final

NUREG-0574

environmental statement

related to selection of the
Preferred Closed Cycle
Cooling System at

INDIAN POINT UNIT NO. 3

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
POWER AUTHORITY OF THE STATE OF NEW YORK

DECEMBER 1979

Docket No. 50-286

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

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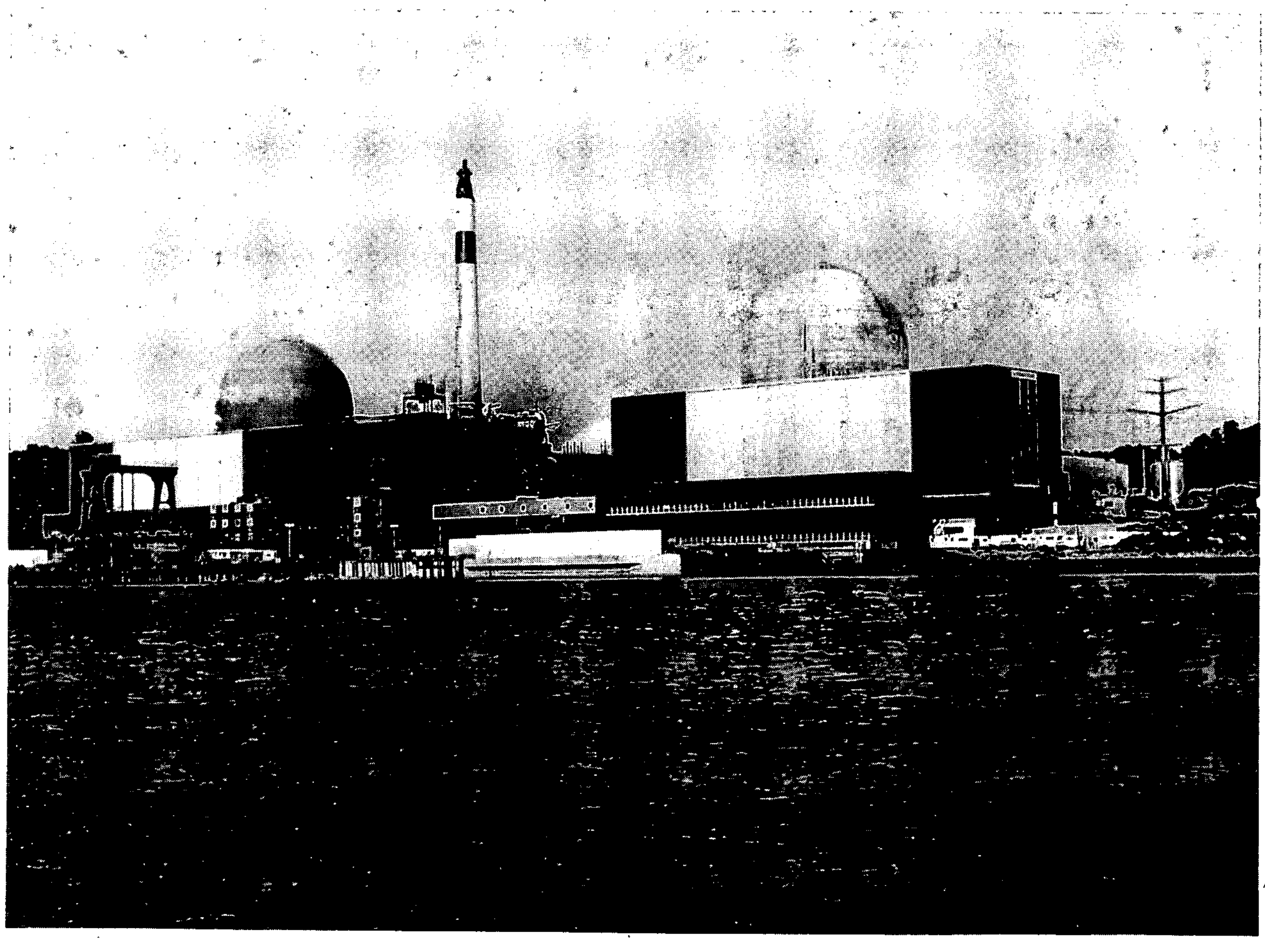
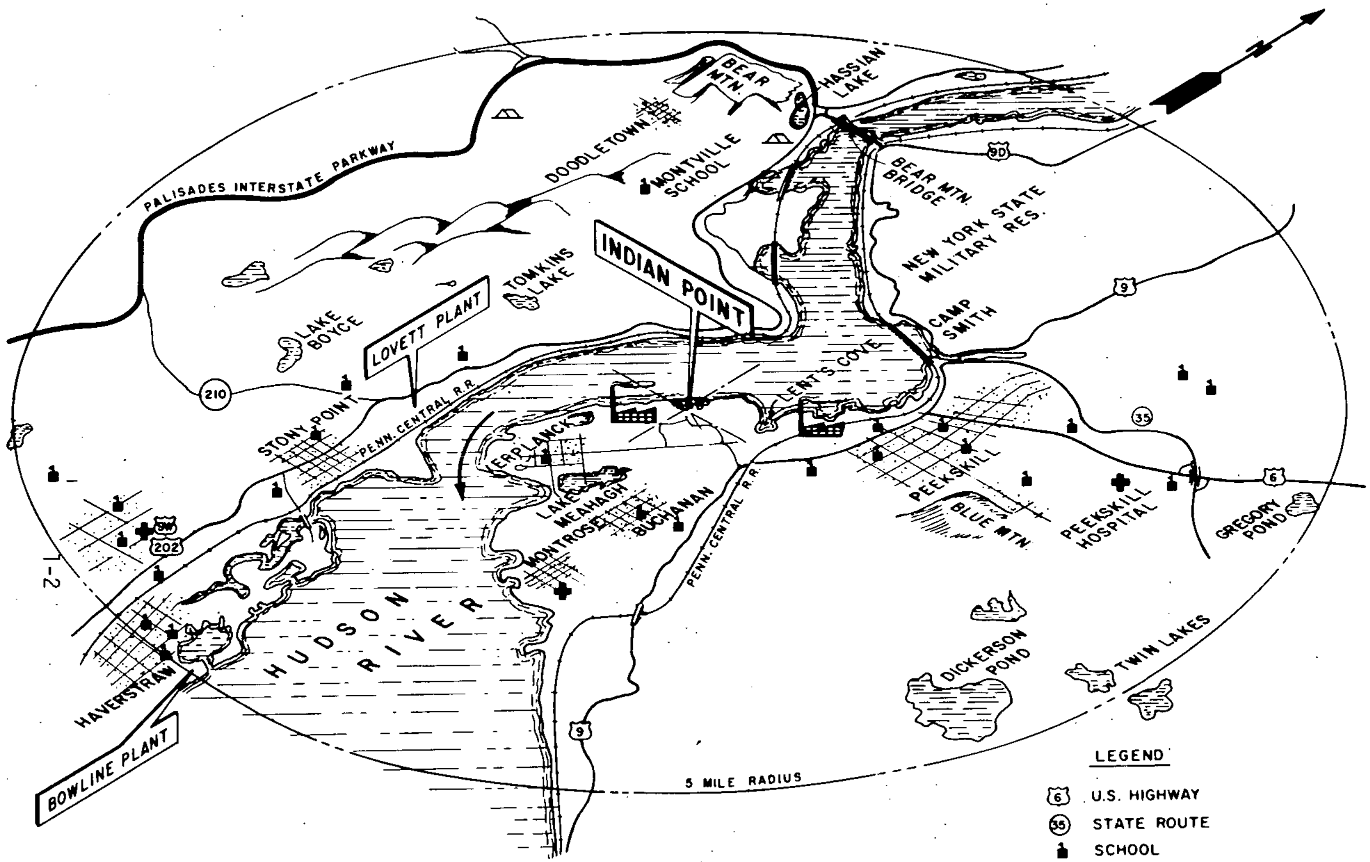


Fig. 1-2. Photograph showing the Indian Point Units Nos. 1, 2 and 3 on the Hudson River Estuary.

Ref.: FES-IP 3, Fig III-1



Ref.: FES-IP-2, Fig. II-1

Fig. 1-1
Indian Point 5 Mile Area

1.2 BACKGROUND INFORMATION

The Indian Point Unit No. 3 is a nuclear generating plant, owned and operated by the Power Authority of the State of New York (PASNY). Unit 3 is located on a 239-acre site on the eastern bank of the Hudson River in an industrial area, about 24 miles north of the New York City boundary line, at Indian Point, Village of Buchanan, in the upper Westchester County, New York State. The site contains two other existing nuclear-power plants, Unit Nos. 1 and 2. Unit No. 2 operates at a power level of 873 megawatts electrical (MWe). Unit No. 1, although presently shut down for plant modifications, has a capability of operating at 265 MWe. Originally licensed for operation at 873 MWe in December 1975, the license was amended (Amendment No. 17) in August 1978, to allow operation at full power (965 MWe).

Figure 1-1 shows a five-mile area surrounding the Indian Point site and Figure 1-2 a picture of the plants as they presently exist. Details of the design, construction and operating characteristics of the three nuclear plants are presented in the staff's Final Environmental Statements for Unit No. 2 issued in September 1972 and for Unit No. 3 issued in February 1975. These documents will be referenced as FES, IP-2, and FES, IP-3, respectively in this environmental statement.

Since 1970, the applicant submitted its Environmental Report with three supplements for Unit No. 2 (ER, IP-2) and the Environmental Report with 12 supplements for Unit No.3 (ER, IP-3). These environmental reports as well as the staff's FES's for IP-2 and IP-3 also provide extensive details of the three Units, their construction, operation, and impacts on the site and surrounding areas, including the need for power from the plants and the importance of electrical power from the plants to New York City and Westchester County which are within the applicant's service area and New York State.

The applicant, in its applications for construction permit and operating license for each of the three units, initially proposed that each condenser cooling system operate with once-through cooling. See Section III in the FES for IP-3 for description of the details of the once-through cooling systems presently existing for the three units.

1.3 LICENSING ACTIONS

There have been numerous licensing proceedings before the Atomic Energy Commission and then the Nuclear Regulatory Commission regarding Indian Point Unit No. 2 and Indian Point Unit No. 3. The proposal under review in this FES, however, is limited to PASNY's request for an amendment to the Indian Point Unit No. 3 license approving the selection of a natural draft cooling tower as the preferred alternative closed cycle cooling system for installation at that unit. The requirement to cease operation of Unit No. 3 with once-through cooling after a specified date derives from Paragraph 2.E of the unit's operating license, which adopts a stipulation entered into by all of the parties to the Indian Point Unit No. 3 operating license proceeding. Pursuant to subparagraph (g) thereof PASNY submitted on January 30, 1976, its environmental report on selection of the preferred closed cycle cooling system. This FES represents the NRC staff's review of PASNY's request for approval of a natural draft cooling tower.

Currently, the Environmental Protection Agency is holding hearings on the need for closed cycle cooling at Indian Point and at other plants on the Hudson River. Inasmuch as the final determination as to the requirement for a closed cooling system depends on the results of the EPA hearing process, final NRC action must await the EPA decision (see Section 4).

1.4 EXISTING PLANT WITH ONCE-THROUGH COOLING SYSTEM

As mentioned above, the existing plants operate with once-through cooling in which the steam produced by means of the steam generator, once dissipated to create electrical energy, is condensed by means of cooling water from the Hudson River. Unit No. 1 has two circulating water pumps, each with 140,000 gpm capacity and six service water pumps for a total capacity of 318,000 gpm to cool the one condenser and provide service water (38,000 gpm). Unit No. 2 and Unit No. 3 each have three condensers which are cooled by means of six circulating water pumps, each with 140,000 gpm capacity for a total flow of 840,000 gpm. Each unit also has six service water pumps of 5,000 gpm capacity. A total flow of 2,058,000 gpm of river water passes through the seven condensers to dissipate heat at the rate of 2.0×10^9 Btu/hr at Unit No. 1, 6.4×10^9 Btu/hr at Unit No. 2 and 7.3×10^9 Btu/hr at Unit No. 3, (based on the initial power rating of each unit).

1. INTRODUCTION

1.1 INTRODUCTORY REMARKS

In January 1976, the Consolidated Edison Company of New York, Inc. submitted to the Commission a report (two volumes) entitled, "Economic and Environmental Impacts of Alternative Closed-Cycle Cooling Systems for Indian Point Unit No. 3," in compliance with Paragraph 2.E.1(g) of Facility Operating License No. DPR-64 for Unit No. 3. The purpose of the report is to evaluate various alternative closed cycle cooling systems and their environmental and economic impacts and to determine which is the preferred closed cycle cooling system for installation at Unit No. 3. This evaluation is to be reviewed and approved by the Commission prior to construction of the preferred closed cycle cooling system at Unit No. 3. The notice of the availability of the applicant's report was published in the Federal Register on March 29, 1976 (41 FR 12933). The announcement of availability also offered an opportunity for a hearing.

In this report, numerous acronyms are used. Those used most frequently are listed below with their meanings.

IP-1	Indian Point Unit No. 1
IP-2	Indian Point Unit No. 2
IP-3	Indian Point Unit No. 3
ER-CCC-3	Environmental Report "Economic and Environmental Impacts of Alternative Closed Cycle Cooling Systems for Indian Point Unit No. 3."
DES	Draft Environmental Statement - Prepared by the NRC staff
FES	Final Environmental Statement - Prepared by the NRC staff
ER	Environmental Report - Prepared by the applicant
FFDSAR	Final Facility Description and Safety Analysis
CCC	Closed Cycle Cooling System
NDCT	Natural Draft Cooling Tower
LMDT	Linear Mechanical Draft Cooling Tower
CMDCT	Circular Mechanical Draft Cooling Tower
W/D MDCT	Wet/Dry Mechanical Draft Cooling Tower
FANDCT	Fan-assisted Natural Draft Cooling Tower
CP	Cooling Pond or Lake
SC	Spray Pond or Canal
DCT	Dry Cooling Tower
MWt	Megawatt thermal power
MWe	Megawatt electric power
SAR	Safety Analysis Report - prepared by the applicant
SER	Safety Evaluation Report - prepared by the NRC staff
ORFAD	Computer program at Oak Ridge National Laboratory used to estimate amounts of fog and drift deposition from operation of wet cooling towers.

a draft environmental statement, prepared by the Office of Nuclear Reactor Regulation, which is then circulated to Federal, State and local governmental agencies for comment. A summary notice is published in the Federal Register of the availability of the applicant's environmental report and the draft environmental statement.

After receipt and consideration of comments on the draft statement, the staff prepares a final environmental statement. This statement includes (1) a discussion of questions and objections raised by the comments and the disposition thereof; (2) a final benefit-cost analysis, which considers and balances the environmental effects of the facility and the alternatives available for reducing or avoiding adverse environmental effects with the environmental, economic, technical, and other benefits of the facility; (3) and a conclusion as to whether--after the environmental, economic, technical, and other benefits are weighed against environmental costs and after available alternatives have been considered, the action called for, with respect to environmental issues, is the issuance or denial of the proposed permit or license or its amendments with appropriate conditioning to protect environmental values.

Dr. Robert P. Geckler is the NRC Environmental Project Manager for this statement. Should there be questions regarding the contents of this statement, Dr. Geckler may be contacted at the following address:

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FOREWORD

This environmental statement was prepared by the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation (the staff) in accordance with the Commission's regulation, 10 CFR Part 51, which implements the requirements of the National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. §4332 et seq. (1976), P.L. 91-190, 83 Stat. 852).

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

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

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

(i) the environmental impact of the proposed action;

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

(iii) alternatives to the proposed action;

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

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

An environmental report accompanies each application for a construction permit or a full-power operating license. Such a report may or may not be required in an application for an amendment to the construction permit or operating license, depending on circumstances. In determining such a requirement, the Commission shall be guided by the Council of Environmental Quality Guidelines, 40 CFR 1500.6. Where a report is required, prior to the staff preparation of an impact statement, pursuant to 10 CFR §51.5b, a public announcement of the availability of the report is made. Any comments by interested persons on the report are considered by the staff. In conducting the required NEPA review, the staff meets with the applicant to discuss items of information in the environmental report, to seek new information from the applicant that might be needed for an adequate assessment, and generally to ensure that the staff has a thorough understanding of the proposed project. In addition, the staff seeks information from other sources that will assist in the evaluation and visits and inspects the project site and surrounding vicinity. Members of the staff may meet with State and local officials who are charged with protecting State and local interests. On the basis of all the foregoing and other such activities or inquiries as are deemed useful and appropriate, the staff makes an independent assessment of the considerations specified in Section 102(2)(C) of the NEPA and 10 CFR Part 51. This evaluation leads to the publication of

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d. Major factors entering into selection of tower type are noise, drift and aesthetics. Although minor differences among the tower types considered were found, the techniques used in evaluation have varying degrees of uncertainty and subjectivity. However, the staff found that the natural draft cooling tower was generally superior to fan-assisted natural draft and circular mechanical draft cooling towers.

8. On the basis of the evaluation and analysis set forth in this Statement and after weighing the environmental, economic, technical, and other benefits against environmental costs and risks and considering available alternatives, the staff concludes that the action called for under the National Environmental Policy Act of 1969 (NEPA) and 10 CFR 51, is issuance of an amendment to the Facility Operating License No. DPR-64 authorizing construction of a natural draft cooling tower as proposed by the licensee and evaluated by the staff with the following conditions:

a. A monitoring program will be established to determine the significance of drift and salt deposition and to detect botanical injury to sensitive plant species if it occurs.

b. The monitoring program formulated will be incorporated into the existing Environmental Technical Specifications for Indian Point Unit No. 3.

c. A qualified archeologist shall conduct a literature and field survey of the area to be disturbed by construction activities. The results of this survey shall be submitted to the staff and to the State Historic Preservation Officer before construction activities associated with the closed-cycle cooling system begin.

In view of the fact that the EPA has the final responsibility for water quality matters, the proposed action can be undertaken only after the EPA proceeding is completed, provided the EPA requires a closed cycle cooling system.

- Department of Agriculture (AGR)
- Department of Commerce (COM)
- Department of Health, Education, and Welfare (HEW)
- Department of the Interior (DOI)
- Department of Housing and Urban Development (HUD)
- Department of the Army, Corps of Engineers (CE)
- Environmental Protection Agency (EPA)
- Energy Research and Development Administration (ERDA)
- Federal Power Commission (FPC)
- National Advisory Council on Historic Preservation (NACHP)
- New York State Department of Environmental Conservation (DEC)
- State of New York Public Service Commission
- State of New York Executive Department
- State of New York Attorney General
- State Historic Preservation Officer (SHPO)
- Hudson River Fisherman's Association (HRFA)
- Save Our Stripers (SOS)
- Consolidated Edison Company of New York, Inc. (CONED)
- Federated Conservationists of Weschester County, Inc. (FCWC)
- Rockland County Conservation Association, Ic. (RCA)
- Environmental Defense Fund (EDF)
- North Brookhaven Sport Fishermen's Club, Inc. (NBSFC)
- Great South Beach Mobile Sportfishermen (GSBMS)
- West Branch Conservation Association (WBCA)
- Connecticut Coastal Anglers Association (CCAA)
- Village of Buchanan, N.Y. (Buchanan)
- Weschester County, N.Y.
- City of Peekskill (Peekskill)
- Town of Cortlandt

6. The Draft Environmental Statement was made available to the Council on Environmental Quality, the public, the applicant, the above-mentioned agencies and interested persons in June 1977.

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

Department of Agriculture
Department of Energy
Environmental Protection Agency
Federal Power Commission
Department of Housing and Urban Development
Department of the Interior
State of New York, Department of Environmental Conservation
New York State Parks and Recreation
City of Peekskill
Village of Buchanan
The University of the State of New York
Power Authority of the State of New York
Hudson River Fishermen's Association and Save Our Stripers

Copies of these comments are included in this Final Environmental Statement as Appendix B. The staff has considered these comments, and responses are included in Section 8.

7. From review and evaluation of the Environmental Report and Supplements thereto, and from independent observations and analyses discussed in this Statement, the staff has reached the following conclusions concerning the environmental impacts of the applicant's proposed closed cycle cooling system for Indian Point Unit No. 3.

a. The acceptable alternative closed cycle cooling systems for Unit No. 3 are natural draft, fan-assisted natural draft, and circular mechanical draft cooling towers.

b. A natural draft cooling tower is the preferred alternative for closed cycle cooling system for Unit No. 3.

c. Other alternatives examined are unacceptable environmentally or economically.

SUMMARY AND CONCLUSIONS

This Environmental Statement was prepared by the U.S. Nuclear Regulatory Commission, Division of Site Safety and Environmental Analysis.

1. This action is administrative.

2. The proposed action is the issuance of an amendment to the Facility Operating License No. DPR-64 for Indian Point Unit No. 3, located in the State of New York, Westchester County, Village of Buchanan, 24 miles north of the New York City boundary line. This facility is owned and operated by the Power Authority of the State of New York.

Under conditions of the operating license (Paragraph 2.E of Facility Operating License No. DPR-64), once-through cooling at Unit No. 3 was to be terminated by September 15, 1980 and the facility was to operate thereafter with a closed cycle cooling system. This termination date has become September 15, 1982 by virtue of Paragraph 2.E.1(e) and could be extended to September 15, 1983 by virtue of Paragraph 2.E.1(i).

In accordance with the license, an Environmental Report dated January 1, 1976 was filed in which various alternative closed cycle cooling systems were evaluated from an economic and environmental standpoint.

This statement considers the information provided in the environmental report and amendments as well as other information developed by the staff in making its independent evaluation and analysis of alternative closed cycle cooling systems under NEPA.

3. Summary of environmental and economic impacts, including beneficial and adverse effects:

a. Visual or aesthetic impact comprised of the tower structure(s) and the visible plume.

b. There will be drift (0.002%) deposited in small amounts over a substantial area, resulting in increased salt concentrations. There is a small possibility that injury may occur occasionally to certain species of plants.

c. There may be a small increase (a matter of hours per year) in the amount of fogging and icing in the area; these are considered negligible.

d. During construction, noise levels and traffic will be increased; however, these are temporary conditions.

e. A monetary direct cost of approximately $245 million (present value) will be incurred by the licensee and the average annual plant capacity will be reduced by 33.5 MWe (4% of the total) while peak generating capability will be reduced by 77.5 MWe (9% of the total).

f. Water taken from the river for cooling purposes will be reduced to approximately one-tenth that taken for once-through cooling of Unit No. 3. This will reduce impingement and entrainment of aquatic species by a similar amount and, thus, aid in the maintenance of biotic populations.

4. The alternative closed cycle cooling systems considered were as follows:

a. Cooling ponds and lakes
b. Spray ponds and spray canals
c. Dry cooling towers
d. Wet-dry mechanical draft cooling towers
e. Wet cooling towers: Natural draft, linear mechanical draft, circular mechanical draft and fan-assisted natural draft.

5. The following Federal, State and local agencies and interested parties have been asked to comment on the Draft Environmental Statement:

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for Selection of the Preferred

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The heated water is then discharged through 10 openings in the common discharge structure which is submerged such as to give a depth of 12 feet (center of portholes to the river surface).

Details of the intake-discharge structure are presented in Section III of the FES for Unit No. 3. Figure 1-3 also shows a schematic of this structure. Table III-1 in the FES for Unit No. 3 shows the power levels for the three plants and Table 1-1 in the applicant's ER-CCC-3 indicates the design parameters for the Unit No. 2 once-through cooling system.

1.5 SUPPORTING ACTIVITIES RELATED TO COOLING TOWERS

In Appendix G of the FES for Unit No. 3, a description of the extensive research involving environmental effects of dry and wet cooling towers using fresh and salt water as makeup is outlined.

As mentioned in Appendix G, DOE is partially supporting research work on the saltwater natural draft cooling towers built at the Chalk Point Plant owned by the Potomac Electric Company on the Patuxent River in Prince Georges County, Maryland. The study program of Chalk Point Cooling Tower Project was described in the proceedings of symposia held at the University of Maryland on March 4-7, 1974 and May 2-4, 1978.

1.6 SITE METEOROLOGICAL CHARACTERISTICS AND MEASUREMENTS PROGRAM

The plant site is located in a climatic region which, though primarily continental in character, is subjected to some modification by marine air which may penetrate to the site area[1,2,3] The regional topography ranges from hilly to mountainous.

During most of the year, continental polar air masses originating in Canada predominate over southeastern New York. In summer, maritime tropical air masses from the Gulf of Mexico or Caribbean Sea become predominant. As a result, winters are relatively cold and occasionally severe while summer temperatures are modified by the maritime influences. Precipitation is uniformly distributed throughout the year, occurring mainly as showers and thunderstorms during the warmer months and as snow in winter. The Hudson Valley southward from Albany has the highest percentage of sunshine in the State.[1]

The site is on the Hudson River and lies within an elongated topographic "bowl", surrounded on almost all sides by higher ground which ranges in elevation from 500 to 900 feet above plant grade. Meteorological conditions in the valley are influenced by this topography in the following ways: (1) The orientation of the ridges channels the valley air flow; (2) wind speeds within the valley tend to be lower than in the open terrain; and (3) differential heating of the hillsides and the bottom of the valley creates local air circulation patterns. Since 1956, several meteorological studies of the site area have been made. The initial onsite meteorological measurements program was conducted during the years 1956 and 1957 for the site Safety Analysis Reports (FFDSAR). Another study was conducted in 1969 and 1970 primarily to describe the diurnal wind direction reversals in the Hudson River Valley. The original onsite measurements program consisted of wind speed and direction and air temperature measured on a 300-ft high tower. The 1969-1970 study utilized a 100-ft high tower at the same location as the original 300-ft tower as well as measurements at several other locations along the river within five miles of the site. During the period 1970-1972, additional data were collected onsite using the 100-ft high tower including wind speed and direction at the 100-ft level and vertical air temperature difference between the 95-ft and 7-ft above ground levels. These data were used in the Final Safety Evaluation of Unit No. 3.[4]

The present onsite meteorological program consists of measurements on a 400-ft high tower located about 2600 feet south of the plant complex. Wind speed and direction are measured at the 33-, 125-, 280- and 400-ft levels, and temperature difference between the 400-ft and 33-ft levels and between the 200-ft and 33-ft levels. Dewpoint temperature is measured at the 33-, 200- and 400-ft levels. Solar radiation and ambient air temperature are measured at the 33-ft level. Precipitation and visibility measurements are also measured near the tower. Meteorological data collected using this system during the one year period from October 1, 1973 through September 30, 1974 as well as supplementary data measured at higher atmospheric levels using balloons, meteorological rockets and constant level balloons (tetroons) were provided by the applicant. Figures 1-5 and 1-4 show, respectively, the relationship of the meteorological tower to other site structures and the array of meteorological instruments on the tower. All the meteorological instruments conform to the recommendations of Regulatory Guide 1.23.[5]

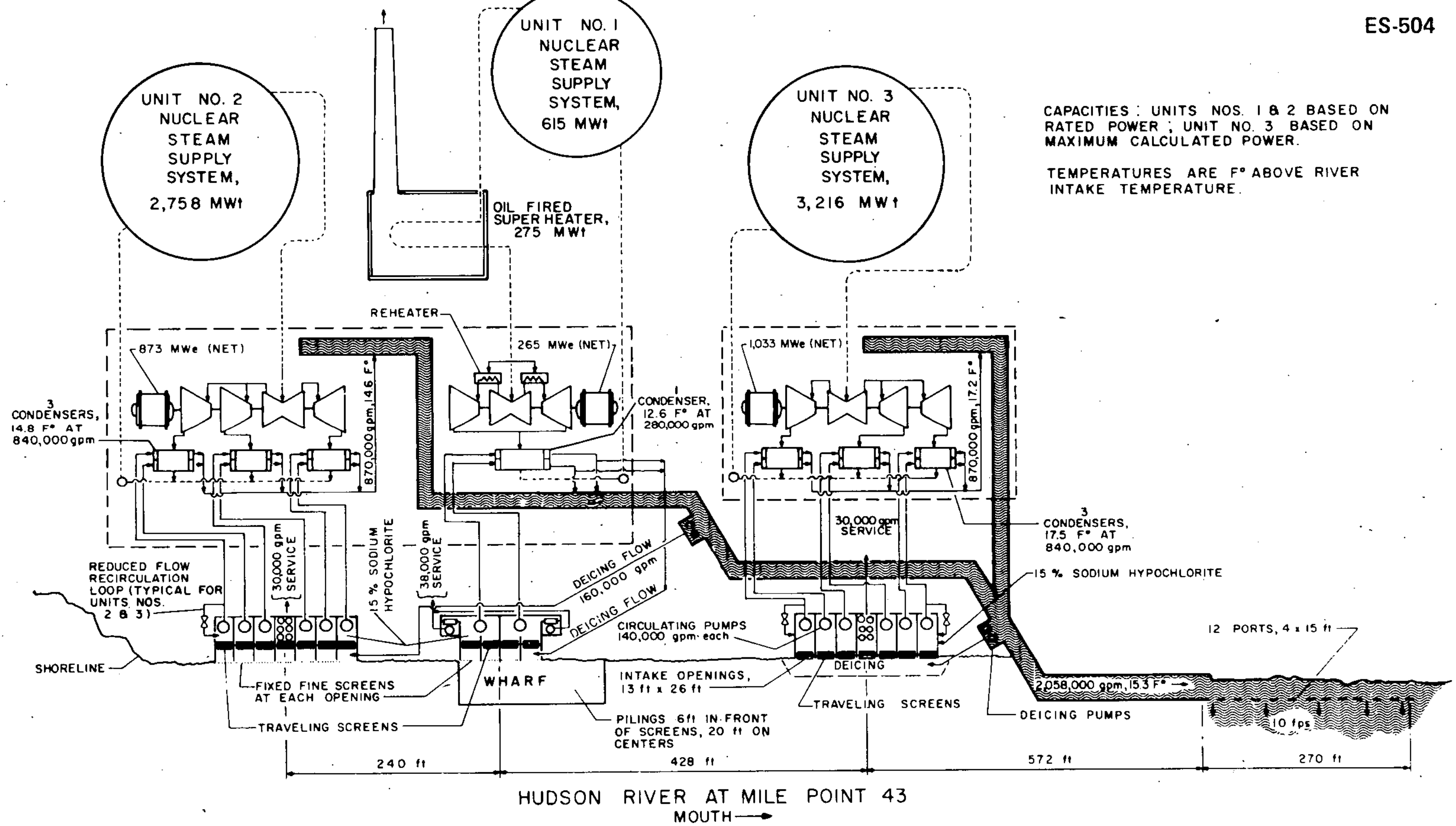
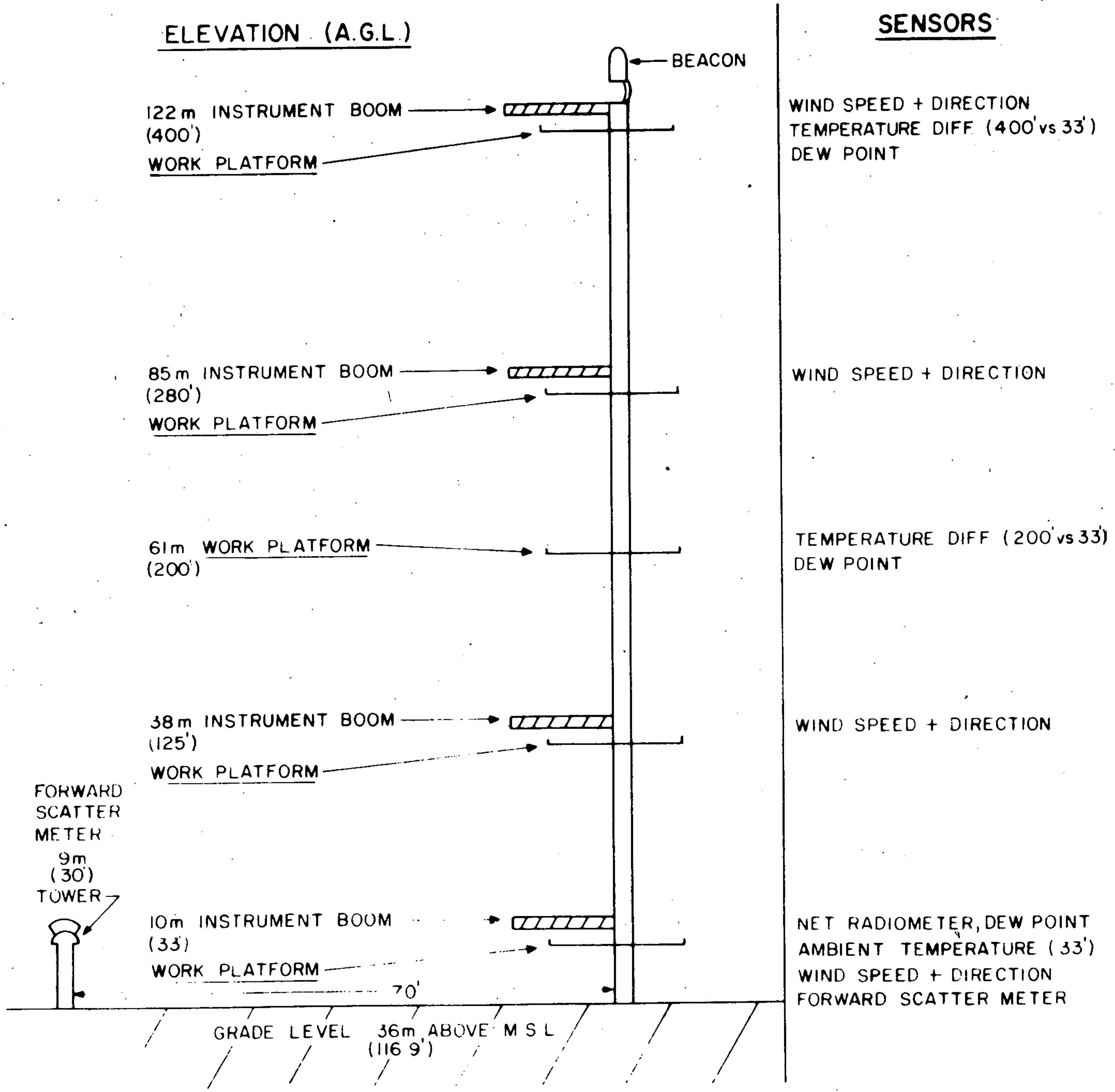


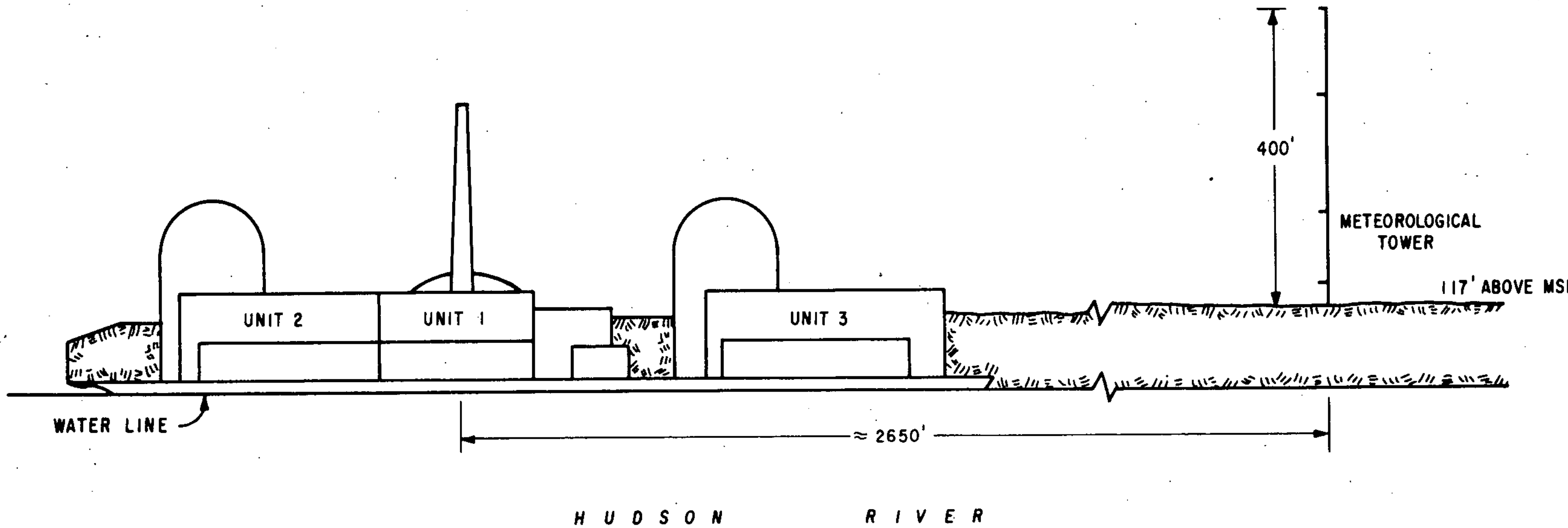
Fig. 1-3 Schematic representation of Indian Point Plant cooling water systems.

