floor drains will normally be only water. The Applicant states that any other liquid's entering the floor drains could only be the result of an accident which would be corrected as soon as possible. The Applicant states that the only kind of accident that would lead to organic material entering the floor drain would be an oil line break, and that the only organic material that could thus be discharged into the floor drain would be turbine lubricating oil.

The Applicant states that if such an accident occured when the sump pumps were operating at full capacity, the oil interceptor would be 90% efficient (that is, it would remove 90% of the oil in the liquid mixture), and that under all other conditions the oil interceptor's efficiency would approach 100%.

Finally, if oil did manage to get beyond the oil interceptor, there would be ample opportunity to clean it up while it was in the drainage ditch, since the flow from the drainage ditch to the Toussaint River is by a submerged pipe.

Comment: (18) There appears to be some discrepancies between the AEC Staff and the Applicant on estimates of the levels of the thermal and chemical effluents. These should be described and explained in the final statement.

Response: See response to EPA question number 2 for chemical difference and response to EPA question number 6 for the thermal differences.

Comment: (19) Clarification of the discharge pathway for the liquid radioactive waste from the miscellaneous liquid radwaste system and detergent waste system (e.g., to the mixing basin or to the lake in another stream) should be presented in the final statement.

Response: The discharge pathway is first to the mixing basin and then to the lake.

Comment: (20) The Applicant has not presented results from the preoperational environmental monitoring program. Such information should be presented in the final statement.

Response: The first data analysis from the radiological monitoring program is not yet available. The results of the F-41-R study program are available as Appendix 2B of the Applicant's FSAR.

Comment: (21) The Station water use diagram indicates production of potable water using a clarifier and chlorine. This potable water line is shown to be interconnected with the sanitary system, fire protection system, and a demineralizer. Specific information should be given for the design and production capacity of the water use system, the methods of water purification, and the method and dosage for disinfection. Protection against contamination from backflow and/or interconnection with other systems should be clearly outlined. A flow diagram of the proposed system should be included in the final statement.

Response: Figure 3.5 has been revised to provide a better understanding of the Station's water usage. This figure is not intended to show the detailed water flow pathways or the exact system interrelationship. The Applicant has obtained the required permits from the Ohio Department of Health (See 1.3.2), and the Staff's evaluation is that the environmental impact will be negligible (Section 3.6 and 10.6).

Comment: (22) Any postulated groundwater effects from the borrow pits should be included in this section.

Response: No deleterious effects on the groundwater due to the presence of the borrow pits are expected. Since the borrow pits are already full of fresh water they cannot lead to a lowering of the local groundwater level. The fresh water from the borrow pits, insofar as it diffuses outward, could only lead to an improvement of local groundwater quality (which has a relatively high concentration of hydrogen sulfide).

H. Federal Power Commission, February 21, 1973

Response: This agency comment does not raise any substantial issue requiring a response.

I. Ohio EPA

Comment: (1) A potential hazard is posed by nuclear accidents and the effect of prevailing winds on dispersed particles, gasses and etc. in the Lake Erie Islands area (the Bass Islands, Kelley's Island, Catawba Point). During the boating months, the Islands are crowded with people and the lake congested with boats. Downwind draft time from the plant to the area considered would be one to three hours. This time is significant because no adequate warning system exists, and there is a question whether an evacuation procedure exists or could be developed to deal with such an occurrence. We would therefore encourage study of these potential problems.

Response: The Applicant will be required to have approved Emergency Plans which establishes an adequate warning system and evacuation procedure from within the low population zone (0-5 miles). These plans are submitted for approval when the Final Safety Analysis Report is filed, and do not form a part of the Environmental Statements. These Emergency Plans must be approved by the AEC and agreements with State and local agencies established prior to issuance of the operating license.

Comment: (2) Additional information relative to the treated sewage effluent (e.g., concentration of suspended solids, phosphates, and nitrates) should have been provided. Section 5.5.3 states that dissolved oxygen concentrations will be near lake levels. A more precise figure should have been given (i.e., a range or an average value) if possible.

Response: The sewage treatment plant uses an extended aeration process. The anticipated suspended solid content in the effluent is less than 17 ppm; phosphates are expected to be in the range of 2-4 ppm and nitrates less than 10 ppm.

A more precise value of the dissolved oxygen content of the Station discharge water cannot be given. Water, after passing through the cooling tower will be saturated with dissolved oxygen at the temperature of the cooling water exit temperature. Since this temperature varies seasonally with the ambient wet bulb temperature, the dissolved oxygen content of the blowdown water will likewise vary. The minimum value, however, will be 7 mg/l corresponding to the extreme high wet bulb temperature of 81°F (approximately one day in 15 years). The maximum value is estimated to be 12 mg/l, corresponding to a minimum tower discharge water temperature of

45°F. The minimum and maximum values for Lake Erie, measured at the City of Toledo water intake in 1969, were 3.8 mg/l at 73°F (43% of saturation) and 15.2 mg/l at 35°F (107% of saturation). The annual average value was about 8.2 mg/l.

Comment: (3) An estimate was provided of the breakdown of the total dissolved solids contained in the cooling tower vapor. Some discussion of potential effects of the added salts on the terrestial environment surrounding the plant site (e.g., soild, vegetation, animals) would seem appropriate.

Response: See Section 5.4, page 5-11.

Comment: (4) Some explanation should have been provided for the need for one acre of riprap. Could the same results have been accomplished by using less riprap? In addition, there is no indication how the riprap will be placed in relation to the discharge outfall (i.e., in a circular, eliptical or lengthwise pattern).

Response: Figure 3.6 of the statement shows the riprap configuration on the lake bottom at the discharge structure. The Applicant states that the exact configuration will be that of a trapezoid with the shortest side at the discharge orifice. The trapezoid will be 27 ft. wide at the discharge orifice. It will widen to a dimension of 107 ft. at a distance of ~200 ft. from the discharge orifice. The riprapped area will be about 1/2 acre. The trapezoidal area will be symmetrical about the centerline of the discharge orifice.

This configuration was designed as a result of Dr. Pritchard's calculations of the discharge plume configuration. The purpose of the riprap is to cover the lake bottom under the discharge plume at all points where the discharge velocity will be 0.5 ft/sec or greater based on Dr. Pritchard's calculations. This velocity is below that at which lake bottom erosion takes place (Physical Characteristics of the Reef Area of Western Lake Erie, Herdendorf and Braidech, 1972) and thus explains why this particular area of riprap configuration was chosen.

Comment: (5) In addition, the commitment of uranium ore necessary for function of this facility is an irreversible and irretrievable commitment of resources.

Response: Section 8.4 has been modified in response to this comment.

Comment: (6) We recommend that the Applicant attempt to reduce the plant's total residual chlorine discharge concentration to 0.1 ppm. maximum and a maximum pounds per day figure (to be determined and forwarded at a later date by Ohio EPA). This level is consistent with the U.S. Environmental Protection Agency standards for other power facilities.

Response: See response to EPA comments 2 and 14.

Comment: (7) We recommend that extensive biological monitoring be extended to two years after start-up instead of one year as suggested. In addition, we would like to see a monitoring program continue for the lifetime of the plant, with frequency and parameters adjusted according to those parameters that seem to depict the effects the plant is having on the biological environment.

Response: Section 6.2 of both the Draft Environmental Statement and the Final Envornmental Statement indicate this type of program for the Station.

Comment: (8) To aid in data compilation, we would be interested in receiving reports issued from the data generated by the radiation and biological monitoring programs undertaken by the Applicant. A report on the effectiveness of the intake bubble screen under various operating conditions is requested.

Response: Copies of the reports will be supplied. The Applicant states that he will be pleased to work closely with Ohio EPA for an evaluation of the effectiveness of the bubble screen.

Comment: (9) If not already planned, provision of a visitor center would be advisable as this is Ohio's first major nuclear power generation facility.

Response: The Applicant has studied the need for, and advisability of a visitors' information center located at the station site and has concluded that construction and operation of a visitors' center is not warranted, both from a viewpoint of corporate expense and as an effective means of public education and information. Limited facilities are available for site visits by groups and a number have been conducted through prior arrangements and this will continue to be done. In addition, the Applicant intends to continue the development and distribution of information pamphlets to the general public and all interested groups and schools.

Final landscaping plans for the Station have not been developed, but the Applicant intends that an area of the site will be available for visitors to stop, obtain a view of the Station facilities, and observe some basic information concerning the Station.

Comment: (10) We would like to see statements provided on the following items:

a. Reliability of the emergency core cooling system (ECCS) and possible modifications necessary to increase its reliability.

b. The possibility of cladding buckling, and preventive measures.

c. Ozone releases which are typical of all high voltage transmission lines.

Response: Discussions concerning the reliability of the ECCS and the fuel cladding are safety related items and beyond the scope of this NEPA statement. The operation of high voltage transmission lines has been postulated to produce ozone which could have adverse effects on the biota in the vicinity of such lines. Reference 1 concludes that "765-kV lines do not contribute any measurable amounts of ozone or other oxidant to the prevailing ambient levels." Reference 2 concludes that "Tests conducted at 20 locations under a variety of meteorological conditions show no ozone formation attributable to high voltage lines." Based on these data, the Staff anticipates no adverse environmental effects as a result of ozone created by the high voltage transmission lines.

Ref. 1 Scherer, H.N. Jr., B. J. Ware, and C. H. Shik, Gaseous Effluents Due to EHV Transmission Line Corona, American Electric Power Service Corp., Canton, Ohio and Battelle Memorial Institute, Columbus Laboratories, Columbus, Ohio.

Ref. 2 Frydman, M., A. Levy, and S. E. Miller, Oxidant Measurements in the Vicinity of Energized 765 kV Lines, American Electric Power Service Corp., Canton, Ohio and Battelle Memorial Institute, Columbus Laboratories, Columbus, Ohio.

Comment: (11) The Ohio Environmental Protection Agency is anxious to review the environmental monitoring program which must be submitted for regulatory approval within ninety days of issuance of the Final Environmental Impact Statement.

Response: The Staff will be pleased to supply Ohio EPA with a copy of the environmental monitoring program for review.

Comment: (12) According to records of the Ohio Department of Economic and Community Development, Figure 2.8 on page 2-14 is in error to the extant that the community of Rocky Ridge does have local zoning.

Response: The comment stating that Rocky Ridge has local zoning is apparently incorrect. The Staff's investigations indicate that that zoning was repealed in November 1969.