Ref.: FES-IP 3, Fig. III-2



Ref.: ER-CCC, IP-2, Fig. 6-4
(modified)

FIGURE 1-4
METEOROLOGICAL TOWER SCHEMATIC



Ref.: ER-CCC, IP-2 Fig. 6-3

FIGURE 1-5
PROFILE OF NUCLEAR FACILITIES WITH METEOROLOGICAL TOWER

Tables 1-1 and 1-2 present climatological data from Albany and New York City.[1,2] Tables 1-3 and 1-4, based on meteorological data collected onsite during the one year period from October 1, 1973 through September 30, 1974, show the frequency distributions of wind speed and wind direction at the 33-, 125- and 400-ft levels on the site tower.[6] The frequency of occurrence of restricted visibility resulting from fog at the site is presented in Table 1-5, while Table 1-6 shows the results of a background, dust bucket sampling program for particulates and sodium concentrations in the site vicinity (ER-CC-2).

Additional and more detailed information concerning meteorological conditions at the site as well as the meteorological data sampling program is presented in Volume 1 and in Appendix A of the applicant's ER-CC-3.

1.7 SCOPE OF THIS STATEMENT

The applicant submitted its closed cycle cooling report in which only alternative closed cycle cooling systems were discussed. The report was based on information derived from preliminary studies and on onsite studies and measurements to determine specific environmental impacts of what the applicant considered to be technologically feasible closed cycle cooling alternatives for Unit No. 3.

Specifically, the program indicated studies of air quality, acoustical emissions and aquatic effects of blowdown as well as considerations of the impact on land, air and the community during construction and operation of the feasible alternatives. Radiological safety considerations were also taken into account. An economic evaluation along with the environmental impacts were also included. On the basis of its economic and environmental evaluation, the applicant has determined that a single natural draft closed cycle wet cooling tower system would be the preferred closed cycle cooling system.

The staff has carried out an intensive review of the applicant's submittals and has had several site visits to observe and discuss the applicant's study programs. During the visits, the staff had independent discussions with local officials and toured the surrounding area; the staff also flew over the areas that might be affected by the operation of the preferred closed cycle cooling system. An independent tree and vegetation survey was made. Several cooling tower vendors were also contacted and extensive discussions were held with them. Visits were made with utilities that have proposed to build power plants cooled by various cooling towers. Independent sources of information on alternative closed cycle cooling systems were also reviewed. The staff has also developed its own cooling tower model to study impacts of salt drift and fogging.

On the basis of the above, the staff carried out its own independent environmental and economic assessment as presented in the following sections and conclusions were reached (See Section 7) regarding the approval or denial of the applicant's selection of the natural draft closed cycle wet cooling system as the preferred closed cycle cooling system for Unit No. 3.

Table 1-1

Meteorological Data For The Current Year

Station: ALBANY, NEW YORK   ALBANY COUNTY AIRPORT   Standard time used: EASTERN   Latitude: 42° 45' N   Longitude: 73° 48' W   Elevation (ground): 275 feet   Year: 1974

Month	Temperature °F Averages: Daily maximum	Daily minimum	Monthly	Extremes: Highest	Date	Lowest	Date	Degree days Base 65 °F: Heating	Cooling	Precipitation in inches, Water equivalent: Total	Greatest in 24 hrs.	Date	Snow, Ice pellets: Total	Greatest in 24 hrs.	Date	Relative humidity, pct. Hour 01 (Local time)	Hour 07	Hour 13	Hour 19
JAN	32.8	13.8	23.3	62	27	-14	18	1785	0	2.04	0.46	20-21	10.0	5.9	9	79	84	62	71
FEB	31.8	10.8	21.3	57	22	-9	9	1216	0	2.12	0.81	22	12.4	6.3	6-7	72	75	53	63
MAR	42.0	22.7	32.4	63	6	7	29	1005	0	3.10	1.03	16-17	5.6	1.9	21	70	71	52	59
APR	60.7	35.5	48.1	84	29	20	7	511	11	2.80	1.09	8-9	11.3	10.7	8-9	74	73	49	56
MAY	65.1	43.0	54.1	88	22	29	5	343	12	3.47	1.47	12	0.0	0.0		76	73	55	50
JUN	76.9	53.0	65.0	92	10	38	13	54	59	3.31	0.85	21	0.0	0.0		89	85	56	66
JUL	81.4	57.1	69.3	92	4	45	21	17	157	4.84	2.01	29-30	0.0	0.0		89	83	55	58
AUG	79.9	55.9	67.9	88	21	47	26	14	111	3.53	0.97	28-29	0.0	0.0		93	91	59	74
SEP	69.2	47.3	58.3	86	13	28	24	227	35	5.37	1.36	20-21	0.0	0.0		93	93	62	85
OCT	55.8	32.9	44.4	78	6	18	28	631	0	1.49	0.74	16	T	T	3	80	83	57	70
NOV	47.5	29.7	38.6	77	1	14	28	786	1	3.83	0.97	12-13	2.2	1.8	25	83	84	65	76
DEC	36.0	21.8	28.9	56	8	0	26	1113	0	2.57	0.86	16-17	12.5	4.4	25	83	84	71	80
YEAR	56.6	35.3	46.0	92	JUL 4	-14	JAN 18	7202	386	38.47	2.01	JUL 29-30	54.0	10.7	APR 8-9	82	82	58	69

Month	Wind Resultant: Direction	Speed m.p.h.	Average speed m.p.h.	Fastest mile: Speed m.p.h.	Direction	Date	Percent of possible sunshine	Average sky cover, tenths, sunrise to sunset	Number of days, Sunrise to sunset: Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Ice pellets 1.0 inch or more	Thunderstorms	Heavy fog, visibility ¼ mile or less	Temperature °F Maximum (b): 90° and above	32° and below	Minimum: 32° and below	0° and below	Average station pressure mb Elev. 292 feet m.s.l.
JAN	27	2.6	9.1	35	W	27	41	7.5	5	8	18	14	2	0	0	0	17	30	6	1010.2
FEB	30	4.8	10.9	40	NW	23	57	6.2	10	4	14	9	2	1	0	0	16	28	7	1004.7
MAR	29	6.0	12.9	47	NW	10	54	7.2	5	8	18	16	2	0	1	0	3	28	0	1003.7
APR	28	3.8	11.3	29	NW	16	51	7.2	4	9	17	14	2	2	0	0	1	14	0	1003.7
MAY	23	3.3	10.0	45	NW	1	49	7.5	2	12	17	14	0	4	1	0	0	2	0	1003.4
JUN	18	3.1	8.3	30	NW	3	57	7.0	2	13	15	14	0	5	2	1	0	0	0	1004.4
JUL	24	3.0	7.7	28	NW	19	65	6.4	5	13	13	13	0	10	2	2	0	0	0	1004.7
AUG	20	2.6	6.8	24	NW	27	61	6.9	5	9	17	9	0	5	6	0	0	0	0	1007.8
SEP	23	1.9	8.2	38	W	13	44	7.0	5	10	15	14	0	4	7	0	0	1	0	1007.1
OCT	25	3.1	9.2	25	W	15	46	6.1	11	4	16	8	0	0	6	0	0	16	0	1011.9
NOV	30	2.3	9.2	26	NW	26	31	8.5	0	7	23	14	1	0	1	0	2	20	0	1006.1
DEC	28	3.3	9.3	31	NW	4	20	8.6	2	3	26	9	4	0	0	0	7	29	1	1006.1
YEAR	26	2.7	9.4	47	NW	MAR 10	49	7.2	56	100	209	148	13	31	26	3	46	168	14	1006.2

Normals, Means, And Extremes

Month	Temperatures °F Normal: Daily maximum	Daily minimum	Monthly	Extremes Ø: Record highest	Year	Record lowest	Year	Normal Degree days Base 65 °F: Heating	Cooling	Precipitation in inches, Water equivalent: Normal	Maximum monthly	Year	Minimum monthly	Year	Maximum in 24 hrs.	Year	Snow, Ice pellets: Maximum monthly	Year	Maximum in 24 hrs.	Year
(a)				9		9					28		28		28		28		28	
J	30.4	12.5	21.5	62	1974	-28	1971	1349	0	2.20	4.12	1958	0.73	1955	1.68	1953	28.8	1966	15.4	1964
F	32.7	14.3	23.5	57	1974	-21	1973	1162	0	2.11	4.14	1950	0.36	1968	1.42	1950	34.5	1962	17.9	1958
M	42.6	24.2	33.4	77	1968	-10	1967	900	0	2.58	5.74	1953	1.07	1949	1.53	1964	34.7	1956	15.9	1956
A	58.0	35.7	46.9	88	1970	10	1965	543	0	2.70	4.71	1953	1.14	1963	2.20	1968	11.3	1974	10.7	1974
M	69.7	45.7	57.7	92	1970	26	1968	253	27	3.26	8.96	1953	1.22	1965	2.17	1968	1.4	1966	1.4	1966
J	79.4	55.6	67.5	98	1968	36	1967	39	114	3.00	7.36	1973	0.65	1964	3.48	1952	0.0		0.0	
J	83.9	60.1	72.0	98	1966	43	1969	9	226	3.12	5.89	1960	0.49	1968	2.70	1960	0.0		0.0	
A	81.4	57.8	69.6	93	1973	37	1965	22	165	2.87	7.33	1950	0.73	1947	4.52	1971	0.0		0.0	
S	73.7	50.1	61.9	93	1973	28	1974	135	42	3.12	7.89	1960	0.40	1964	3.66	1960	0.0		0.0	
O	62.8	40.0	51.4	84	1968	16	1969	422	0	2.63	8.83	1955	0.20	1963	2.66	1972	2.0	1952	2.0	1952
N	48.1	31.1	39.6	77	1974	5	1972	762	0	2.84	8.07	1972	1.17	1960	2.01	1959	24.6	1972	21.9	1971
D	34.1	17.7	25.9	65	1970	-22	1969	1212	0	2.93	6.73	1973	0.64	1958	4.02	1948	57.5	1969	18.3	1966
YR	58.1	37.1	47.6	98	JUN 1968	-28	JAN 1971	6088	574	33.36	8.96	MAY 1953	0.20	OCT 1963	4.52	AUG 1971	57.5	DEC 1969	21.9	NOV 1971

Month	Relative humidity pct. Hour 01 (Local time)	Hour 07	Hour 13	Hour 19	Wind: Mean speed m.p.h.	Prevailing direction	Fastest mile: Speed m.p.h.	Direction	Year	Pct. of possible sunshine	Mean sky cover, tenths, sunrise to sunset	Mean number of days, Sunrise to sunset: Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Ice pellets 1.0 inch or more	Thunderstorms	Heavy fog, visibility ¼ mile or less	Temperatures °F Max. (b): 90° and above	32° and below	Min.: 32° and below	0° and below	Average station pressure mb. Elev. 292 feet m.s.l.
(a)	9	9	9	9	36	15	36	36		36	36	36	36	36	28	28	36	36	9	9	9	9	2
J	78	79	63	73	9.8	WNW	57	W	1952	46	7.0	6	8	17	12	4	*	1	0	17	30	9	1008.5
F	73	76	58	67	10.3	WNW	71	NW	1953	51	6.9	6	7	15	11	4	*	1	0	13	27	5	1007.6
M	72	74	54	62	10.5	WNW	55	W	1941	52	7.0	6	8	17	12	3	1	1	0	4	26	*	1005.8
A	70	70	47	55	10.4	WNW	49	W	1954	53	6.9	6	8	16	12	1	1	1	0	*	15	0	1003.2
M	78	74	52	60	9.1	S	50	W	1950	55	6.9	5	9	17	13	*	4	2	*	0	2	0	1002.7
J	83	78	56	65	8.1	S	57	NW	1971	59	6.6	5	11	14	11	0	6	1	2	0	0	0	1004.8
J	83	79	54	63	7.3	S	43	NW	1938	64	6.3	6	13	12	11	0	7	1	4	0	0	0	1004.7
A	86	83	54	68	6.9	S	38	S	1950	61	6.0	7	12	12	10	0	5	3	2	0	0	0	1007.1
S	87	87	57	75	7.3	S	48	S	1961	57	6.0	8	10	12	9	0	3	4	1	0	1	0	1007.5
O	83	84	55	73	7.9	S	45	NW	1939	54	6.1	8	9	14	8	*	1	5	0	0	9	0	1009.9
N	80	82	64	75	8.9	S	70	E	1950	36	7.5	4	7	19	12	1	*	2	0	2	18	0	1005.4
D	81	82	68	77	9.1	S	54	W	1944	38	7.3	5	7	19	13	4	*	2	0	13	28	2	1007.0
YR	79	79	57	68	8.8	S	71	NW	FEB 1953	53	6.7	72	109	184	135	16	28	24	8	48	156	17	1006.2

Ø For period February 1965 through current year.
Means and extremes above are from existing and comparable exposures. Annual extremes have been exceeded at other sites in the locality as follows: Highest temperature 104 in July 1911; maximum monthly precipitation 13.48 in October 1869; minimum monthly precipitation 0.08 in January 1860; maximum precipitation in 24 hours 4.75 in October 1903; maximum snowfall in 24 hours 30.4 in March 1888.

(a) Length of record, years, through the current year unless otherwise noted, based on January data.
(b) 70° and above at Alaskan stations.
* Less than one half.
T Trace.

NORMALS - Based on record for the 1941-1970 period.
DATE OF AN EXTREME - The most recent in cases of multiple occurrence.
PREVAILING WIND DIRECTION - Record through 1963.
WIND DIRECTION - Numerals indicate tens of degrees clockwise from true north. 00 indicates calm.
FASTEST MILE WIND - Speed is fastest observed 1-minute value when the direction is in tens of degrees.

Table 1-2

Meteorological Data For The Current Year

Station: NEW YORK, NEW YORK JOHN F. KENNEDY INTL AIRPORT Standard time used: EASTERN Latitude: 40° 39' N Longitude: 73° 47' W Elevation (ground): 13 feet Year: 1974

Month	Temp °F Avg Daily maximum	Daily minimum	Monthly	Extremes Highest	Date	Lowest	Date	Degree days Base 65 °F Heating	Cooling	Precip. Water equivalent Total	Greatest in 24 hrs.	Date	Snow, Ice pellets Total	Greatest in 24 hrs.	Date	Rel. humidity pct. Hour 01	Hour 07	Hour 13	Hour 19 (Local time)	Wind Resultant Direction	Resultant Speed m.p.h.	Average speed m.p.h.	Fastest mile Speed m.p.h.	Direction	Date	Percent of possible sunshine	Average sky cover, tenths, sunrise to sunset	Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Ice pellets 1.0 inch or more	Thunderstorms	Heavy fog, visibility ¼ mile or less	Max. (b) 90° and above	Max. 32° and below	Min. 32° and below	Min. 0° and below	Average station pressure mb Elev. 22 feet m.s.l.
JAN	41.3	29.0	35.1	65	27	10	18	920	0	2.83	0.72	11	6.7	4.4	9	76	79	68	71	31	5.0	12.0	31	31	31		6.8	6	10	15	11	3	0	7	0	10	19	0	1020.0
FEB	37.5	25.7	31.6	54	22	12	5	929	0	1.41	0.51	19-20	10.5	6.3	8	65	69	59	64	33	6.6	15.0	37	28	23		5.8	9	10	9	12	3	0	1	0	9	24	0	1014.2
MAR	50.0	35.3	42.7	69	7	23	25	686	0	4.60	1.61	21	4.1	4.1	29	59	64	54	57	31	5.5	15.4	37	27	17		6.9	4	12	15	8	1	1	4	0	0	8	0	1013.9
APR	60.6	44.4	52.5	82	29	29	10	373	7	2.33	1.09	8-9	T	T	10	71	70	61	66	25	4.5	13.5	30	26	15		6.5	6	9	15	9	0	2	4	0	0	1	0	1014.6
MAY	66.6	52.5	59.6	89	17	42	2	183	24	2.69	1.15	9-10	0.0	0.0		75	67	58	67	20	2.0	12.0	37	18	12		6.1	8	12	11	9	0	1	4	0	0	0	0	1013.9
JUN	74.9	60.6	67.8	88	22	53	3	26	116	2.38	0.51	16-17	0.0	0.0		84	82	71	78	16	2.5	10.5	24	29	30		6.5	7	10	13	12	0	1	4	0	0	0	0	1014.6
JUL	85.0	68.1	76.6	97	9	60	26	0	366	1.29	0.75	5	0.0	0.0		72	69	53	64	25	3.1	11.0	29	29	5		5.6	9	14	8	5	0	1	0	9	0	0	0	1014.9
AUG	83.7	67.7	75.7	92	14	59	11	0	342	4.24	1.22	28	0.0	0.0		77	76	58	72	20	3.8	10.0	33	19	4		6.1	6	13	12	10	0	5	1	1	0	0	0	1018.0
SEP	74.4	59.4	66.9	88	13	43	24	47	111	5.97	1.56	3-4	0.0	0.0		79	77	60	72	27	1.7	11.1	28	19	3		5.8	10	8	12	13	0	5	1	0	0	0	0	1016.9
OCT	62.7	46.0	54.4	76	15	32	21	327	1	2.19	2.00	15-16	0.0	0.0		69	71	51	62	30	4.3	10.7	24	33	20		4.8	14	8	9	4	0	0	1	0	0	1	0	1022.0
NOV	54.6	41.0	47.9	76	1	26	27	508	1	1.10	0.59	12-13	0.2	0.2	25-26	71	72	55	66	29	6.3	13.1	36	25	21		5.3	10	10	10	8	0	0	2	0	0	8	0	1015.9
DEC	45.5	34.1	39.8	56	7	25	5	775	0	6.07	2.46	16	T	T	31	68	71	58	62	30	5.3	13.2	46	06	2		6.9	6	5	20	9	0	0	1	0	0	13	0	1015.9
YEAR	61.4	47.0	54.2	97	JUL 9	10	JAN 18	4769	968	37.10	2.46	DEC 16	21.5	6.3	FEB 8	72	72	59	67	28	3.1	12.3	46	06	DEC 2		6.1	95	121	149	110	7	16	30	10	19	74	0	1016.2

Normals, Means, And Extremes

Month	Temp °F Normal Daily maximum	Daily minimum	Monthly	Extremes Record highest	Year	Record lowest	Year	Normal Degree days Base 65 °F Heating	Cooling	Precip. Water equivalent Normal	Maximum monthly	Year	Minimum monthly	Year	Maximum in 24 hrs. #	Year	Snow, Ice pellets Maximum monthly	Year	Maximum in 24 hrs $	Year	Rel. humidity pct. Hour 01	Hour 07	Hour 13	Hour 19 (Local time)	Wind Mean speed m.p.h.	Prevailing direction	Fastest mile Speed m.p.h.	Direction	Year	Pct. of possible sunshine	Mean sky cover, tenths, sunrise to sunset	Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Ice pellets 1.0 inch or more	Thunderstorms	Heavy fog, visibility ¼ mile or less	Max. (b) 90° and above	Max. 32° and below	Min. 32° and below	Min. 0° and below	Average station pressure mb. Elev. 22 feet m.s.l.
(a)				14		14					27		27		27		16		16		13	13	13	13	16		11	11			16	16	16	16	16	16	16	16	13	13	13	13	2
J	38.0	24.8	31.4	65	1974	0	1968	1042	0	2.69	5.77	1949	0.21	1956	1.60	1958	17.4	1965	13.0	1964	69	71	59	64	13.4		52	26	1966		6.1	8	9	14	10	2	*	3	0	9	23	*	1018.7
F	39.1	25.2	32.2	65	1972	-2	1963	918	0	3.05	5.48	1960	1.41	1974	2.87	1958	25.3	1961	19.9	1969	67	70	58	62	14.2		46	25	1967		6.3	7	8	13	10	2	*	3	0	6	22	*	1016.8
M	46.5	32.1	39.3	72	1963	7	1967	797	0	3.77	7.93	1953	1.35	1966	2.27	1962	21.1	1960	8.1	1967	68	70	57	63	14.0		44	28	1971		6.2	7	10	14	11	1	1	4	0	1	13	0	1015.4
A	58.1	41.7	49.9	87	1973	26	1969	453	0	3.59	6.99	1973	1.12	1963	2.12	1971	3.2	1971	3.2	1971	70	69	55	65	13.2		44	26	1970		6.2	7	10	13	11	*	2	3	0	0	2	0	1013.6
M	68.4	51.1	59.8	99	1969	34	1966	188	27	3.54	6.14	1951	0.38	1955	2.88	1968	T	1967	T	1967	76	70	57	68	12.0		44	16	1973		6.1	7	12	12	11	0	3	3	*	0	0	0	1013.1
J	78.0	60.9	69.5	99	1964	45	1967	9	144	2.98	6.70	1972	T	1949	2.23	1973	0.0		0.0		80	74	61	72	10.9		32	24	1972		6.2	7	11	12	10	0	4	4	2	0	0	0	1015.1
J	83.2	66.9	75.1	104	1966	55	1963	0	313	4.04	8.48	1969	0.46	1954	3.21	1969	0.0		0.0		77	73	57	70	10.7		37	34	1969		6.1	7	12	12	9	0	5	2	5	0	0	0	1014.8
A	81.7	65.4	73.6	98	1973	46	1965	0	267	4.30	17.41	1955	0.42	1972	6.59	1955	0.0		0.0		78	76	57	71	10.4		46	30	1965		5.7	7	14	10	9	0	4	2	2	0	0	0	1017.2
S	75.4	58.6	67.0	94	1961	40	1963	42	102	3.31	9.60	1960	0.70	1951	5.83	1960	0.0		0.0		79	78	57	70	10.8		40	30	1970		5.4	10	10	10	8	0	2	1	1	0	0	0	1017.3
O	65.8	48.7	57.3	84	1967	25	1961	247	8	2.76	6.41	1958	0.09	1963	3.42	1972	0.5	1962	0.5	1962	75	77	54	68	11.2		39	26	1967		5.2	12	9	10	7	0	1	3	0	0	*	0	1019.8
N	53.7	39.3	46.5	76	1974	20	1967	555	0	3.90	9.51	1972	1.10	1974	4.09	1972	2.1	1967	2.1	1967	72	74	57	67	12.5		44	05	1968		6.3	7	9	14	11	*	*	2	0	0	5	0	1015.8
D	41.3	28.4	34.9	68	1962	5	1962	933	0	3.60	6.16	1969	1.46	1971	2.46	1974	16.4	1960	8.2	1960	71	73	61	66	12.9		46	06	1974		6.4	8	8	15	11	1	*	3	0	4	19	0	1016.6
YR	60.0	45.3	53.1	104	JUL 1966	-2	FEB 1963	5184	861	41.53	17.41	AUG 1955	T	JUN 1949	6.59	AUG 1955	25.3	FEB 1961	19.9	FEB 1969	73	73	57	67	12.2		52	26	JAN 1966		6.0	94	122	149	117	7	22	32	10	19	85	*	1016.2

(a) Length of record, years, through the current year unless otherwise noted, based on January data.
(b) 70° and above at Alaskan stations.
* Less than one half.
T Trace.

NORMALS - Based on record for the 1941-1970 period.
DATE OF AN EXTREME - The most-recent in cases of multiple occurrence.
PREVAILING WIND DIRECTION - Record through 1963.
WIND DIRECTION - Numerals indicate tens of degrees clockwise from true north. 00 indicates calm.
FASTEST MILE WIND - Speed is fastest observed 1-minute value when the direction is in tens of degrees.

$ Greatest calendar day through March 1969.
\# Greatest calendar day August 1966 through March 1969.

Table 1-3

INDIAN POINT SITE
WIND DIRECTION DISTRIBUTIONS
OCTOBER 1, 1973 - SEPTEMBER 30, 1974

Direction	Frequency of Occurrence (%) 33 ft	125 ft	400 ft
N	5.9	8.6	7.3
NNE	12.7	12.9	13.5
NE	14.7	12.0	6.7
ENE	5.6	3.4	2.4
E	2.2	1.7	1.9
ESE	1.2	1.4	1.5
SE	1.4	1.7	2.0
SSE	2.2	3.2	2.3
S	6.9	10.2	10.7
SSW	9.3	8.1	9.2
SW	8.7	7.4	10.7
WSW	3.3	3.3	4.6
W	3.2	3.1	3.7
WNW	4.2	4.8	4.7
NW	8.2	10.3	10.7
NNW	6.2	7.7	8.0
CALM	4.1	0.2	0.1

Table 1-4

INDIAN POINT SITE
WIND SPEED FREQUENCY DISTRIBUTIONS
OCTOBER 1, 1973 - SEPTEMBER 30, 1974

Level	Frequency Distribution (%) Wind Speed Category (mph) 0-3	4-7	8-12	13-18	19-24	24+
33 ft	51.4	34.6	12.2	1.7	0.1	0.0
125 ft	23.5	33.2	27.5	13.0	2.2	0.6
400 ft	15.8	26.9	25.7	21.8	7.4	2.4

Table 1-5

INDIAN POINT SITE
OCTOBER 1973 THROUGH AUGUST 1974

OCCURRENCE OF RESTRICTED VISIBILITY (FOG)
WHEN RELATIVE HUMIDITY EQUALS OR EXCEEDS 80%

MONTH	VISIBILITY 3/4 mi or less Hours	%	5/16 mi or less Hours	%
OCT	18	4.00	12	2.67
NOV	37	5.15	20	2.78
DEC	46	6.18	32	4.30
JAN	28	4.15	19	2.81
FEB	4	0.59	2	0.29
MAR	31	4.38	24	3.39
APR	26	3.61	15	2.08
MAY	15	2.09	7	0.97
JUN	20	3.27	13	2.12
JUL	0	0.00	0	0.00
AUG	9	1.21	2	0.26
Total	234	3.12	146	1.95

Total valid hours in sample = 7505 (93.4% of possible hours)

Table 1-6

DUST BUCKET AVERAGES
7/1973 - 8/1974

Sampling Station	Summer Average mg/cm^2/mo.	Winter Average mg/cm^2/mo.	Year Average mg/cm^2/mo.
	SETTLEABLE PARTICULATES		
IP3	0.6978	0.8195	0.7727
VER	0.4686	0.6157	0.5544
BUC	0.3862	0.3590	0.3695
CRO	0.4148	0.3190	0.3590
	SODIUM CONCENTRATIONS		
IP3	4.062×10^{-3}	7.909×10^{-3}	6.429×10^{-3}
VER	4.104×10^{-3}	4.396×10^{-3}	4.274×10^{-3}
BUC	4.384×10^{-3}	7.630×10^{-3}	6.382×10^{-3}
CRO	4.216×10^{-3}	6.121×10^{-3}	5.328×10^{-3}
CSM	3.328×10^{-3}	6.469×10^{-3}	5.261×10^{-3}

The five sampling stations which surround the Indian Point facility on the Eastern side of the Hudson River are:

IP3 - Located at the Indian Point facility next to a one hundred foot meteorological tower.

Verplanck - Located approximately one hundred and twenty feet east of the Hudson River.

Buchanan - Located approximately three hundred feet east of Route 9A (Albany Post Road).

Croton Point - Located approximately one hundred and fifty feet south of the northern tip of Croton Point.

Camp Smith - Located on the Camp Smith Military Reservation approximately 1750 feet WNW of the Peekskill traffic circle.

REFERENCES FOR SECTION 1

1. U. S. Department of Commerce, Environmental Data Service: Local Climatological Data, Annual Summary with Comparative Data - Albany, N.Y. Published annually.

2. U. S. Department of Commerce, Environmental Data Service: Local Climatological Data, Annual Summary with Comparative Data - New York, N.Y. (J. F. Kennedy Airport). Published annually.

3. U. S. Department of Commerce, Environmental Data Services: Local Climatological Data, Annual Summary with Comparative Data - New York, N.Y. (La Guardia Field). Published annually.

4. Directorate of Licensing, U. S. Atomic Energy Commission, Safety Evaluation of the Indian Point Nuclear Generating Unit No. 3, Docket No. 50-286, September 21, 1973 and Supplement No. 1, January 16, 1975.

5. Directorate of Regulatory Standards, U. S. Atomic Energy Commission, Regulatory Guide 1.23, "Onsite Meteorological Programs," Washington, D. C, 1972.

6. Economic and Environmental Impacts of Alternate Closed-Cycle Cooling System for Indian Point Unit No. 3, Consolidated Edison Company of New York, Inc., January 1976.

2. DESCRIPTION OF ALTERNATIVE CLOSED CYCLE COOLING SYSTEMS

2.1 ALTERNATIVE CLOSED CYCLE COOLING SYSTEMS CONSIDERED

In a closed cycle cooling (CCC) system, most (up to 99%) of the waste heat from the plant's condenser and service water cooling systems is transferred from the circulating water system directly to the atmosphere. The resulting cooled water is then returned to the condensers for reuse rather than as in once-through cooling. In evaporative cooling systems, a small fraction (1-3%) of the circulating water must be continuously purged from the system to prevent the buildup of dissolved materials in the system. The water purged is called "blowdown." A schematic of a typical CCC system is shown in Figure 2-1.

The staff has considered eight CCC systems for use at Indian Point Unit No. 3: (1) natural draft wet cooling towers (NDCT), (2) linear mechanical draft wet cooling towers (MDCT), (3) wet/dry mechanical draft cooling towers (W/D MDCT), (4) fan-assisted natural draft cooling towers (FANDCT), (5) circular mechanical draft cooling towers (CMDCT), (6) cooling ponds (CP), (7) spray canals (SC), and (8) dry cooling towers (DCT).

Except for dry towers, all of the available alternate cooling systems can also be operated in the open cycle (sometimes called "helper") mode of operation; that is, all of the cooling water is returned to its source without recirculation. This method of operation would reduce, but not eliminate the heat load on the Hudson River. However, the volume of water flowing through the plant would not be significantly decreased. The staff concludes that the helper-cycle is not a viable option for this plant, as it would not reduce the rate of fish impingement or entrainment.

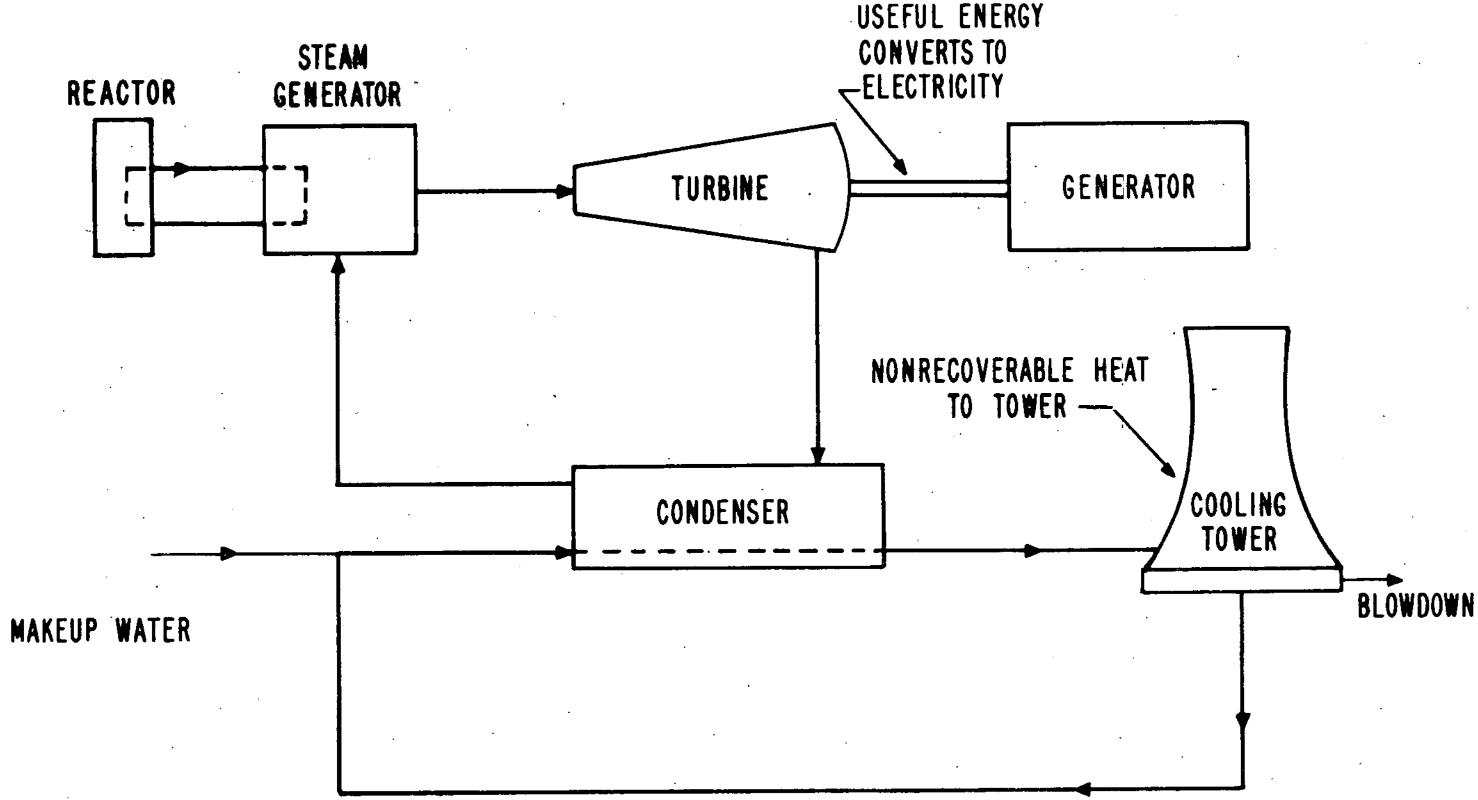
The primary process for heat transfer from the circulating water to the atmosphere in the first seven cooling options listed above is evaporation. New water must be continuously added to the circulating water supply to replace that lost by evaporation, blowdown, leaks and drift. Thus, the use of CCC does not eliminate the need for a reliable source of water and for an intake structure; however, it reduces but does not eliminate the environmental impacts of the makeup water system and the thermal and chemical effects of the blowdown.

Closed cycle cooling systems do not eliminate thermal pollution problems; they transfer the primary impact from the hydrosphere to the atmosphere. Because CCC systems transfer large amounts of heat and water vapor (except for DCT's) to the atmosphere from small areas, they have a potential to create adverse atmospheric effects. The atmospheric impacts of the CCC systems that could be used at Indian Point Unit No. 3 are discussed in Section 5.1. The terrestrial and aquatic impacts from the drift and blowdown are also discussed in Sections 5.2 and 5.4.

2.2 COOLING PONDS AND LAKES (CP)

The cooling pond is a proven, effective and economical heat sink in areas where sufficient level land can be purchased at reasonable cost. It operates in a similar manner as once-through cooling except the body of water used is restricted. Heat transfer from the heated water in the cooling pond occurs by radiation, conduction and evaporation prior to the water being recirculated from the pond to the condenser inlet. Area requirements for dissipation of waste heat via surface effects from a cooling lake or pond are of the order of 1 to 3 acres per MWe.[1,2] On this basis, an impoundment covering approximately 1,000 to 3,000 acres would be required to serve Unit No. 3. Additional land is required in order to eliminate the effects of steam fogs to off-site roads, buildings, etc. A buffer zone of about 1500 feet would be satisfactory.

Since the entire plant site area occupies only 239 acres, and considering that the surrounding terrain does not lend itself to the construction of a separate cooling pond of this size, the staff does not consider a cooling pond to be a viable cooling alternative for this site.



Ref.: ER-CCC, IP-2, Fig. 2-1

FIGURE 2-1
CLOSED-CYCLE COOLING SYSTEM

2.3 SPRAY PONDS AND SPRAY CANALS (SC)

The size of a cooling lake can be made much smaller, by a factor of up to 20 by use of sprays.[2] As with cooling ponds, however, a buffer zone of about 1000 to 1500 feet would be needed to confine fogging and drift effects to the site.