Comment: (13) Ohio Environmental Protection Agency (Ref: Final Report on Total Impact Assessment of the Davis-Besse Nuclear Power Station, "Battelle Columbus Laboratories, Sections 3.3.3 and 3.3.1 Pages 42 and 43). Using values from the Applicant SER for fission and corrosion products and tritium releases, there is concern that the limits of proposed 10 CFR 50, Appendix I, Part A will be exceeded and the limits of 10 CFR 20 will be approached.

Response: It should be pointed out that the tritium limit given in the proposed 10 CFR Part 50 Appendix I, Section II, Paragraph A is a design objective to guide the designer in providing a system to meet the as low as practicable criteria. The Technical Specification for Davis-Besse will delineate the limits for the controlled releases of all radioactive effluents from the plant. The Applicant will be required to utilize all radwaste equipment to assure that the design objectives are met.

J. Ohio Department of Economic and Community Development, December 6, 1972

Response: This agency comment does not raise any substantive issues requiring a response.

K. Toledo Edison Company, January 31, 1973

Comment: (1) Applicants concur in the desirability of monitoring residual chlorine concentration in the Station effluent. Applicants, however, do not concur with the suggestion that there is a need to keep this concentration at 0.1 ppm or below. As discussed in Section 5.5.3 of the Draft Environmental Statement, the area and volume of the lake seeing any appreciable fraction of chlorine contained in the discharge effluent is extremely small due to the rapid mixing and action with adejacent waters. It is extremely unlikely that fish will enter this mixing zone area due to its turbulent nature and, if drawn into it, would not have a residence time sufficient to have any appreciable effect.

Response: In the absence of specific data indicating otherwise, it is the Staff's evaluation that the Station can operate with a 0.1 ppm chlorine concentration in the discharge, not to exceed 2 hours/day. In view of recent EPA recommendations*, if the Applicant can demonstrate either by adequate calculations or by operating experience that a higher chlorine level is required and that the higher level will not result in adverse environmental effects, the Staff will consider increasing the chlorine effluent limit to 0.2 ppm, not to exceed 2 hours/day, provided an adequate chlorine environmental surveillance program is established.

Comment: (2) The suggested method of operation contained in Appendix B of the Statement is undesirable because of potential scaling problems on condenser tubes which could result from this type of intermittent blowdown operation. Maintenance of the condenser-cooling tower system water at a non-scale-forming condition requires careful control of pH which would be very difficult under the conditions of suggested operation which would result in a constantly changing concentration factor of the system water and resulting pH control feed.

Response: It is the Staff's opinion that the suggested method of operation can, in theory, be accomplished by calculating the worst potential scaling condition in the system, then adding sufficient acid to prevent scaling at that point. Obviously this will increase the operating cost of the tower. The Staff is not making a determination of practicality (for example, the problem of enhanced corrosion has not been evaluated), but simply providing an alternative.

*U.S. Environmental Protection Agency Comments on the Cook Nuclear Plant, February 23, 1973, pg 20.

APPENDIX A

WATER POLLUTION CONTROL BOARD
OHIO DEPARTMENT OF HEALTH
COLUMBUS, OHIO

RESOLUTION ESTABLISHING AMENDED CRITERIA OF STREAM-WATER QUALITY FOR VARIOUS USES ADOPTED BY THE BOARD ON APRIL 14, 1970

WHEREAS, Section 6111.03, of the Ohio Revised Code, provides, in part, as follows:

"The water pollution control board shall have power:

(A) To develop programs for the prevention, control and abatement of new or existing pollution of the waters of the state; ...." and

WHEREAS, Primary indicators of stream-water quality are needed as guides for appraising the suitability of surface waters in Ohio for various uses; and

WHEREAS, The stream-water quality criteria for various uses and minimum conditions applicable to all waters adopted by the Board of June 14, 1966, have been amended by the Ohio River Valley Water Sanitation Commission; and

WHEREAS, The criteria adopted by the Board on October 10, 1967, have been further amended by the Ohio River Valley Water Sanitation Commission;

THEREFORE IT BE RESOLVED, That the following amended stream-water quality criteria for various uses, and minimum conditions applicable to all waters, and policies for protection of high quality waters and for water quality design flow, are hereby adopted in accordance with amendments of the Ohio River Valley Water Sanitation Commission, and the recommendations of the Federal Water Pollution Control Administration.

AND BE IT FURTHER RESOLVED, That the amended stream-water quality criteria for various uses, for minimum conditions, for protection of high quality waters, and, for water quality design flow, be made applicable to the following waters of the state:

1. Maumee, Tiffin, St. Joseph, and St. Marys River Basins;
2. Lake Erie & Interstate Waters thereof;
3. Great Miami, Whitewater, and Wabash River Basins;
4. Ashtabula River, Conneaut and Turkey Creeks;
5. Ohio River of Ohio-West Virginia and Ohio-Kentucky;
6. North Central Ohio Tributaries of Lake Erie;
7. Scioto River Basin;
8. Little Miami River Basin;
9. Rocky, Cuyahoga, Chagrin, and Grand River Basins;
10. Muskingum River Basin;
11. Hocking River Basin.

MINIMUM CONDITIONS APPLICABLE TO ALL WATERS AT ALL PLACES AND AT ALL TIMES

1. Free from substances attributable to minicipal, industrial or other discharges, or agricultural practices that will settle to form putrescent or otherwise objectionable sludge deposits.

2. Free from floating debris, oil, scum and other floating materials attributable to municipal, industrial or other discharges, or agricultural practices in amounts sufficient to be unsightly or deleterious.

3. Free from materials attributable to municipal, industrial or other discharges, or agricultural practices producing color, odor or other conditions in such degree as to create a nuisance.

4. Free from substances attributable to municipal, industrial or other discharges, or agricultural practices in concentrations or combinations which are toxic or harmful to human, animal, plant or aquatic life.

PROTECTION OF HIGH QUALITY WATERS

Waters whose existing quality is better than the established standards as of the date on which such standards become effective will be maintained at their existing high quality, pursuant to the Ohio water pollution control statutes, so as not to interfere with or become injurious to any assigned uses made of, or presently possible, in such waters. This will require that any industrial, public or private project or development which would constitute a new source of pollution or an increased source of pollution to high quality waters will be required, as part of the initial project design, to provide the most effective waste treatment available under existing technology. The Ohio Water Pollution Control Board will cooperate with other agencies of the state, agencies of other states, interstate agencies and the Federal Government in the enforcement of this policy.

WATER QUALITY DESIGN FLOW

Where applicable for the determination of treatment requirements, the water quality design flow shall be the minimum seven consecutive day average that is exceeded in 90 percent of the years.

STREAM-QUALITY CRITERIA

FOR PUBLIC WATER SUPPLY

The following criteria are for evaluation of stream quality at the point at which water is withdrawn for treatment and distribution as a potable supply:

1. Bacteria: Coliform group not to exceed 5,000 per 100 ml as a monthly average value (either MPN or MF count); nor exceed this number in more than 20 percent of the samples examined during any month; nor exceed 20,000 per 100 ml in more than five percent of such sampled.

2. Threshold-odor Number: Not to exceed 24 (at 60 deg. C.) as a daily average.

3. Dissolved solids: Not to exceed 500 mg/l as a monthly average value, nor exceed 750 mg/l at any time.

4. Radioactivity: Gross beta activity not to exceed 1,000 picocuries per liter (pCi/l), nor shall activity from dissolved strintium 90 exceed 10 pCi/l, nor shall activity from dissolved alpha emitters exceed 3 pCi/l.

5. Chemical constituents: Not to exceed the following specified concentrations at any time.

Constituent	Concentration (mg/l)
Arsenic	0.05
Barium	1.0
Cadmium	0.01
Chromium (hexavalent)	0.05
Cyanide	0.025
Fluoride	1.0
Lead	0.05
Selenium	0.01
Silver	0.05

FOR INDUSTRIAL WATER SUPPLY

The following criteria are applicable to stream water at the point at which the water is withdrawn for use (either with or without treatment) for industrial cooling and processing:

1. Dissolved oxygen: Not less than 2.0 mg/l as a daily-average value, nor less than 1.0 mg/l at any time.

2. pH: Not less than 5.0 nor greater than 9.0 at any time.

3. Temperature: Not to exceed 95 deg. F. at any time.

4. Dissolved solids: Not to exceed 750 mg/l as a monthly average value, nor exceed 1,000 mg/l at any time.

FOR AQUATIC LIFE A

The following criteria are for evaluation of conditions for the maintenance of a well-balanced, warm-water fish population. They are applicable at any point in the stream except for areas necessary for the admixture of waste effluents with stream water:

1. Dissolved oxygen: Not less than an average of 5.0 mg/l per calendar day and not less than 4.0 mg/l at any time.

2. pH:*

   A. No values below 6.0 nor above 8.5.

   B. Daily fluctuations which exceed the range of pH 6.0 to pH 8.5 and are correlated with photosynthetic activity may be tolerated.

3. Temperature:

   A. No abnormal temperature changes that may affect aquatic life unless caused by natural conditions.

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

   C. Maximum temperature rise at any time or place above natural temperatures shall not exceed 5 deg. F. In addition, the water temperature shall not exceed the maximum limits indicated in the following table.

	Maximum Temperature in Deg. F. During Month											
WATERS	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
All waters except Ohio River	50	50	60	70	80	90	90	90	90	78	70	57
Main Stem-Ohio River	50	50	60	70	80	87	89	89	87	78	70	57

4. Toxic Substances: Not to exceed one-tenth of the 48-hour median tolerance limit, except that other limiting concentrations may be used in specific cases when justified on the basis of available evidence and approved by the appropriate regulatory agency.

FOR AQUATIC LIFE B

The following criteria are for evaluation of conditions for the maintenance of desirable biological growths and, in limited stretches of a stream, for permitting the passage of fish through the water, except for areas necessary for admixture of effluents with stream water:

1. Dissolved oxygen: Not less than 3.0 mg/l as a daily-average value, nor less than 2.0 mg/l at any time.

2. pH: Not less than 6.0 nor greater than 8.5 at any time.

3. Temperature: Not to exceed 95 deg. F. at any time.

4. Toxic substances: Not to exceed one-tenth of the 48-hour median tolerance limit, except that other limiting conditions may be used in specific cases when justified on the basis of available evidence and approved by the appropriate regulatory agency.