Heat dissipation to the atmosphere using spray ponds or spray canals is effected primarily through evaporation and conduction. However, spray ponds are similar to cooling ponds in that they depend upon local temperature, relative humidity, and wind conditions. Therefore, their reliability is variable. In order to maximize cooling by reducing recirculation of air between sprays and to minimize fogging, spray modules are generally placed in a long meandering canal.[3] The efficiency and drift loss from spray modules are a function of the spray height and spray drop size, which are dependent on the design of the spray pump system. At higher pressures, the drops become very fine resulting in high heat transfer, but can be transported readily by the wind, causing more local fogging in the cooler months.

The applicant describes the two types of spray systems: the conventional fixed-pipe spray system and the relatively new "powered spray module". The applicant estimates that the fixed-pipe spray ponds require about 5% of the land used for natural cooling ponds but is about twice that of a powered spray-module spray canal. To add a powered spray-module system at Unit No. 3 would require about 55 acres and to add the fixed-pipe system would require about 100 acres at Unit No. 3.

Because of the lack of suitable level land on or near the site, the staff does not consider a spray canal or pond to be a viable cooling option, especially when contrasted with wet cooling towers.

2.4 COOLING TOWERS

Among possible alternatives to the once-through cooling water system are closed cycle systems that would utilize one or more cooling towers to dissipate the waste heat to the atmosphere. There are two basic types of cooling towers: the wet tower that carries away heat by evaporation and sensible heat transfer, and the dry tower that relies on air to carry away heat and, in principle, functions like an automobile radiator. The two types of wet cooling towers are mechanical and natural draft towers which differ in the method of inducing air flow from the heated water to the ambient air. These cooling towers can be designed as counterflow or crossflow towers. Counterflow towers maximize the air-water heat transfer time, thereby resulting in a thermally more efficient tower. Crossflow towers offer less resistance to air flow and, therefore, result in lower energy consumption for mechanical draft cooling towers.

When operated in the closed cycle mode, wet cooling towers require makeup water to compensate for losses sustained through evaporation and drift. As evaporation occurs, the natural salts in the cooling water become concentrated; to prevent buildup and deposition on the components of the system, they are continuously returned to the source of cooling water supply by blowdown. Chemicals used in treating the cooling water to prevent growth of algae, freezing, etc., are also discharged during blowdown, and their effect upon the ecology of the receiving waters must be taken into account (See FES, IP-2, Appendix XI-1).

The mechanical draft towers are relatively low structures and, as such, may cause fogging, misting, and icing that could be hazardous if highways, roads, or streets are nearby. Natural draft towers, on the other hand, are tall hyperbolic structures, about 500 ft high, which minimize the effects of drift and fogging at ground level. The plume behavior is governed by the ambient atmospheric conditions and its own heat and moisture content. However, when the wind is strong, the plume may be caught in the aerodynamic downwash surrounding the tower structure and be carried downwards. Observations at operating towers indicate that downwash rarely if ever brings the plume to ground level.[4-9] Isolated, detached puffs of the visible plume are occasionally observed downwind of a cluster of eight NDCT's in England.[5] Other factors to be considered such as visual impact, noise levels, chemical effects from blowdown, salt drift, increased generating costs, etc., are discussed in Sections 5 and 6.

The size of the cooling tower will depend upon certain design parameters, such as the cooling range (the decrease in temperature of the water passing through the tower), approach to wet-bulb temperature (difference in temperature between the water leaving the tower and the ambient wet-bulb temperature), and the amount of waste heat to be dissipated. Evaporation of 1 lb of water will transfer about 1000 Btu to the atmosphere.[10] In wet cooling towers, about 75% of the average annual heat transfer is due to evaporation, and 25% due to sensible heat transfer.[11] The fraction due to evaporation varies with weather conditions; values of 60% in winter and 90% in summer are typical.[11] Since about 7.35×10^9 Btu/hr of heat will be rejected to the atmosphere in the cooling

tower for Unit No. 3, the average annual evaporation rate will be about 15,000 gpm. Evaporation of 1% of the water volume will result in a reduction of the water temperature by approximately 10°F. Drift, the carryover of water droplets by air, accounts for a small loss of water, about 0.002% of the circulating water flow rate for an NDCT with the state-of-the-art drift eliminators.

Observations at operating cooling towers in Europe as well as the United States indicate that the primary environmental impacts of natural draft cooling towers are the visual impact of the structures and the generation of visible plumes that remain aloft.[4,5,12,13] See Section 6 for further discussion of the visual impact of the NDCT.

2.4.1 Dry Cooling Towers (DCT)

Dry cooling towers remove heat from a circulating fluid through conduction to the air being circulated past the heat exchanger tubes. There is no direct contact between the circulating cooling water and the ambient air. Because of the poor heat-transfer properties of the metal-to-air interface, the dry tower's tubes are generally finned to increase the heat-transfer area. See Figure 2-9 in the applicant's ER-CC-3, p. 2-24 for an illustration of a DCT. The theoretical lowest temperature that a dry cooling system can achieve is the dry-bulb temperature of the air. The dry-bulb temperature is always higher than (or equal to) the wet-bulb temperature, which is the theoretical lowest temperature that a wet cooling tower can achieve. Turbine backpressures will be increased, as will the range of backpressures over which the turbines must operate. This will result in a reduced station capability for a given size reactor.

The advantage of a dry cooling tower system is its ability to function without large quantities of cooling water. Theoretically, this allows power plant siting without consideration of water availability, and eliminates thermal/chemical pollution of blowdown. In practice, some makeup water will always be required, so that power plant siting cannot be completely independent of water availability. From an environmental and cost/benefit standpoint, dry cooling towers can permit optimum siting with respect to environmental, safety and load distribution criteria without fogging or dependence on a supply of cooling water. When considered as a direct alternative to wet cooling towers, the advantages of dry cooling towers include elimination of drift, fogging and icing problems, and blowdown disposal.

The principal disadvantage of dry cooling towers is economics: for a given reactor size, plant capacity can be expected to decrease by about 5 to 15 percent, depending on ambient temperatures and assuming an optimized turbine design.[14] Bus-bar energy costs are expected to be in the order of 20% more than a once-through system and 15% more than a wet cooling tower system, assuming 1980 operation.[14] The environmental effects of heat releases from dry cooling towers have not yet been quantified; some air pollution problems may be encountered; noise generation problems for mechanical draft dry towers will be more severe than those of wet cooling towers because of increased air flow requirements; and the aesthetic impact of natural-draft dry towers, which would be much taller than a wet NDCT, will increase despite the absence of visible plume. Dry cooling towers now being used for European and African fossil plants are limited to plants in the 200-megawatt or smaller category in areas with cool climates and winter peak loads; the use of dry towers to meet the much larger cooling requirements of 1000 MWe nuclear stations with summer peak loads requires new turbine designs to achieve optimum efficiencies at the higher peak pressure and range required of this system.[15,16]

At Indian Point Unit No. 3, the applicant estimates that the backpressure on the turbine with a dry cooling tower in operation would be 9.5 inches of mercury which would be associated with "high condenser cooling water temperature." The optimum approach would be 30 F° and the range would be 24 F° for a dry cooling tower system at Unit No. 3. Because of limitations of the existing turbine at Unit No. 3, where backpressures can not exceed 5 inches of mercury without causing severe thermal stresses on the turbine, dry cooling towers at Unit No. 3 do not appear to be feasible.

After weighing the overall advantages and disadvantages of dry cooling towers, and particularly when comparing their greater fuel use and the economic and engineering penalties associated with their use, the staff has concluded that dry cooling towers are not feasible for the Indian Point site.

2.4.2 Wet-Dry Mechanical Draft Cooling Towers (WDCT)

In this type of tower, a dry cooling section is added to a conventional evaporative cooling tower. Most design concepts and all operating units are of the mechanical draft type,[2,17-20] although a wet-dry natural draft tower is feasible.[21] The design is an attempt to combine some

of the best features of both wet and dry cooling towers (little or no fogging in winter, lower consumptive use of water, more economical cooling in summer, etc.) with minimizing the disadvantages of each (especially the higher capital and operating costs of dry units for summer conditions).

Four basic water- and air-flow patterns are possible: air flow in series or parallel, and water flow in series or parallel. In one design, the hot water first passes through the dry section of the tower and then the wet; air flow is passed through either the wet or the dry section, or both, with adjustable louvers used to control the two air flows, as shown in Figure 2-2.[20] While other designs are possible, the one just described and shown in Figure 2-2 is the only one now in use. The two air flows mix inside the tower prior to discharge. The effluent air has a higher temperature and a lower absolute humidity than it would have from a standard MDCT, thus reducing the potential for fogging, icing,and long plumes. The amount of reduction of fogging and plumes will depend on the relative sizes of the two cooling sections. Such towers can be designed to operate with "dry only" cooling below a design temperature, say 35 F°.[20] It is expected that such units would operate as "wet-only" units in summer. Thus, water conservation would be obtained only in winter.

Since more cooling surface is required for a dry section than for wet surfaces of equal cooling capacity and since an excess of surface may be required to achieve a flexibility in the operating mode, wet-dry mechanical draft cooling towers would be larger in size than wet MDCT's and more costly to build and operate than either natural draft or mechanical draft units. Utilization of this combined wet-dry system can be of great advantage to those industries whose geographical location is such that the incremental contribution of cooling tower moisture to the atmosphere could increase the occurrence of fog in the vicinity of the cooling towers to an unacceptable degree.

The applicant has made an analysis of the feasibility and cost of this type of cooling for Indian Point No. 3 and concluded that three cooling towers (28 cells), one 480 ft long and two 430 ft long, 70 ft wide and 74 ft tall[22] would be needed. These wet/dry units would have the same thermal performance characteristics as a pure wet MDCT (See Section 2.4.3.2 below).

Experience with wet-dry towers is limited, as only a relatively few cells have been operational. A demonstration cell for a wet/dry cooling tower was built and put into operation during 1973 by the Westinghouse Electric Corporation for the Duke Power Company's Cliffside Station in North Carolina.[23] Marley[20] has reported a wet/dry cooling system in operation at a St. Joseph (Missouri) Light and Power Generating Station. Marley's parallel path wet/dry mechanical draft units offer control of visible plumes and water conservation capability.

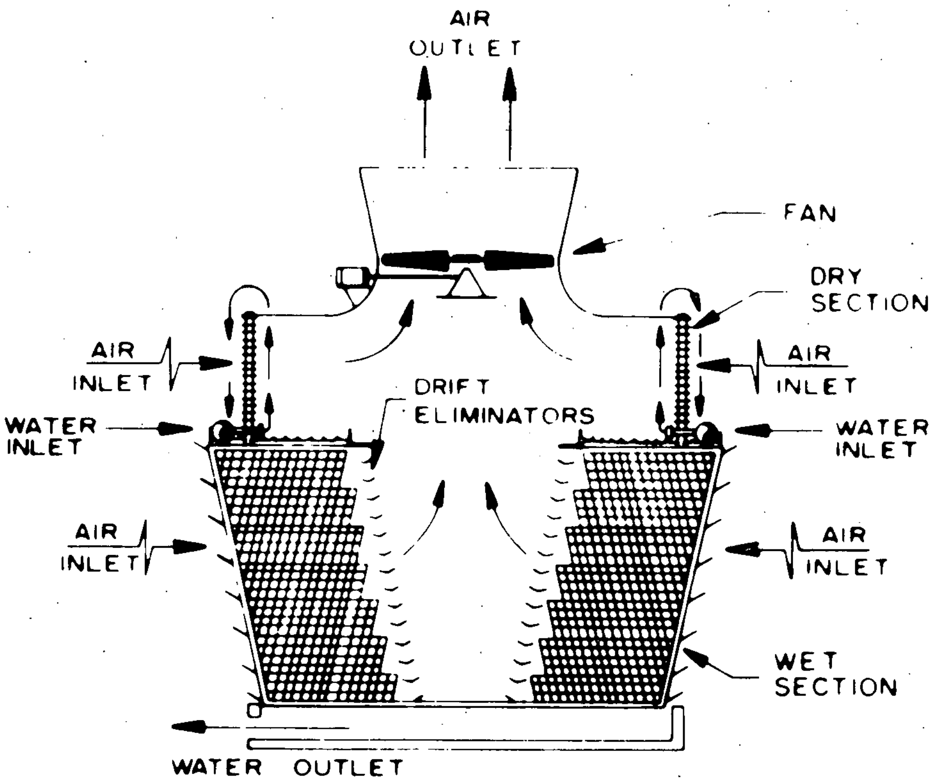
Although experience is limited, wet/dry mechanical draft cooling towers would be a viable cooling alternative at Indian Point Unit No. 3.

2.4.3 Wet Cooling Towers

2.4.3.1 Natural Draft Cooling Towers (NDCT)

A wet natural draft cooling tower consists of a large reinforced concrete chimney, such as that indicated in Figures 2-3 and 2-4,which creates a chimney effect to induce an upward flow of air through falling drops of the water to be cooled. The chimney, or shell, is hyperbolic in shape to decrease resistance to air flow. The condenser cooling water is sprayed onto baffles, or fill material, where the water is cooled by evaporative and conductive heat transfer to the air. The differential density between the heated air inside the tower and the air outside creates the natural draft; the warm, vapor-laden plume will usually continue to rise for some distance after leaving the top of the tower due to its momentum and buoyancy. Two basic types of hyperbolic cooling towers are the crossflow (Fig. 2-3) and counterflow (Fig. 2-4). The first has fill in a ring outside the tower. Although this arrangement may seem to produce a lower water pumping head than the counterflow, fill inside the counterflow tower is spread out over a much larger area; thus, its depth is shallower and vertical water rises are shorter. Pressure drop through fill in the crossflow tower is less than in a counterflow tower. This leads to less resistance to air flow.[2] Selection of either tower will depend upon design conditions at the particular installation.

Important advantages of natural draft towers when compared to mechanical draft units are low operating cost since plant power is not required to move the air, noise levels are relatively low, and the discharge height above the terrain greatly reduces the possibilities of ground-level drift deposition, fogs, and icing problems. Major disadvantages are the relatively high capital cost and the fact that, from an aesthetic standpoint, the large structures and visible plumes tend to dominate the surroundings.



Ref.: ER-CCC, IP-2,
Fig. 2-8

FIGURE 2-2
MECHANICAL DRAFT WET-DRY COOLING TOWER

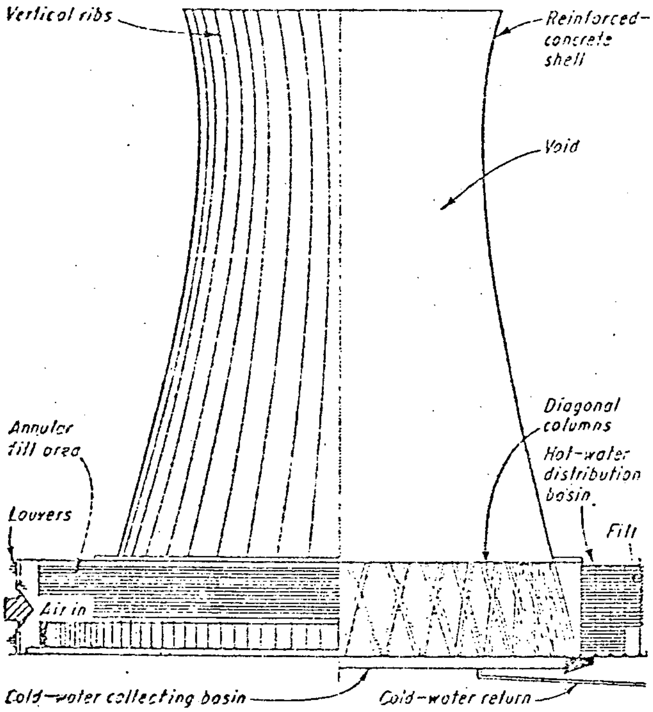


Fig. 2-3

Crossflow Natural Draft Cooling Tower

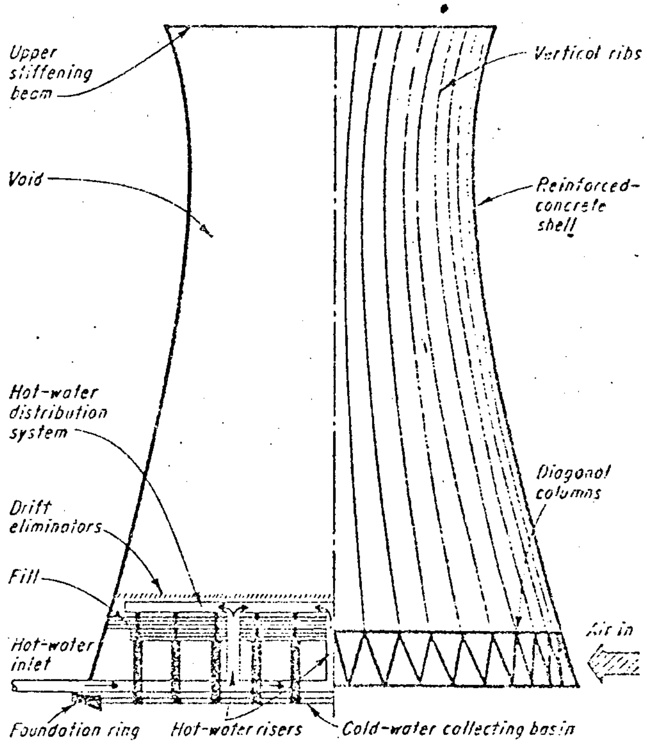


Fig. 2-4

Counterflow Natural Draft Cooling Tower

Ref.: Hansen and Cates[20]

The operating parameters of any cooling system (flow rate, cold water temperature, and temperature rise across the condensers) must be closely matched with the rest of the plant (condensers, turbine design, etc.) for optimal power production.[2] At Indian Point Unit No. 3, where the turbines and condensers are already in operation and optimized for once-through operation, the degrees of freedom for cooling tower options are reduced.

The applicant has made a study to determine the optimal design for a natural draft cooling tower for Indian Point Unit No. 3.[22] A 74 F° wet-bulb temperature, a value which is exceeded 5% of the time during the summer months, was used in developing the design of the natural draft cooling tower proposed by the applicant. This study concludes that the best combination of variables is a circulating water flow rate of 600,000 gpm, a cooling range of 25 F° and an approach of 16 F°.[22] The shell of a counterflow tower for this set of parameters would be 565 ft tall and have base and top diameters of 462 and 310 ft, respectively. A counterflow tower of the same capacity would be 40-50 feet shorter, but would have a larger base diameter.[2]

The Staff considers the natural draft wet cooling tower to be one of the feasible alternative CCC systems for Indian Point Unit No. 3.

2.4.3.2 Linear Mechanical Draft Cooling Towers (MDCT)

Mechanical draft cooling towers and natural draft cooling towers operate on the same basic thermodynamic principle--that is, cooling takes place by evaporation and sensible heat transfer. In MDCT's, fans are used to pull air through the fill section. Although both cross and counterflow designs are in use, almost all are of the crossflow design. Figure 2-5 is a schematic cross section of a MDCT cell; Figure 2-6 shows other engineering features of a 3-cell unit.

MDCT's have been used for several decades for power plant cooling and are proven, reliable and economical heat sinks. They have several advantages when compared to natural draft units, such as lower capital costs, greater flexibility, greater control of cold-water temperature, and a lesser visual impact of the structure due to their lower profile. The primary disadvantage of mechanical draft cooling towers when compared to natural draft units is the increased potential for ground-level fogging and icing, especially in winter. This phenomenon is caused by the relatively low discharge point for the water vapor from the mechanical draft towers, with aerodynamic downwash the primary cause of fogging at such towers.[25] Experience at such towers indicates that the fog either evaporates or lifts to become stratus clouds within about 1500 ft (0.5 km) of the towers.[11,25,26] Drift rates from such towers are somewhat higher than for natural draft units; however, almost all of the drift that strikes the ground will do so within 1000 ft or so of the towers.[12,27,28] The remaining drift droplets will evaporate to dryness and their salts remain airborne.

The applicant has indicated that three mechanical draft cooling towers (26 cells) of conventional design (that is, linear) would be required for adequate cooling.[22] One tower would be 320 ft long, 75 ft wide and 68 ft tall. The other two would be 360 ft long and the same height and width. The design optimization includes a cooling range of 25 F° and an approach of 17 F° for the design 74 F° wet bulb temperature.

The staff concludes that linear MDCT would be a feasible option for Indian Point Unit No. 3.

2.4.3.3 Circular Mechanical Draft Cooling Towers (CMDCT)

A variety of circular mechanical draft cooling towers exists. One design uses one very large fan (up to 85 ft in diameter) to pull air through fill similar to that in standard mechanical draft units. (Fig. 2-7) A large number of towers of this type are now in use in Europe, with unit sizes of up to 300 MWe (fossil) per tower. Due to their tall stacks (up to 179 ft), some of the force pulling air through the tower is due to the natural draft effect. In fact, this type is sometimes called a fan-assisted tower.

Another design concept for a round or circular mechanical draft tower is to place the individual cells of the standard wet MDCT type into a circular array, and place the fans on the roof above the circular space inside the fill sections, as shown in Figure 2-8. An elevated stack can be added to the tower to increase the height of release of the effluent gases. One CMDCT is now in operation in the United States, an 13-fan unit at a 500-MWe fossil plant in Mississippi.[29] This tower became operational in March 1975, so experience with it is limited. A drift rate of 0.005% is possible with this unit. Table 2-1 lists the utilities which have plans to build CMDCT, including information on the rating and size of the CMDCT.

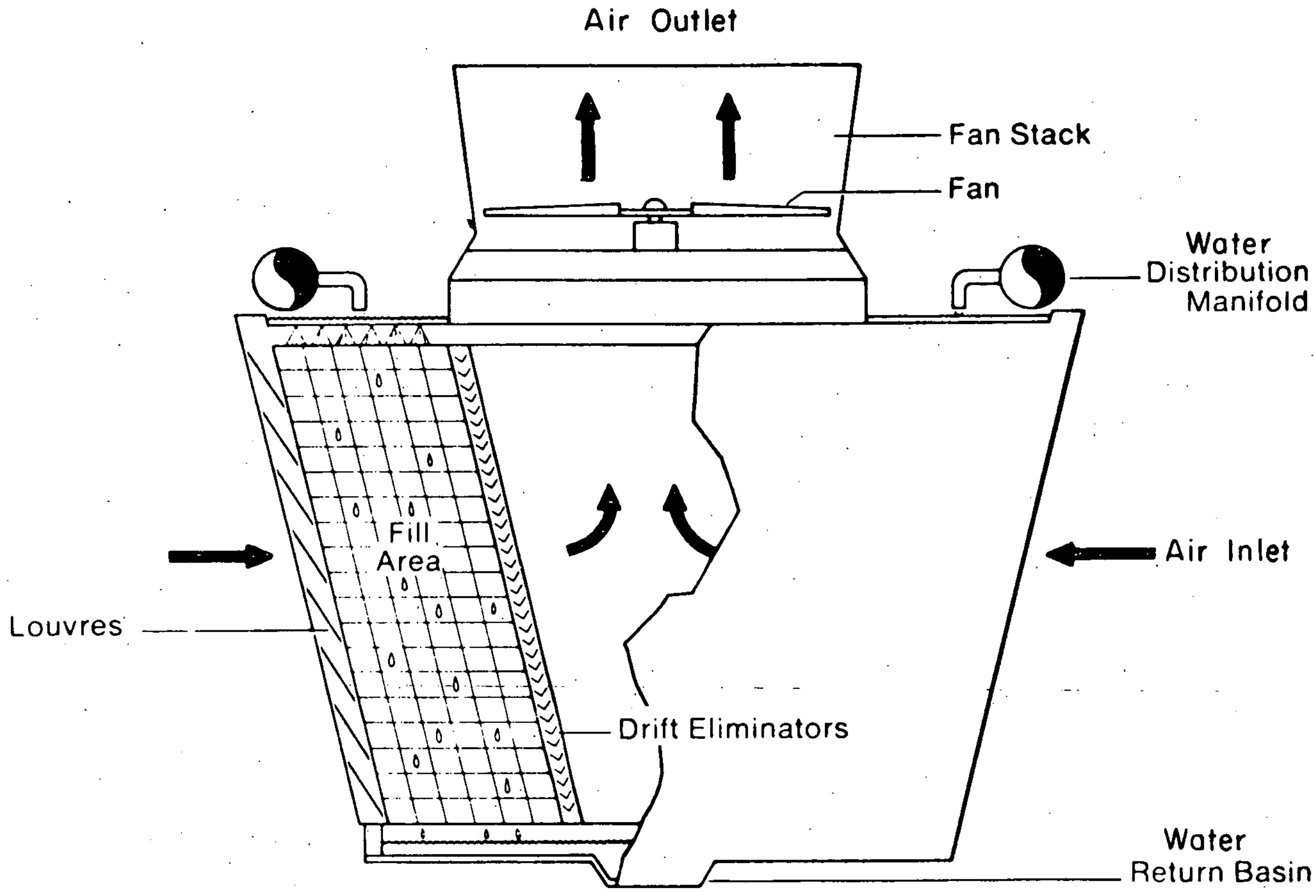


FIGURE 2-5

MECHANICAL-DRAFT WET COOLING TOWER (CROSS FLOW)

Ref.: ER-CCC, IP-2, Fig. 2-5

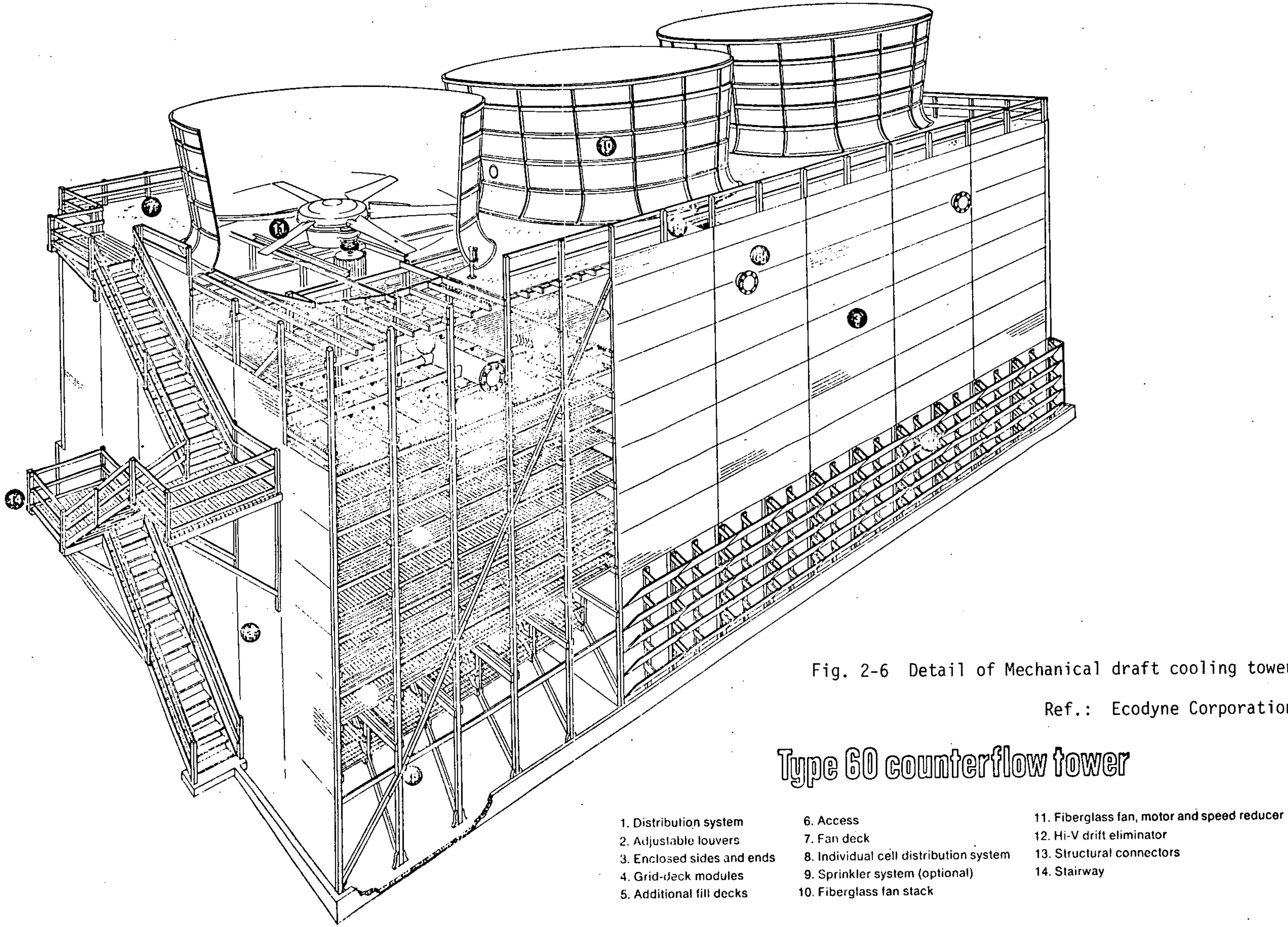


Fig. 2-6 Detail of Mechanical draft cooling tower

Ref.: Ecodyne Corporation

1. Fan
2. Reinforced Concrete Tower Shell
3. Fan Rotor Housing
4. Drift Eliminators
5. Asbestos-Cement Fill Sheets
6. Vertical Fan Drive Shaft
7. Engine Room
8. Bevel Gear Hydraulic Coupling and Motor

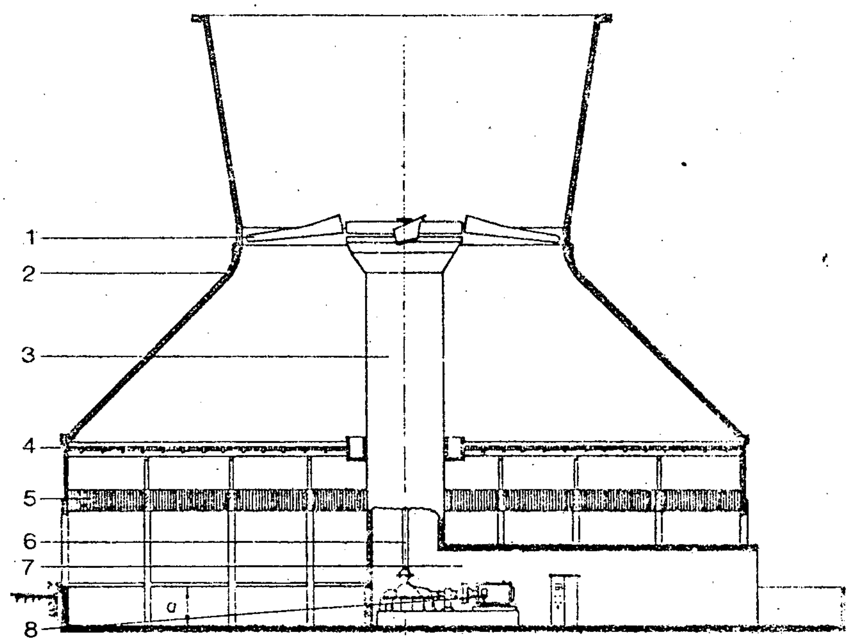


Fig. 2-7 Cutaway view of circular mechanical draft cooling tower.

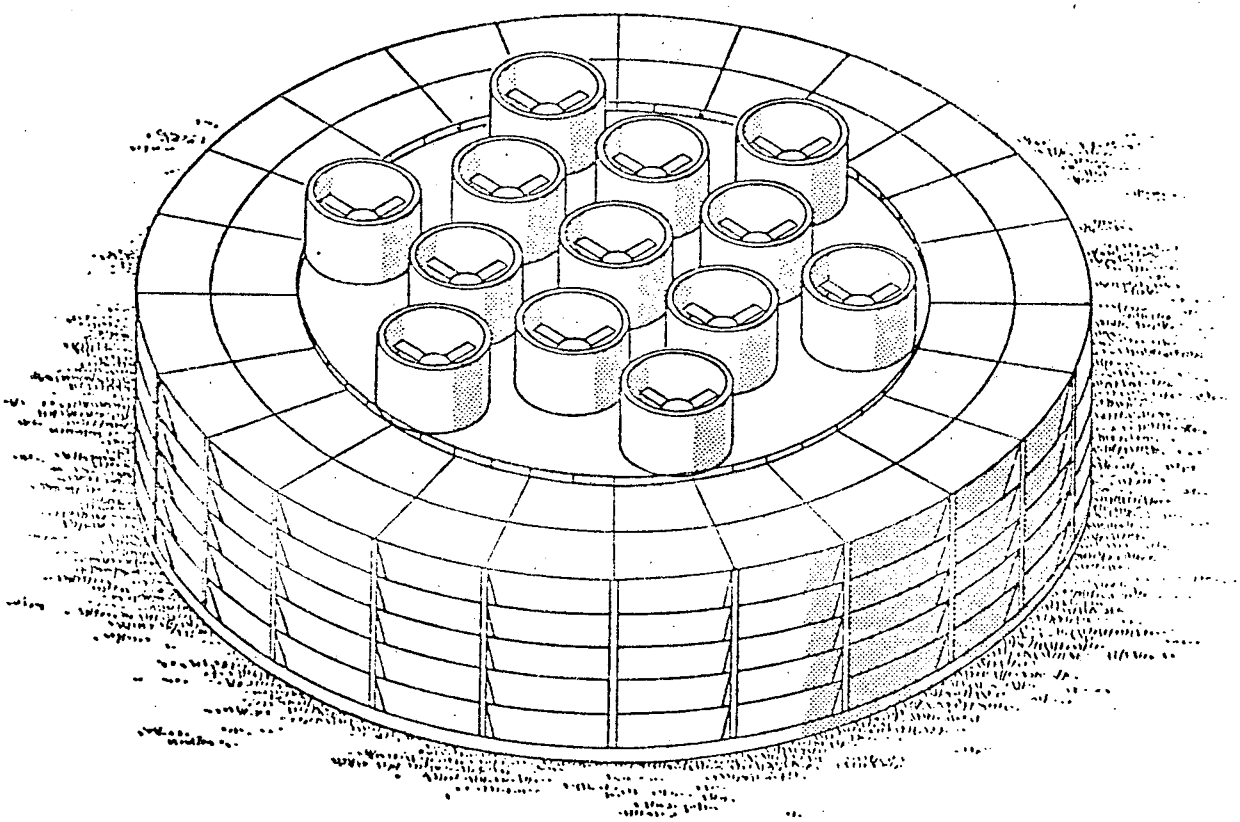


Fig. 2-8 Conceptual sketch of circular mechanical-draft cooling tower. (The tower is about 270 ft in diameter and 74 ft high.)

Ref.: Draft Environmental Statement, Cherokee Nuclear Station Units 1, 2 and 3. U. S. Nuclear Regulatory Commission, March 1975, Docket Nos. STN 50-491, 50-492 and 50-493.