FOR RECREATION

The following criterion is for evaluation of conditions at any point in waters designated to be used for recreational purposes, including such water-contact activities as swimming and water skiing:

Bacteria: The fecal coliform content (either MPN or MF count) not to exceed 200 per 100 ML as a monthly geometric mean based on not less than five samples per month; nor exceed 400 per 100 ML in more than ten percent of all samples taken during a month.

FOR AGRICULTURAL USE AND STOCK WATERING

The following criteria are applicable for the evaluation of stream quality at places where water is withdrawn for agricultural use or stock-watering purposes:

1. Free from substances attributable to municipal, industrial or other discharges, or agricultural practices that will settle to form putrescent or otherwise objectionable sludge deposits.

2. Free from floating debris, oil, scum and other floating materials attributable to municipal, industrial or other discharges, or agricultural practices in amounts sufficient to be unsightly or deleterious.

3. Free from materials attributable to municipal, industrial, or other discharges, or agricultural practices producing color, odor or other conditions in such degree as to create a nuisance.

4. Free from substances attributable to municipal, industrial or other discharges or agricultural practices in concentrations or combinations which are toxic or harmful to human, animal, plant or aquatic life.

APPENDIX B

DEVELOPMENT OF BLOWDOWN SCHEDULE TO PREVENT DISCHARGE OF EXCESSIVE CHLORINE FROM RECIRCULATING COOLING WATER SYSTEMS

The decay and buildup of chemical species in the recirculating condenser-cooling tower circuit was analyzed by using the following equation for the rate of change of the content of a solute,

$$V\frac{dc}{dt} = c_M M - cB - cFR, \quad (1)$$

where, V is the volume of the system, c is the concentration in the system at the time t, c_M is the concentration in the makeup at rate M, B is the blowdown rate, R is the recirculation flowrate and F is the fraction of the solute lost (by evaporation or chemical reaction, e.g., light-catalyzed reduction of free chlorine) per pass through the system.

Integrating (1) and solving for c gives:

$$c = \frac{c_M M - (c_M M - A\, c_o)e^{-\frac{A}{V}t}}{A}, \quad (2)$$

where c_o, is the solute concentration at time zero, and $A \equiv B + FR$. The use of equation 2 involves the assumption that the composition in all parts of the system is the same, therefore, for rapid changes, the applicability would be poor.

For the present case, we wish to examine the possibility of operating with no blowdown for periods when the concentration of residual chlorine in the recirculating system is in excess of some quantity declared to be the maximum permissible. For purposes of the calculation, we shall use 0.1 ppm, the maximum figure declared by the EPA to be without harm to the aquatic ecology if discharges are limited to 30 minutes per day.

Assuming that the chloramines are predominantly produced by reaction between the ammonia nitrogen in the makeup water and the free chlorine added, the concentration reaches the level of 0.021 ppm in the 30-minute chlorination period, if none are lost by aeration in the cooling tower (see Table B.1). Actually, it is expected that a significant amount will be lost; in Section 3 of this Statement, we have chosen 50% as a conservative estimate of the fraction of chloramines lost in one pass through the cooling tower.

In Table B.1 are shown calculated values of the expected chloramine concentrations (actually ppm chlorine present in the form of chloramines) at the end of 30 minutes and four other times to be developed below. The equivalent concentration in the incoming water was the ammonia nitrogen. Only at the longest times and lowest evaporative losses is the 0.1 ppm criterion exceeded. Accordingly, the free chlorine concentration will be examined for its limitations.

TABLE B.1. Calculated Chloramine Buildup in Station Recirculating System (concentrations in parts per million)

Fraction Lost per Pass	Time, minutes				
	30	66.45	89.78	201.3	376.9
0	0.021	0.047	0.064	0.143	0.267
0.1	0.020	0.041	0.053	0.096	0.133
0.5	0.016	0.025	0.028	0.033	0.033
0.9	0.013	0.017	0.018	0.018	0.018

Assumptions: Makeup rate = 9225 gpm
Blowdown rate = 0
Makeup concentration = $0.34 \times \frac{35.46}{14} = 0.861$ ppm
Volume = 11.2 million gallons
Recirculating flowrate = 480,000 gpm
Initial concentration, zero

The planned procedure is to maintain 0.5 ppm residual free chlorine during the chlorination periods. Following the time when chlorination is stopped, the free chlorine concentration will decline by reduction to chloride by reaction with chlorine-demand constituents in the makeup water and by reduction to chloride by reaction with water, including the catalytic effect of light. The fraction lost by reaction with water per pass through the system is not known, and may vary, depending on time of day and sunlight intensity. Calculations were therefore made of the times required for the concentration to decline from 0.5 to 0.1 ppm (at the same four values of the loss fraction that had been employed for Table B.1), with the results shown in Table B.2. Adding 30 minutes to each of these times gives the length of the period during which blowdown would be prohibited.

TABLE B.2. Calculation of Blowdown Rates as a Function of Free Chlorine Losses

	Case 1	Case 2	Case 3	Case 4
Fraction of free chlorine lost during each pass through the system	0	0.1	0.5	0.9
Time (in minutes) for free chlorine to decay from 0.5 to 0.1 ppm	346.9	171.3	59.78	36.45
Period of prohibited blowdown (minutes)	376.9	201.3	89.78	66.45
Total dissolved solids built up during period of prohibited blowdown (ppm)	552.2	517.6	495.7	491.1
Recovery time (minutes)	Impossible	158.7	270.22	323.55
Required blowdown rate (gpm)	-	19,390	11,880	10,840

During such periods of no blowdown, the total dissolved solids content would increase in the average case to the values shown in the fourth row of Table B.2 (calculated using 239 ppm make-up concentration and 478 ppm initial cooling tower concentration). Chlorinating four times a day allows 360 minutes each time for periods of prohibited discharge and recovery to some chosen reference concentration. Selecting the value given in the ER for the average TDS, 478 ppm, led to the calculated required blowdown rates shown in the last row of Table B.2.

Note for the circumstances chosen, it would never be possible to blowdown if there was no significant loss of free chlorine by reaction with water, because the rate of addition of chlorine-demand constituents in the makeup water would require more than 330 minutes to decrease the free chlorine level to 0.1 ppm. Of course, employment of a less stringent discharge criterion would alleviate this problem. Also, selecting operating conditions so as to encourage the chlorine-water reaction (e.g., establish no-blowdown decay periods for daylight hours only, use shallow trough for return of water from cooling tower to recirculating pumps) would be helpful. The service water used for cooling tower makeup should not be chlorinated during the prohibited blowdown periods. Schedules could be the same for chlorination of service water and recirculating cooling water.

For the three feasible cases calculated, the blowdown rates do not seem unreasonable, being at worst somewhat greater than twice the presently-expected average blowdown rate. With care in planning and design, operation is probably feasible under blowdown restrictions for periods when the residual chlorine in the recirculating cooling water is in excess of a chosen level.

There would appear to be no substantial problem to such a general procedure if chlorine were destroyed after a no-blowdown period of chlorination by the controlled addition of a chemical such as sodium sulfite. Apparently, reasonable blowdown rates would then prevent the development of excessive total dissolved solids concentration.

Appendix C

ADVISORY COUNCIL
ON
HISTORIC PRESERVATION

WASHINGTON, D.C. 20240

December 18, 1972

RECEIVED
DEC 20 1972
U.S. ATOMIC ENERGY COMMISSION

50-346

Mr. Daniel R. Muller
Assistant Director for
Environmental Projects
Directorate of Licensing
Atomic Energy Commission
Washington, D.C. 20545

Dear Mr. Muller:

In response to your request of November 22, 1972, for comments on the following environmental statement Davis-Besse Nuclear Power Station, and pursuant to its responsibilities under Section 102(2)(C) of the National Environmental Policy Act of 1969, the Advisory Council on Historic Preservation has determined that your draft environmental statement appears adequate regarding our area of expertise and we have no further comment to make.

Sincerely yours,

Robert R. Garvey Jr.
Robert R. Garvey Jr.
Executive Secretary

6936

THE COUNCIL, an independent agency of the Executive Branch of the Federal Government, is charged by the Act of October 15, 1966, with advising the President and Congress in the field of Historic Preservation, commenting on Federal, federally assisted, and federally licensed undertakings having an effect upon properties listed in the National Register of Historic Places, recommending measures to coordinate governmental with private activities, advising on the dissemination of information, encouraging public interest and participation, recommending the conduct of special studies, advising in the preparation of legislation, and encouraging specialized training and education, and guiding the United States membership in the International Centre for the Study of the Preservation and the Restoration of Cultural Property in Rome, Italy.

Appendix D-1

50-346

DEPARTMENT OF AGRICULTURE
OFFICE OF THE SECRETARY
WASHINGTON, D. C. 20250

RECEIVED
JAN 15 1973
U.S. ATOMIC ENERGY COMMISSION
Regulatory
Mail Section

January 11, 1973

Mr. Daniel R. Muller
Directorate of Licensing
Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Muller:

We have had the draft environmental statement for the Davis-Besse Nuclear Power Station, The Toledo Edison Company, reviewed in the relevant agencies of the Department of Agriculture, and comments from Forest Service, Economic Research Service and Soil Conservation Service, all agencies of the Department, are enclosed.

Sincerely,

T. C. Byerly

T. C. BYERLY
Coordinator, Environmental
Quality Activities

Enclosures

ECONOMIC RESEARCH SERVICE
UNITED STATES DEPARTMENT OF AGRICULTURE

Draft Environmental Statement, Davis-Besse Nuclear Power Station, Toledo Edison Company

The Applicant basically justifies the Station on existing and projected growth rates of electricity consumption. Inasmuch as the production of electricity consumes natural resources and results in environmental change, we feel that the statement should include a discussion of measures that the Applicant and the regional power network of which it is a member have under consideration to encourage more efficient utilization of electricity. Some measures which could have a significant impact on demand projections might include special metering to reduce demands for costly peak power, implementation of rate structures designed to promote more efficient consumption, and the revision of any existing utility promotional efforts. Such a discussion would be compatible with NEPA Guidelines for environmental impact statements which require evaluation of alternatives to the proposed action. Recent interpretation of section 102 (2) (c) of NEPA held, in essence, that the range of alternatives required to be considered were those "reasonably available." None were to be ruled out, "merely because they do not offer a complete solution to the problem." NRDC v. Morton (D.C. Cir. 1972).

United States Department of Agriculture
Forest Service

RE: Davis-Besse Nuclear Power Station, Toledo Edison Company

This project is in place. The main impact on forest land is the result of the construction of 101 miles (1800 acres) of transmission lines. Of this total, the draft states that the 44 mile extension of the "Beaver" line being constructed by Ohio Edison is "under a separate project." So this draft covers 4.7 miles of right-of-way through wooded areas, or 86 acres of forest cleared. The power plant site itself required the "removal of very few trees."

Both the Toledo Edison Company's Supplement to Environmental Report, Volume 1, and the draft state that consideration was given to "disturbance of forest areas," among other factors including cost, in selecting the location for the rights-of-way.

Toledo Edison's Volume 1 states that Geological Survey Circular 645, "A Procedure for Evaluating Environmental Impact" was used to analyze the impact of installing the transmission lines. The impact on forestry is described in these words: "Forest areas in the Toledo area are relatively small and mainly are used as a local supply of lumber and wood products. Any cleared land will in most instances be used for farm production. Some areas will be left as sanctuaries for birds and animals."

This impact description does not recognize other forest values which must be realized in this area for hunting, other forms of recreation, aesthetics, and other amenities. No part of the evaluation of impact is carried over into the draft statement.

Soil Conservation Service, USDA, Comments on Draft Environmental Statement prepared by the U.S. Atomic Energy Commission for Davis-Besse Nuclear Power Station.

In the course of our review, we have made the following comments:

1. There should be a statement concerning what methods and procedures are being used to prevent erosion and sediment damage during construction of the nuclear plant.

2. It is stated in Chapter 2 on page 23 that the applicant has constructed a 7½ mile railroad extension to the Norfolk and Western main line. A statement specifying what erosion and sediment control measures were implemented should be included.

3. There should be a statement in regard to what affect the proposed site will have on natural drainage patterns of other properties in the area.

4. The loss of 150 acres of agricultural land to the proposed project site will have an impact on the area. The degree and magnitude of this impact should be so stated.

Appendix E

DEPARTMENT OF THE ARMY
DETROIT DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1027
DETROIT, MICHIGAN 48231

50-346

IN REPLY REFER TO
NCEED-ER

3 JAN 1973

Mr. Daniel R. Muller
Assistant Director
Environmental Projects
Directorate of Licensing
U.S. Atomic Energy Commission
Washington, D.C. 20545

Dear Mr. Muller:

This is in response to your request for comments on the draft environmental statement issued November 1972 for the Davis-Besse Nuclear Power Station of the Toledo Edison Company, Ohio.

Review of the subject statement indicates that the questions presented in our letter of 3 January 1972 in response to the Environmental Report for this nuclear station have been addressed in a satisfactory manner.

Section 1.3.1.d. of the draft statement should be revised since the Corps of Engineers no longer issues permits governing the discharge of plant effluents. Any such discharge will require separate authorization by the Environmental Protection Agency under Public Law 92-500 enacted by Congress recently.

A Public Notice regarding the Toledo Edison Company's application for a permit to construct intake and discharge structures in Lake Erie at Ottawa County, Ohio, will be issued by the District Engineer on 26 December 1972 to expire 30 days from the date of issuance. The determination as to whether a permit will be issued will be based on an evaluation of all relevant factors including the effect of the proposed work on navigation, fish and wildlife, conservation, pollution, and the general public interest. Department of the Army permits under Section 10, River and Harbor Act of 1899, will be required to construct offshore facilities.

NCEED-ER
Mr. Daniel R. Muller

8 JAN 1973

We appreciate the opportunity to review your environmental statements as they relate to water related resources.

Sincerely yours,

B. G. DeCooke
P. McCALLISTER
Chief, Engineering Division

THE ASSISTANT SECRETARY OF COMMERCE
Washington, D.C. 20230

January 4, 1973

50-346

Mr. Daniel R. Muller
Assistant Director for Environmental
Projects
Directorate of Licensing
Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Muller:

The draft environmental impact statement for Davis-Besse Nuclear Power Station which accompanied your letter of November 22, 1972, has been received by the Department of Commerce for review and comment.

The Department of Commerce has reviewed the draft environmental statement and has the following comments to offer for your consideration.

Section 3.3.2 - Discharge Structure, Page 3-9, last paragraph: This paragraph indicates that the volume of the collecting basin is small in comparison with flow rates into it. The possibility of enlarging the capacity of this basin to increase hold-up time, in order to reduce the discharge of toxic materials to the lake, should be included in the final environmental impact statement.

Section 4.2.2 - Intake and Discharge Pipelines, Page 4-5, first paragraph: The construction of this pipeline during the spring and summer of 1973 for a 4 to 5 month period could cause problems for spawning fish; a discussion of protective measures that will be used should be presented.

Section 5.2.3 - Thermal Discharges, Page 5-3, first paragraph: Since the maximum heat loading to the lake occurs during April, increased water temperature might affect the spawning activities of Perch and Walleye that also take place at this time. In addition, it should be pointed out that Perch require a period of 6 months or more at temperatures of 39°F or below for successful maturation of gonads and normal reproductive success. The following statement by Dr. Donald Mount, Director of the Duluth National Water Quality Laboratory, sums up recent work in this field:

> "The level of reproductive success among perch held at 39°F for about 6 months (70% fertile eggs, 53% normal larvae) was approximately twice as great as for fish held at 43°F for about 6 months (35% fertile eggs, 31% normal larvae) and approximately four times as great as for fish held at 46 and 50°F for about 6 months (16 and 21% fertile eggs, 13 and 7% normal larvae. Exposure to the above temperatures for periods less than 6 months lowered reproductive success at each temperature. The data indicate substantial impairment of Yellow Perch reproduction by an increase in winter temperature of approximately 4°F above 39°F, the lowest temperature tested. It is expected that the reproduction of closely related species such as Sauger and Walleye, may be impaired by similar increases in winter temperature."

The statement should discuss the possibility that these species of fish will become resident in a warm water area, thus suffering reproductive decline. There is a distinct possibility that this will occur, the statement should also discuss what steps will be taken to alleviate the expected adverse impact upon these populations.

<u>Section 5.5.3 - Discharge Effects, Page 5-13:</u> Recent research on the toxic effects of chlorine on fish and other aquatic life has indicated that levels as low as .003 ppm have reduced reproductive potential of scuds (amphipods), an important food organism present in the area (page 2-37). Since there is a common effluent collecting basin, the potential impact of chlorine in the sewage effluent (page 5-5, Section 5.2.6) should also be considered.

<u>Page 5-15, first paragraph:</u> The statement should discuss the possibility that congregation of fish in the area of the heated discharge plume, even if it is only a few degrees above ambient, could cause reproductive problems (see comment for page 5-3, Section 5.2.3).

<u>Section 6.2.3 - Radiological Monitoring Program, Pages 6-5 through 6-7:</u> Analyses of aquatic plants were omitted from the radiological monitoring program (Table 6.2). Also, the map showing sampling locations (Fig. 6-1) is a poor reproduction and does not indicate which type of sample is collected at which location; that is, the station numbers seem unrelated to material in the text and tables. These deficiencies should be remedied in the final statement.

<u>Section 8.2.2 - Aquatic Effects, Page 8-8:</u> As indicated in the comments on Page 5-13, Section 5.5.3, chlorine in small sublethal amounts may have a pronounced adverse effect on the aquatic system; this effect should also be considered in this section.

<u>Section 10.3 - Discharge System Alternatives, Page 10-4:</u> The possibility of using the high velocity discharge in winter (when fry are at a minimum) to minimize the sinking plume effect and winter residence by fish (with the possibility of cold kill during shutdown and the possibility of reduced reproductive rates) should be considered. On the other hand, during other times of the year when the receiving water is warmer than 4°C (39°F) and the plume would not sink and contact the bottom of the lake, a low velocity surface release could be used, thus reducing entrainment into the plume of fry and plankters and permitting more rapid loss of the waste heat to the atmosphere than would be obtained with a submerged jet-type discharge.

<u>Section 10.5 - Biocide System, Page 10-4:</u> The use of mechanical cleaners for the condenser should be explored.

As described by the AEC staff on page 3-22, a 30-day uniform release period after an average 60-day hold-up of waste radioactive gases in pressurized decay tanks would mean 6 such release periods spread throughout the year. We consider such a mode of release to be sufficiently regular to warrant the approach used to compute an average annual dose from year-long, continuous, meteorological diffusion statistics. However, the staff does not indicate the meteorological data used and the resulting average relative concentration which we need to make a quantitative evaluation. If the releases are from roof top vents, then the wind data presented in figure 2.10 for the 300-ft. level would not be appropriate without modification. For similar reasons, we are unable to evaluate the environmental effects of postulated accidental releases of radioactive gases.

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

Sincerely,

Sidney R. Galler

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20201

FEB 5 1973

FEB 7

Mr. Daniel R. Muller
Assistant Director for
Environmental Projects
Directorate of Licensing
U.S. Atomic Energy Commission
Washington, D. C. 20545

50-346

Dear Mr. Muller:

This is in response to your letter of November 22, 1972, wherein you requested comments on the draft environmental impact statement for the Davis-Besse Nuclear Power Station, Toledo Edison Company, Docket Number 50-346.

The Department of Health, Education, and Welfare has reviewed the health aspects of the above project as presented in the documents submitted. This project does not appear to represent a hazard to public health and safety.

The opportunity to review the draft environmental impact statement is appreciated.

Sincerely yours,

Richard L. Seggel

Richard L. Seggel
Acting Assistant Secretary
for Health

Appendix H

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

MAILING ADDRESS:
U.S. COAST GUARD (GWS/83)
400 SEVENTH STREET SW
WASHINGTON, D.C. 20590
PHONE: 426-2262

9 JAN 1973

RECEIVED JAN 12 1973 U.S. ATOMIC ENERGY COMMISSION

50-346

Mr. Daniel R. Muller
Assistant Director for
Environmental Projects
Directorate of Licensing
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Muller:

This is in response to your letter of 22 November 1972 addressed to Mr. John E. Hirten, Assistant Secretary for Environment and Urban Systems, concerning the draft environmental impact statement, environmental report and other material on the Davis Besse Nuclear Power Station, Ottawa County, Ohio.