TABLE 2-1

THE MARLEY COMPANY

ROUND TOWER INSTALLATION LIST

Owner	Engineer	Rating	Size & Type
Washington Public Power Supply System Hanford Unit 2 Richland, Washington	Burns and Roe	1100 MW (Nuclear) 570,000 GPM 104.3-76.3-60	Class 700 6 @ 6 Fans
*Mississippi Power Company Jack Watson Unit 5 Gulfport, Mississippi	Southern Services	550 MW 172,000 GPM 120-90-80	Class 700 1 @ 13 Fans
Gulf States Utilities Sabine Unit 5 Bridge City, Texas	Brown & Root	480 MW 254,915 GPM 112-91-81	Class 700 2 @ 7 Fans
Duke Power Company Catawba Unit 1 & 2 York, South Carolina	Duke Power	2 @ 1180 MW (Nuclear) 1,328,000 GPM 112-88-76	Class 700 6 @ 13 Fans
Kansas Power and Light Co. Energy Center-Units 1 & 2 Belvue, Kansas	Black & Veatch	2 @ 640MW 664,000 GPM 114-92.7-80	Class 600 4 @ 8 fans
Gulf States Utilities River Bend Station Units 1 & 2 West Feliciana Parish, La.	Stone & Webster	2 @ 934 MW (Nuclear) 1,109,580 GPM 118.5-93-81	Class 700 8 @ 7 Fans
Louisville Gas & Co. Millcreek Unit No. 3 Louisville, Ky.	Fluor Pioneer	425 MW 205,000 GPM 116-95-78	Class 700 1 @ 8 Fans
Gulf State Utilities Ray S. Nelson Station Unit No. 5 Lake Charles, Louisiana	Bechtel	550 MW 212,410 GPM 117.23-91-82	Class 700 1 @ 13 Fans

*Operational

2.4.3.4 Fan-Assisted Natural Draft Cooling Towers

A relatively new design concept, the fan-assisted natural draft cooling tower (FANDCT), could be used to cool the plant. In such towers, fans are used to augment the airflow through the tower and fill created by the buoyancy of air in the tower. While no FANDCT's are in use or are under construction in this country, a few are in use in Europe.[31-33]

A variety of FANDCT designs exist, including both cross flow and counterflow arrangements for the fill. In some plans, the multiple fans can be turned off on all but the warmest days and the unit operates as a natural draft tower. In others, the fans are used at all times for additive cooling capacity for a given size cooling tower. For example, in a typical English fossil-fired power plant, eight natural draft cooling towers (each about 374 ft tall with a base diameter of 302 ft) are used to cool a 2000-MWe fossil power complex.[4] The bulk of these towers and their visible plumes have created an aesthetic impact. In an effort to reduce this impact, a single FANDCT is now being built at the 1000-MWe fossil Ince power plant in England,[34,35] which will be able to do the cooling of the four NDCT's it will replace. In this design, the shell is unchanged but the fill will be outside in a typical cross flow arrangement in a circle 564 ft across; 35 fans will provide the necessary air flow. This tower is shown in Figure 2-9. The fans will use 0.6% of the plants electrical output.[34]

Another tower design consists of a concrete shell similar to, but shorter than that of a pure counterflow natural draft unit, with a circle of fans around the base to augment air flow, as shown in Figure 2-10. For a given heat load, these towers will be about half as tall and two-thirds the diameter of a natural draft unit.[2] Several such towers are now in use in Europe, two such towers, each 268 ft tall are used to cool the 1200 MWe Biblis-A nuclear plant.[33]

Computer model and wind tunnel tests for the Biblis-A FANDCT's in Germany indicated frequent fogging downwind from 170 (52 m) and 220 ft (67 m) units; a tower height of 268 ft (82 m) was required so that "ground touching plumes will be extremely rare."[34] It has also been stated that "although the assisted draught cooling towers gave higher ground impacts than the natural draught towers, their environmental influence can still be considered as being well within tolerable limits..."[32]

The drift rate from FANDCT's would depend in part on the effectiveness of the drift eliminators. However, due to higher exit air speeds, the drift rate could be greater than that of a natural draft tower. Tests made in a large test cell indicate that, with proper engineering of the drift eliminators, the drift rate is negligible.[34,35]

The staff considers the two types of FANDCT's discussed above to be feasible for Indian Point Unit No. 3.

2.5 SUMMARY OF ALTERNATIVE CLOSED CYCLE COOLING SYSTEMS

The staff has reviewed the information of various alternative CCC systems which are feasible for construction and operation at Indian Point Unit No. 3 and has reached the following conclusions.

1. Because of insufficient level land on and near the site, the staff believes that cooling ponds or spray canals are not viable alternatives for the Indian Point site;

2. Due to engineering problems associated with much higher back pressures in the turbine and to high costs involved, the staff has rejected dry cooling towers as a satisfactory cooling option for construction and operation at Indian Point;

3. In consideration of the environmental impacts, land area requirements, and costs, the staff believes that natural draft, fan-assisted, linear and circular mechanical draft and wet/dry cooling towers would be feasible for construction and operation at Indian Point. The details regarding the construction, land requirements, operation, and environmental and economic evaluations of each type are delineated in the following sections of this Statement.

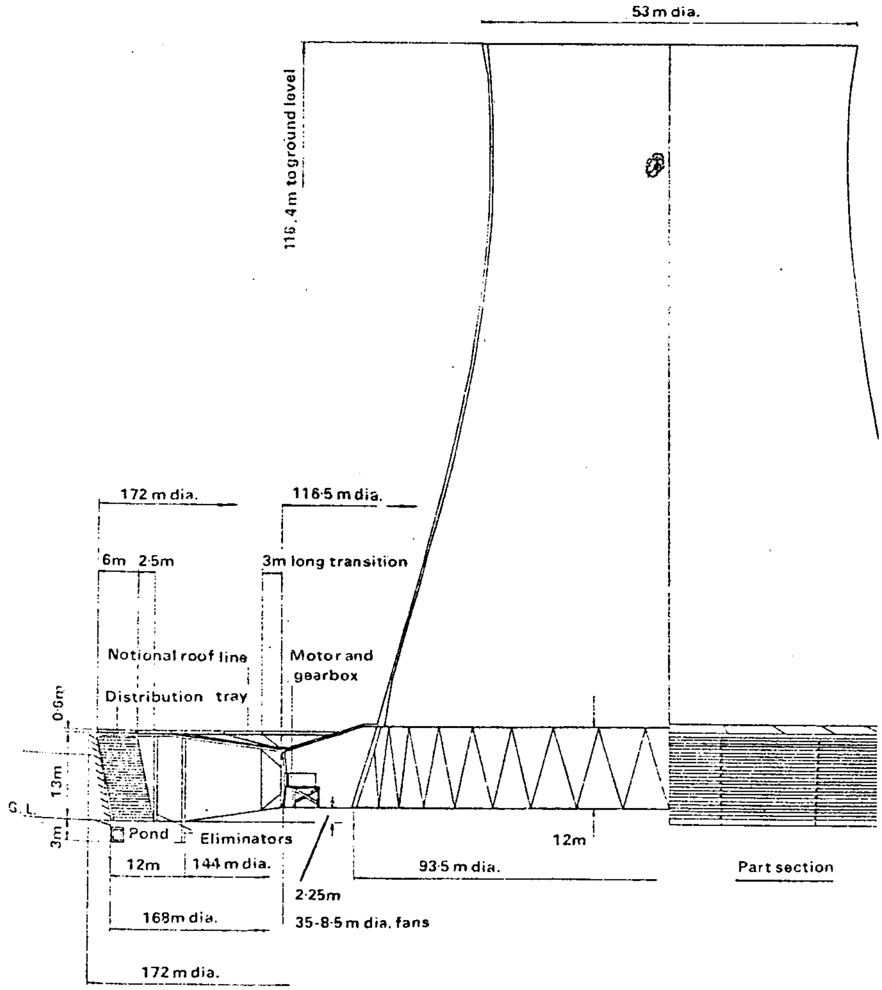


Fig. 2-9 Fan-assisted natural draft cooling tower.

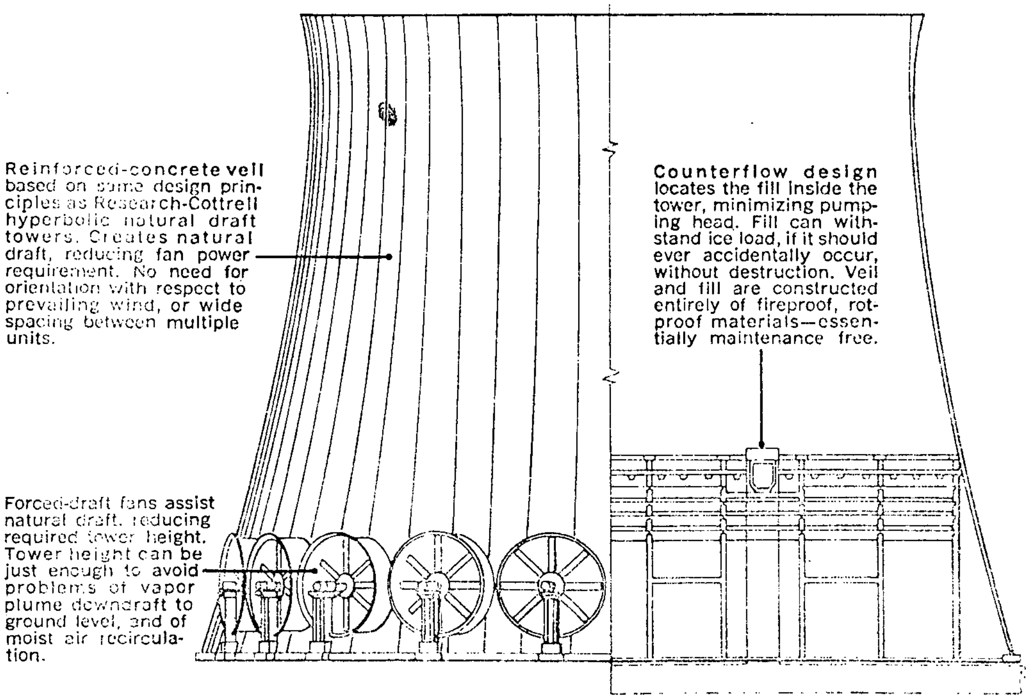


Fig. 2-10 Schematic of a counterflow fan-assisted natural draft cooling tower.

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34. D. J. W. Richards, "Engineering Research Aspects of Assisted Draught Cooling Towers," *Atmospheric Environment,* 8:425-432, April 1974.

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3. DESIGN, CONSTRUCTION AND OPERATING CHARACTERISTICS OF ALTERNATIVE CLOSED CYCLE COOLING SYSTEMS

3.1 DESIGN AND DESCRIPTION OF FEASIBLE ALTERNATIVE CLOSED CYCLE COOLING (CCC) SYSTEMS

The design of the feasible alternative CCC systems is dependent on a number of factors, including the wet bulb temperature, the heat load, the cooling range and approach. A design wet bulb temperature that is too high can result in an oversized tower; and a design wet bulb temperature that is too low can result in inadequate tower capacity in summer. The applicant has selected the thermal design characteristics for three different feasible cooling towers as outlined in Table 3-1, using 74°F as the design summer wet bulb temperature. A circulating flow of 600,000 gpm through the closed cycle condenser cooling system is proposed for each different cooling tower the applicant has evaluated. The applicant has continuously been exploring the concept of a closed cycle natural draft cooling tower. After an optimization technique, the applicant also proposed a single hyperbolic structure with a 445 ft base diameter and 450 ft high capable of cooling 590,000 gpm of water at a 74°F design wet bulb temperature and 55 per cent design relative humidity. This cooling tower design was described in Appendix G of the FES for Unit No. 3.

The approach value is the design criterion which can have the greatest effect on the size and costs of the cooling tower. For a given heat load, the size of the cooling tower increases with decreasing approach. The applicant has used this characteristic to design a single natural draft cooling tower 565 ft high with a 460 ft base diameter. The applicant has selected (in its ER-CC-3) 16 F° as the design approach. The approach selected in the FES for Unit No. 3 for the single 450 ft natural draft cooling tower described above was 21.5 F°.

The applicant has selected the range of 25 F° for a power level of 3,217 MWt with the circulation of 600,000 gpm flow through the condenser and cooling tower. The total heat to be dissipated will be 7.35×10^9 Btu per hour. The excess heat from the service water system for the reactor and turbine-generator will be dissipated by once-through cooling regardless of which alternative cooling system is selected for the condenser.

In terms of the mechanical draft cooling tower, the applicant has used 17 F° for the design approach which requires three towers, with a total of 28 cooling cells. One tower is about 320 ft long, 75 ft wide and 68 ft high; the others are about 360 ft long with the other dimensions the same.

Since the wet/dry cooling tower design is dependent in part on the ambient dry-bulb temperature in the winter (20 F° at a winter design relative humidity of 80%), the applicant has proposed that the wet/dry mechanical draft cooling tower system with a design approach of 17 F° should include three towers, with a total of 28 cooling cells. One tower is about 480 ft long, 70 ft wide and 74 ft high while the others are about 430 ft long, the other dimensions remaining the same.

The applicant also provided information and analyses for circular mechanical draft towers (CMDCT) and fan-assisted natural draft cooling towers (FANDCT) although he does not consider them viable options. Two towers each would be required for Unit No. 3. Each FANDCT would be about 270 ft in base diameter and 205 ft overall height. A single FANDCT would require 24 fans. Each CMDCT would have dimensions of 285 ft in base diameter and 67 ft overall height and each tower would have 13 fans.

Based on the above dimensions and design criteria of these different cooling tower alternatives, the applicant showed in its Table 3-2, the reduced electrical capability of Indian Point Unit No. 3 resulting from total derating for each alternative cooling system for cooling system auxiliary loads and effects on the backpressure of the turbine. For the peak ambient wet-bulb temperature of 74°F in the summer, the total derating due to each alternative closed cycle cooling system is estimated to be 78, 82, and 84 MWe for the natural draft, linear wet mechanical draft, and the wet/dry mechanical draft cooling towers, respectively. The two FANDCT and CMDCT would produce a derating of 80 MWe and 82 MWe, respectively.

TABLE 3-1

THERMAL DESIGN CRITERIA

	Natural-Draft Wet Cooling Tower	Mechanical-Draft Wet Cooling Tower	Mechanical-Draft Wet/Dry Cooling Tower	Fan-Assisted Natural Draft Cooling Tower	Circular Mechanical Draft Cooling Tower
Condenser Heat Load, 10^6Btu/hr	7,350	7,350	7,350	7,350	7,350
Cooling Water Flow, gpm	600,000	600,000	600,000	600,000	600,000
Cooling Range, F°	25	25	25	25	25
Tower Approach, F°	16	17	17	16	17
Design Summer Wet-Bulb Temp., °F	74	74	74	74	74
Design Summer Relative Humidity, %	55	55	55	55	55
Design Winter Dry-Bulb Temp., °F	--	--	20	--	--
Design Winter Relative Humdity, %	--	--	80	--	--

REF.: ER-CC 1P-3, p.3-16

TABLE NO. 3-2

Study For
Indian Point Station

NATURAL DRAFT COOLING TOWERS

Case #	GPM	Cooling Range	Approach @73wb	Approach @74wb	Approach @76wb	No. of Towers	Shell Height	O.A. Diam.	Pump Head	Current Installed Budget Cost
A-1	840,000	18	18.3	18	17.4	2	370'	405'	62'	$13,500,000
A-2	840,000	18	20.3	20	19.4	2	370'	395'	55'	$12,400,000
A-3	840,000	18	22.3	22	21.4	1	500'	505'	69'	$ 9,700,000
A-4	840,000	18	24.3	24	23.3	1	500'	465'	69'	$ 9,100,000
B-1	670,000	22.6	16.3	16	15.4	2	370'	380'	62'	$12,900,000
B-2	670,000	22.6	18.3	18	17.4	1	500'	505'	69'	$ 9,700,000
B-3	670,000	22.6	20.3	20	19.3	1	500'	455'	69'	$ 9,000,000
B-4	670,000	22.6	24.4	24	23.3	1	450'	445'	62'	$ 8,100,000
C-1	590,000	25.8	16.3	16	15.4	1	500'	510'	69'	$ 9,750,000
C-2	590,000	25.8	18.3	18	17.3	1	500'	450'	69'	$ 9,000,000
C-3	590,000	25.8	20.4	20	19.3	1	500'	455'	62'	$ 8,500,000
C-4	590,000	25.8	22.4	22	21.3	1	450'	440'	62'	$ 8,000,000
D-1	505,000	30	14.3	14	13.4	1	500'	505'	69'	$ 9,700,000
D-2	505,000	30	17.4	17	16.3	1	450'	445'	69'	$ 8,800,000

Notes:

1. All selections assume a design relative humidity of approximately 55%.
2. Prices include concrete cold water basin and riser piping.
3. Prices do not include excavation, pilings or caissons, backfilling, landscaping, underground piping, or future cost escalation beyond today's price level.
4. Time required to prepare quotation = approximately 8-10 weeks.
   Onsite Construction time = approximately 24 months for one tower;
   approximately 36 months for two towers.

John C. Hensley

THE MARLEY COMPANY 12-6-73

The plant net power rating for Unit No. 3 based on the derating at peak ambient temperatures would be 1033 MWe for once-through cooling, 1000 MWe for natural draft cooling towers, 984 MWe for linear mechanical draft cooling towers and 984 MWe for the wet/dry mechanical draft cooling towers. As shown in Table 3-3, the plant net heat rates are estimated to be 10,970, 11,130 and 11,140 Btu/kWh for each of the respective cooling towers.

3.2 PHYSICAL LOCATION OF COOLING TOWERS

The applicant has investigated the optimum location for erection of the towers with respect to engineering practicality, safety reasons, and economic justifications. The applicant has provided detailed drawings of the general arrangement of the natural draft, wet linear mechanical draft, and wet/dry cooling towers on the site. Because of a major item of expense of cost of piping and pumps to transfer water in the initial concept of laying out the cooling towers on the site, it was decided to locate the cooling tower as close as possible to the existing condenser system and yet far enough away to take into account safety reasons for locating the tower relative to the containment structure. (See Section 3.4.5 for a discussion of safety considerations.)

The outside edge of the natural draft cooling towers at the base is located south from the outside wall of the Unit No. 3 containment building. This tower will have a base elevation of 45 ft above MSL (mean sea level) as shown in Figure 3-1. A service-access roadway would be built around the cooling tower basin. The location and size of this natural draft tower is similar to that shown in Figure G-6 in Appendix G of the FES for Unit No. 3.

In the case of the two types of mechanical draft cooling towers considered by the applicant, their locations are not so limited because of their height for safety reasons. Figures 3-2 and 3-3 show the general layout for these towers.

In addition to the location of towers themselves, the drawings show the layout of the piping and pumps. Further discussion of these are presented below.

For the CMDCT and FANDCT, the locations of the tower system are shown in Figures 3-4 and 3-5.

3.3 SITE PREPARATION AND EXCAVATION

Because of the topography of the site, extensive excavation will be required (1) to build temporary and permanent roads for access to the specific location where the preferred closed cycle cooling system is to be placed and (2) to level off the area needed prior to the building of the specific system required. Figures 3-1, 3-2, 3-3, and 3-4, also show the existing contour of the land before excavation for the cooling tower systems evaluated.

The applicant in his Table 3-4 (ER-CC-3) has estimated the total amounts of material to be excavated prior to laying the tower foundation and the tunnel piping and pump pits for each of the respective towers. These are listed below.

Tower System	Amount of Excavation cu yds
NDCT	241,330
LMDCT	466,629
WDMDCT	577,907
CMDCT	139,400
FANDCT	139,400

The bottom of the basin, irrespective of tower type, will be located at the 45 ft elevation above MSL so that land above that elevation would have to be removed to obtain a level area. Room for air to flow in the towers must also be provided. The existing main plant road system would be used for access to the site both during construction and normal operation. A permanent road would be extended from the cooling tower to the existing Unit No. 3 turbine building and screen-well area. However, temporary roads for construction purposes would also be needed to restrict traffic in the plant area.

Disposal of the material excavated may also require another temporary road. However, the Unit No. 1 wharf could be used for delivery of construction materials or removal of excavated material. The beach of Lent's Cove could also be used for delivery and disposal of material.

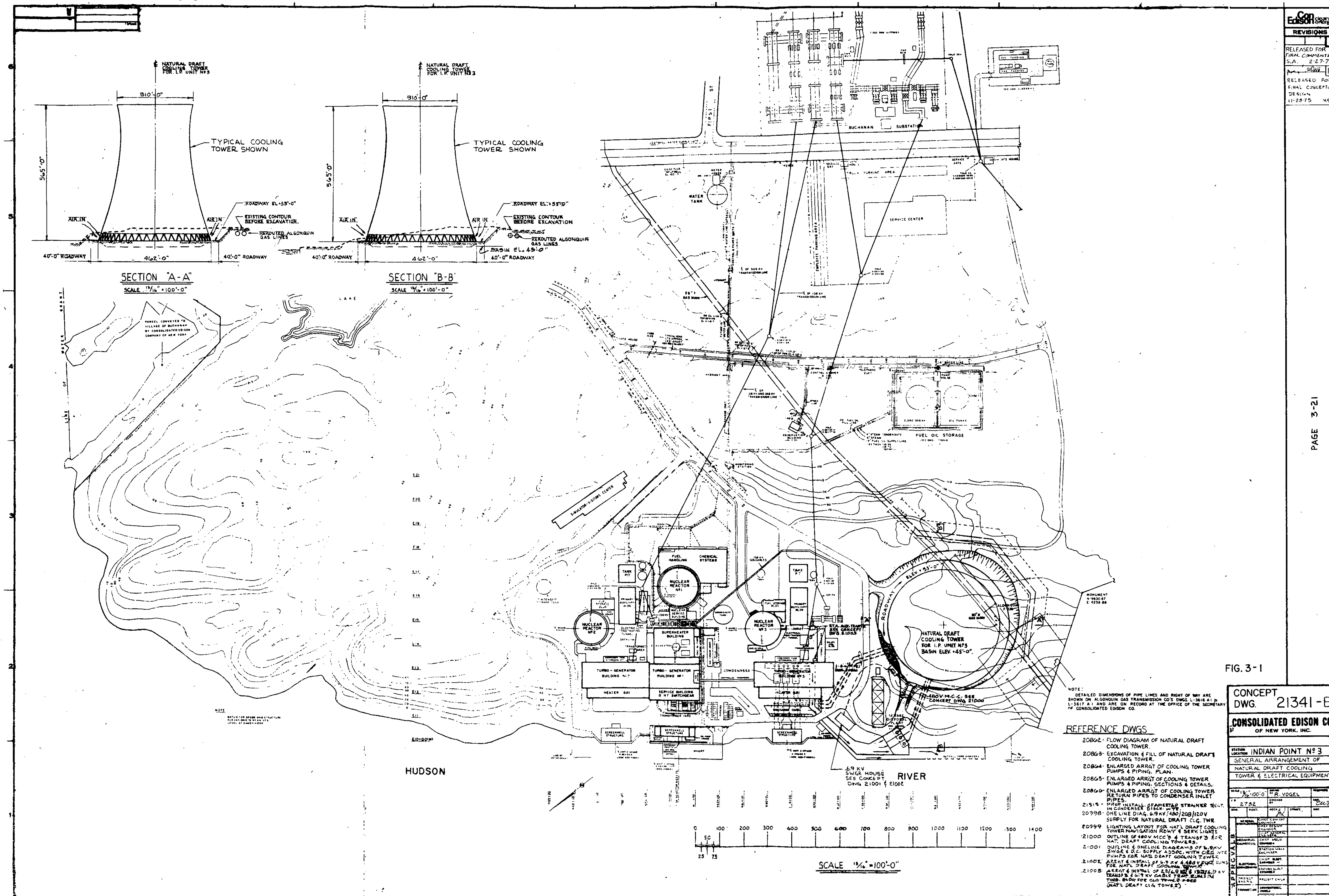

SECTION "A-A"
SCALE 13/16" = 100'-0"
SECTION "B-B"
SCALE 13/16" = 100'-0"
TYPICAL COOLING TOWER SHOWN
NATURAL DRAFT COOLING TOWER FOR I.P. UNIT No 3
BUCHANAN SUBSTATION
WATER TANK
SERVICE CENTER
FUEL OIL STORAGE
NUCLEAR REACTOR No 1
NUCLEAR REACTOR No 2
NUCLEAR REACTOR No 3
NATURAL DRAFT COOLING TOWER FOR I.P. UNIT No 3 BASIN ELEV. +45'-0".
HUDSON
RIVER
SCALE 13/16" = 100'-0"
NOTE:
DETAILED DIMENSIONS OF PIPE LINES AND RIGHT OF WAY ARE SHOWN ON ALGONQUIN GAS TRANSMISSION CO'S DWGS. L-3616 A1 & L-3617 A1 AND ARE ON RECORD AT THE OFFICE OF THE SECRETARY OF CONSOLIDATED EDISON CO.
REFERENCE DWGS
20862 - FLOW DIAGRAM OF NATURAL DRAFT COOLING TOWER.
20863 - EXCAVATION & FILL OF NATURAL DRAFT COOLING TOWER.
20864 - ENLARGED ARRGT OF COOLING TOWER PUMPS & PIPING. PLAN.
20865 - ENLARGED ARRGT OF COOLING TOWER PUMPS & PIPING. SECTIONS & DETAILS.
20866 - ENLARGED ARRGT OF COOLING TOWER RETURN PIPES TO CONDENSER INLET PIPES.
20998 - ONE LINE DIAG. 6.9 KV/480/208/120V SUPPLY FOR NATURAL DRAFT CLG. TWR.
20999 LIGHTING LAYOUT FOR NAT'L DRAFT COOLING TOWER NAVIGATION RDWY & SERV. LIGHTS
21000 OUTLINE OF 480V MCC'S & TRANSF'S FOR NAT. DRAFT COOLING TOWERS.
FIG. 3-1
CONCEPT DWG. 21341-B
CONSOLIDATED EDISON CO. OF NEW YORK, INC.
INDIAN POINT No 3
GENERAL ARRANGEMENT OF NATURAL DRAFT COOLING TOWER & ELECTRICAL EQUIPMENT.
R. VOGEL
2732
PAGE 3-21

Figure 3-1

TABLE 3-3

CHANGE IN PLANT NET HEAT RATE OF INDIAN POINT UNIT NO. 3
TURBINE-GENERATOR OPERATED AT REACTOR POWER AT
3217 MWT MAXIMUM CALCULATED LOAD
AT YEARLY AVERAGE CONDITIONS (1)

Cooling Systems (2)	OT	NW	LMW	MWD	RMW	FN
1. Turbine Net, MWe	1,068	1,052	1,040	1,040	1,040	1,052
2. Loss of Turbine Capacity, Avg MWe	0	16	28	28	28	16
3. Cooling System Auxiliaries, MWe	0	17.5	20.5	21.5	20.5	19.5
4. Total Derating due to Alternative Cooling System, MWe, (2) + (3)	0	33.5	48.5	49.5	48.5	35.5
5. Normal Plant Auxiliary Load, MWe	35	35	35	35	35	35
6. Total Loss, MWe (4) + (5)	35	68.5	83.5	84.5	83.5	70.5
7. Plant Net, MWe 1068 - (6)	1,033	999.5	984.5	983.5	984.5	997.5
8. Plant Net Heat Rate	10,630	10,970	11,130	11,140	11,130	10,990

NOTES: (1) 65°F Wet Bulb Temp & 74°F River Temp for a 3-month Summer; 35°F Wet Bulb Temp & 49°F River Temp for a 9-month non-summer period.

(2) OT - Once Through; NW - Natural Draft Wet Tower; LMN - Linear Mechanical Draft Wet Tower; MWD - Mechanical Draft Wet/Dry Tower; RMW - Round Mechanical Draft Wet Tower; FN - Fan-Assisted Natural Draft Wet Tower.

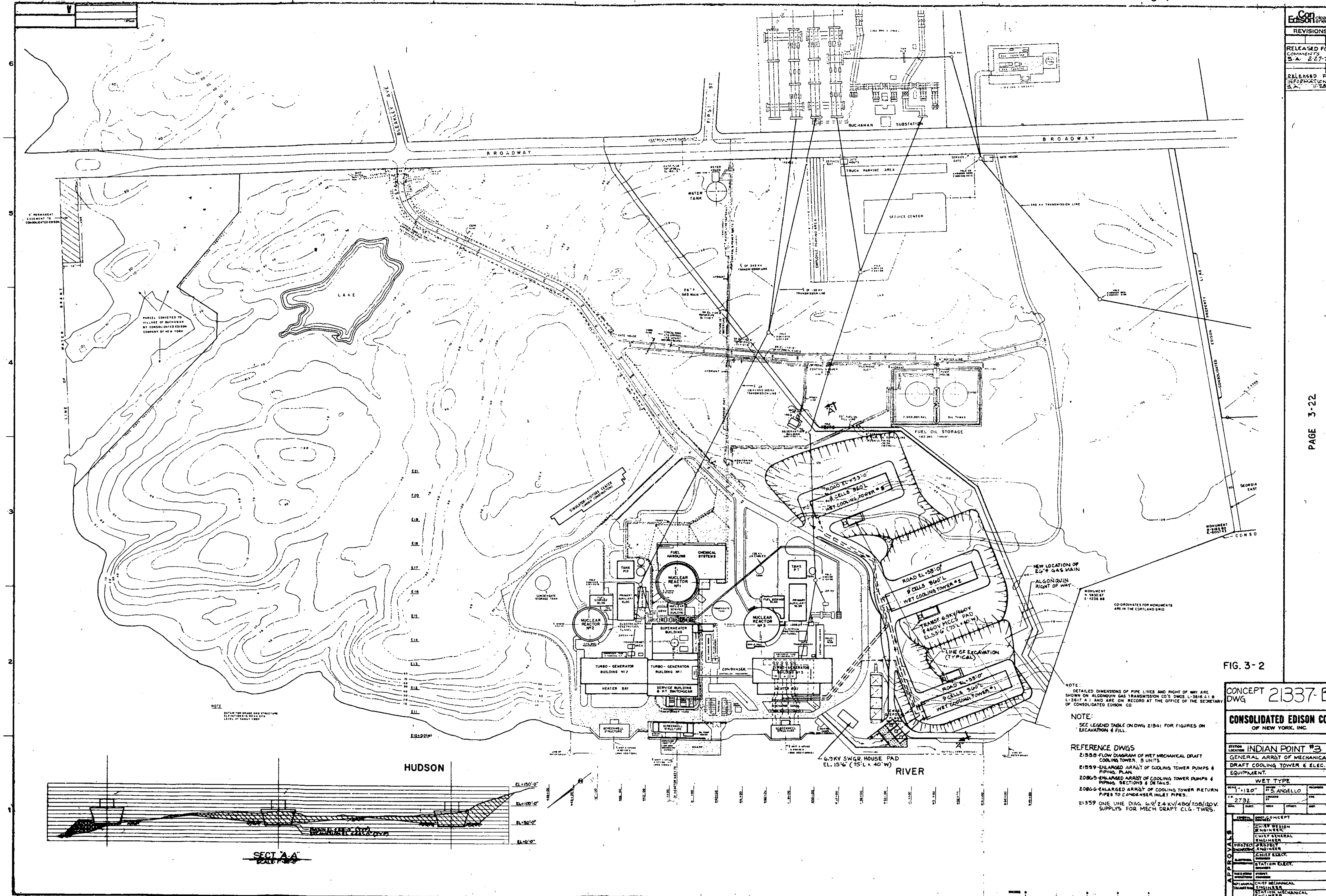
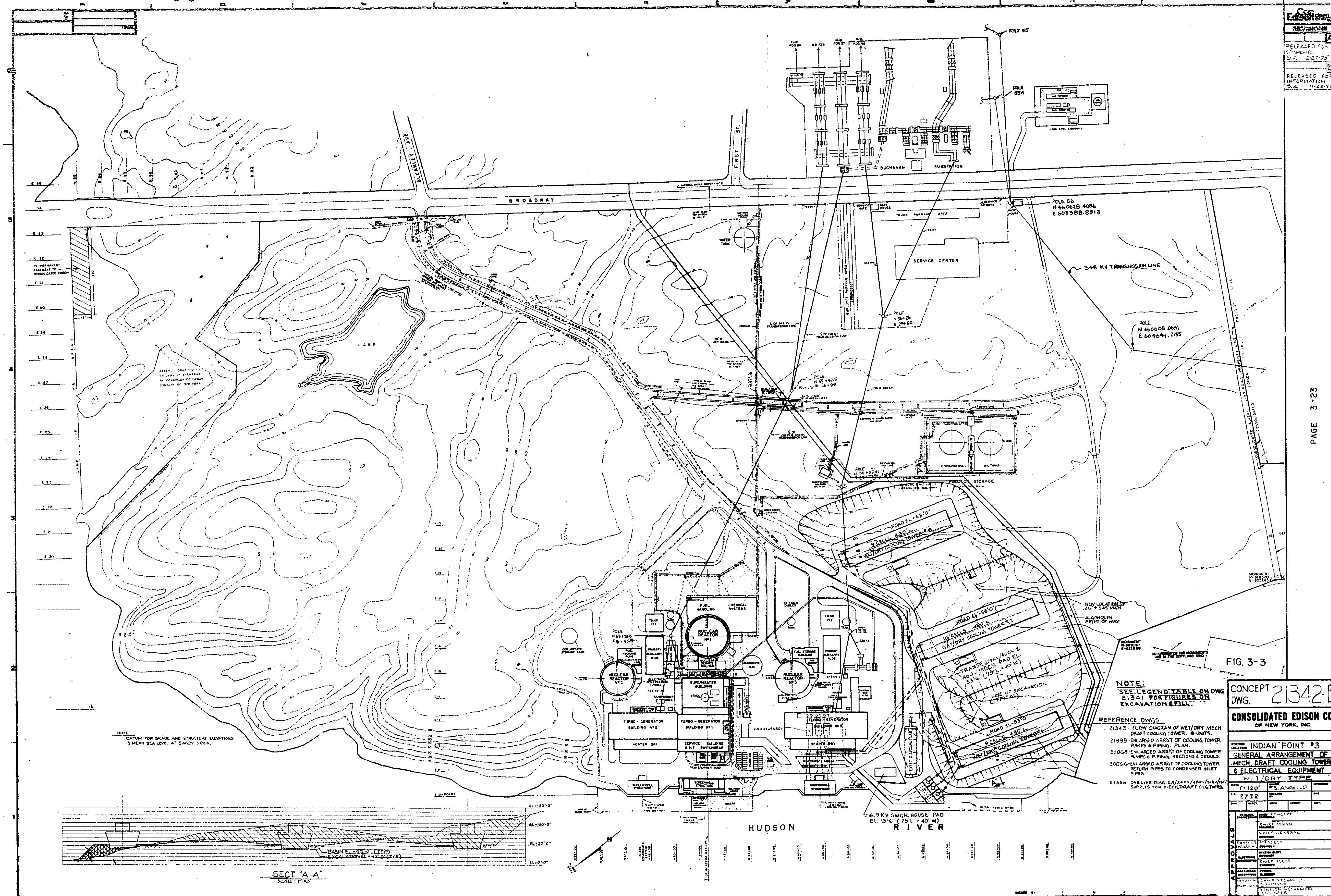

Con Edison clean energy
REVISIONS
RELEASED FOR COMMENTS S.A. 2-27-75
RELEASED FOR INFORMATION S.A. 11-28-75
PAGE 3-22
BROADWAY
BLEAKLEY AVE
FIRST ST
BUCHANAN SUBSTATION
TRUCK PARKING AREA
SERVICE CENTER
WATER TANK
LAKE
EMPLOYEE PARKING AREA
FUEL OIL STORAGE
SIMULATOR-VISITORS CENTER
FUEL HANDLING
CHEMICAL SYSTEMS
NUCLEAR REACTOR Nº1
NUCLEAR REACTOR Nº2
NUCLEAR REACTOR Nº3
SUPERHEATER BUILDING
TURBO-GENERATOR BUILDING Nº2
TURBO-GENERATOR BUILDING Nº1
SERVICE BUILDING & HT SWITCHGEAR
HEATER BAY
CONDENSER
ROAD EL +55'-0"
8 CELLS 520'L
WET COOLING TOWER #3
9 CELLS 560'L
WET COOLING TOWER #2
WET COOLING TOWER #1
TRANSF 6.9KV/460V & 460V MCCS PAD EL 55'-0" (75'L x 40'W)
LINE OF EXCAVATION (TYPICAL)
NEW LOCATION OF 26"Ø GAS MAIN
ALGONQUIN RIGHT OF WAY
6.9KV SWGR. HOUSE PAD EL. 15'6" (75'L x 40'W)
HUDSON
RIVER
SECT "A-A"
FIG. 3-2
NOTE:
DETAILED DIMENSIONS OF PIPE LINES AND RIGHT OF WAY ARE SHOWN ON ALGONQUIN GAS TRANSMISSION CO'S DWGS L-3616 A1 & L-3617 A1 AND ARE ON RECORD AT THE OFFICE OF THE SECRETARY OF CONSOLIDATED EDISON CO.
NOTE:
SEE LEGEND TABLE ON DWG 21341 FOR FIGURES ON EXCAVATION & FILL.
REFERENCE DWGS
21338-FLOW DIAGRAM OF WET MECHANICAL DRAFT COOLING TOWER, 3 UNITS
21339-ENLARGED ARRG'T OF COOLING TOWER PUMPS & PIPING. PLAN.
20865-ENLARGED ARRG'T OF COOLING TOWER PUMPS & PIPING. SECTIONS & DETAILS.
20866-ENLARGED ARRG'T OF COOLING TOWER RETURN PIPES TO CONDENSER INLET PIPES.
21359 ONE LINE DIAG. 6.9/2.4 KV/480/208/120V. SUPPLYS FOR MECH DRAFT CLG. TWRS.
CONCEPT DWG 21337-B
CONSOLIDATED EDISON CO. OF NEW YORK, INC.
INDIAN POINT #3
GENERAL ARRG'T OF MECHANICAL DRAFT COOLING TOWER & ELEC. EQUIPMENT.
WET TYPE
1"=120'
S. ANGELLO
APPROVALS
CHIEF DESIGN ENGINEER
CHIEF GENERAL ENGINEER
PROJECT ENGINEER
CHIEF ELECT.
STATION ELECT.
CHIEF MECHANICAL ENGINEER
STATION MECHANICAL ENGINEER