The concerned operating administrations and staff of the Department of Transportation have reviewed the material presented. Noted in the review by the Federal Railroad Administration is the following:

"The Federal Railroad Administration is pleased to observe that Fig. 3.10 is probably the most definitive transmission line location map presented in a draft environmental impact statement. Although railroad company names are considerably out of date due to mergers, their location and those of the new 345 KV lines are clearly delineated.

"While not stated in the draft environmental impact statement, there appears a strong possibility for electrical interference effects with railroad signal and communication circuits. The transmission of EHV power can cause extraneous voltages by metallic cross or ground potential and electric or magnetic induction. Aside from the obvious personal safety hazard, it should be noted that these currents can destroy the integrity of railroad signal and communication systems and therefore create the potential for serious accident. We suggest that this problem be addressed in the final environmental impact statement."

The Department of Transportation has no further comments to offer on the draft statement. We have no objection to the project nor to its implementation. The final statement, however, should address the concern of the Federal Railroad Administration.

The opportunity for the Department of Transportation to review and comment on the proposed impact statement for the Davis Besse Project is appreciated.

Sincerely,

J. D. McCANN
Captain, U. S. Coast Guard
Acting Chief, Office of Marine
Environment and Systems

50-346

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

25 JAN 1973

RECEIVED
JAN 25 1973
U.S. ATOMIC ENERGY COMMISSION

Mr. L. Manning Muntzing
Director of Regulation
U.S. Atomic Energy Commission
Washington, D.C. 20545

Dear Mr. Muntzing:

The Environmental Protection Agency has reviewed the draft environmental statement for the Davis-Besse Nuclear Power Station and our detailed comments are enclosed.

Our principal concern is with the appropriateness of this draft statement for the consideration of both the continuation of the previously issued construction permit and the issuance of an operating license. The current review should be adequate for considering the potential impact of the continuation of construction. We believe, however, that substantial additional information will be developed by the time the plant is ready for licensing, on which a more accurate final assessment of the environmental impact can be based. The AEC should evaluate such additional information as it becomes available, and should determine whether a supplemental review is necessary.

We will be pleased to discuss our comments with you or members of your staff.

Sincerely,

Sheldon Meyers

Sheldon Meyers
Director
Office of Federal Activities

Enclosure

ENVIRONMENTAL PROTECTION AGENCY

Washington, D.C. 20450

JANUARY 1973

ENVIRONMENTAL IMPACT STATEMENT COMMENTS

Davis-Besse Nuclear Power Station

TABLE OF CONTENTS

IMAGE EVALUATION
TEST TARGET (MT-3)

6"

MICROCOPY RESOLUTION TEST CHART

IMAGE EVALUATION TEST TARGET (MT-3)

6″

MICROCOPY RESOLUTION TEST CHART

INTRODUCTION AND CONCLUSIONS

The Environmental Protection Agency (EPA) has reviewed the draft environmental statement for the Davis-Besse Nuclear Power Station prepared by the U.S. Atomic Energy Commission (AEC) and issued on November 22, 1972. Following are our major conclusions:

1. We noted in our review that this draft statement has been submitted in support of two proposed actions: (1) the continuation of Construction Permit No. CPPR-80 and (2) the issuance of an operating license. It is expected that substantial additional information, which will enable a more accurate assessment of the environmental impact to be conducted, will be developed by the time the plant is ready for licensing. This additional information is expected to include final system design details, operating experience at similar large nuclear power reactors, and results of environmental studies. While the current review should be adequate for consideration of the continuation of CPPR-80, prior to plant operation the AEC should assess the best information then available to determine if the conclusions reached during the current review are still valid, and to determine whether a supplemental environmental review is necessary.

2. The major non-radioactive waste stream is blowdown from the condenser cooling system. The condenser cooling water is chlorinated and the blowdown is discharged with other wastes into Lake Erie. Other wastes include sanitary sewage treatment effluent, storm runoff, neutralized ion exchange regenerant, water and waste treatment

sludges, debris trapped in the intake structure, deposits resulting from the evaporation of the drifting cooling tower plume, and other miscellaneous chemicals. The final statement should consider alternative treatment systems to provide further reductions of chlorine and total dissolved solids in the effluent being discharged to Lake Erie.

RADIOLOGICAL ASPECTS

Radioactive Waste Management

The radioactive waste treatment systems provided for the Davis-Besse plant appear to be designed to minimize the discharge of radioactive waste and thus, the effluent levels are expected to be consistent with the concept of "as low as practicable." While the plant appears to have adequate waste management systems, neither the Preliminary Safety Analysis Report, the environmental report, nor the draft environmental statement addressed the handling of the liquid waste resulting from the sluicing of the secondary coolant system condensate polishing demineralizers. A very brief discussion of a four cell settling basin is given in the applicant's environmental report but no decontamination factors are presented. During periods of primary-to-secondary coolant leakage combined with significant fuel failures, the secondary coolant will become contaminated with radioactivity. A large fraction of this radioactive material will be collected by the demineralizers and therefore some will be expected in the backwash of these units. Since there is little information regarding the disposition of the demineralizer sluice water, or the frequency, volumes, and concentrations of radioactivity involved, it is not possible to estimate the environmental consequences of the possible discharges from this source. The final statement should contain an analysis of the discharge pathway including (1) a description of the waste management techniques to be used to control the environmental impact, (2) the annual discharge volumes and quantities of radionuclides, and (3) an estimate of the dose resulting from the discharged radioactivity.

Dose Assessment

In evaluating the effluent release source terms, the AEC assumed a partition factor of 100 for iodine in the steam generators. Since the steam generators are of the "once-through" design, in which approximately one-half the steam generator tube surface area is covered by secondary coolant, it is not justifiable to assume a partition factor greater than 1.0. In all previous environmental statements for similar reactors, the AEC assumed an iodine partition factor of 1.0 in the steam generator. The final statement should either provide the bases for the partition factor used or reevaluate the potential iodine releases and thyroid doses.

Transportation and Reactor Accidents

In its review of nuclear power plants, EPA has identified a need for additional information on two types of accidents which could result in radiation exposure to the public: (1) those involving transportation of spent fuel and radioactive wastes and (2) in-plant accidents. Since these accidents are common to all nuclear power plants, the environmental risk for each type of accident is amenable to a general analysis. Although the AEC has done considerable work for a number of years on the safety aspects of such accidents, we believe that a thorough analysis of the probabilities of occurrence and the expected consequences of such accidents would result in a better understanding of the environmental risks than a less-detailed examination of the questions on a case-by-case basis. For this reason we have reached an understanding with the AEC that they will conduct such analyses with EPA participation concurrent with review of impact statements for individual facilities and will make the results available in the near future. We are taking this approach primarily because we believe that any changes in equipment or operating procedures for individual plants required as a result of the investigations could be included without appreciable change in the overall plant design. If major redesign of the plants to include engineering changes were expected or if an immediate public or environmental risk were being taken while these two issues were being resolved, we would, of course, make our concerns known.

The statement concludes "... that the environmental risks due to postulated radiological accidents are exceedingly small." This conclusion is based on the standard accident assumptions and guidance issued by the AEC for light-water-cooled reactors as a proposed amendment to Appendix D of 10 CFR Part 50 on December 1, 1971. EPA commented on this proposed amendment in a letter to the Commission on January 13, 1972. These comments essentially raised the necessity for a detailed discussion of the technical bases of the assumptions involved in determining the various classes of accidents and expected consequences. We believe that the general analysis mentioned above will be adequate to resolve these points and that the AEC will apply the results to all licensed facilities.

NON-RADIOLOGICAL ASPECTS

Thermal Effects

The heated water discharged into Lake Erie is predominantly from the cooling tower blowdown, which is discharged at a rate of 20 to 27 cfs. The discharge temperature is maintained at a level which is no greater than 20°F above lake ambient by mixture with dilution water pumped from Lake Erie. Since dilution pumping to reduce the blowdown temperature to a 20°F temperature differential prior to discharge may cause increased mechanical damage to aquatic organisms, we suggest that alternatives to dilution pumping be presented in the final statement. Because lake water is involved in both dilution pumping and lake mixing, consideration might be given to dilution to a lower temperature to take place in the lake and thereby avert mechanical damage to organisms. The final statement should compare the environmental effects and benefits of dilution with the effects and benefits of keeping the discharge at a 20°F temperature differential.

The heated discharge will generate a thermal plume in the lake. The area of the 3°F surface temperature isotherm is estimated by the AEC staff to be 0.6 acres, and by the applicant to be three times less than this, though both the AEC and the applicant have used Pritchard's model to estimate the extent of the thermal enriched area. We believe this discrepancy should be resolved. For a very small area, it should be noted that the 20°F discharge temperature differential may cause a receiving water temperature in excess of the National Technical Advisory Committee's recommendations. Temperature standards for Lake Erie are presently under consideration, and if possible, the final statement should discuss the capability of the plant to meet those proposed standards.

The 1972 Amendments to the Federal Water Pollution Control Act, Public Law 92-500, define the thermal component of any discharge as being a pollutant. The new Amendments also require the application of "best practicable control technology" by 1977. EPA is also required by the new law to set effluent guidelines for steam electric power plants by the fall of 1973. Effluent discharges from the Davis-Besse Nuclear Power Plant will have to be in accordance with the requirements of Public Law 92-500.

Biological Effects

Public Law 92-500 provides that cooling water intake structures should reflect the "best technology available." The final statement should discuss those factors considered in the design of the intake and how the present design meets the requirements of "best technology available" for minimizing adverse environmental effects.

It appears that excessive numbers of fish may be drawn into the intake because of the vertical current created by the upward direction of the intake structure. Fish have very little resistance to vertical current and are very easily drawn into intakes of such design. (There is some indication that intake structures with openings on the sides create a horizontal current which entrains fewer fish.) Experiments at the Monroe Plant (which has an intake structure similar to the one proposed) indicate that large numbers of fish are drawn into the intake structure even when a bubble curtain is employed. The possibility of a similar situation occurring at Davis-Besse should be discussed in the final statement.

In the final statement, estimates should also be presented for different seasons as to the kinds and numbers of fish per acre in this area, their mobility, and the effects of artifical reef structures on their distribution, since the intake will be an artifical "reef". The biological habitat at the site with respect to fish migratory paths, spawning grounds, and nursery areas should also be carefully delineated. It is recommended that a program be devised to determine the significance of fish egg and larvae passage through the power plant.