Figure 3-2



PAGE 3-23

Figure 3-3B

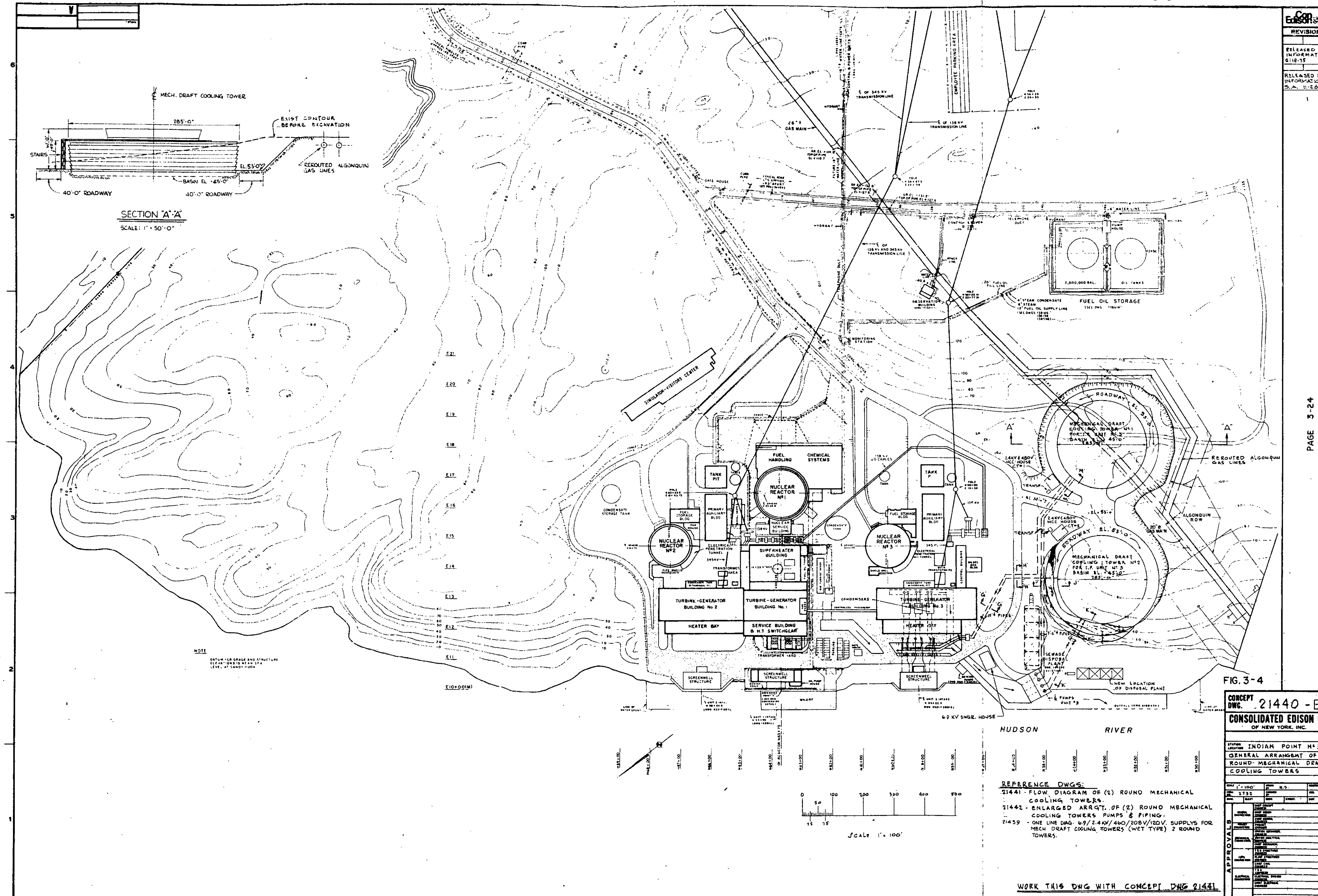
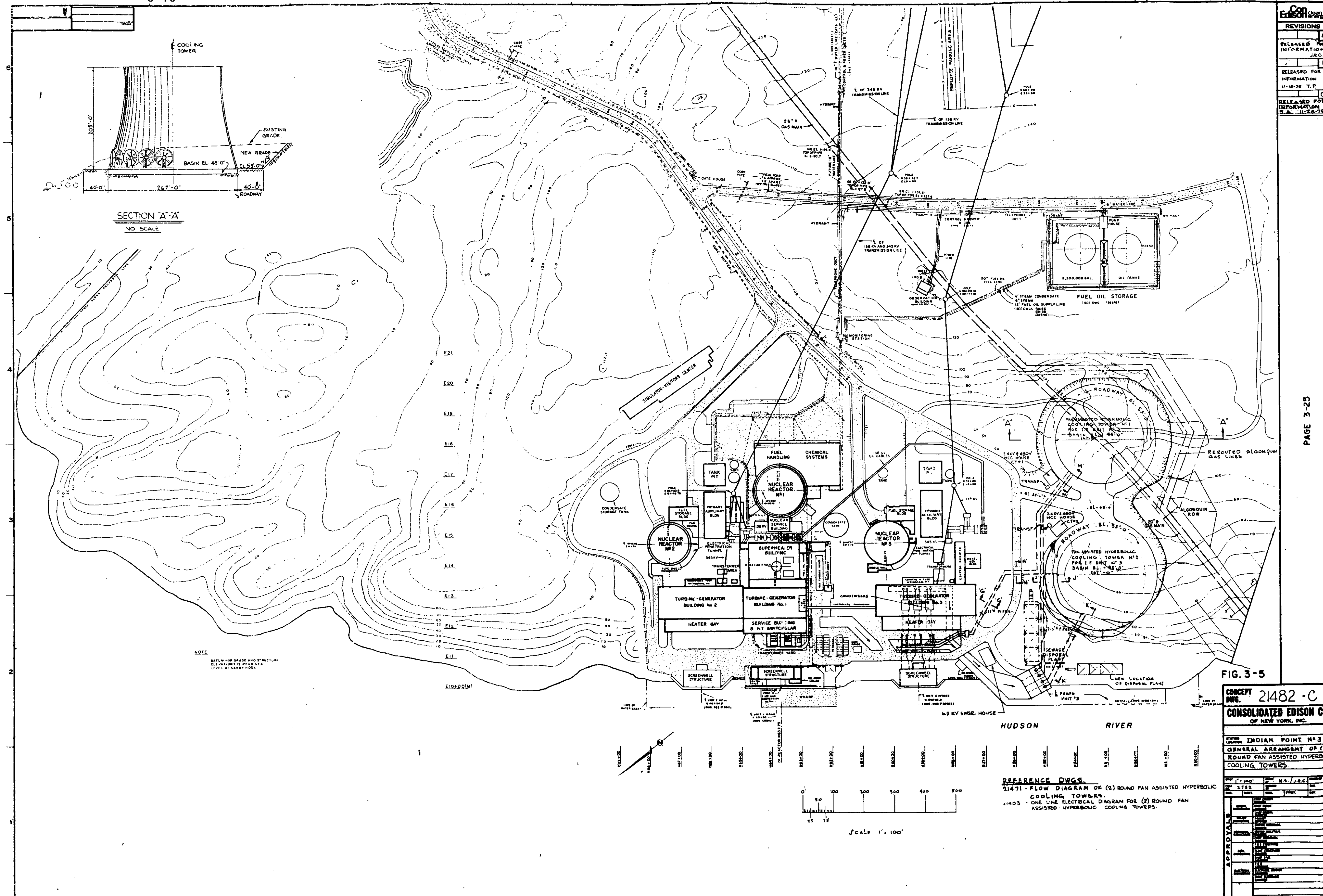


FIG. 3-4

Figure 3-4



COOLING TOWER
EXISTING GRADE
NEW GRADE
BASIN EL. 45'-0"
ROADWAY
SECTION "A"-"A"
NO SCALE
REVISIONS
RELEASED FOR INFORMATION
SIMULATOR-VISITORS CENTER
GATE HOUSE
EMPLOYEE PARKING AREA
FUEL OIL STORAGE
OBSERVATION BUILDING
MONITORING STATION
CONDENSATE STORAGE TANK
TANK PIT
FUEL HANDLING
CHEMICAL SYSTEMS
NUCLEAR REACTOR No 1
NUCLEAR REACTOR No 2
NUCLEAR REACTOR No 3
FUEL STORAGE BLDG
PRIMARY AUXILIARY BLDG
SUPERHEATER BUILDING
TURBINE-GENERATOR BUILDING No 2
TURBINE-GENERATOR BUILDING No 1
TURBINE-GENERATOR BUILDING No 3
HEATER BAY
SERVICE BUILDING
SCREENWELL STRUCTURE
WHARF
FAN ASSISTED HYPERBOLIC COOLING TOWER No 1
FAN ASSISTED HYPERBOLIC COOLING TOWER No 2
REROUTED ALGONQUIN GAS LINES
ALGONQUIN ROW
SEWAGE DISPOSAL PLANT
NEW LOCATION OF DISPOSAL PLANT
6.9 KV SWGR. HOUSE
HUDSON RIVER
NOTE
REFERENCE DWGS.
21471 - FLOW DIAGRAM OF (2) ROUND FAN ASSISTED HYPERBOLIC COOLING TOWERS.
21483 - ONE LINE ELECTRICAL DIAGRAM FOR (2) ROUND FAN ASSISTED HYPERBOLIC COOLING TOWERS.
SCALE 1" = 100'
FIG. 3-5
PAGE 3-25
CONCEPT DWG. 21482-C
CONSOLIDATED EDISON CO. OF NEW YORK, INC.
INDIAN POINT No 3
GENERAL ARRANGEMENT OF (2) ROUND FAN ASSISTED HYPERBOLIC COOLING TOWERS.
APPROVALS

Figure 3-5

Proper procedures during blasting of the material to be excavated will have to be followed in order to have no effect on the operation of Unit No. 2 during excavation. The applicant discusses precautions to be taken on pages 3-11 to 3-14 of its ER-CC-3.

Excavation is estimated to take about 12 months as pointed out in Appendix G of the FES for Unit No. 3. Further, according to the applicant, excavation is a major cost item in the capital cost of building the preferred cooling tower. Discussions of costs are presented in Section 6 of this statement.

3.4 CONSTRUCTION CONSIDERATIONS OF THE FEASIBLE ALTERNATIVE CCC SYSTEMS

3.4.1 System Components and Piping Needed

Table 3-4 of the ER-CC-3 summarizes the physical description of the major components for construction of the closed-cycle cooling systems considered by the applicant. These include the number and size of circulating water pumps and makeup pumps, the dimensions of the piping from the pumps to the cooling tower and from the tower to the existing condenser, field lines, and the electrical power equipment such as transformers, motors and switch-gear breakers.

Flow diagrams of the five types of cooling tower systems are shown in Figures 3-6 through 3-10 in the applicant's ER-CC-3. For the NDCT, the LMDCT and the WDMDCT, circulating water pumps of 200,000 gpm each (7,000 HP) will be used for the CCC-condenser system to pump the water from the condenser waterbox discharge side to the cooling tower hot water distribution system. For the CMDCT and FANDCT, four pumps of 150,000 gpm (5,250 HP) would be used. The cooled water from the discharge side of the cooling tower would then flow by gravity back to the condensers via three new conduits. The existing vertical circulating water pumps located in the screenhouse would not be used during the closed-cycle operation but will be available for return to once-through cooling operation in order to maintain system flexibility. The applicant will be able to operate one or the other cooling system mode by proper operation of isolation valves installed in the cooling system.

Figures 3-11 through 3-14 in the applicant's ER-CC-3 present detailed drawings of the mechanical and structural engineering designs of various components of the NDCT system.

The three circulating water pumps would be located in a pump pit south of the Unit No. 3 screenwell building and be at an elevation of 15 ft above MSL. This pump pit foundation would be on bedrock. A mobile crane would be available for servicing the pumps.

The two new makeup pumps each of 30,000 gpm capacity (500 HP) will have the capability of operating as makeup pumps for closed cycle operation and as circulating water pumps for once-through cooling operation. The existing reinforced concrete intake structure, which consists of six main intake channels for six circulating water pumps each with 140,000 gpm capacity and a divided intake channel with six smaller pumps, each with 5,000 gpm capacity, for the service water system, will be modified by the addition of the two makeup pumps. The reduction in flow because of a CCC system will cause the average water velocity passing through the trash bars (1 ft/sec) at a flow rate of 30,000 gpm to be reduced to approximately 0.05-0.07 ft/sec passing through the travelling screens. Figure 1-3 is a diagrammatic sketch of the existing intake structure discharge structure.

The existing discharge structure will be modified. This structure consists of a discharge canal that serves all three of the Indian Point Units. The existing outfall structures at the end of the canal is 270 ft long. Heated water discharges through 10 ports, 4 ft high by 15 ft wide spaced at 21 ft centers. Two additional ports are closed but are available if needed for once-through cooling. The discharge ports are submerged to a depth of 12 ft (center to surface) at mean low water. The ports are equipped with adjustable gates and are designed to create mixing in such a way as to minimize water temperature differences in the river. The blowdown water from the cooling towers will be discharged through this system. See Section III of the FES for Unit No. 3 for additional discussion on the intake-discharge system.

The applicant reports that the circulating water will be circulated through cement-lined carbon steel conduits. The system piping will be both underground and above ground depending on the site terrain. For the underground installation, the piping would be generally placed in a compacted sand bed within excavated trenches. There may be a need for support saddles for the piping if the bearing material is unsatisfactory.

The existing condenser waterboxes and discharge pipes will be modified for the installation of mechanical tube cleaning retrieval devices. Valves are provided to divert the flow as desired, for either closed-cycle or open-cycle operation. For both modes, the condenser flow leads into

the existing discharge tunnel as shown in Figure 3-11, ER, CC-3. This tunnel in turn leads to the new pump pit which connects with three 8-1/2' diameter pipes that connect to the tower. On the discharge side of the tower there would also be three lines which would each be bifurcated into two 6' diameter pipes and thereafter connected to the existing 7' diameter pipes which supply each individual waterbox.

3.4.2 Special Facilities Needed

Certain facilities such as those needed for chemical treatment of the circulating water system are required. Sulfuric acid will be used to prevent scale formation from the bicarbonate in the cooling circuit. Chlorination treatment to prevent algae and biofouling growth will be intermittently used. However, the existing chemical treatment facilities for Unit No. 3 can be used. The applicant has reported that a new residual chlorine analyzer would be installed at the blowdown release point.

The 30-inch blowdown line would be taken off one of the cold circulating water lines before it enters the condenser and would be piped into the Unit No. 1 discharge canal.

3.4.3 Materials of Construction

Although no specific information was provided by the applicant regarding the types of materials, except for the carbon-steel lined pipes that would be used for the construction of the tower, the various cooling tower vendors use different materials which include pressure-treated lumber with casings and louvers of asbestos cement board. The fill is available as wood or polyvinyl chloride plastic. Certain components such as fan cylinders in mechanical draft towers use glass-reinforced polyster. Hyperbolic structures use steel crossbars for support with the cement and concrete used in the construction of the shell. The reason for the hyperbolic shape is aero-dynamic and structural rather than thermodynamic. Less material is required for this shape and the shell is designed by membrane theory and results in thin sections, as little as 5 inches of reinforced concrete.

Because the feasible closed-cycle cooling systems would have to be operated with salt water for cooling purposes, the applicant would have to use due caution in selection of the material to be used in the construction of the tower. Salt water cooling towers have been built in Europe with very good results. The subject of such towers and the materials used has been addressed in several papers, including the one by Warner and Lefevre of Research Cottrell, entitled "Salt Water Natural Draft Cooling Tower Design Considerations," presented at the American Power Conference in Chicago, Illinois in April 1974. Another report sponsored by the former Atomic Energy Commission entitled, "The State of the Art of Saltwater Cooling Towers for Steam Electric Plants," published in February 1973, discusses the salt effects on the design, construction, and performance of the salt water cooling towers. On April 1975, this report was sent to the Licensing Board for its information. In addition, the staff visited the Chalk Point saltwater cooling tower which is a hyperbolic natural draft crossflow tower rising 400 ft above its base. A description of the tower is presented in several papers given at the University of Maryland Cooling Tower Conference on March 4-6, 1974.

One major component of the cooling tower system is the drift eliminators. Examples are the Marley's herring bone, sinusoidal-wave and duplex drift eliminators. See J. D. Holmberg's paper at the U. Maryland conference that discusses these different eliminators. With advances made in the design and construction of drift eliminators, drift can be controlled to 0.002% of the circulating water flow of the closed cycle cooling system. This is the value used by the applicant in its calculation of drift for the natural draft cooling tower.

3.4.4 Electrical System and Controls

The pumps used in the closed-cycle cooling system each would require 7,000 Brake Horsepower (BHP) motors for the circulating water pumps and 500 BHP motors for the makeup water pumps. For the mechanical-draft towers, 26 motors (200 BHP) for the 26 fans would be needed and for the wet/dry cooling towers, 28 motors (200 BHP) for the 28 fans would be needed. The fan-assisted natural draft tower would require 48 motors (200 BHP) while the circular mechanical draft tower would need 26 motors (200 BHP).

Power for the closed-cycle cooling system would be available from two independent sources each having the capability to supply the total new load. One feeder would be from the 138 kV/6.9 kV station auxiliary transformer and the other from a new 2.2 kV/6.9 kV transformer connected to the main generator loads. The 6.9 kV underground feeders would terminate in the 6.9 kV switch gear.

This switch gear could supply power to the new circulating water pumps and the 480 motor control center via the 6.9 kV/480 V transformers. The motor control center would provide power for large motor-operated valves and supply feeds to a second motor control center. This second center would supply auxiliary power to the aircraft warning lights on the cooling towers, roadway light, and other smaller-operated valves. See Figure 3-15 through 3-21 of the applicant's ER-CC-3 for details.

3.4.5 Safety Considerations

The closed cycle condenser cooling system, as well as the present once-through cooling system, is only required for heat removal in the plant turbine cycle and it does not perform any essential safety-related functions. If the function of the condenser cooling system were lost, there would be a loss of condenser vacuum, a turbine trip and a reactor scram. This occurrence does not involve an unreviewed safety question since it involves the same chain of events as previously evaluated in the SAR and SER.

Due to the geometry and physical construction of the NDCT's, the staff believes that a NDCT would collapse before it would topple over. Therefore, it is extremely unlikely that the collapse of a NDCT would damage any safety-related structures or equipment. The capability of the Unit No. 2 and Unit No. 3 structures to withstand tornado-generated missiles has been previously evaluated by the Commission and found to be adequate. The Unit No. 3 cooling tower will, therefore, not introduce any new tornado problems for Unit No. 2 or Unit No. 3. The capability of Unit No. 1 to withstand any tornado-generated missiles will be evaluated in consideration of any future operating authority for Unit No. 1.

The postulated maximum flood would increase the water level at the Indian Point site to 14.5 ft above mean-sea-level. Since the proposed cooling tower basin would be located at an elevation of about 45 ft above MSL, the postulated maximum flood will have no effect on the integrity of the cooling tower.

The potential of a rupture of the cooling tower circulating water lines does not affect the probability of flooding of safety related features at the Indian Point site. The existing circulation water piping in the turbine building will remain unchanged except for the addition of valves and added connections from the discharge of each condenser waterbox to the circulating pumps. If these valves or the connecting lines to the pumps fail, the circulating water would flow into the discharge canal located below the lines. The discharge canal would direct the water out of the turbine building and the flooding hazard of the safety-related equipment would, therefore, not be increased. Failure of the circulating water lines outside the turbine building would only cause a flow of water to the river because of the natural contour of the land.

The applicant has stated that it will establish limits on the use of explosives during cooling tower construction to assure that there will be no damage to safety-related structures or equipment. The applicant has carried out a controlled geotechnic investigation to determine the appropriate restrictions on blasting operations. A monitoring program for such blasting will be conducted and any required modifications will be made as the excavation proceeds.

Excavation activities for the new cooling tower will not result in any damage to safety-related structures due to dewatering. The safety-related structures are founded on rock and, therefore, will not settle because of any temporary lowering of the water table.

The applicant also described the relocation of the service water discharge piping system of Unit No. 3 because of interference with the new piping systems designed for the closed-cycle cooling system. During the modification of the single discharge line, the reactor will be required to be shutdown for a four-day alteration period since the service water system will have to be secured during this phase of the work.

In addition to the foregoing, a gas pipeline owned by Algonquin Gas Transmission Company will have to be relocated because of its proximity to the location of the cooling tower.

3.5 OPERATING CHARACTERISTICS

3.5.1 Chemical Treatment of Circulating Water System

Chemicals have to be used for treatment of the closed-cycle cooling system to reduce scale and to inhibit growth. See Appendix XI-1 in the FES for Unit No. 2 on the details of chemicals used for such purposes.

As stated above, sulfuric acid will be added at feed rate of about 1/4 gpm to the circulating water to control scaling from the bicarbonate in the water.

Although the applicant has not specified the concentration to be used, the staff requires that the pH of any acidic discharge to the Hudson River be controlled in such a manner as to be within State water quality limits. The subject of the use of sulfuric acid was addressed on page G-22 of the FES for Unit No. 3.

Algae and befowling growth in the cooling circuit will be controlled by chlorinating the circulating water. The applicant will be required to maintain residual chlorine in the blowdown of less than 0.5 ppm in accordance with the State water quality standards. The applicant has also proposed to use Amertap balls as an alternative to cleaning the tubes in the condenser. This was recommended by the staff on page XI-16 of the FES for Unit No. 2 and page XI-53 of the FES for Unit No. 3 to reduce the effects of residual chlorine discharges on the Hudson River biota.

About 15,000 gpm of water from the circulating water circuit will be discharged as blowdown resulting from reconcentration by a factor of two of the solids dissolved in the circulating water system compared to the makeup water concentration. All chemical discharges in the blowdown will be required to meet State water quality requirements. The 30,000 gpm from the service water system and if Unit No. 1 pumps are in operation, another 318,000 gpm from Unit No. 1 of river water would be available for additional dilution of the chemical discharges. Tables 6-2 and 6-3 in the applicant's ER-CC-3 show the chemical composition of the blowdown discharges with and without this dilution.

3.5.2 Cooling Tower Blowdown

A maximum of about 7.35 x 10^9 Btu/hr of waste heat is presently rejected by the condensers of Unit No. 3 to the Hudson River. With the addition of the alternate closed cycle cooling system, this heat will be rejected mainly to the atmosphere. Blowdown to the Hudson River will dissipate a maximum of 111 x 10^6 Btu/hr during the winter months and a yearly average of about 110 x 10^6 Btu/hr. The service water system will continue to supply the cooling needs of the remainder of the plant and will reject an average of about 140 x 10^6 Btu/hr. This gives a total yearly average of 251 x 10^6 Btu/hr of waste heat rejected to the Hudson River.

3.5.3 Evaporation and Drift

The applicant has estimated that there will be about 15,000 gpm of the makeup water evaporated and 15 gpm of drift (0.002%) carried over from the natural draft cooling tower and 0.005% for the mechanical draft tower.

3.5.4 Makeup Water and Water Inventory

With a blowdown rate of 15,000 gpm and 15,000 gpm of evaporation and drift, the total amount of makeup water required is estimated to be about 30,000 gpm which corresponds to the capacity of one makeup pump.

3.6 SUMMARY OF DESIGN, CONSTRUCTION, AND OPERATION OF FEASIBLE CLOSED CYCLE COOLING SYSTEMS

The staff has reviewed the detailed information provided by the applicant regarding the design, construction, and operation of feasible natural draft, wet mechanical draft, wet/dry mechanical draft, fan-assisted natural draft and circular wet mechanical draft cooling towers and concludes that from a design, structural, electrical and mechanical engineering point of view, any one of these cooling towers listed above could be built on the Indian Point site and operated without affecting the safety of the plant.

The size of the cooling towers proposed by the applicant appears to be reasonable.

One potential problem to consider is the corrosive attack of the saltwater on the cooling tower structural materials. The applicant will be required to pay special attention to areas exposed to wetting and drying in order to provide methods to protect metals from corrosion. Materials of construction such as plastic will have to be selected to avoid the problem of corrosion.

To minimize the salt drift effects, the applicant will be required to build the preferred cooling tower system with drift eliminators which will reduce drift to 0.0025% or less.

Another consideration is that this construction involves backfitting the cooling tower to the plant. The applicant appears to have considered every detail in the design and intertie of the cooling tower alternative to the existing condenser system. The applicant will have the capability of operating the plant with once-through cooling or with the closed cycle cooling system.

4. SCHEDULE AND PERMITS

4.1 SCHEDULE FOR CONSTRUCTION AND INITIATION OF OPERATION WITH THE PREFERRED CLOSED CYCLE COOLING SYSTEM

The Atomic Safety and Licensing Appeal Board in its Decision (ALAB-188) of April 4, 1975 established the conditions for the termination date for operation with once-through cooling at Unit No. 2. The present date required in the operating license for termination of once-through cooling at Unit No. 2 is May 1, 1982.

In the stipulation (see Section 1.3), the termination date for once-through cooling at Unit No. 3 is September 15, 1980. Under paragraph 2(e)* the date has been extended to September 15, 1982. Under paragraph 2(i)** of the Unit No. 3 license, and considering the present date for termination of once-through cooling at Unit No. 2, this date would be further extended to September 15, 1983. In view of the continued pendency of the EPA proceedings, the September 15, 1983 date itself is subject to some uncertainty.**

4.2 PERMITS AND REGULATORY APPROVALS

In addition to the approvals listed in Table I-2 of the FES-OL for IP-3, the design of the preferred closed cycle cooling alternative must be reviewed by various Federal, State and local agencies. The following is a list of the principal permits and regulatory approvals which are required for the construction or operation of a natural draft closed cycle cooling tower system at Indian Point Unit No. 3:

1. United States Nuclear Regulatory Commission - Review and approval of preferred alternative closed cycle cooling system for installation, approval of construction pursuant to 10 CFR Section 50.59, and amendment of operating license.

2. United States Environmental Protection Agency - Amendment of discharge permit, if required.

3. United States Advisory Council on Historic Preservation - Review of environmental impacts on historic and cultural resources.

4. United States Federal Aviation Agency - Permit for tower.

*Condition 2(e) reads as follows:

(e) The September 15 date is subject to extension if the empirical data referred to in subparagraph (c) are insufficient solely because the plant has not operated at at least 40% of rated power for 45 or more full days (8:00 a.m. to 7:59 a.m.) during the period from May 15 to July 31 in each calendar year, commencing January 1, 1975. The September 15 date will be extended one year for each calendar year in which such operation is not achieved. However, no such extension shall be granted after the plant has achieved such operation in two calendar years, and no more than two such extensions shall be granted. This subparagraph shall not bar an application for an extension under subparagraph (c) because of lack of operation. As long as an extension of the September 15 date is possible pursuant to this subparagraph, whenever the plant operates at less than 20% of rated power for more than 12 consecutive hours during the May 15 to July 31 period, no more than three circulating water pumps shall be used.

**Condition 2(i) reads as follows:

(i) No acceleration of the September 15 date shall be made pursuant to subparagraph (b) or (h) to the extent that such acceleration would result in the simultaneous excavation or outage for the construction of closed-cycle cooling systems for both Indian Point Unit Nos. 2 and 3.

5. New York State Department of Environmental Conservation - Permit to construct air contamination source (6 NYCRR Section 201.2(a)).

6. Division for Historic Preservation, New York State Parks and Recreation - Review of impacts on historic sites.

7. New York State Agency to be designated pursuant to Coastal Zone Management Act of 1972 (P.L. 92-583) - Approval of certification.

5. ENVIRONMENTAL IMPACTS OF FEASIBLE ALTERNATIVE CLOSED CYCLE COOLING SYSTEMS

The staff has carried out an intensive review of the environmental effects and impacts of those cooling towers discussed in detail by the applicant, namely, the natural draft, wet mechanical draft and wet/dry mechanical draft towers. In addition, the staff has under consideration the fan assisted natural draft cooling tower and the circular mechanical draft cooling tower. The applicant has provided the staff with detailed engineering designs of these two additional systems. The staff has made its own independent assessment of the impacts of these two additional systems.

In the following sections are discussed the effects on the environment of construction and operation of five alternative closed cycle cooling systems.

5.1 ATMOSPHERIC EFFECTS

5.1.1 Cloud and Precipitation Formation

5.1.1.1 Natural Draft Cooling Tower (NDCT)

The visible plume from a cooling tower is in fact an artificial cloud. The extra heat and water vapor can, under proper meteorological conditions, create cumulus clouds. Aynsley,[27] Spurr,[2,9] Smith, et al.[6] and others have observed that, if meteorological conditions are proper, the updraft from a NDCT can create cumulus clouds after the initial visible plume has evaporated.

Aynsley concludes that this is a "rare occurrence," and that these man-made clouds only precede natural cloud formation. Experience in England indicates that natural draft cooling towers do create clouds but not precipitation.[1,3,4,8,28] The state-of-the-art in cloud physics is such that meteorologists cannot now say with any degree of certainty that there will or will not be an increase in rainfall amounts due to cooling tower plumes.[29-32] It is possible that the plume from a cooling tower could somehow trigger an existing atmospheric instability and create extra cumulus congestus clouds and precipitation miles downwind of the release point.

Although there are many examples of cloud generation from natural draft cooling tower operation, no cases of showers of precipitation being generated by the plume have been observed and reported in the literature. It is quite possible that a cooling tower will modify the pattern of rainfall in the area, but not the total amount for the region, as the vapor flux from the tower is very small compared to natural fluxes. It is also possible that the rainfall amount could be somewhat higher below a cooling tower plume because of falling drops collecting water from the visible plume than in areas removed from the plume. A numerical model study indicates that the amount of extra moisture is on the order of 10 mm/year, or a 1% increase over natural rainfall.[33] This model also predicts a decrease in summer sunshine of less than 4 minutes/day except for areas within one mile of the tower.[33] This is a conservative estimate of shadowing, since periods with natural cloud cover were not subtracted from the computer results.

The climatological data before and after the installation of a complex of eight NDCT's serving a 2000-MWe power station in England showed no detectable changes in total rainfall, hours of bright sunshine, or incidence of morning fog during the four-year period after the station became operational.[34]

5.1.1.2 Mechanical Draft Cooling Towers (MDCT)

Hanna and Perry[21] report that, on rainy days, the plume sometimes forms a stratus-type cloud that may extend for tens of kilometers below the natural overcast layer, and that a cumulus cloud can form in the updraft created by a cooling tower plume after the initial plume has evaporated completely. In the Oak Ridge study, it was concluded that some form of cloud development was initiated on 10% of all days. Very light snow caused by a MDCT discharge has been observed in Tennessee[35] and Indiana.[36]

5.1.1.3 Summary and Conclusions

The visible plume from wet cooling towers is a cloud that will reduce sunshine in the offsite area by at most an average of a few minutes per day. Cumulus clouds will sometimes form from the vertical updraft created by the plume; this type of cloud formation will usually occur on those days in which cumulus clouds will form due to natural processes. Increases in precipitation, if any, will be quite small and not detectable in the natural variability of climatological conditions.

5.1.2 Ground Level Fogging and Icing

5.1.2.1 Natural Draft Cooling Tower (NDCT)

Most reports written more than a few years ago on NDCT's state that they have the "potential" to cause ground level fogging and icing; however, observations at such towers indicate that they rarely,if ever,do. The warm, moist plume enters the atmosphere at heights of 375 ft or more above ground level and either evaporates or merges with a natural cloud layer before reaching ground level. In England, it has been observed that two or three times per year "a few detached fragments" of visible plume were observed touching the ground; this condition occurs only when strong winds create aerodynamic downwash downwind of a complex of eight closely spaced, relatively short (375 ft) NDCT's.[3]

There have been no cases of visible plumes reaching the ground during the five years of operation of the 2250-MWe steam plant at Paradise, Kentucky.[10] According to observers of meteorological conditions in the vicinity of the Keystone, Pennsylvania, Power Plant (1800-MWe) no surface fogs or icing have been observed in four years of operation. The same conclusions have been reported in England,[1,3,8,12] Switzerland,[4,38] and the United States.[5, 9-11] Hosler does report one occasion on which the visible plume from a natural draft cooling tower did reach the ground in a mountainous terrain area; however, this is the only reported case.[37]

The Central Electricity Generating Board of Great Britain reported its findings on the environmental effects of cooling towers[28] in which no measurable change in relative humidity was detected downwind. The visible plume sometimes persisted for a number of miles downwind, altering sunshine in the area. No drift was observed from the towers. They reported that cumulus clouds were sometimes formed but that no cases of showers or precipitation being generated by the plumes have been observed. More recent observations in England, Europe,and the United States confirm these conclusions.

Photographs taken at cooling tower sites sometimes show ground level fog completely separate from the rising plume from the towers.[27, 38] The surface fog is caused by natural processes, such as nocturnal radiation; the rivers and reservoirs used to supply makeup water to the towers aid in its formation.

Thus, observations at operating NDCT's show that the NDCT does not cause fogging and icing in level terrain areas.

a. Applicant's Analysis of Fogging and Icing from a NDCT

The applicant has reported in Appendix B of the ER-CC-3, that the results of the mathematical model used to compute plume dispersion indicate that since the visible portion of the plume is not expected to reach ground level for sustained periods, ground fog due to a natural draft tower operation would be rare. Only one hour of predicted ground fog resulted from the computer runs. The terrain was accounted for in these runs. The staff agrees with the conclusions reached by the applicant and concurs that there would be no safety hazard on highways or to boating on the river. The applicant reported that about 79 hours of natural fog (defined as visibility less than 1/4 mile at the 33 ft level) were measured at the meteorological tower.

This represents an annual frequency of about 1-2%. The applicant also reported the increase in ground level relative humidity (RH) and found that about 99% of all hours had an incremental increase of less than 1% RH. The staff concurs that the NDCT will cause minimal impact on the surrounding environment with respect to increased RH.

The conclusions reached by the applicant regarding minimal induced fogging effects and RH increases from NDCT are similar to that reached by the staff in the FES for Unit No. 3. In the FES for Unit No. 3, the staff found only a small increase of 4 hr per year resulting from fogging from the NDCT. The staff also found that downwash effects of the plume from the NDCT would be very rare and occur only with wind speeds in excess of 21 mph.

The applicant also discusses the probability of ice and frost formation due to the plume from the NDCT and found that the potential for ice accumulation on structures located in the plume path is negligible. The staff also pointed out in Appendix G of the FES for Unit No. 3 that condensation of the cooling tower plume in cold weather causes the plume to rise to much higher elevations, an effect that tends to reduce local icing. Thus,the staff agrees with the applicant that there will be very small impacts from fogging and icing from the NDCT.

With regard to precipitation, the applicant also found that incremental increases in snowfall or rainfall from the plume during periods of naturally occurring snowfall or rain would be negligible or very localized. The staff concurs with this finding as had been previously pointed out in Appendix G of the FES for Unit No. 3 and by Overcamp and Houll.[39] Any contribution of the operation of the NDCT to the precipitation in the Indian Point area would be much below the natural variability of precipitation. Thus, the staff expects that there will be no precipitation effects in the environment from operation of the NDCT.

b. Staff's Analysis

See Section 5.1.3.3 for staff's analysis of fogging and icing from a NDCT.