While the biological monitoring program proposed by the applicant would normally be considered adequate, further review of the proposed monitoring system is suggested since the area in which the power plant is to be located is in close proximity to Lake Erie and is in a highly viable marsh area. The projected chemical and biological monitoring system should be carefully reviewed to be inclusive of the total ecological systems involved. The subtle effects on the ecosystem that could arise from the operation of a power plant may not otherwise be discerned.

Chemical Effects

If operated as planned, the Davis-Besse Nuclear Power Station will probably meet existing Ohio water quality standards. However, the State of Ohio is now revising the Ohio water quality standards as they apply to Lake Erie and other waters, and is also developing effluent standards. These final standards will probably be available soon. The AEC and the applicant should be aware of these changes, and if possible, should explicity compare the proposed effluent composition with the state standards in the final statement.

The draft statement indicates that the use of an orthophosphate corrosion inhibitor at a concentration of about 2 milligrams per liter will be considered at a later date. Since Lake Erie needs no further enrichment, it is suggested that the use of orthophosphate for this purpose be very carefully detailed in the final statement. The disposal of detergents as described in the draft statement should also be reevaluated for similar reasons. All possible steps should be taken by the applicant to reduce the discharge of nutrients into Lake Erie in view of the present eutrophic conditions there. Any preventive measures that may be taken to avert additional algae blooms in the vicinity of the station should be described in the final statement.

The station plans to discharge 0.5 ppm chlorinated water for four periods per day, each period being about 2.1 hours in duration. The 0.5 ppm level of either free or combined chlorine is expected to be toxic to most aquatic organisms, including fish. For intermittent discharges EPA recommended a total residual chlorine discharge of no more that 0.1 ppm chlorine for 30 minutes per day or less; or 0.005 ppm chlorine not to exceed two hours per day. The final statement should present the applicant's program to reduce the discharge of chlorine to the levels recommended by EPA.

The draft statement states that the average concentration of dissolved solids in the effluent is expected to be about 478 ppm, based upon an intake water concentration of 225 ppm and the incremental addition of 253 ppm ' :ved solids. It should be noted that the specific water quality objectives outlined in the International Joint Agreement on Great Lakes Water Quality specify that the level of total dissolved solids in Lake Erie should not exceed 200 milligrams per liter (Annex 1, 1.[c]). Further, this agreement has a non-degradation clause which specifies as follows:

> "Not withstanding the adoption of specific water quality objectives, all reasonable and practicable measures shall be taken in accordance with paragraph 4 of Article III of the Agreement to maintain the levels of water quality existing at the date of entry into force of the Agreement in those areas of the boundary waters of the Great Lakes System where such levels exceed the specific water quality objectives." (Annex 1,3.)

The specific water quality objectives outlined in the International Joint Agreement on the Great Lakes for Lake Erie, and the practicability of reducing total dissolved solids to a lower level, in keeping with the non-degradation clause applicable to Lake Erie, should be addressed in the final statement.

It is of interest that the AEC recommended in the final statement for the Point Beach Nuclear Plant (Page iii) that the applicant should determine a method of substantially reducing the discharge of demineralizer regenerant waste to Lake Michigan. Such equipment or operating techniques were to be in operation by January 1, 1974. This treatment method may be equally applicable to the Davis-Besse plant.

The interceptor system for the floor and storm drain systems may not be considered adequate if the oil content of the waste discharged through this system is high. In the final statement, the effectiveness of the oil interceptor system should be estimated together with the organic content of the waste. The possibility of non-nuclear accidental spills at the site and contingency plans should be considered in this evaluation.

Recommended operating measures for the Davis-Besse Nuclear Power Station discharge system might include a prohibition against any increase in effluent loading over normal operating constituent loads during the time of dilution in the mixing basin. A program to alleviate synergistic effects of thermal and chemical discharges should be presented if two or more conditions are near the lethal limits for biological organisms.

There appears to be some discrepancies between the AEC staff and the applicant on estimates of the levels of the thermal and chemical effluents. These should be described and explained in the final statement.

ADDITIONAL COMMENTS

During the review we noted in certain instances that the draft statement did not present sufficient information to substantiate the conclusions presented. We recognize that much of this information is not of major importance in evaluating the environmental impact of the Davis-Besse Nuclear Power Station. The cumulative effects, however, could be significant. It would, therefore, be helpful in determining the impact of the plant if the following topics were addressed in the final statement.

1. Clarification of the discharge pathway for the liquid radioactive waste from the miscellaneous liquid radwaste system and detergent waste system (e.g., to the mixing basin or to the lake in another stream) should be presented in the final statement.

2. The applicant has not presented results from the preoperational environmental monitoring program. Such information should be presented in the final statement.

3. The station water use diagram indicates production of potable water using a clarifier and chlorine. This potable water line is shown to be interconnected with the sanitary system, fire protection system, and a demineralizer. Specific information should be given for the design and production capacity of the water use system, the methods of water purification, and the method and dosage for disinfection. Protection against contamination from backflow and/or interconnection with other systems should be clearly outlined. A flow diagram of the proposed system should be included in the final statement.

4. The discussion of the borrow pits both during and after construction would be enhanced in the final statement if all comments concerning their use would be presented in one section. Any postulated groundwater effects from the borrow pits should be included in this section.

Appendix J

FEDERAL POWER COMMISSION
WASHINGTON, D.C. 20426
February 21, 1973

50-346

IN REPLY REFER TO:

Mr. Daniel R. Muller
Assistant Director for
Environmental Projects
Directorate of Licensing
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Muller:

This is in response to your letter dated November 22, 1972, requesting comments on the AEC Draft Environmental Statement related to the proposed continuation of Construction Permit No. CPPR-80 and the issuance of an operating license to the Toledo Edison Company (TEC) and the Cleveland Electric Illuminating Company (CEIC) for the Davis-Besse Nuclear Power Station (Docket No. 50-346).

Pursuant to the National Environmental Policy Act of 1969 and the April 23, 1971 Guidelines of the Council on Environmental Quality, these comments are directed to a review of the need for the facilities as concerns the adequacy and reliability of the affected bulk power systems and matter related thereto.

In preparing these comments, the Federal Power Commission's Bureau of Power staff has considered the AEC Draft Environmental Statement; the Applicant's Environmental Report and Amendment thereto; related reports made in response to the Commission's Statement of Policy on Adequacy and Reliability of Electric Service (Order No. 383-2); and the staff's analysis of these documents together with related information from other FPC reports. The staff of the Bureau of Power generally bases its evaluation of the need for a specific bulk power facility upon long term considerations as well as the load-supply situation for the peak load period immediately following the availability of the facility.

Need for the Facility

The 872-megawatt Davis-Besse Nuclear Power Station is located on the southwest shore of Lake Erie in Ottawa County about 21 miles east of Toledo, Ohio. The station is owned jointly by TEC and CEIC, who divide its ownership and output in shares of 52.5 percent and 47.5 percent, respectively. The two participants are investor-owned public utility companies engaged in supplying electric energy to the public. TEC is responsible for the design, construction and operation of the station. Both companies are members of the Central Area Power Coordination Group (CAPCO) which includes, in addition to the Davis-Besse participants, the Duquesne Light Company, the Ohio Edison Company, and Ohio Edison's subsidiary, the Pennsylvania Power Company. CAPCO is an operating pool in which the members' generating and transmission capability are jointly planned and in some instances jointly owned. It is also a member of the East Central Area Reliability Coordination Agreement (ECAR) which is a coordinating council of electric utility systems serving Indiana and Ohio and portions of Kentucky, Maryland, Michigan, Pennsylvania, Virginia and West Virginia.

The following tabulation shows the electric system loads to be served by the Applicants and the Central Area Power Coordination Group, and the relationship of the electric power output of the Davis-Besse Nuclear Power Station to the projected available reserve capacities on the summer-peaking Applicants' and the summer-peaking CAPCO systems at the time of the 1975 summer peak load. With the presently scheduled commercial operation date of December 1974, the 1975 summer is the anticipated initial peak service period of the new unit, but its life is expected to be some 30 years or more, and it is expected to constitute a significant part of the Applicants' total generating capacity throughout the period. Therefore, the unit will be depended upon to supply power to meet future demands over a period of many years beyond the initial service needs discussed in this report.

Mr. Daniel R. Muller

1975 Summer Peak Load-Supply Situation

	Toledo Edison Company	Cleveland Electric Illuminating Company	CAPCO
Conditions With Davis-Besse Nuclear Power Station (872 Megawatts) 1/			
Net Total Capability - Megawatts	1,614	4,099	13,813
Net Load Responsibility - Megawatts	1,389	3,500	11,804
Reserve Margin - Megawatts	225	599	2,009
Reserve Margin - Percent of Peak Load	16.2	17.2	17.0
Conditions Without Davis-Besse Nuclear Power Station			
Net Total Capability - Megawatts	1,337	3,785	12,942
Net Load Responsibility - Megawatts	1,389	3,500	11,804
Reserve Margin - Megawatts	-52	285	1,138
Reserve Margin - Percent of Peak Load		8.1	9.6

1/ Toledo Edison Company and Cleveland Electric Illuminating Company share ownership of Davis-Besse plant in 52.5% and 47.5% shares, respectively; initially, plant output will be distributed as follows: Ohio Edison Co. - 280 MW, Toledo Edison Co. - 277 MW and Cleveland Electric Illuminating Co. - 314 MW.

The Applicants and CAPCO will face the 1975 summer peak period with several large new units that will have had only brief maturation periods. The 856-megawatt nuclear Beaver Valley Unit No. 1 scheduled for service in October 1974, the 872-megawatt nuclear Davis-Besse plant scheduled for service in December 1974 and the 825-megawatt coal-fired Mansfield Unit No. 1 scheduled for service in April 1975, comprise the new capacity additions planned for the CAPCO pool by the summer of 1975, except for about 500 megawatts of gas turbine capacity now planned for operation by the 1974 summer peak period. Neither the Applicants nor the Pool have indicated their policies in regard to minimum reserve margin for their respective systems. Since neither of the Applicants would have adequate reserves to cover the loss of the largest unit on their systems even if all planned units are placed in commercial operation on schedule, the

CAPCO group must provide emergency reserves to the member systems in the event of loss of a large unit. Pool reserves appear adequate to meet the simultaneous loss of two large units, but a third contingency could result in serious consequences.