5.1.2.2 Mechanical Draft Cooling Towers

The fog potential from shorter forced-ventilation MDCT's is much greater than for NDCT's for the following reasons:

(1) MDCT's release their water vapor at a much lower elevation (50 to 80 ft compared to 350 to 500 ft) where winds are weaker, the saturation deficit is less, and the surface nocturnal inversion frequently prevails.

(2) The plumes are frequently trapped in building eddies due to aerodynamic downwash.

(3) Much higher entrainment rates are generated owing to smaller exit diameters, higher exit speeds, and additional turbulence created by the fan.

Although wet MDCT's have been used to cool power plants for decades, there is very little quantitative data available on the water droplet plumes which they generate, and even fewer references on significant adverse impacts due to their operation. Several studies have reported light, friable rime icing from cooling tower operation,but there are no known reports of severe icing on adjacent roads or structures as the result of the operation of modern mechanical draft cooling towers. The primary cause of surface fogging and icing near mechanical draft cooling tower is aerodynamic downwash, which brings the plume to the ground very near the tower.[21,22,40] A recent study of the plumes from the Oak Ridge, Tennessee induced draft towers (about 2000 MWt) indicates that during a seven-month period (December 1972 through June 1973), downwash was observed on 65% of all days (the photographs were taken during the afternoon) and occurred whenever the wind speed was more than 3 meters per second (mps) and wind direction was more than 10° from the long axis of the towers. This fog either evaporated completely or lifted due to its buoyancy once it escaped the tower cavity region, or about 100 meters downwind. With the wind direction along the long axis of the towers (within $\pm$ 10°), no downwash was observed with winds up to 5 mps. The greatest distance over which fog was observed at Oak Ridge was 0.5 km.[27] EPA studies indicate "Mechanical draft towers may cause problems, but in most cases fogging and icing would be onsite (i.e., within 1000-2000 ft of the tower)."[25]

Fog affects the environment because of wetting, icing, and reduced visibility. The impact of cooling system fog on most human activities (such as highway traffic) depends primarily on horizontal visibility. Unfortunately, the term "fog" means different things to different people. To some, fog exists only when "one cannot see his hand in front of his face." The international definition of fog, and the one used by the U.S. National Weather Service (NWS), is a condition consisting of a visible aggregate of minute water droplets or ice crystals suspended in the atmosphere near the earth's surface which reduces visibility to less than one kilometer (0.62 miles). If horizontal visibility is one kilometer or more, the condition is mist. The NWS uses these definitions in its synoptic (six-hourly) weather codes, and "dense fog" for conditions in which the visibility is less than 0.25 mile. Contrary to international usage, the NWS in its hourly (airways) weather observations describes the condition of visibility of six miles or less due to water drops or ice crystals as fog; the exact reduction in visibility is given in another portion of the weather report. The "fogging" effects discussed in the literature on cooling systems seem to refer to any reduction of horizontal visibility due to thermal discharges, including those which would have only a very minor effect on man's activities. If the air

temperature is below 32°F, this fog is supercooled and will be deposited mostly on vertical surfaces as rime ice with a very low density and little structural strength. Wetting of structures and biota downwind of cooling towers can be caused by both drift deposition and drops in the visible plume. This wetting can cause damage or corrosion to structures as well as provide conditions favorable to plant disease.

See staff comments in Subsection 5.1.2 regarding the applicant's results on the use of its model to estimate fogging and icing effects. For the period of October 1973 through September 1974, the applicant found that the plumes from the MDCT's would induce a total of 97 hours of fog. Details of the results of the applicant's analysis of MDCT's effects are presented in Appendix C to the ER-CC-2. The frequency of occurrence of fog for each month was reported in the applicant's Figures 5.4.1 through 5.4.12 for the October 1973-September 1974 period when the possibility of fog formation is the greatest. The applicant also reported the occurrence of 83 hours of induced icing during the period October 1973 through April 1974. (See the applicant's Figures 5.5.1 through 5.5.5 in Appendix C of the ER-CC-2 for the frequency of occurrence of icing.)

The staff also investigated the frequency of occurrence of fogging from the MDCT's described in Appendix G in the FES for Unit No. 3 with MDCT's at both Units No. 2 and 3. The increase in fogging is estimated to be a maximum of 66 hr/year about two miles north of the site. The meteorological data for these calculations, however, were those supplied by the applicant in the FFDSAR for Unit No. 3 and discussed in Appendix E in the FES for Unit No. 3 and thus were different from those obtained from the 400 ft meteorological tower during the October 1973 through September 1974 period. See Section 5.1.3.3 for discussion of the staff's analysis of fogging and icing, using the data from the 400-ft meteorological tower.

5.1.3 Drift and Salt Deposition

In each alternative closed cycle cooling system, water is evaporated and the vapor released as the plume from the top of the specific wet cooling tower unit under consideration. In addition, entrained water in the form of small droplets called "drift" also exits from the top of a wet or wet/dry cooling tower. The salts and other chemicals dissolved in the drift, particularly when brackish water is used as circulating cooling water, will,therefore,be carried out of the top of the tower and the water droplets may deposit on the local surrounding area.

The applicant used 0.002% as the drift level for its NDCT, 0.005% for the MDCT's,and 0.0025% for FANDCT's in its calculations on salt deposition and salt aerosol concentration. These values are consistent with the reported drift rates from modern, well-maintained cooling towers.

As described in Appendices A and B of the ER-CC-3, the applicant has performed an analysis of saline drift deposition and has estimated effects from two NDCT and linear wet and linear wet/dry MDCT's and FANDCT's at the Indian Point site. Models which consider drift particle size, accretion, evaporation, settling, turbulent dispersion, aerodynamic effects and topographic effects were used for the estimation of drift deposition. Two cycles of concentration were assumed in both the NDCT and MDCT models. Weather data for the models were obtained from the site during the period October 1973 through August 1974. The model also used field data on plume growth by an empirical correlation derived from photographic observations of the plume from the Paradise Plant NDCT obtained in a cooperative program with the Tennessee Valley Authority.

The applicant also carried out field studies to estimate the ambient salt deposition in the surrounding area. The ambient salt deposition ranges from 38 to 366 $Kg/Km^2/mo$ (0.36 to 3.4 lbs/acre/mo) with a mean value of 160 $Kg/Km^2/mo$ (1.4 lbs/acre/mo). In comparison, maximum seasonal values of the salt deposition from NDCT at Units 2 and 3 are 510 $Kg/Km^2/mo$ (winter), 15 $Kg/Km^2/mo$ (spring), 250 $Kg/Km^2/mo$ (summer) and 420 $Kg/Km^2/mo$ (autumn). Maximum seasonal values predicted by the applicant from an NDCT at Unit 2 and MDCT at Unit 3 were estimated to be the following: 840 $Kg/Km^2/mo$ (winter), 50 $Kg/Km^2/mo$ (spring), 1500 $Kg/Km^2/mo$ (summer), and 2700 $Kg/Km^2/mo$ (autumn).

During the eleven-month sampling period, the ambient salt concentration (as sodium chloride aerosol) ranged from 0 to 6.15 $\mu g/m^3$ and averaged approximately 1.0 $\mu g/m^3$.

5.1.3.1 Applicant's Analysis of Drift from NDCT

The analysis of drift deposition was based on monthly average ambient make-up water salinities ranging from below 100 ppm to a maximum of 3500 ppm and "two cycles of concentration". The applicant indicates that a 3500 ppm represents a highly probable and realistic one-month average make-up water salinity for study of botanical injury (ER-CC-3, p. 6-18).

Based on the above salinity, the applicant calculated for two natural draft cooling towers at Indian Point Units 2 and 3 that the highest annual average offsite aerosol concentration would be 1.5 mg/m^3 and that the highest monthly offsite drift deposition (350 kg/Km^2/mo) would be occurring at 1.20 miles southeast of the tower.

Conventional units for drift deposition are Kg/Km^2, Kg/Ha* or lbs/acre. The unit "lbs/acre" is more understandable to non-technical readers. The units are interconvertible as follows: 896 Kg/Km^2 = 8.96 Kg/Ha = 8.0 lbs/acre.** Thus, the applicant's conservative estimate of drift deposition suggests that about 3 pounds of salt per acre per month (3.5 Kg/Ha/mo) will be deposited annually from an NDCT in the area of highest deposition. Five miles downwind of the tower the predicted deposition is 8.0 Kg/Km^2/mo or about 0.07 lbs/acre/mo.

Estimates of average annual drift deposition are not sufficiently detailed for estimating biological effects since much of the deposition may occur during late fall, winter, or early spring when most vegetation is normally dormant and not strongly susceptible to damage from salt. During the winter months, however, injurious effects will not be enhanced because plants are not actively metabolizing or translocating substances and also because salt drift will be very low. In the spring, drift will be at the low point of the annual cycle and dormancy will be broken with no saline barrier to growth. Estimated monthly salt deposition has been provided by the applicant for 11 months of the year. Most critical of these are the months of July through October since these are the months when high river salinities occur, vegetation is fully developed, and long periods without rain are possible. Drift isopleths for the month of August are given in Figure 5-1 reproduced in this statement as an example of the applicant's results for the NDCTs. The highest offsite deposition rate was found to be about 350 Kg/Km^2/mo ($\sim$3 lbs/acre) because of high river salinities and occurs about 1.2 miles south of the tower (ER-CC-3). Staff estimates of monthly and annual deposition for an NDCT are given in Table 5-1. Staff predictions for two NDCT's at the Indian Point site are contained in Section 5.1.3.3.

Deposition falls off rapidly with distance from the tower. In all cases during the critical four months, it is equal to or less than 200 Kg/Km^2 (1.8 lb/acre) at or beyond 2 miles from the tower in all directions. During the remaining eight months of the year, the values range downward from those indicated.

5.1.3.2 Applicant's Analysis of Drift from MDCT's for Unit 3 and NDCT for Unit 2

Drift modelling for the mechanical draft case (linear wet mechanical draft, linear wet/dry mechanical draft, round wet mechanical draft) was based on 45-year records of monthly river salinities and on an assumed drift rate of 0.005% of the circulating water flow. Fan assisted natural draft was assumed to have a drift rate of .0025%. Two cycles of concentration were assumed and site weather data (October 1973 - September 1974) were used. One representative month for each season was selected: May (spring), August (summer), November (autumn), and February (winter). Average monthly river salinities were used and spring drift deposits were not calculated due to extremely low river salinities for all spring months.

The linear MDCT model results show that monthly maximum salt drift would amount to 6000 Kg/Km^2/mo (53 lbs/acre/mo) during August, 2700 Kg/Km^2/mo (24 lbs/acre/mo) in November, and 1200 Kg/Km^2/mo (11 lbs/acre/mo) in February.

With mechanical draft wet/dry cooling towers at Unit No. 3 and NDCT at Unit No. 2, the applicant predicted maximum salt deposition rates in winter of 840 Kg/Km^2/mo, spring 50 Kg/Km^2/mo, summer 1500 Kg/Km^2/mo, and autumn 2700 Kg/Km^2/mo. Round or circular mechanical draft wet cooling towers (CMDT) for Unit No. 3 and NDCT of Unit No. 2 were predicted by the applicant's model to have maximum monthly drift deposition values of 1000 Kg/Km^2/mo (winter), 200 Kg/Km^2/mo (spring), 5000 Kg/Km^2/mo (summer), and 5000 Kg/Km^2/mo (autumn).

Fan assisted natural draft towers at Unit No. 3 plus an NDCT at Unit No. 2 would potentially deposit 63 Kg/Km^2/mo in the winter, 30 Kg/Km^2/mo in spring, 1000 Kg/Km^2/mo in the summer and 1500 Kg/Km^2/mo during autumn.

*Ha = hectare.

**Kg/Ha x 0.89 = lbs/acre.

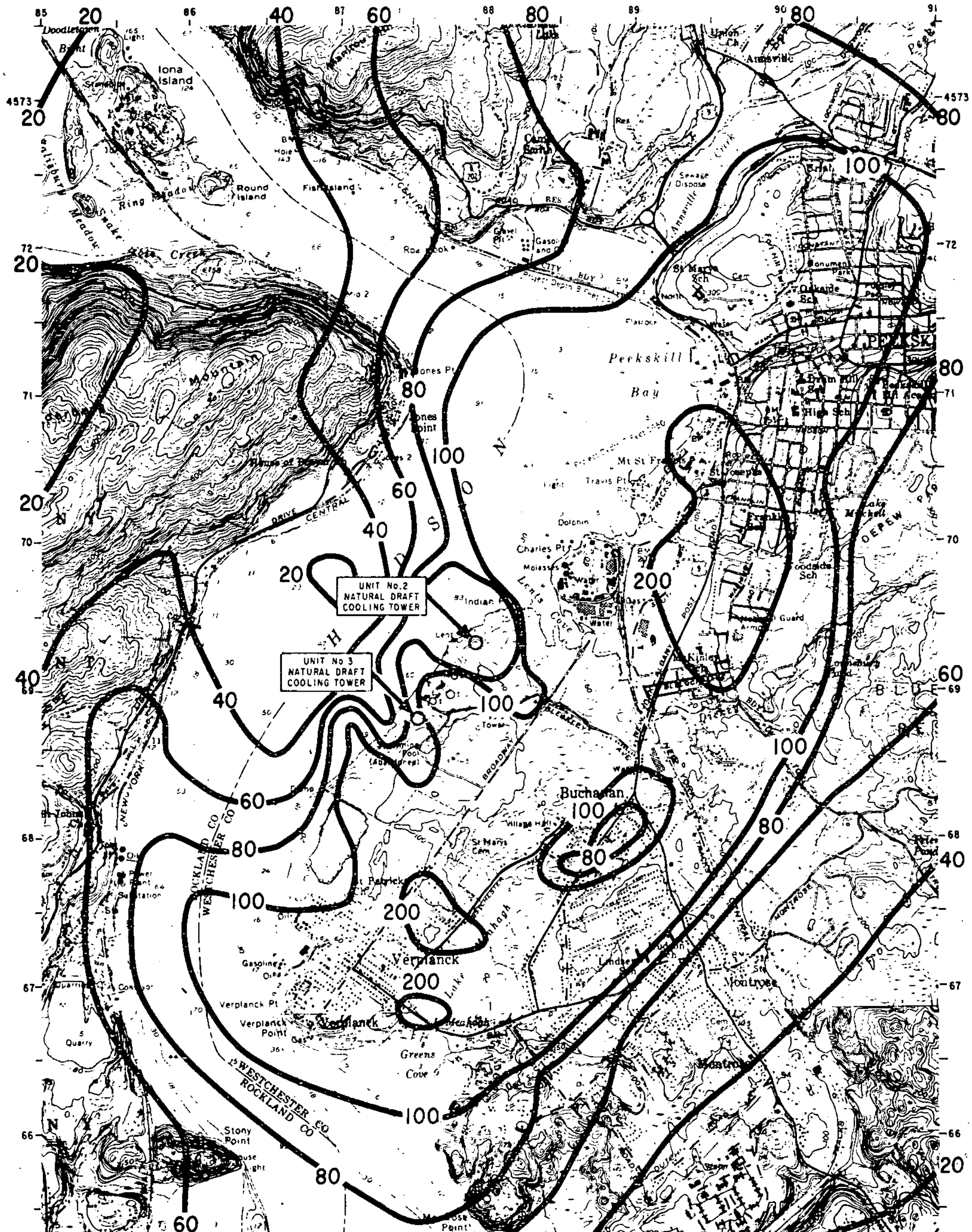


FIGURE 5-1

SALT ACCUMULATION AUGUST 1974 (Kg/Km^2)
UNIT 2 - NATURAL DRAFT WET TOWER
UNIT 3 - NATURAL DRAFT WET TOWER
DRIFT SALINITY 7000 ppm

Ref: ER-CC-3 Figure 6-5

Figure 5-1

TABLE 5-1

MAXIMUM CUMULATIVE DRIFT DEPOSITION FOR A NATURAL DRAFT COOLING TOWER AT INDIAN POINT*

Period	Maximum at One Mile Kg/Ha	lb/Acre	Maximum at Two and One-Half Miles Kg/Ha	lb/acre
Year	6.0	5.3	2.5	2.2
Oct.	1.2	1.1	.28	.25
Nov.	.084	.075	.026	.023
Dec.	.098	.087	.026	.023
Jan.	.12	.11	.033	.029
Feb.	.25	.22	.093	.083
Mar.	.00060	.00054	.00015	.00013
Apr.	.000016	.000014	.0000048	.0000043
May	.0098	.0099	.0023	.0021
June	.49	.43	.11	.094
July	1.5	1.4	.27	.24
Aug.	3.7	3.3	.93	.83
Sep.	2.5	2.2	.76	.67

*By choosing the midpoint of a line connecting the centers of the two towers as the reference point, a reasonable description of the drift resulting from two NDCTs can be obtained by doubling the magnitude of these cumulative drift deposition predictions. (See Section 5.1.3.3.b.2 for a discussion of these results.)

Highest predicted deposition values for each tower combination are predicted to occur close to the tower and the land area covered is very small and vegetation is scarce. Certain small areas of Verplanck to the south and Peekskill to the north could receive in the range of 500 to 1000 Kg/Km^2/mo (4-9 lbs/acre/mo) from linear mechanical draft towers under normal humidity conditions.

Examples of the predicted August deposition for the four types of mechanical draft towers considered by the applicant for Unit No. 3 as well as the preferred NDCT for Unit No. 2 are given in Figures 5-2, 5-3, 5-4 and 5-5 reproduced from applicant's ER-CC-3. Because of the geographical position of Indian Point Unit Nos. 2 and 3 and the prevailing winds of the area, much of the total saline emission is predicted to fall into the Hudson River to the south or in Peekskill Bay to the north. The heaviest terrestrial deposits are likely to occur on or near the shoreline of the river and bays.

5.1.3.3 The Staff's Model Predictions of Fog, Icing, and Salt Deposition and Aerosol Concentration

The staff has performed an independent assessment of potential salt drift deposition and increased hours of fogging for NDCT and circular MDCT for Indian Point Unit No. 2. For Unit No. 3, the staff has extended these calculations by linear super-position and graphical interpolation of the Unit No. 2 results. This procedure has been followed for the case of two NDCTs and four circular MDCTs. The possible drift effects of the combination of two circular MDCTs for Unit No. 3 and NDCT for Unit No. 2 would be dominated (within the accuracy of the calculations) by the drift pattern from the circular MDCTs. The staff judges the separation of the towers for the two units to be great enough that interaction of the two plumes would have little effect on the frequency of tower induced fogging. The fog and ice predictions presented here are, therefore, the same as those analyzed for Unit No. 2. The applicant's predictions of fog and drift for conventional MDCTs at Unit No. 3 and an NDCT at Unit No. 2 have been accepted as representative state-of-the-art calculations by the staff. (See Appendix B of the ER-CC-3.) Wet/dry MDCT effects from drift have been assumed to be the same during the critical months (July, August, September, and October) as those of the linear MDCT since the wet-only mode would be operable during these months. Reduced visible plume during operation in the wet-dry mode in the winter months would be an advantage for the wet dry towers. An independent assessment was made of the potential fog and drift for the NDCT since this is the applicant's preferred closed cycle system. The CMDCT effects were also analyzed since they represent a relatively new design which could reduce the impacts of MDCT. It was assumed that the fan-assisted towers (FANDCT) would have improved drift characteristics with respect to CMDCT although not as good as an NDCT. The fogging potential for FANDCT was assumed to be similar to the levels predicted for NDCT.

The staff's analysis used ORFAD,[41] a predictive mathematical model based on the empirical plume rise equations of Briggs,[42] as modified by Hanna[43] and by Briggs[44] to account for the increased buoyancy effect of multiple plumes. The program was modified to allow the calculations to be performed by month so that the effects of seasonal variations in river salinity could be accounted for in the evaluation of potential biological damage. A further modification was incorporated so that data from the 400-ft high meteorological tower on site could be utilized since a full year of these data (October 1973 thru September 1974), taken at hourly intervals, were available. Prior staff calculations, shown in Appendix G of the FES for Unit No. 3 for Indian Point, used surface weather data for Newburgh, New York which were obtained from the National Weather Records Center.[45] It became evident that despite the much longer period of record for Newburgh (at least ten years), the valley effects at Indian Point dominated the wind patterns and, therefore, the predicted fog and drift patterns obtained from the Newburgh data would not be credible. Subsequent calculations on the CMDCT using 400 ft and 125 ft wind speed and direction information indicated that the variation of wind speed and direction with height could also have a significant effect on the predicted fog and drift patterns. Since the Newburgh data had only surface wind speed and direction, this was also viewed as a shortcoming for this particular case.

An independent evaluation of cooling tower impact with the KUMULUS model[80] compared well with the results of the ORFAD model used by the staff. The Argonne model review[81] identified some problems inherent in the ORFAD model which might effect the results derived from using it. This discovery has prompted a review of the ORFAD model. However, the model as used by the staff for Indian Point provided comparable results to those resulting from KUMULUS. In view of the apparent similarity in results as presented in this environmental statement and in Reference 80, it seems the ORFAD results accurately reflect the cooling tower salt deposition impact at the Indian Point site.

The choice of onsite data caused some further complications. The onsite meteorological program does not record the natural incidence of fog nor does it provide the information on cloud cover used by ORFAD in determining atmospheric stability classes. The natural fog incidence was resolved by arbitrarily assigning an hour of natural fog whenever the visibility was less than one-fourth of a mile. (The applicant defined natural fog as visibility of less than 1/4-mile at the 33-ft level.) The stability class was determined by using the temperature difference between 33 feet and 400 feet and tables from Regulatory Guide 1.23. When utilizing NOAA data, ORFAD determines the rate of temperature change with height by using an average value for each stability class. For the calculations presented here, the actual temperature change as measured on the met tower was used.

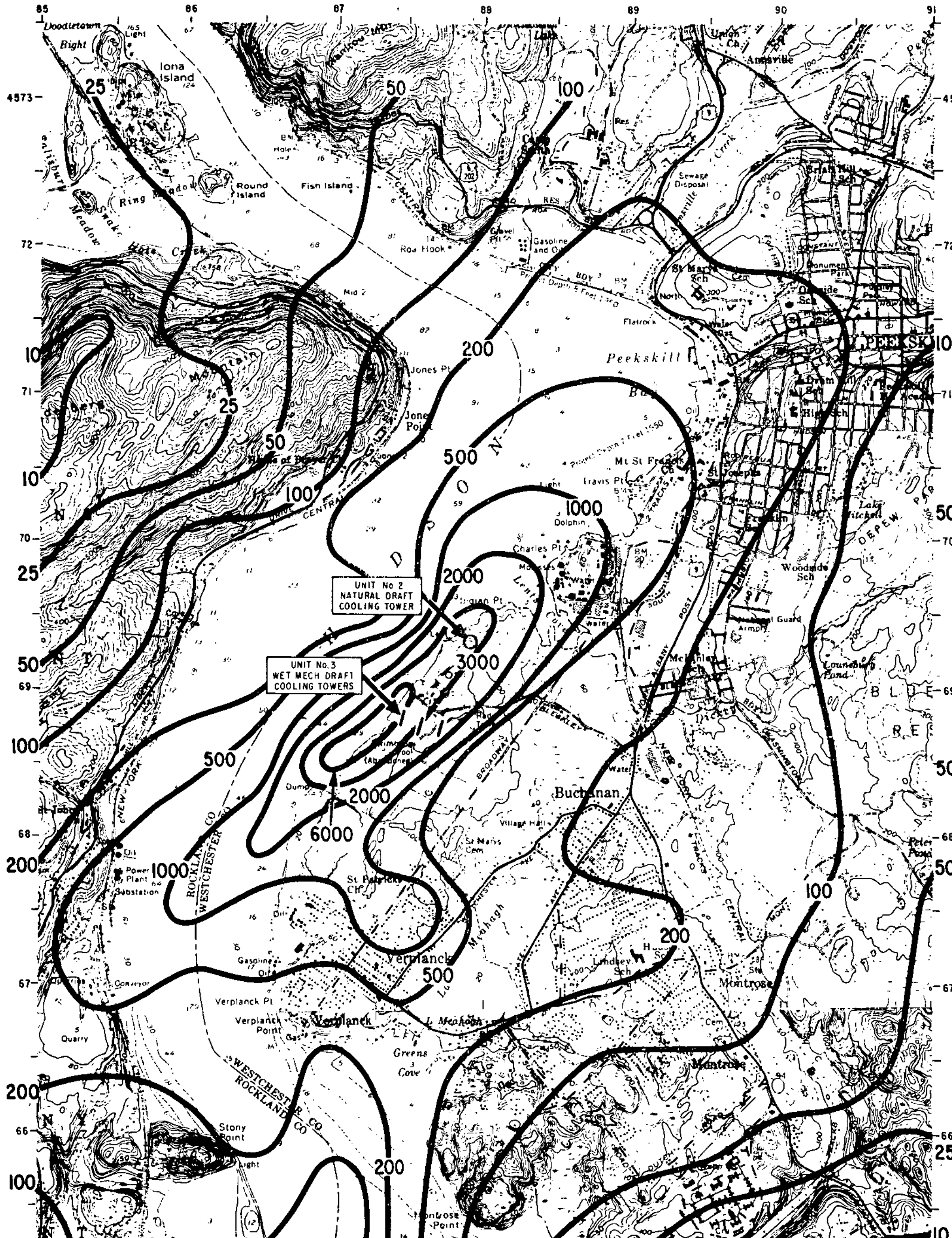


FIGURE 5-2

SALT ACCUMULATION AUGUST 1974 (Kg/Km^2)

UNIT 2 - NATURAL DRAFT WET TOWER

UNIT 3 - LINEAR MECHANICAL DRAFT WET TOWER

DRIFT SALINITY 7000 ppm

Ref: ER-CC-3 Figure 6-6

Figure 5-2

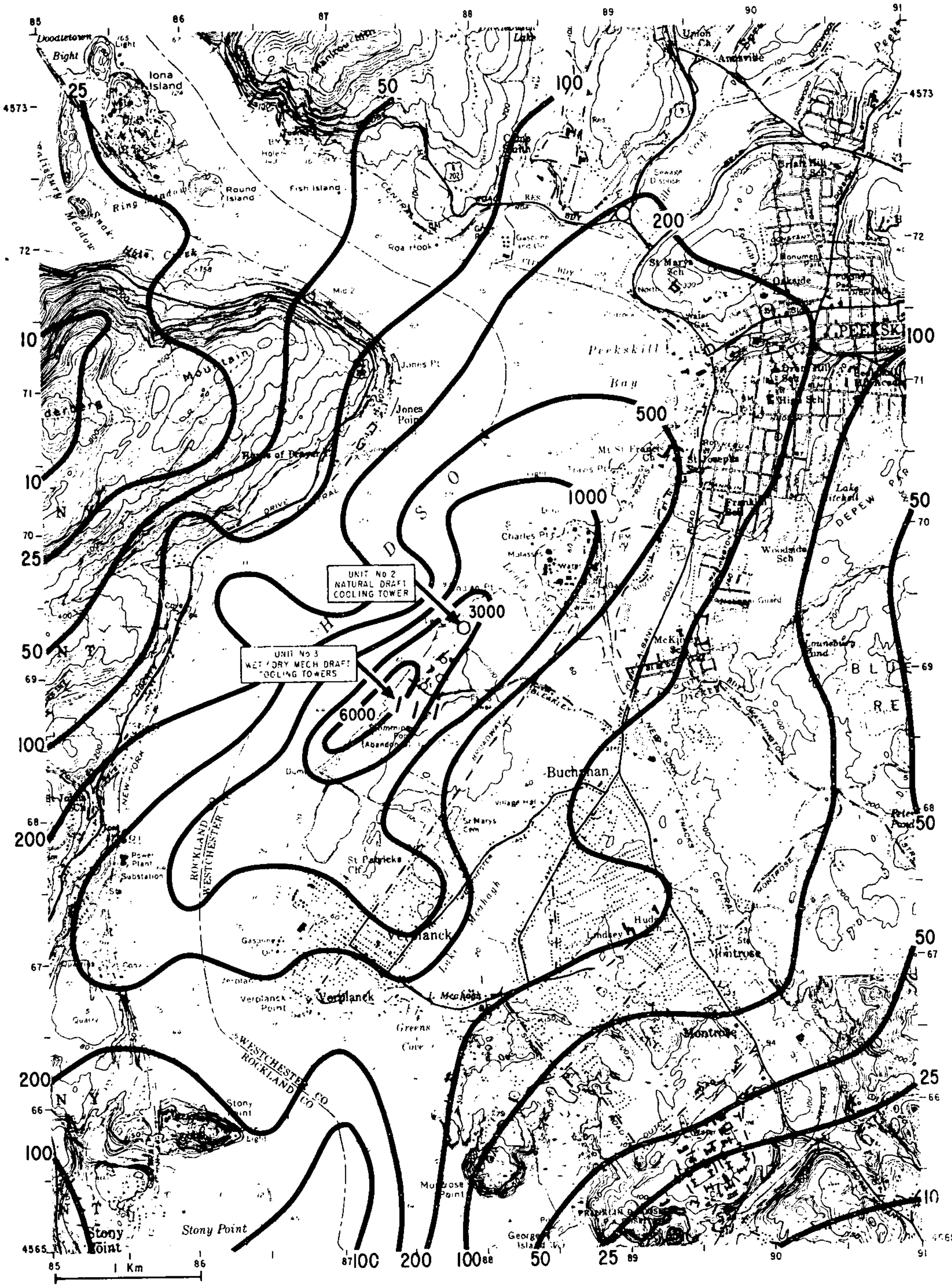


FIGURE 5-3

SALT ACCUMULATION AUGUST 1974 (Kg/Km^2)
UNIT 2 - NATURAL DRAFT WET TOWER
UNIT 3 - MECHANICAL DRAFT WET/DRY TOWER
DRIFT SALINITY 7000 ppm

Ref: ER-CC-3 Figure 6-7

Figure 5-3

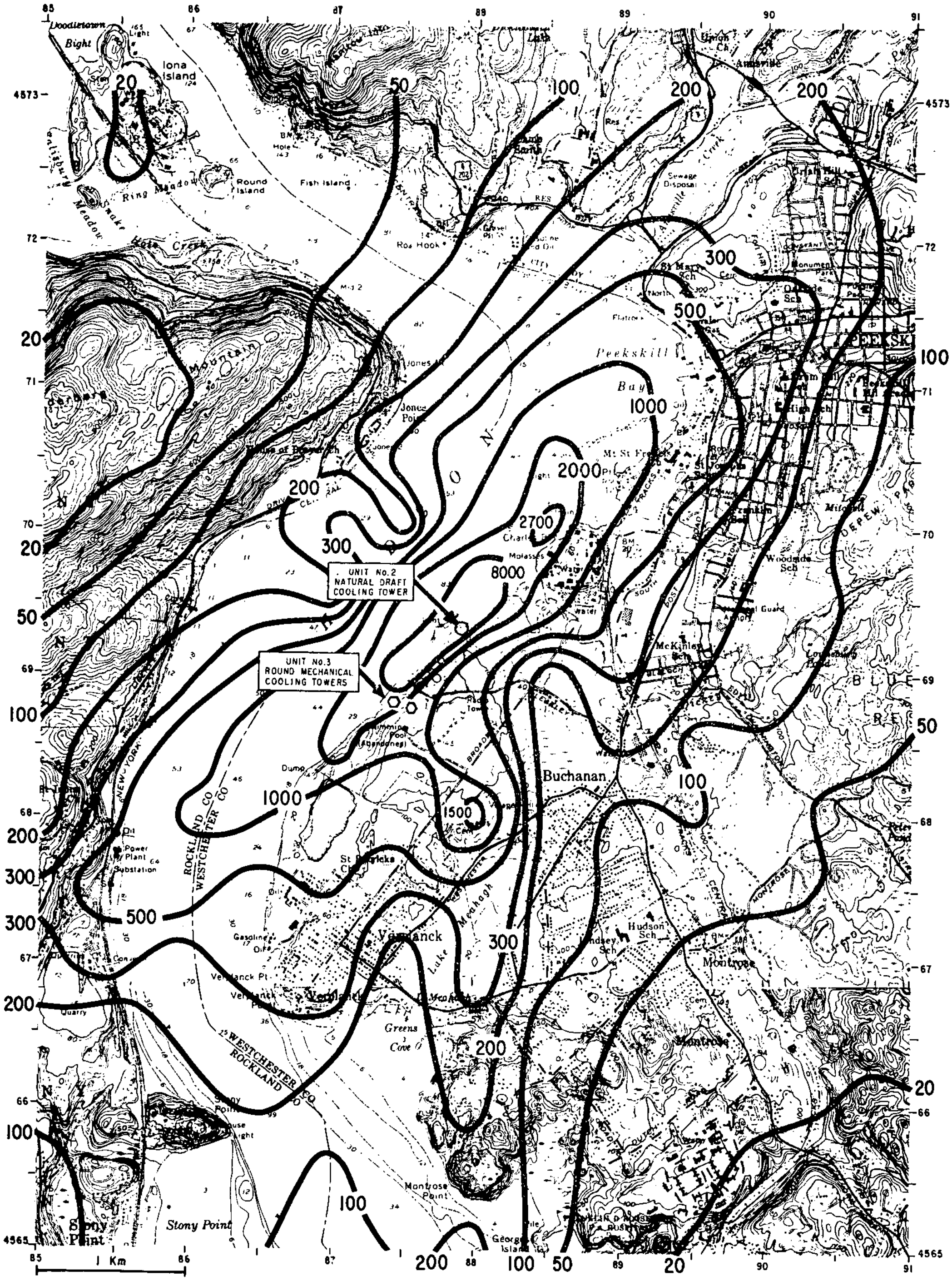


FIGURE 5-4

SALT ACCUMULATION AUGUST 1974 (Kg/Km²)
UNIT 2 - NATURAL DRAFT WET TOWER
UNIT 3 - ROUND MECHANICAL DRAFT WET TOWER
DRIFT SALINITY 7000 ppm

Ref: ER-CC-3 Figure 6-8

Figure 5-4

FIGURE 5-5

SALT ACCUMULATION AUGUST 1974 (Kg/Km^2)
UNIT 2 - NATURAL DRAFT WET TOWER
UNIT 3 - FAN ASSISTED NATURAL DRAFT WET TOWER
DRIFT SALINITY 7000 ppm

Ref: ER-CC-3 Figure 6-9

Figure 5-5

The information in the remainder of this section (5.1.3.3) consists primarily of a description of the calculations for Unit No. 2 as presented in the FES related to selection of the Preferred Closed Cycle Cooling System at Indian Point Unit No. 2 (NUREG-0042). Sub-sections b.2 and c.2 have been added to describe the calculations for multiple cooling towers resulting from construction of towers for Unit No. 3 in addition to the towers for Unit No. 2.

a. The ORFAD Program

ORFAD is a computer program written at the Oak Ridge National Laboratory (ORNL) to estimate the amounts of fog and drift deposition that could result from operation of wet cooling towers. The program produces reasonable estimates rather than exact values. Elaborate analyses cannot be justified for practical applications, since the numerical parameters necessary to a complete description of fog and drift phenomena are still but poorly known and inadequate for a firm basis in theory. Of the procedures currently available, empirical relationships are widely accepted as the most reliable and best adapted for analyses using reasonable amounts of computer time.

The primary inputs to the program are the tower dimensions, operating parameters, and hourly meteorological data taken onsite.

The model assumes that the effluent from a wet cooling tower consists of a plume containing pure water vapor and droplets containing salts (primarily NaCl) in solution initially in the same concentration as in the water in the cooling tower basin. The density of the water vapor is assumed to have a Gaussian distribution around the centerline of the plume. Computations are made for 16 azimuthal sectors corresponding to the points of the compass and for selected distances downwind of the towers. The surrounding terrain is assumed to have a uniform elevation above sea level. The wind speed is assumed to be independent of altitude, and the horizontal transport rate for the effluent is taken to be that of the mean ambient wind speed. For the case in hand, Indian Point Unit No. 2, it was possible to select from the onsite data the wind speed and direction most appropriate for the tower height. For the NDCT, this was the 400 ft wind data and for the CMDCT, it was the 125 ft wind data.