The availability of the Davis-Besse Nuclear Power Station for the 1975 summer peak load period would provide the TEC system with a reserve margin of 225 megawatts, or 16.2 percent of peak load, and the CEIC system with a reserve margin of 559 megawatts or 17.1 percent of peak load. Should delays for any reason make the unit unavailable for this peak period, system reserve margins would be reduced to a negative 52 megawatts on the TEC system and 285 megawatts or 8.1 percent of peak load on the CEIC system. The reserve margins with the unit available are based on firm power sales to the Ohio Edison Company of 280 megawatts and distribution to Toledo Edison Company of 277 megawatts and to the Cleveland Electric Illuminating Company of 314 megawatts. Similarly, on the CAPCO system with the Davis-Besse unit available for the 1975 summer peak period, the reserve margin is estimated to total 2,009 megawatts or 17.0 percent of peak load, and without the unit the reserve margin would be reduced to 1,138 megawatts, or 9.6 percent of peak load.

These capacity reserves are gross and include not only all of the capacity scheduled to be available for meeting expected loads, but that which may be delayed and not available, that which may be out of service for scheduled maintenance or forced outages, and any capacity that might be needed to meet unforeseen demands due to errors in load-forecasting and exceptional weather. Current experience in bringing large new generating units into service reflects delays from one month to two years or more in construction or licensing. Delay results in reduced system reliability from lower reserves before a unit is placed in service, and high-forced outage rates are probable during its initial year of operation before the unit attains reliable operation. Hence, the adequacy and reliability of the Applicants' and the CAPCO systems at the 1975 summer peak load period is dependent upon the timely commercial operation of the three large nuclear and fossil units not now in service.

The main function of the East Central Area Reliability Coordination Agreement (ECAR) is the furthering of the reliability of the bulk power systems in the region through coordination of the members' plans for expansion and operation of their generation and transmission facilities, and provision for short term emergency relief in the event of contingencies normally experienced on interconnected power systems. Such short term emergency relief is not, however, a substitute for adequate reserves which should be maintained by each member system, based on its load. ECAR reports a gross reserve margin of 14,137 megawatts or 23.0 percent of 1975 summer peak load. However, about 16,000 megawatts of the ECAR capacity, which includes all of the reserves for the 1975 summer period, are vested in new generating units that are not yet in operation.

Transmission Facilities

Three overhead 345-kilovolt transmission lines will be required to integrate the Davis-Besse Nuclear Power Station into the Applicant's existing transmission system. Two lines will extend west from the plant switchyard on parallel rights-of-way for a distance of about 2 miles where the rights-of-way will diverge. One line will continue generally west-northwest for a distance of about 21 circuit miles to the Toledo Edison Company's existing Bay Shore Substation. The second line will extend generally west-southwest for a distance of about 21 circuit miles to the Toledo Edison Company's existing Lemoyne Substation. The third 345-kilovolt line will extend generally south-southeast for a distance of about 15 circuit miles from the plant switchyard to a tie point on the boundary between the Ohio Edison Company and the Toledo Edison Company. The line will continue eastward in Ohio Edison Company's territory for a distance of 44 circuit miles. This latter portion of the line is being constructed under a separate project as part of the CAPCO group's transmission system. The lines will be mounted in a vertical configuration on double-circuit latticed steel towers. Since only one circuit will be located on each line, a second circuit could be added to each line without additional tower construction, when needed for system reinforcement.

Although the planning and design of the transmission lines was undertaken before the distribution of the Department of the Interior and Department of Agriculture joint publication, Environmental Criteria for Electric Transmission Systems, the Applicants state that the design and routing of the transmission lines associated with the Davis-Besse Nuclear Power Station were selected to minimize the impact of the lines on the environment. The lines were routed to avoid paralleling major highways to the extent possible and crossings were selected in agricultural areas where practical; rights-of-way will be left in their natural state when crossings of highways occur. In an effort to reduce the number of utility corridors in the area, the lines will parallel existing transmission lines, and the railroad spur needed to serve the station shares the Lemoyne line right-of-way.

The Applicants state that the transmission line design practices used were consistent with the previously mentioned criteria and that herbicides will not be used for maintenance of rights-of-way, in accordance with the criteria.

Mr. Daniel R. Muller

Alternatives and Costs

The Applicant, in determining the need for additional generation to meet its projected system needs, considered in addition to firm power purchases, a number of other alternatives including locations, plant types, fuels, environmental effects and economics. The general area of the plant site is centrally located between load centers, in a low-lying, marshy region on the shore of Lake Erie with an abundant supply of cooling water. The final plant site was a result of an exchange of similar land tracts with the U. S. Bureau of Sport Fisheries and Wildlife, Department of the Interior, to provide a valuable ecological resource providing breeding grounds for wildlife and refuge for migratory wildfowl. About 75 percent of the plant site has been leased to and will be managed by the U. S. Government as a wildlife refuge.

The undeveloped hydroelectric potential of the area in 1968 was reported as 249,200 kilowatts which is inadequate to meet the baseload capacity requirements. Gas turbine peaking capacity cannot economically meet these capacity requirements. Natural gas and fuel oil were not considered available in adequate quantities to meet the projected needs for a baseload generating plant of comparable capacity. The only alternative fuel available was coal. The choice of the nuclear-fueled plant was made after consideration of the environmental effects and economics of the coal-fueled and nuclear-fueled plants. The Applicants estimated capital costs at $321 million or $368 per kilowatt of capacity for the nuclear-fueled plant and $174 million or $200 per kilowatt of capacity for a coal-fired alternative plant; annual fuel costs were estimated at $8.3 million for the nuclear-fueled plant and $24 million for the coal-fired plant, which resolve to 1.4 mills and 3.9 mills, respectively. The staff of the Bureau of Power finds the estimated costs comparable to some of those currently reported by the industry.

Mr. Daniel R. Muller

Conclusions

The staff of the Bureau of Power concludes that the electric power output of the Davis-Besse Nucleai Power Station will be needed to meet the Applicants' and the Central Area Power Coordination Group's projected system loads and to provide them with reserve margins needed for adequate system reliability. Furthermore, two other large new units must also be completed and placed in service on schedule if an adequate reserve margin is to be attained.

Very truly yours,

T. A. Phillips
Chief, Bureau of Power

Appendix K

OHIO DEPARTMENT OF ECONOMIC AND COMMUNITY DEVELOPMENT

65 South Front Street / Columbus, Ohio 43215 / (614) 469-2480

JOHN J. GILLIGAN
Governor

DAVID C. SWEET
Director

RECEIVED
DEC 12 1972

50-346

December 6, 1972

Mr. Daniel R. Muller
Assistant Director for Environmental Projects
Directorate of Licensing
Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Muller:

The position of Atomic Energy Coordinator has been eliminated in this Department so we are not prepared at this time to comment on the draft environmental impact statement for the Davis-Besse power plant. Perhaps the newly-formed Power Siting Commission could more effectively deal with future reports.

Sincerely,

David E. Jones

David E. Jones

DEJ:lav

Appendix L

State of Ohio Environmental Protection Agency, Box 118, 450 East Town Street, Columbus, Ohio 43216 (614) 469-3543

Re: Draft Environmental Impact Statement for The Davis-Besse Nuclear Power Station Docket No. 50-346

RECEIVED JAN 18 1973

January 16, 1973

United States Atomic Energy Commission
Washington, D. C. 20545

OhioEPA

Attention: Daniel R. Muller, Assistant Director for Environmental Projects Directorate of Licensing

John J. Gilligan
Governor
Dr. Ira L. Whitman
Director

Dear Mr. Muller:

The Ohio Environmental Protection Agency has been charged, by the Governor, with the lead agency and review coordination responsibilities for the State on all Federal Environmental Impact Statements. The above referenced draft Environmental Impact Statement was reviewed by sections of the Ohio Environmental Protection Agency, the Ohio Department of Natural Resources, the Ohio Department of Health, the Ohio Department of Economic and Community Development, the Ohio Historical Society and other agencies. The following comments constitute those received from the above agencies and have been coordinated under the auspices of the State Clearinghouse.

The Ohio Department of Natural Resources contracted with Battelle Memorial Institute of Columbus to do an Environmental Assessment of the Davis-Besse Nuclear Power Station. The Battelle Report was submitted in final form in July of 1972. We enclose a copy for your perusal and use. In addition to those findings, we furnish the following.

i) <u>The environmental impact of the proposed action</u>

Several agencies expressed concern for a potential environmental impact which did not appear to be discussed. While we realize that safety measures and monitoring programs will be initiated to deal with accident occurrences, particular instances are of concern. A potential hazard is posed by nuclear accidents and the effect of prevailing winds on dispersed particles, gasses and etc. in the Lake Erie Islands area (the Bass Islands, Kelley's

Island, Catawba Point). During the boating months, the Islands are crowded with people and the lake congested with boats. Down wind draft time from the plant to the area considered would be one to three hours. This time is significant because no adequate warning system exists, and there is a question whether an evacuation procedure exists or could be developed to deal with such an occurrence. From the material presented, it appears that 40% of the prevailing winds could carry suspended or gaseous material to the island area in the mentioned time period. We would therefore encourage study of these potential problems.

This draft gives a brief description of the on-site sewage treatment plant and the anticipated Biological Oxygen Demand leading to the lake. Additional information relative to the treated sewage effluent (e.g. concentration of suspended solids, phosphates, and nitrates) should have been provided. Section 5.5.3 states that dissolved oxygen concentrations will be near lake levels. A more precise figure should have been given (i.e. a range or an average value) if possible.

An estimate was provided of the breakdown of the total dissolved solids contained in the cooling tower vapor. Some discussion of potential effects of the added salts on the terrestrial environment surrounding the plant site (e.g. soils, vegetation, animals) would seem appropriate.

The Toledo Edison Company and the Cleveland Electric Illuminating Company propose placing riprap over one acre of the lake's bottom near the discharge outfall. This measure is felt to be necessary to reduce turbidity in the lake waters caused by the plant's high velocity discharge striking the lake's sediment. Some explanation should have been provided for the need for one acre of riprap. Could the same results have been accomplished by using less riprap? In addition, there is no indication how the riprap will be placed in relation to the discharge outfall (i.e. in a circular, eliptical or lengthwise pattern).

ii) Any adverse environmental effects which cannot be avoided should the proposal be implemented

The adverse environmental effects appear to be adequately discussed.

iii) Alternatives to the proposed action

The alternatives to the proposed action appear to be adequately addressed.