Because of its excess temperature above ambient and its water vapor content, the plume emerging from the top of the cooling tower will be buoyant and will rise, be caught and bent over by the wind, and travel for relatively long distances downwind, either as a visible or invisible plume. The method of calculating the plume rise consists of determining the flux buoyancy parameters from a single cooling tower using the relationships of Briggs,[17] as modified by Hanna,[43] to represent the effects of latent heat given up by condensing moisture in the plumes. (Although this modification is included in the ORFAD program, this study did not take credit for the increased buoyancy effect.) The method of Briggs[44] is then used to account for the additional buoyancy forces from the combined plumes of multiple cooling tower installations. (Again, this refinement was not utilized in the present analysis.)

Shear forces along the edges of a plume cause surrounding air to be drawn into it and the plume then expands both horizontally and vertically, with the moisture in the plume being cooled and diluted by the entrained ambient air. The concentration of water vapor in the plume can be expressed as a function of the mass evaporation rate in the tower, the height of the plume above the ground, wind speed, and the plume dimensions. To provide an estimate of the amount of fogging (hours per year) that would occur at ground level due to operation of the towers, the program first checks the taped data to see if ground fog is naturally occurring. For Indian Point, this is accomplished by selecting the hours for which the visibility was less than one-fourth of a mile and classifying those hours as having naturally occurring fog. If visibility was greater than one-fourth of a mile, the moisture content of the centerline of the plume at the ground level is calculated and compared to the saturation deficit of the ambient air, based on the dewpoint and dry bulb temperature readings. If the amount of water vapor that must be added to the ambient air to cause saturation is less than the concentration of moisture added by the plume, fogging is assumed to occur. Since the tape of meteorological data for Indian Point reports the temperatures only to the nearest 0.1F°, however, when the ambient dry bulb and wet bulb temperatures are reported as being equal, the saturation deficit is calculated to be zero, and any moisture added by the plume, no matter if insignificantly small, under the above outlined procedure would be tallied as additional fog (even though none were occurring naturally). In the staff's view, this results in more hours of fog being counted than would probably actually exist. A further consideration is that since the fogging probability is estimated beneath the centerline of the plume, and the plume width normally does not extend over the 22.5° of the compass sector which serves as a basis for reporting the results, the hours of fog at each location are multiplied by the fraction that the plume width is of the sector width at that point.

Drift particles of finite size will fall toward the ground as well as being swept along by the plume, and they will have a trajectory below the centerline of the plume that is dependent upon the particle diameters. The trajectory is very sensitive to the drop size, with the very large

drops striking the ground close to the towers and the smaller drops being carried to great distances. Observed distributions of percent mass versus particle diameter (in μ) are used to assign drops to classes, or fraction of the total. A separate calculation of the trajectory is made for each class, and proper weights are given to each to obtain the total drift deposition at ground level. The procedure used by ORFAD is a modified version of the Hosler et al.,[46] method which divides drops into three classes: (a) those that do not evaporate, (b) those that evaporate to a saturated solution, and (c) those that evaporate to dryness. The falling velocity of the evaporating droplet is initially described as a value dependent on the drop diameter, and a final uniform value for the velocity after a given fall distance. This distance is thus dependent on the initial diameter and the ambient relative humidity. Empirical relationships are used to provide the fall velocities of the three regimes mentioned above in various relative humidity ranges. The method of calculating drift deposition in the ORFAD program is not based on a Gaussian plume but on the notion that all drift particles of a certain original size will fall to earth at nearly the same distance. This distance is that at which the total fall of the drop just equals the plume rise, and, of course, depends on the original drop size. When the relative humidity is greater than 76%, the drop is assumed to fall at constant velocity; when the humidity is less than 76%, an iterative solution is required to determine the diameter of a drop falling a given distance. For simplicity, evaporating particles are assumed to strike the ground with terminal velocities of saturated or dry droplets, even though they may not have fallen far enough to attain their final state.

The concentration of solids deposition is expressed as a function of the distance downwind. The ORFAD program has been arranged to "smear" the drift concentration calculated directly beneath the centerline of the plume over a 22.5° sector, since the wind direction given for each sector can be realistically envisioned as meandering back and forth across the sector.

b. Staff's Analysis of Drift from a NDCT

b.1 Single unit calculations

The input parameters for the NDCT calculations are presented in Table 5-2. These are tower parameters as reported by the applicant or as derived from the reported information. The salinities in the cooling tower basin were obtained from monthly average river flows and salinity measured as a function of river flow as shown in Table 5-3. The dropsize distribution used as shown in Table 5-4 was that measured by F. M. Shofner, et al., for the Hornaing cooling tower.[47] Redundant calculations were made using the applicant's drop-size distributions but this did not substantially affect the results.

The results of the staff's calculations for Unit No. 2 for the full year of onsite data and for the critical months of July, August, September, and October for drift deposition are presented in Figures 5-6 through 5-10. It is evident that these drift patterns and levels are dominated by the valley effect and the river salinity. It is interesting to note that the highest level for the full year is very close to the sum of the highest levels for the four critical months. See Table 5-1 for the levels of salt drift deposition. Although these maxima are not all at the same location, the dominance of the critical months is definitely established by close comparison of these figures. These predictions are in reasonable agreement with those of the applicant in spite of the fact that applicant's calculations included the influence of the local topography, a different drop-size distribution and different salinities. They do differ substantially in all but the critical months because the applicant's NDCT calculations in the ER on CCC Unit No. 2 did not allow for the reduced salinity of the makeup water. The applicant's calculations in the ER on Unit No. 3 did allow for the variable intake salinity and are in reasonable agreement with the staff's calculations.

The results of the staff's calculations for the full year of onsite data for additional hours of fog are presented in Figure 5-11. The ORFAD calculation, using a visibility less than one-fourth of a mile criterion, excluded 104 hours from consideration for additional hours of fog or ice and classified them as naturally-occurring periods of restricted visibility. Using a slightly different criterion, i.e., visibility less than 1500 ft and relative humidity greater than or equal to 80 percent, the applicant classified 146 hours as naturally-occurring fog. During the month of October, the visibility sensor was inoperative for approximately 295 hours out of 712 otherwise analyzable hours. Eleven hours were classified as fog by ORFAD and twelve hours by the applicant for the hours when the sensor was in operation. Projecting fog occurrence to the unknown hours would add about 8 hours to the reported fog for the month of October and bring the yearly total to approximately 110 hours by staff estimate. The additional fogging predicted for October was less than one-tenth of an hour. Adjusting this figure to account for the missing data would still yield an insignificant amount of additional fog. The staff predictions are judged to be extremely conservative estimates of possible tower-induced fog; i.e., an overestimate of the number of hours of induced fog from the NDCT operation. The staff's estimate of naturally-

TABLE 5-2

INPUT FOR NATURAL DRAFT COOLING TOWER DRIFT AND FOG CALCULATIONS
INDIAN POINT UNIT NO. 3

Height (meters)	172.00
Range (F degrees)	25.00
Water/Air Ratio	1.44
Inner Radius (meters)	44.80
Efflux Speed (m/s)	3.80
Heat Out (megacal/s)	525.00
Drift Fraction	0.000020
Latitude	41.27
Longitude	73.95
Elevation (feet)	45.00
Aerosol Height (meters)	4.00

TABLE 5-3

MONTHLY VARIATION IN DISSOLVED SOLIDS IN COOLING TOWER DRIFT AT INDIAN POINT UNIT NO. 3 AS USED IN STAFF'S ANALYSIS OF A NATURAL DRAFT COOLING TOWER

Month	Monthly Average Flow in River, cfs[a]	Salinity at Indian Point, ppm[b]	Dis. Solids in Drift, ppm[c]
Jan.	14,900	270	540
Feb.	11,300	1,100	2,200
Mar.	27,500	1.8	3.6
Apr.	37,500	0.05	0.1
May	21,000	23	46
June	11,000	1,250	2,500
July	8,000	4,000	8,000
Aug.	6,500	5,000	10,000
Sept.	7,200	4,500	9,000
Oct.	9,200	2,400	4,800
Nov.	14,500	300	600
Dec.	15,600	200	400

[a]ER, IP-3, App. I, Fig. 2.

[b]ER, IP-3, App. I. Fig. B-5.

[c]Based on concentration factor of 2.

TABLE 5-4

DROP SIZE DISTRIBUTION CURRENTLY USED IN STAFF'S ANALYSIS OF NATURAL DRAFT COOLING TOWER AT THE INDIAN POINT UNIT NO. 3

25 μ	19% of mass
75 μ	34%
125 μ	18%
175 μ	11.8%
225 μ	7.7%
275 μ	4.6%
325 μ	2.6%
375 μ	2.3%

F. M. Shofner et al., "Measurement and Interpretation of Drift Particle Characteristics" in Cooling Tower Environment - 1974, ERDA Symposium Series, CONF-74 0302, pp. 427-454, March 1974.

occurring fog is also judged to be conservative. Allowing the visibility criterion to relax from visibility less than one fourth mile to visibility less than one half mile would increase the naturally-occurring fog to approximately 180 hours. The conservative tower-induced hours of fog estimate (about 20 hours) is thus less than the variation which would be caused by relaxing the criterion. In fact,the induced fog estimate is less than the difference between the applicant's estimate of hours of naturally-occurring fog (146 hours) and the staff's estimate (110 hours).

The staff's icing calculations for the full year are presented in Figure 5-12. The criteria for ice are additional fog and temperatures at or below 32°F. Half of the staff-predicted fog (10 hours) thus occurs during freezing conditions in the winter. The contribution to icing from drift is probably more significant but would be restricted to onsite areas within a few thousand feet of the tower.

The staff's predictions of aerosol salt concentrations in micrograms per cubic meter ($\mu g/m^3$) are presented in Figure 5-13. These values are significantly lower than any recorded values that are known to have caused damage to plants.

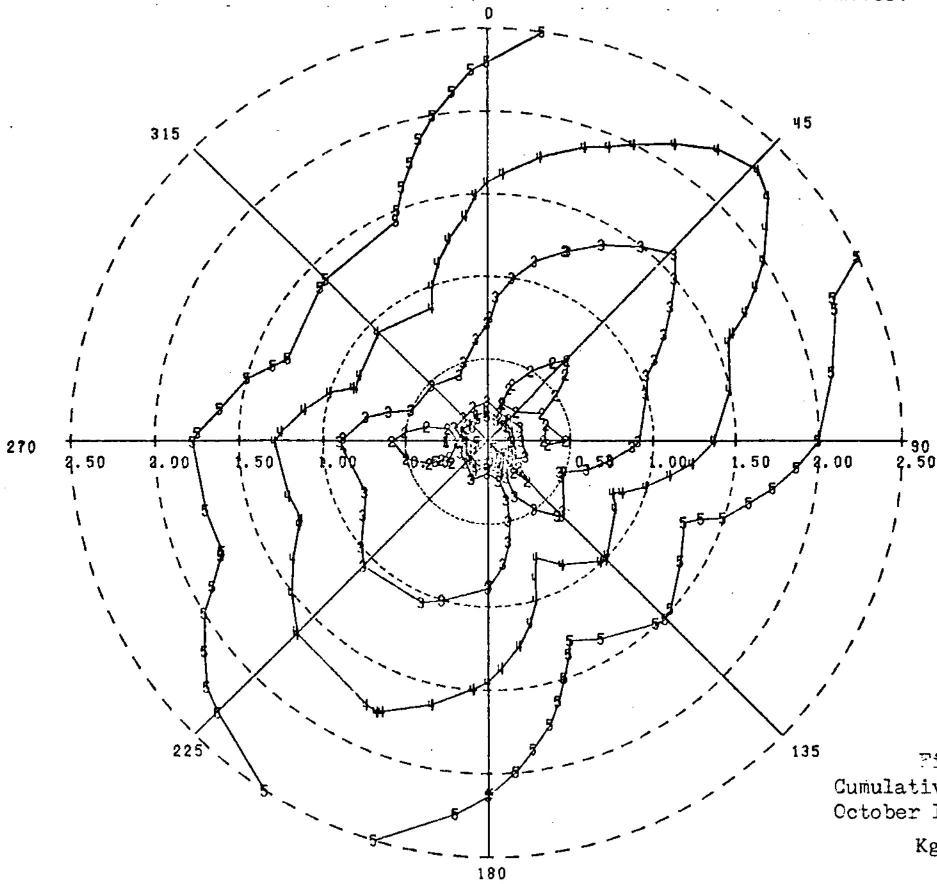
The complete set of calculations on salt drift, salt aerosol concentration,and fogging and icing for a single NDCT is presented in Appendix A to this Statement.

b.2 Two Unit Calculations

The evaluation of cooling towers for Unit No. 3 requires that the calculations allow for the presence of closed cycle cooling for Unit No. 2. In this section, the option discussed is two NDCTs with the same specifications as the Unit No. 2 tower. Single tower calculations,therefore, yield identical results. The center to center spacing of approximately 0.64 km (0.4 mi.) makes one hesitant to simply double the results of the single tower calculations as can be done reasonably for normal tower spacings. The ORFAD program is not presently capable of accommodating such spacings. The staff,therefore,prepared overlays of the single unit drift calculations for the four critical months and the cumulative year calculations, superimposed these overlays with centers translated to allow for the proper tower spacing, and graphically interpolated to obtain composite drift contours for the two unit case. These composite contours are presented as Figures 5-14 through 5-18 inclusive.

To demonstrate the difference between the one and two unit calculations,the staff then superimposed the single unit calculations on a map of the area immediately surrounding Indian Point and centered on the midpoint of the line joining the centers of the two towers. An overlay of the two unit calculations was then prepared. The results of this comparison are presented in

Note: In Figures 5-6 through 5-35, the distances are in miles.

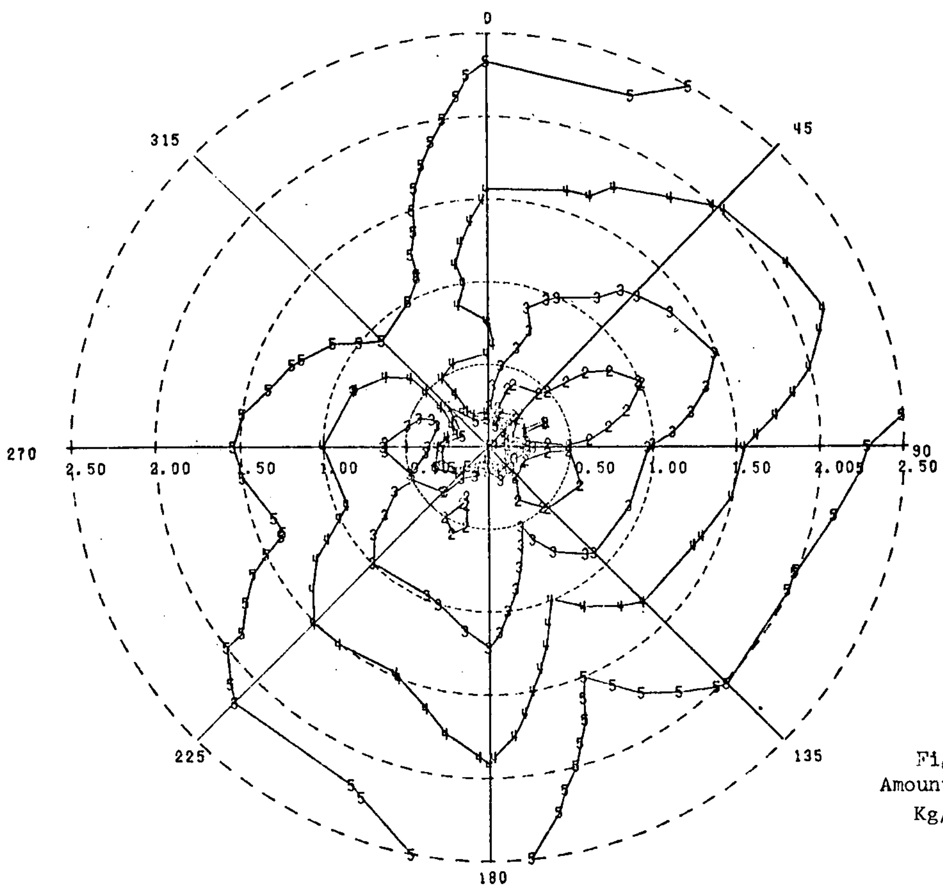


1	22.0
2	11.0
3	5.5
4	2.75
5	1.37

Figure 5-6 NDCT
Cumulative amount of drift
October 1973 - September 1974

Kg/Ha

IP-3

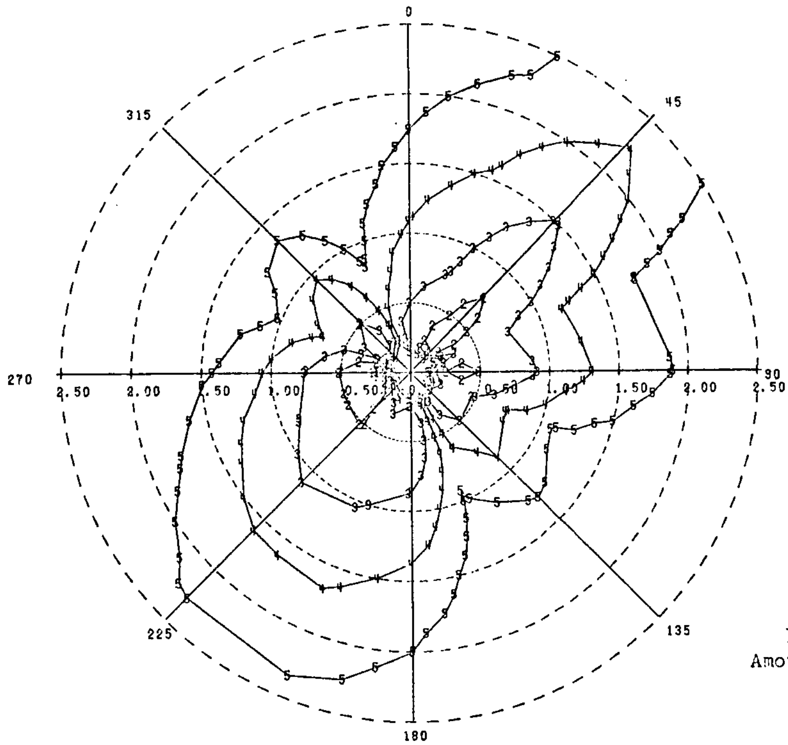


1	3.00
2	1.50
3	0.75
4	0.37
5	0.19

Figure 5-7 NDCT
Amount of drift - July

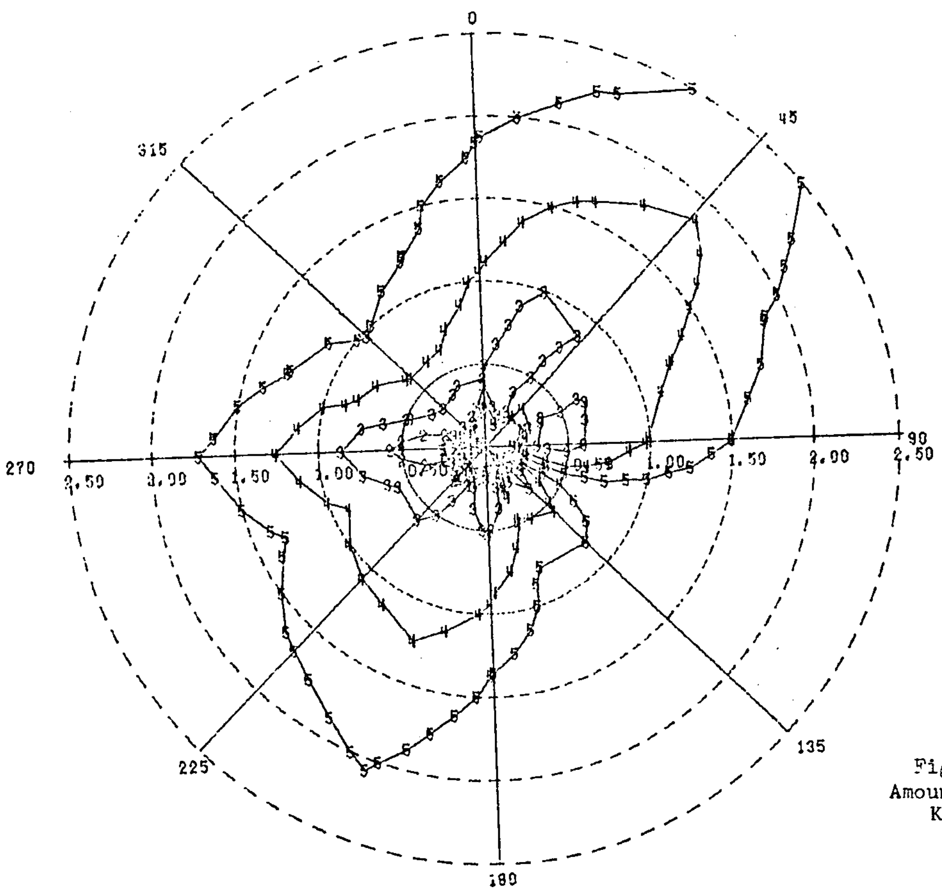
Kg/Ha

IP-3



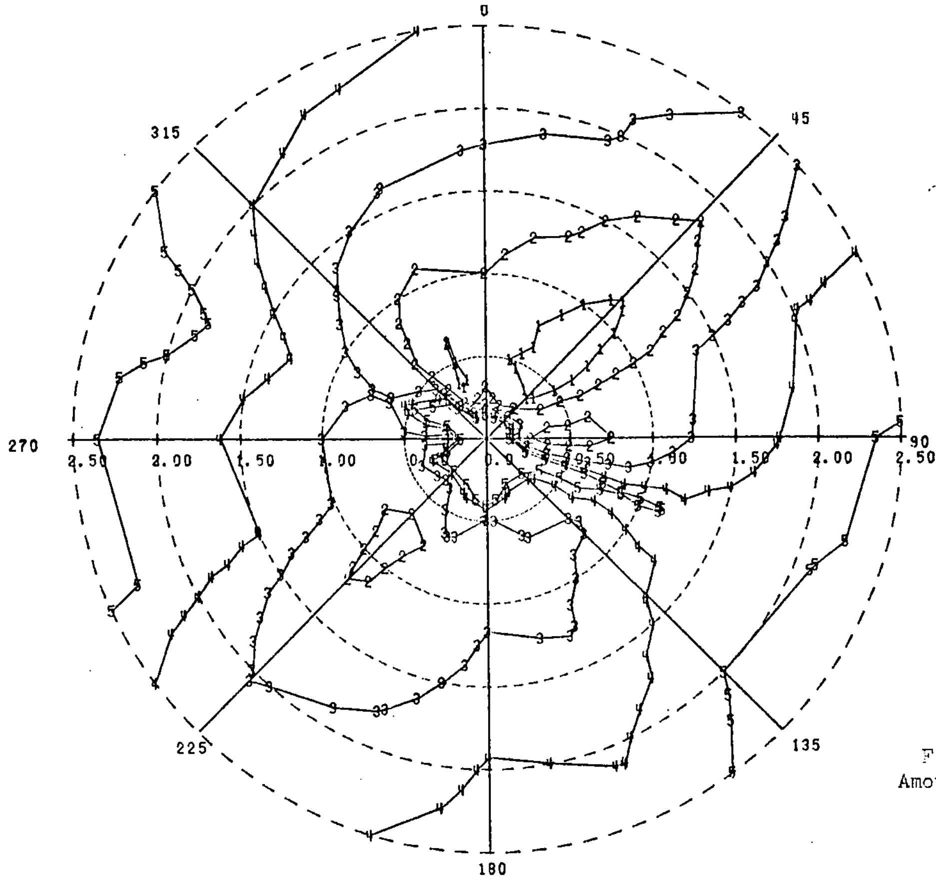
1 9.00
2 4.50
3 2.25
4 1.12
5 0.56

Figure 5-8 NDCT
Amount of drift - August
Kg/Ha
IP-3



1 10.00
2 5.00
3 2.50
4 1.25
5 0.62

Figure 5-9 NDCT
Amount of drift - Sept.
Kg/Ha
IP-3



1	1.00
2	0.50
3	0.25
4	0.12
5	0.06

Figure 5-10 NDCT
Amount of drift - Oct.

Kg/Ha
IP-3

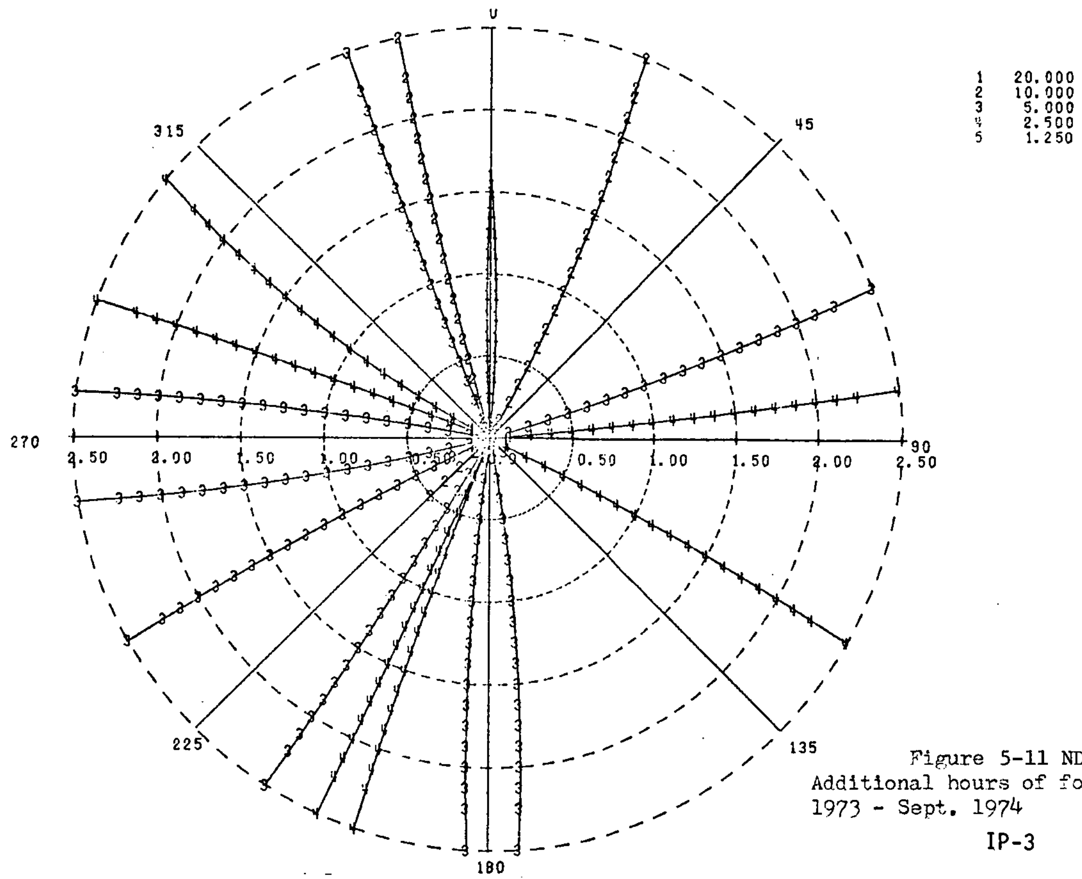


Figure 5-11 NDCT
Additional hours of fog Oct. 1973 - Sept. 1974

IP-3

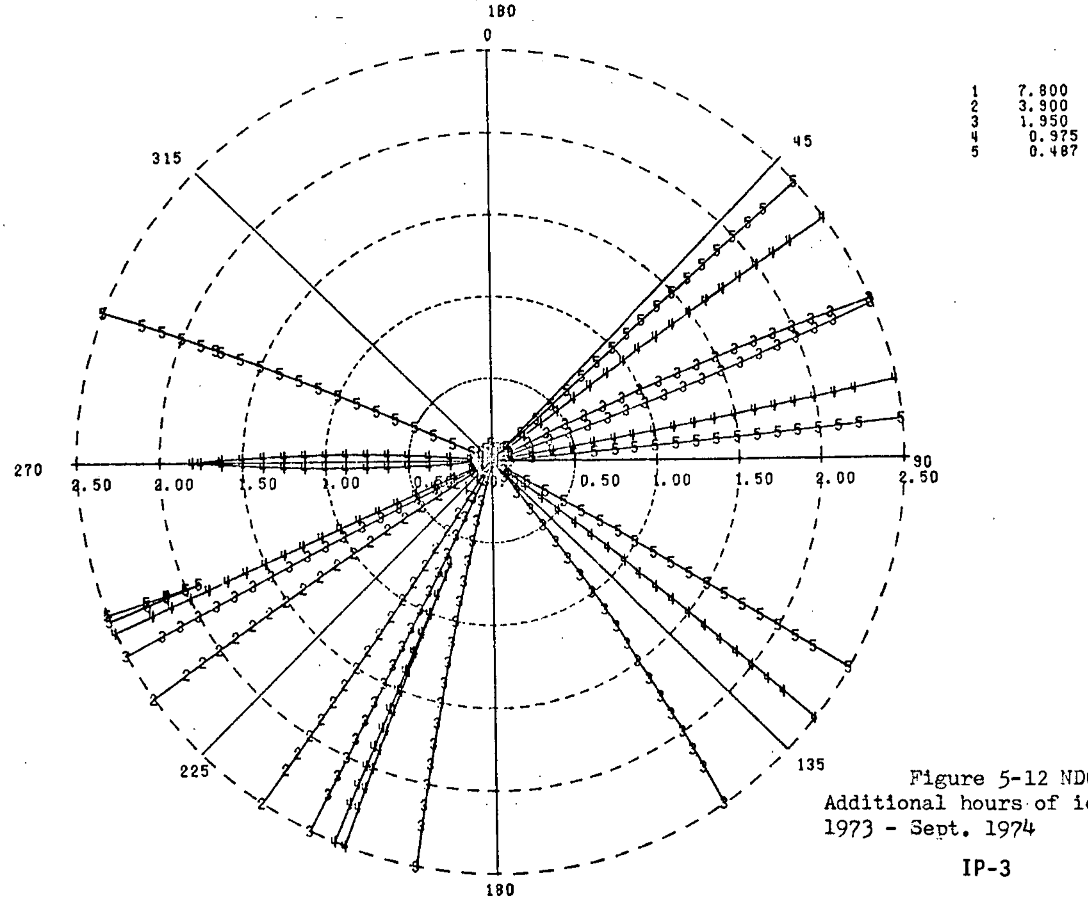


Figure 5-12 NDCT
Additional hours of ice Oct. 1973 - Sept. 1974

IP-3

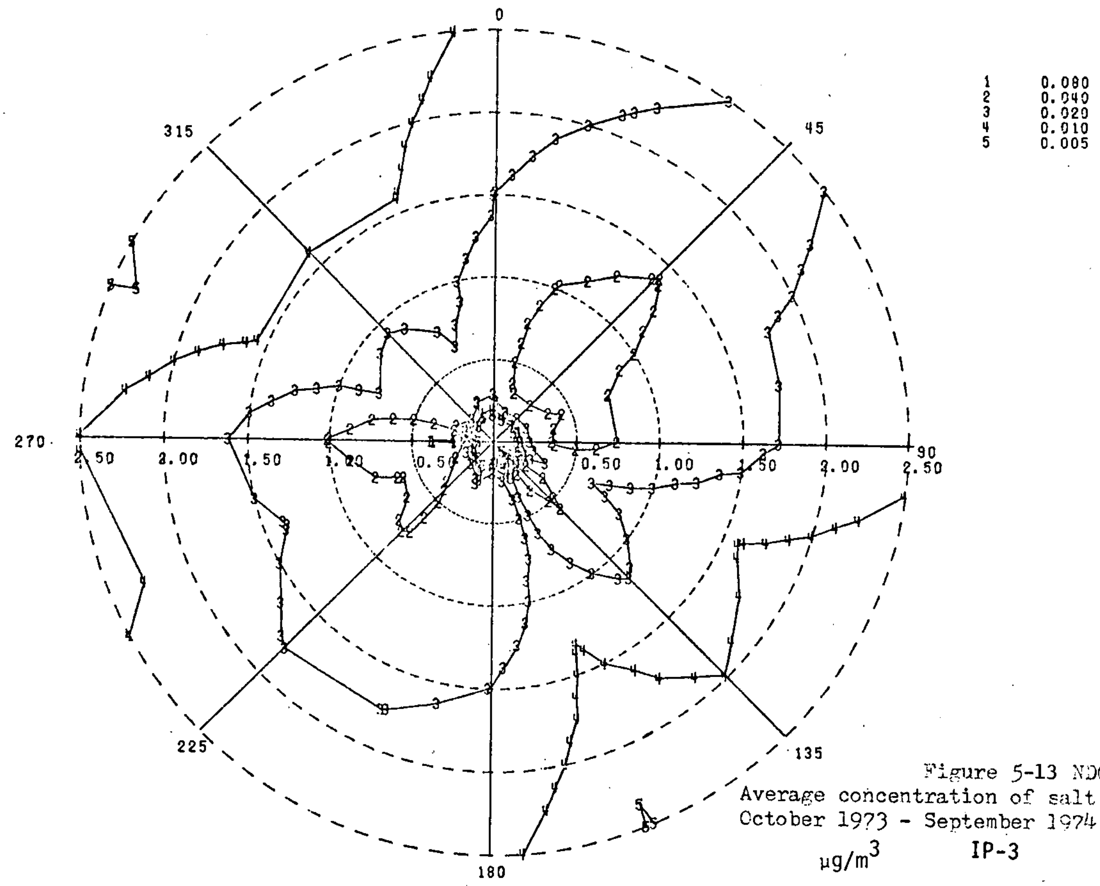


Figure 5-13 NDCT
Average concentration of salt in air
October 1973 - September 1974
μg/m³ IP-3

Figures 5-19 and 5-20 for the cumulative year and the month of August. The high degree of correlation for this case demonstrates that a simple doubling of the values for the single unit calculation and a shift of origin represent a reasonable estimate of offsite drift levels. Only in the area between the towers or within approximately 1000 feet of the towers is there evidence of significant deviation. It should be stated that the extremely restricted areas of maximum concentration in the single unit calculation do not overlap so that the maximum drift levels onsite are the same or only slightly greater than those for the single unit calculation. It would be a serious error to associate accuracy with the fine structure of any of these drift predictions. The location, shape,and magnitude of the isopleths can only be regarded as approximations to the location and magnitude of drift deposition. To this extent,the comparison demonstrates that the single unit drift calculations presented in Appendix A (including those for aerosol) can be regarded as valid for the two-unit case if the magnitudes of the isopleths are doubled and the maximum isopleths (detail near the center) are ignored.

The statement has already been made that the frequency of fog and ice from two NDCTs at Indian Point will differ insignificantly from the single tower predictions because of the tower separation. The areal extent and possibly the duration of individual occurrences of fog may be affected by interaction of the vapor plumes of the multiple tower case but the conservative nature of the one unit calculations should easily accommodate any variations. To this extent, the single unit fog and ice predictions are also retained by the staff, without modification, as representative of the effects of two unit operation.

c. Staff's Analysis of Drift from MDCT's

c.1 One Unit Calculation

The input parameters for the single CMDCT calculations are presented in Table 5-5.

TABLE 5-5

INPUT FOR CIRCULAR MECHANICAL DRAFT COOLING TOWER DRIFT AND FOG CALCULATIONS

Height (meters)	21.00
Range (F degrees)	25.00
Water/Air Ratio	1.41
Inner Radius (meters)	18.03*
Efflux Speed (m/s)	11.90
Heat Out (megacal/s)	262.50**
Drift Fraction	0.000020
Latitude	41.27
Longitude	73.95
Elevation (feet)	45.00
Aerosol Height (meters)	4.00

*Effective radius for thirteen fans, each with a 10-m diameter.