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

No comment.

v) Any irreversible and irretrievable commitment of resources which would be involved in the proposed action should it be implemented

This topic appears to be adequately addressed. In addition, the commitment of uranium ore necessary for function of this facility is an irreversible and irretrievable commitment of resources.

General Comments

The Ohio Historical Society Director has certified that no known prehistoric or historic landmarks eligible for the National Register of Historic Places of the United States Department of the Interior are adversely affected by the subject project.

We recommend that the applicant attempt to reduce the plant's total residual chlorine discharge concentration to 0.1 p.p.m. maximum and a maximum pounds per day figure (to be determined and forwarded at a later date by Ohio EPA). This level is consistent with the US Environmental Protection Agency standards for other power facilities. One method of realization of this level may be reduction of free chlorine concentration applied at four different points in the water system of the plant.

We recommend that extensive biological monitoring be extended to two years after start-up instead of one year as suggested. In addition, we would like to see a monitoring program continue for the lifetime of the plant, with frequency and parameters adjusted according to those parameters that seem to depict the effects the plant is having on the biological environment.

The Ohio Department of Natural Resources is participating in a study of the aquatic ecosystem in the Toussaint Marsh area. This project is in its fourth year of operation and will continue for an additional six years. In addition, a monitoring program is underway to the right of the cooling tower tracing tridium through the ecosystem. The involvement of the State of Ohio in these and further studies will allow compilation and study of much needed base line data. To aid in data compilation, we would be interested in receiving reports issued from the data generated by the radiation and biological monitoring programs undertaken by the applicant. A report on the effectiveness of the intake bubble screen under various operating conditions is requested.

If not already planned, provision of a visitor center would be advisable as this is Ohio's first major nuclear power generation facility.

We would like to see statements provided on the following items:

a. Reliability of the emergency core cooling system (ECCS) and possible modifications necessary to increase its reliability.

b. The possibility of cladding, buckling, and preventive measures.

c. Ozone releases which are typical of all high voltage transmission lines.

These are concerns which have been raised in the past on other facilities. The best possible systems to deal with these items may already be planned, but the above information should be included in the impact statement.

The Ohio Environmental Protection Agency is anxious to review the environmental monitoring program which must be submitted for regulatory approval within ninety days of issuance of the Final Environmental Impact Statement.

A statement appeared in Section 2.7.1 that the walleye population has declined. Recent surveys conducted by the Ohio Department of Natural Resources, Division of Wildlife indicate that the walleye fishery is improving.

According to records of the Ohio Department of Economic and Community Development, Figure 2.8 on page 2-14 is in error to the extent that the community of Rocky Ridge does have local zoning.

We appreciate this opportunity to review and comment on the draft Environmental Impact Statement. We look forward to receipt of the Final Statement.

Very truly yours,

Ira L. Whitman

Ira L. Whitman, Ph.D.
Director

ILW/jt
Enclosure

cc: William B. Nye, Director, Ohio Department of Natural Resources
State Clearinghouse, 62 E. Broad Street, Columbus, Ohio

annual average specific activities given in the tables actually constitute average specific activities (concentrations) during only the period of discharge, which occurs for only about 60 hours over a year's calendar time. Thus the values are about 140 times greater than if they had been expressed as a true annual average. In the sections which follow, annual radiation dose estimates that are developed from these data consider the time factor; that is the dose values are lowered by a factor of 140 to obtain true annual averages.

Regarding tritium releases to Lake Erie, the value of 350 Ci/yr is also based on 0.1% defective fuel. Since the liquid radioactive waste treatment system does not remove tritium during processing, no conservative decontamination factor is available to compensate for the assumed low degree of fuel failure. Therefore, tritium discharges and their effects will be calculated on the basis of both 0.1% and 1% defective fuel. For 1% defective fuel the annual tritium discharge from the Davis-Besse plant would be about 440 Ci based on the information given in Table 8A-4 of the D-BSER. Again these tritium discharges (350 Ci/yr and 440 Ci/yr) would occur during a period of only about 60 hours within a calendar year. In calculating annual radiation dose values therefore, the releases will be treated on a true annual basis using the same time factor as described above for the fission and corrosion product activities.

Liquid Emissions For Once-Through Cooling Alternative

It is assumed that the emissions would be the same as for the present design. However, the much greater flow of water for dilution (685,000 gpm versus 20,000 gpm) would result in radioactivity concentrations in the discharge water which would be 34 times lower than are expected for the present plant design.

3.3.3.1 Physical Environment

Present Plant Design

The annual discharge of radioactivity into Lake Erie is expected to consist of about 10 mCi of mixed fission and corrosion products and from 350 Ci to 440 Ci of tritium. The average concentration in the water effluent during discharge is estimated to be less than 2×10^{-8} uCi/ml for fission and corrosion products and from 1.6×10^{-3} to 2.0×10^{-3} μCi/ml for tritium.

The expected fission and corrosion product concentration is less than 20% of 10CFR20 maximum permissible limits for an unidentified mixture. On an annual average basis the estimated fission and corrosion product activity in the discharge would be about 1.4×10^{-10} μCi/ml which is only about 0.7% of the limit in proposed 10CFR50, Appendix I, part A. The tritium concentrations range from about 53% to 67% of the 10CFR20 maximum permissible concentration for tritium. On an annual average basis the tritium concentration in the discharge would be 1.2 to 1.4×10^{-5} μCi/ml which is about 3 times the limit in proposed 10CFR50, Appendix I, part A.*

It appears that no radiological monitoring data have been collected in the vicinity of the Davis-Besse site. However, natural water bodies in the United States usually contain less than about 10^{-8} μCi/ml of gross beta radioactivity(17) (excluding tritium) and a survey of tritium in surface waters around the country(18) indicates concentrations of several hundred picocuries per liter (1 pCi/l = 10^{-9} μCi/ml) are common. Adjusting the effluent concentrations to an annual average basis, the fission and corrosion product concentrations in the water delivered to the lake would be only about one percent of the estimated natural gross beta radioactivity level, but the tritium concentration in the discharge water would be about a factor of 50 greater than the estimated ambient tritium concentration in the lake. Therefore, even assuming a factor of 10 dilution in the station outfall mixing zone, tritium discharges from the plant would probably be measurable at this location in the lake. The corresponding concentration of discharged tritium in the lake water near the beach at Camp Perry, which is located about 2.8 miles from the Davis-Besse site, can be estimated from the surface concentration distribution data given in Table 4-6 of the D-BSER. This estimate yields an average annual tritium concentration at that location of about 8×10^{-8} μCi/ml or roughly 20% of the anticipated ambient tritium concentration in the lake. Since dispersion increases with distance into

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*However, it should be noted that tritium discharges from the Davis-Besse plant will satisfy the requirements of proposed Appendix I under part C, since radiation doses to people should be well below the 5 mrem/yr limit.

Appendix M

50-346

TOLEDO EDISON

GLENN J. SAMPSON
Vice President, Power

January 31, 1973

Docket No. 50-346

U.S. Atomic Energy Commission
Washington, D.C. 20545

Attention: Daniel R. Muller, Assistant Director
for Environmental Projects
Directorate of Licensing

Dear Mr. Muller:

Applicants have reviewed the Draft Environmental Statement for the Davis-Besse Nuclear Power Station and are in general agreement with the Draft Statement and conclusions contained therein. Applicants do, however, have several comments which are as follows:

Summary and Conclusions, Page iii, Paragraph 7.

This paragraph concludes that the actions called for are the continuation of the Construction Permit and issuance of an operating license subject to certain conditions. Included in these conditions was the development of a comprehensive environmental pre-operational monitoring program and a non-radiological Technical Specification requirement for a comprehensive operational environmental monitoring program.

Applicants are convinced that operation of the station will have minimum effects on the environment and these effects will be negligible and undetectable in comparison with the effects caused by actions other than the station's existence and operation, both naturally occurring and resulting from man.

Applicants, however, concur with the conditions set forth concerning monitoring programs and are formulating plans for a pre-operational environmental monitoring program which can serve as an adequate baseline. In regards to lake biota, it is anticipated that this will take the form of supplementing and augmenting the F-41-R Project discussed in Section 6.2.2 of the Draft Environmental Statement.

Preliminary review of requirements for a terrestrial monitoring program which will be implemented is being undertaken based on the work required to obtain the site flora and fauna inventory during 1972 and which is continuing on a seasonal basis. It should be noted that naturally occurring events such as the November 14, 1972, storm which inundated most of the marsh and low-lying areas along western Lake Erie could cause changes of such a nature as to make a pre-operational monitoring program meaningless as a baseline against which any effects of station operation could be measured. In regards to the marsh areas, major changes which are not necessarily adverse can result from water level control by the Bureau of Sport Fisheries and Wildlife for site areas and by private owners in adjacent marshes.

Applicants are sponsoring a program to monitor the effects of the cooling tower on migratory birds as noted in Section 6.2.1 of the Draft Environmental Statement. This program was initiated prior to the cooling tower reaching full height and will continue for a sufficient period of time to obtain an adequate evaluation of the effect of the structure's presence.

Applicants concur in the desirability of monitoring residual chlorine concentration in the station effluent. Applicants, however, do not concur with the suggestion that there is a need to keep this concentration at 0.1 ppm or below. As discussed in Section 5.5.3 of the Draft Environmental Statement, the area and volume of the lake seeing any appreciable fraction of chlorine contained in the discharge effluent is extremely small due to the rapid mixing and action with adjacent waters. It is extremely unlikely that fish will enter this mixing zone area due to its turbulent nature and, if drawn into it, would not have a residence time sufficient to have any appreciable effect.

The suggested method of operation contained in Appendix B of the Statement is undesirable because of potential scaling problems on condenser tubes which could result from this type of intermittent blowdown operation. Maintenance of the condenser-cooling tower system water at a non-scale-forming condition requires careful control of pH which would be very difficult under the conditions of suggested operation which would result in a constantly changing concentration factor of the system water and resulting pH control feed.

Notwithstanding the above comments, Applicants concur that releases of chlorine should be kept to a minimum and are investigating alternate modes of operation to accomplish this.

Applicants appreciate the opportunity to comment on this Statement which we feel is a complete review of the environmental factors associated with the Davis-Besse project.

Yours very truly,

Glenn J. Sampson

GJS:cd