**Heat for one tower, total heat = 525 megacal/sec.

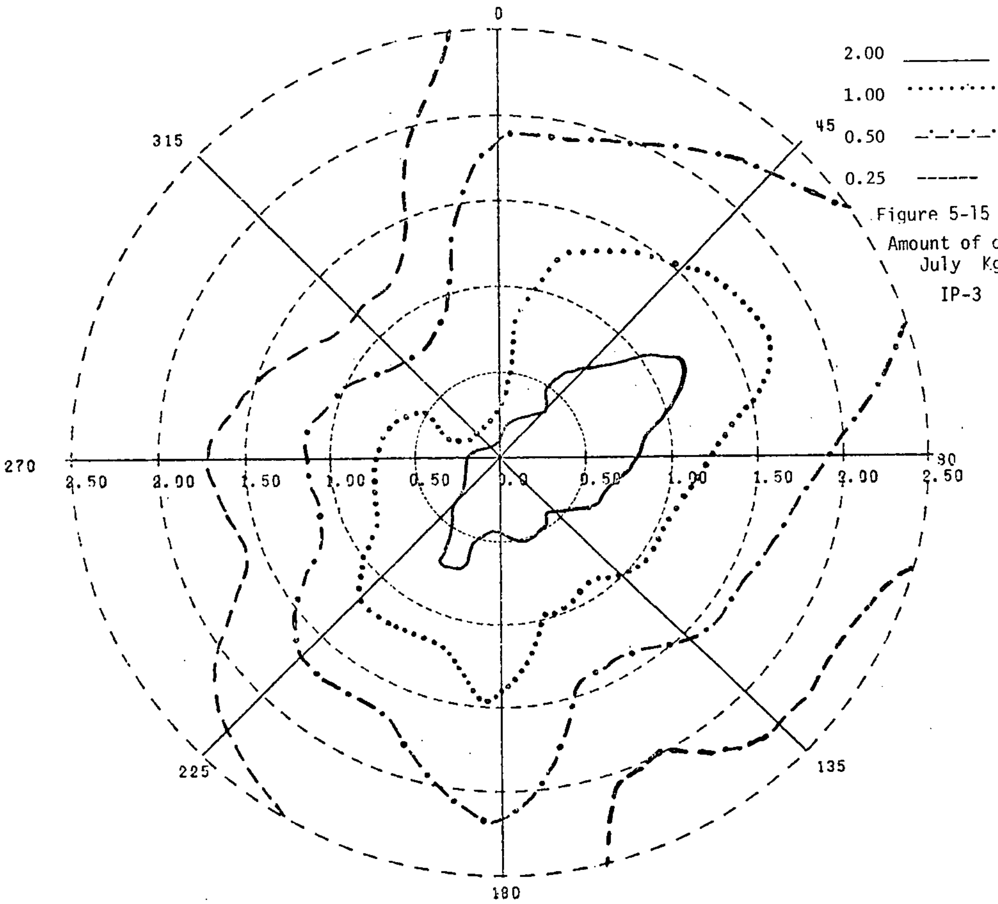


Figure 5-15 2 NDCT
Amount of drift--
July Kg/Ha
IP-3

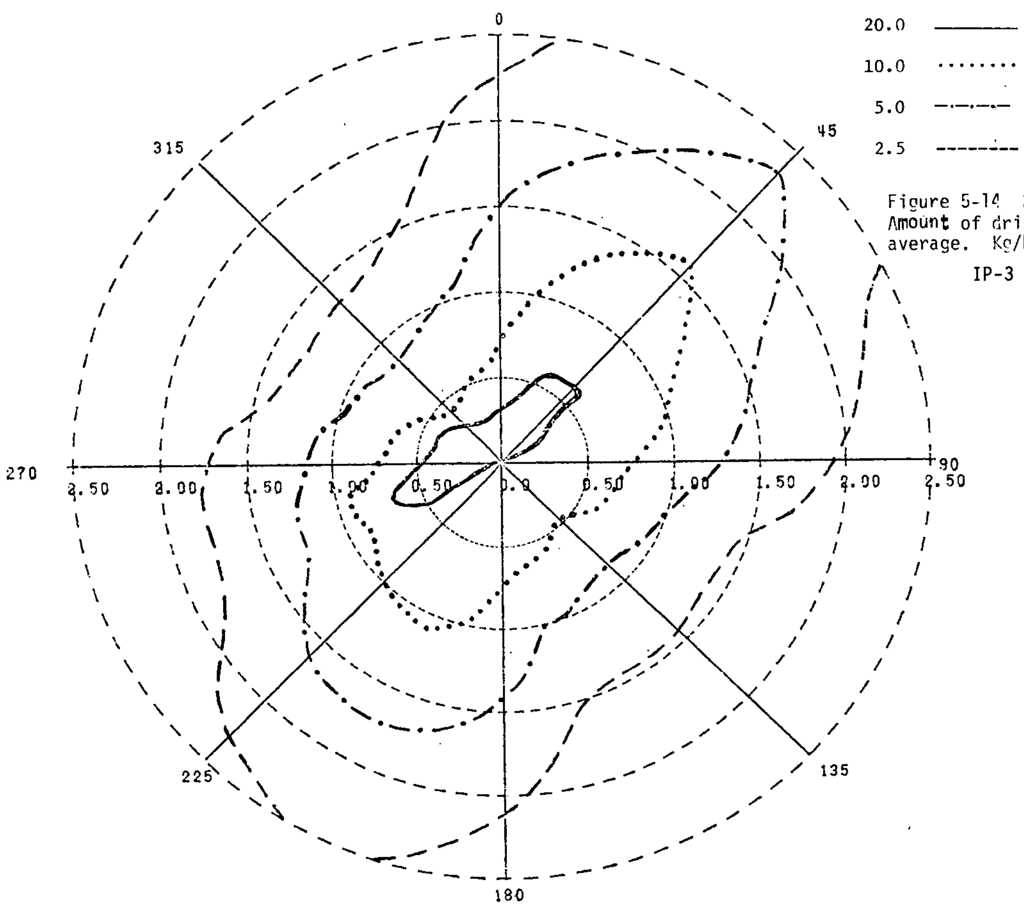


Figure 5-14 2 NDCT
Amount of drift--yearly
average. Kg/Ha
IP-3

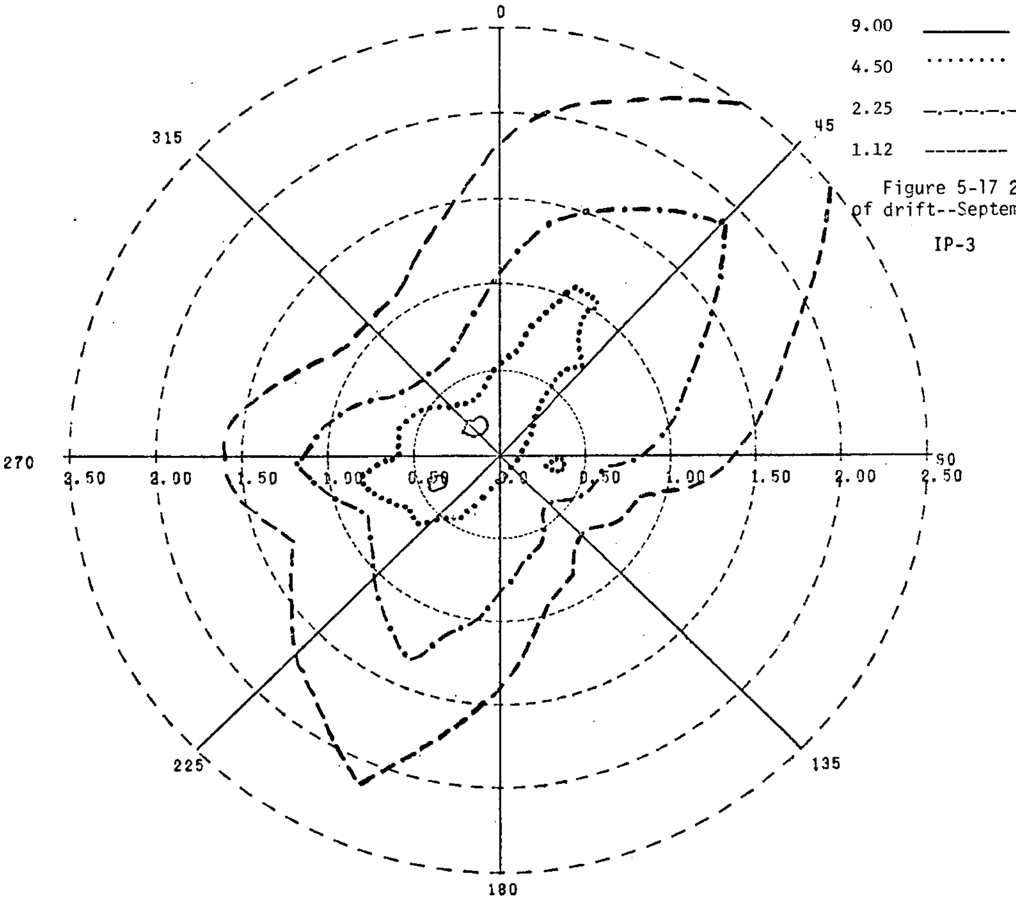


Figure 5-17 2 MDCT Amount of drift--September Kg/Ha

IP-3

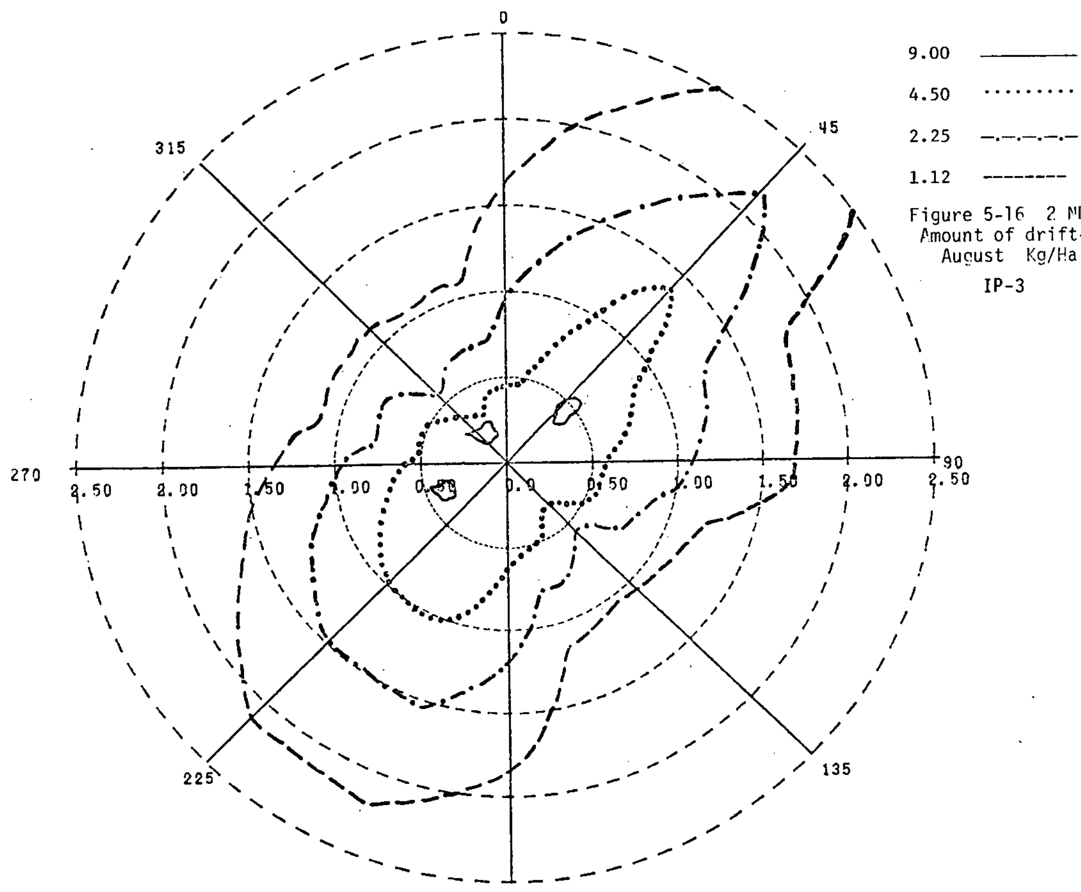


Figure 5-16 2 MDCT Amount of drift-- August Kg/Ha

IP-3

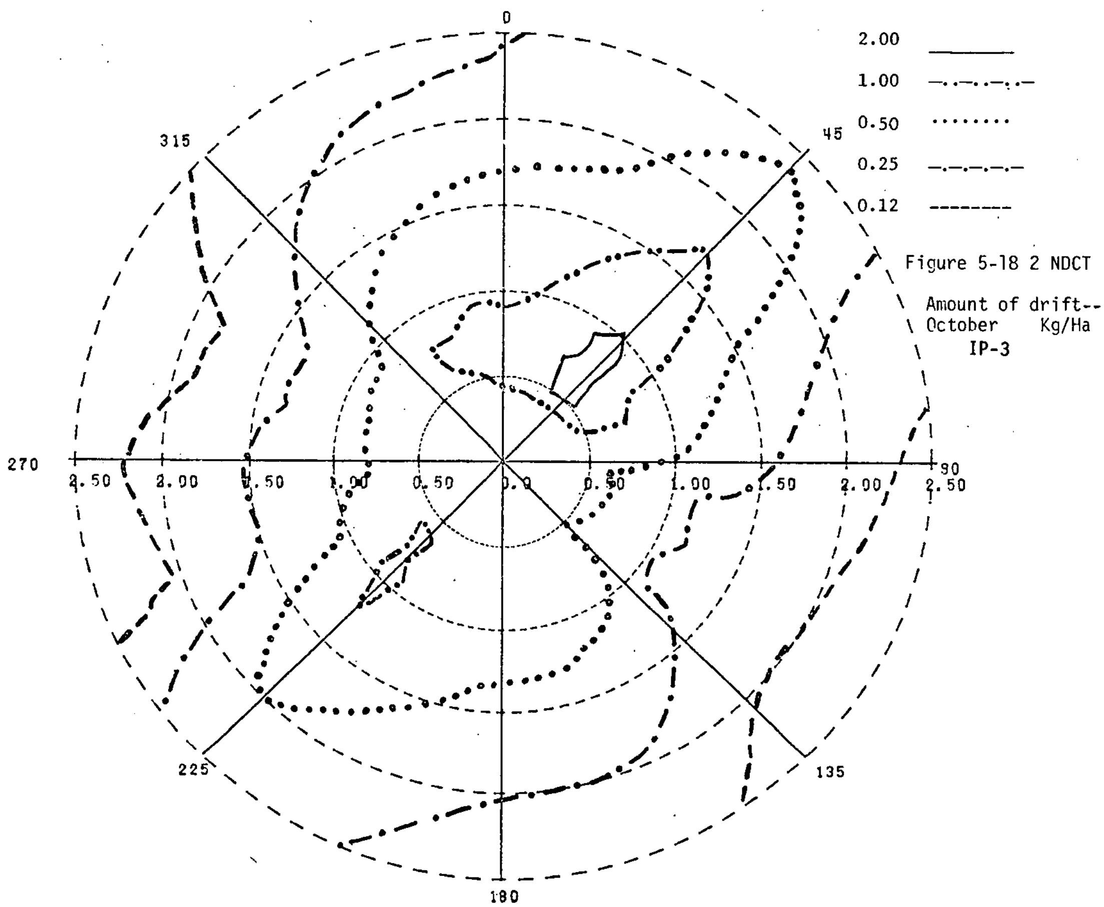


Figure 5-18 2 NDCT

Amount of drift--
October Kg/Ha
IP-3

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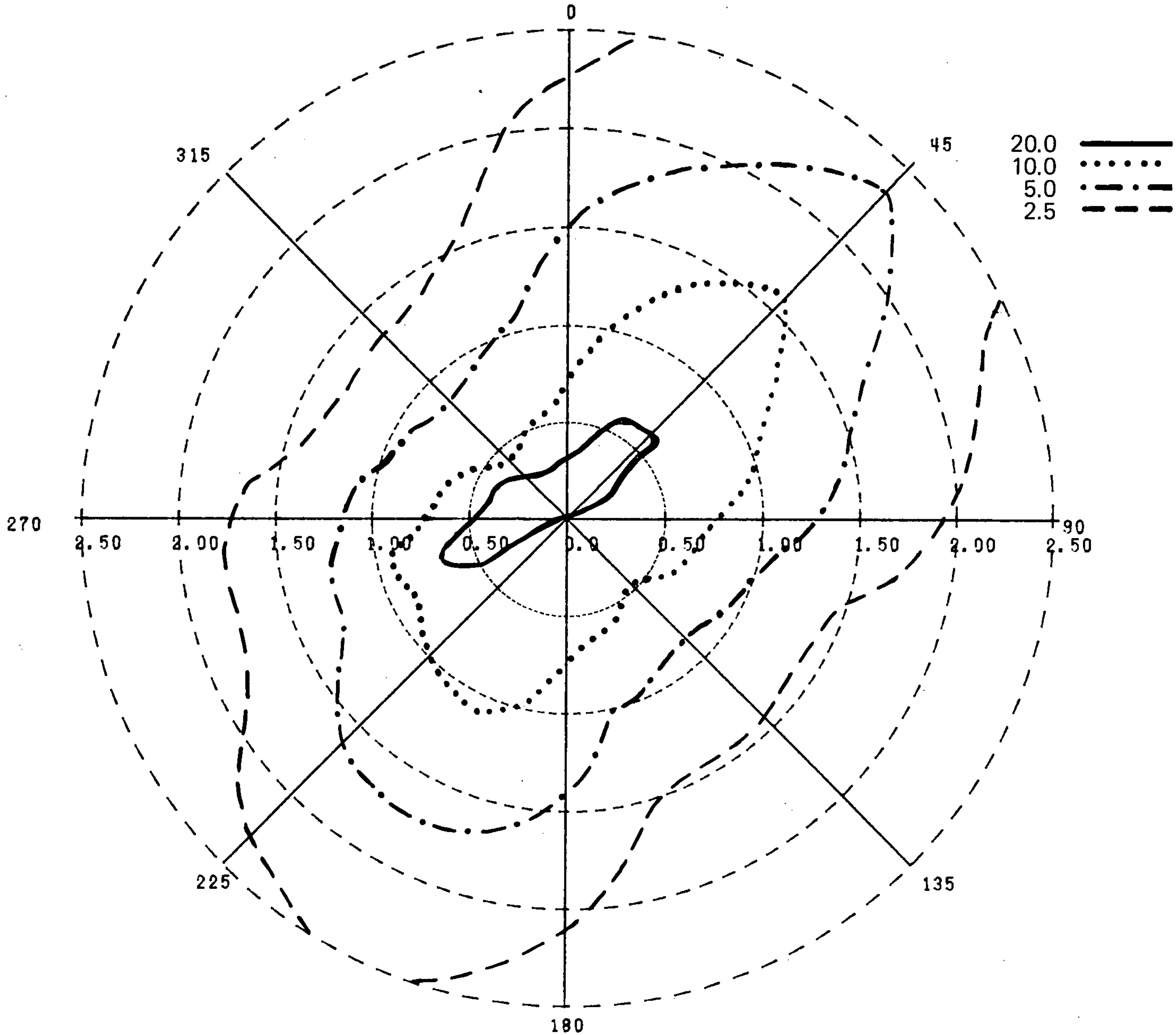

FIGURE 5-19 (A) 2 NDCT AMOUNT OF DRIFT—YEARLY AVERAGE KG/HA

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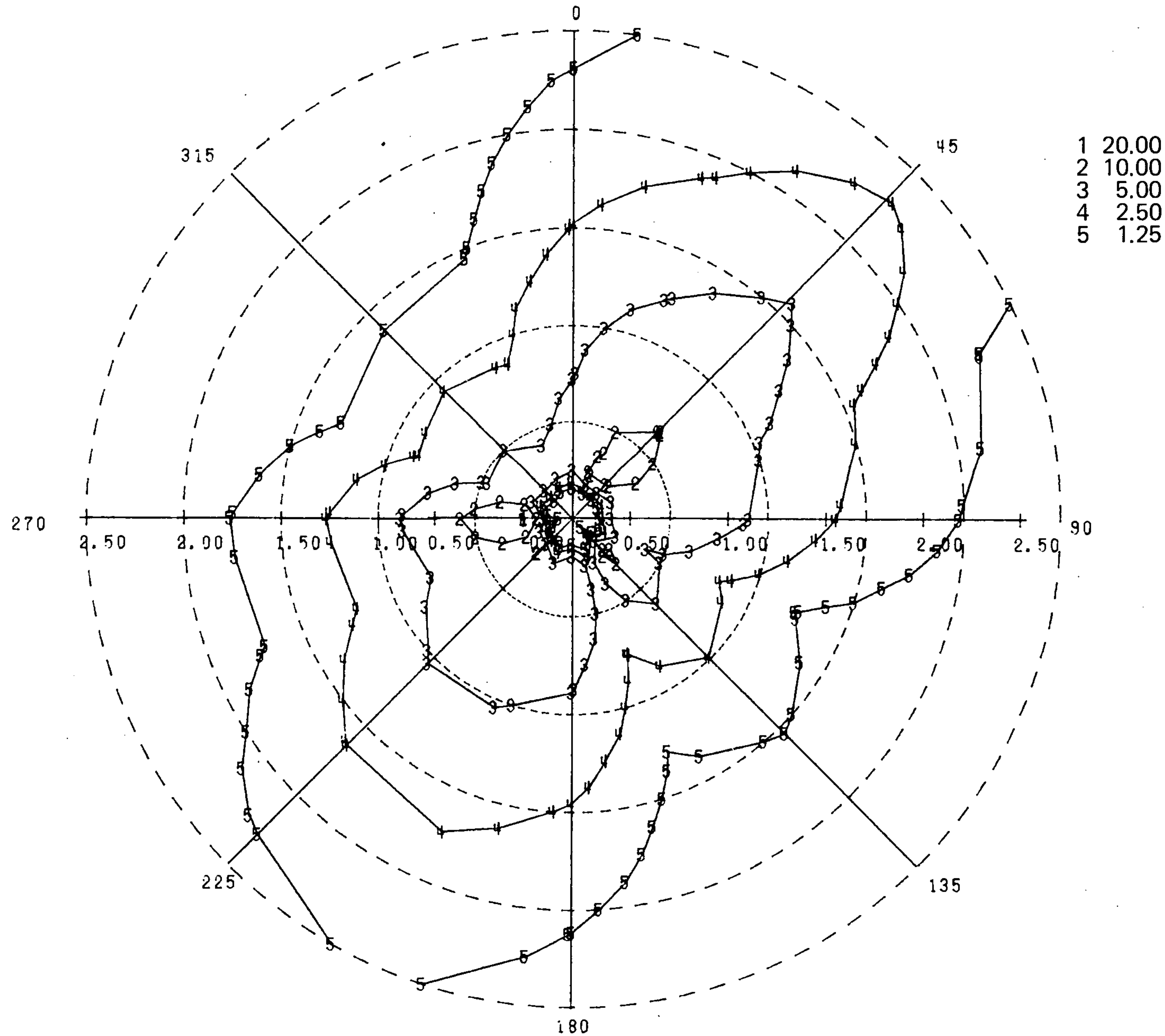

FIGURE 5-19 (B) SINGLE NDCT AMOUNT OF DRIFT YEARLY AVERAGE KG/HA

IP-3

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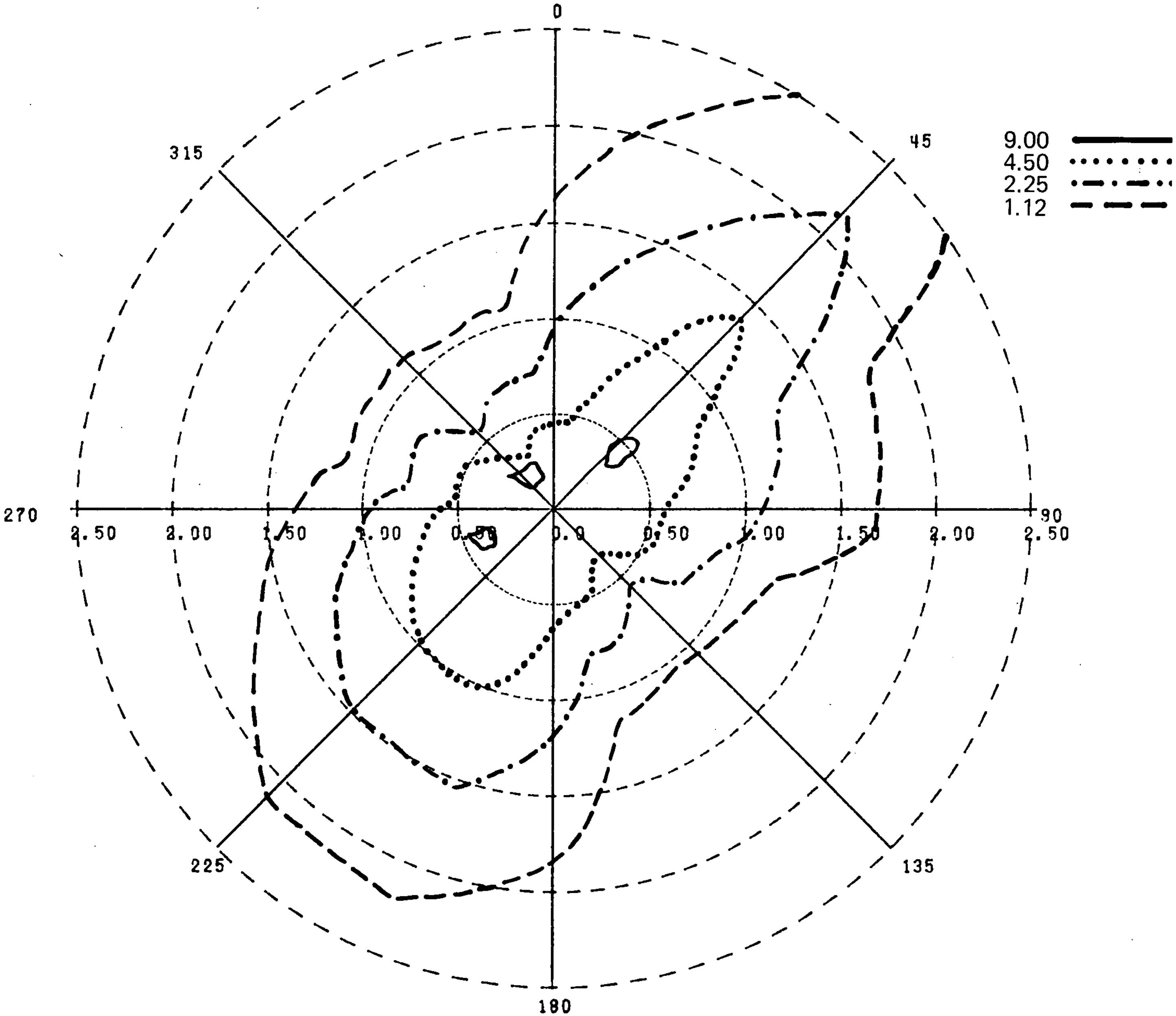

FIGURE 5-20 (A) 2 NDCT AMOUNT OF DRIFT AUGUST KG/HA

IP-3

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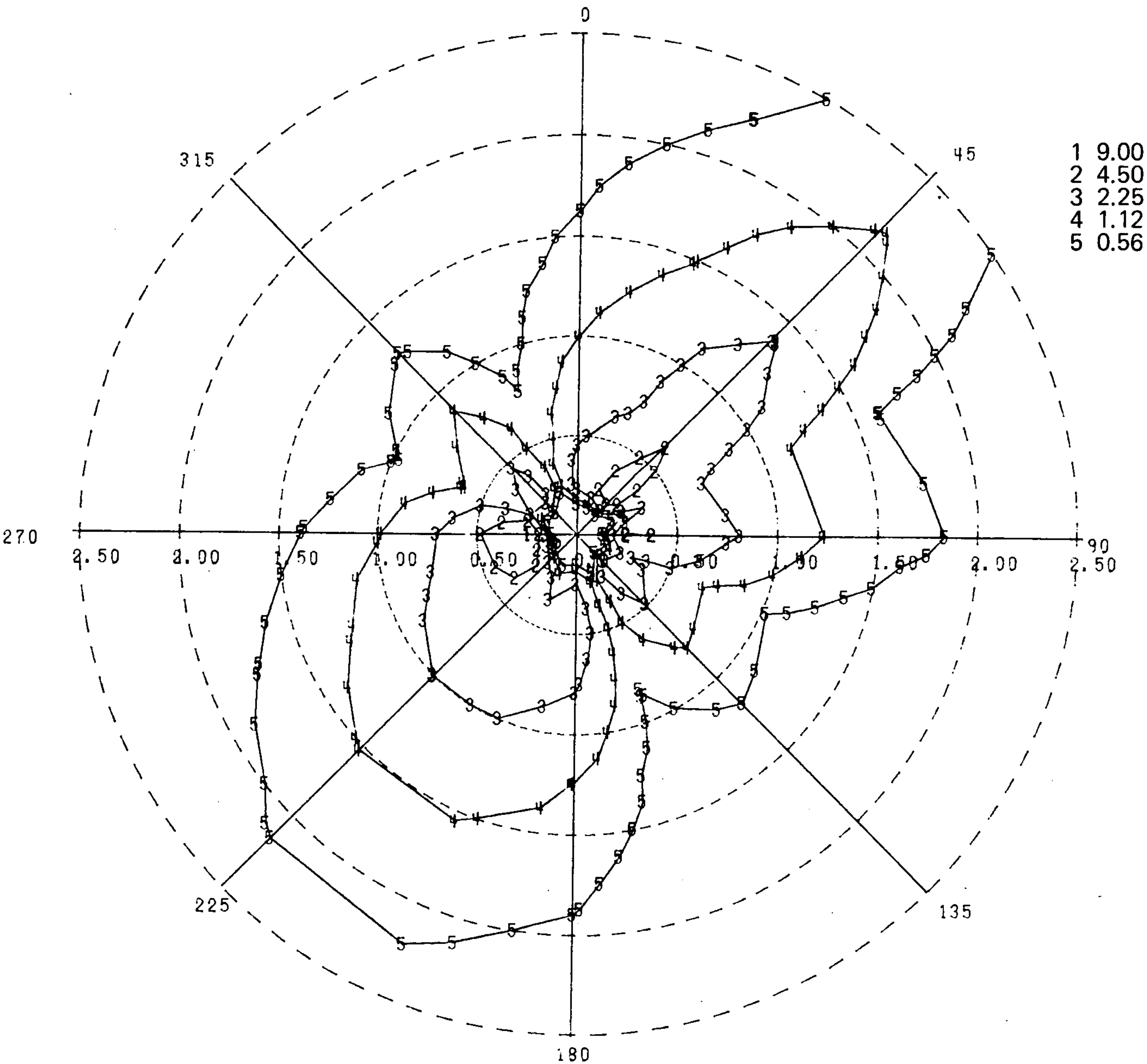

FIGURE 5-20 (B) SINGLE NDCT AMOUNT OF DRIFT AUGUST KG/HA

IP-3

Detailed information was not obtained from the applicant; these parameters represent the best information available to the staff. The basic assumption is two cooling towers with thirteen fans each. For calculational purposes a single tower with twice the salt concentration (as presented in Table 5-3) in the basin was used. Since the circular towers can be located with a one-radius separation from each other, it was assumed that a single tower located midway between the two with a doubled salt concentration would adequately represent the drift source characteristics for one unit and that the conservative relative humidity threshold for fogging would give a small but acceptable error in the calculation of additional hours of fog. The tower radius was assigned by equating the area for a single aperture to that of the total exit area of thirteen fan cylinders. The drop size distribution used is shown in Table 5-6.

The results of the staff's calculations for the full year of onsite data and the the critical months of July, August, September and October for drift deposition for one unit are presented in Figures 5-21 through 5-25. The lower wind speeds at the 125-ft level are responsible for concentration of the isopleths around the towers. The calculations using 400 ft wind data demonstrated greater dispersal of the deposited salts. The pattern of deposition is again dominated by valley effects. The comparison of peak values for the year with the sum of the peak values for the four critical months again demonstrates the dominance of the four critical months in determining the annual drift deposition as shown in Table 5-7. The patterns and levels are in substantial agreement with those which the applicant predicted for conventional mechanical draft cooling towers although the onsite levels are higher and the offsite levels lower.

The results of the staff's calculations for the full year of onsite data for additional hours of fog and ice are presented in Figures 5-26 and 5-27. The maximum predicted is approximately 26 hours of additional fog to the south and southwest of the tower. This again falls within the differences between staff's and applicant's classifications of naturally occurring hours of fog but is greater than hours of NDCT-induced fog. The applicant's maximum predicted fogging for MDCT towers was approximately 80 hours of additional fog. The circular towers achieve the reduced fogging through a more buoyant plume which is achieved by clustering the fan cylinders. Hours of additional plume-induced icing are increased because the plume is closer to the ground than for NDCT, in spite of the increased buoyancy due to clustering. Drift-induced icing near the towers would be more severe for the CMDCT than for the NDCT due to the lower height of the tower.

TABLE 5-6

DROP SIZE DISTRIBUTION CURRENTLY USED IN THE STAFF's ANALYSES OF CIRCULAR MECHANICAL DRAFT COOLING TOWERS[a,b]

0	60 μ	50 % of mass
60	125 μ	22 %
125	180 μ	5 %
180	225 μ	4 %
225	325 μ	8 %
325	425 μ	6 %
425	525 μ	5 %

[a]Performance Data for CCW Cooling Towers, ER Table 3.4.0-2, Perkins Nuclear Station Environmental Report, Amendment 2, January 1975, Docket Nos. STN 50-488/489/490.

[b]As provided by the Marley Company.

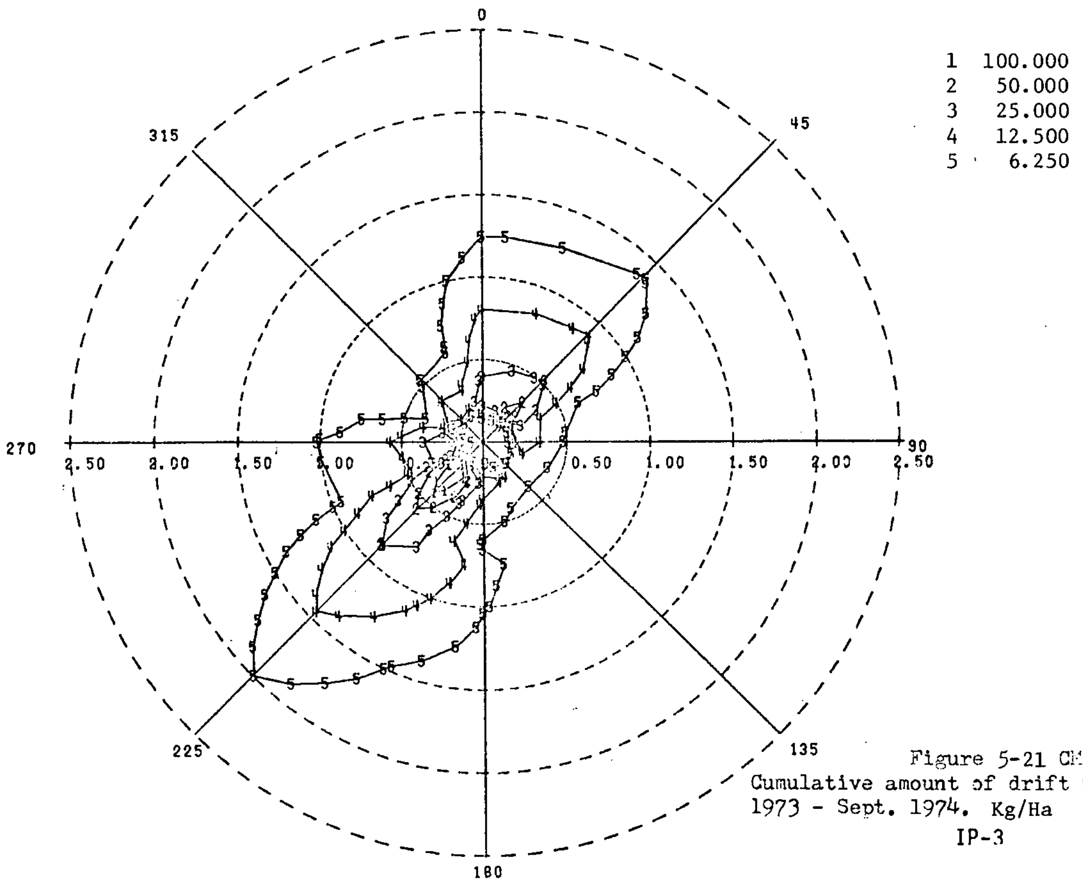

Figure 5-21 CMDT
Cumulative amount of drift Oct. 1973 - Sept. 1974. Kg/Ha
IP-3

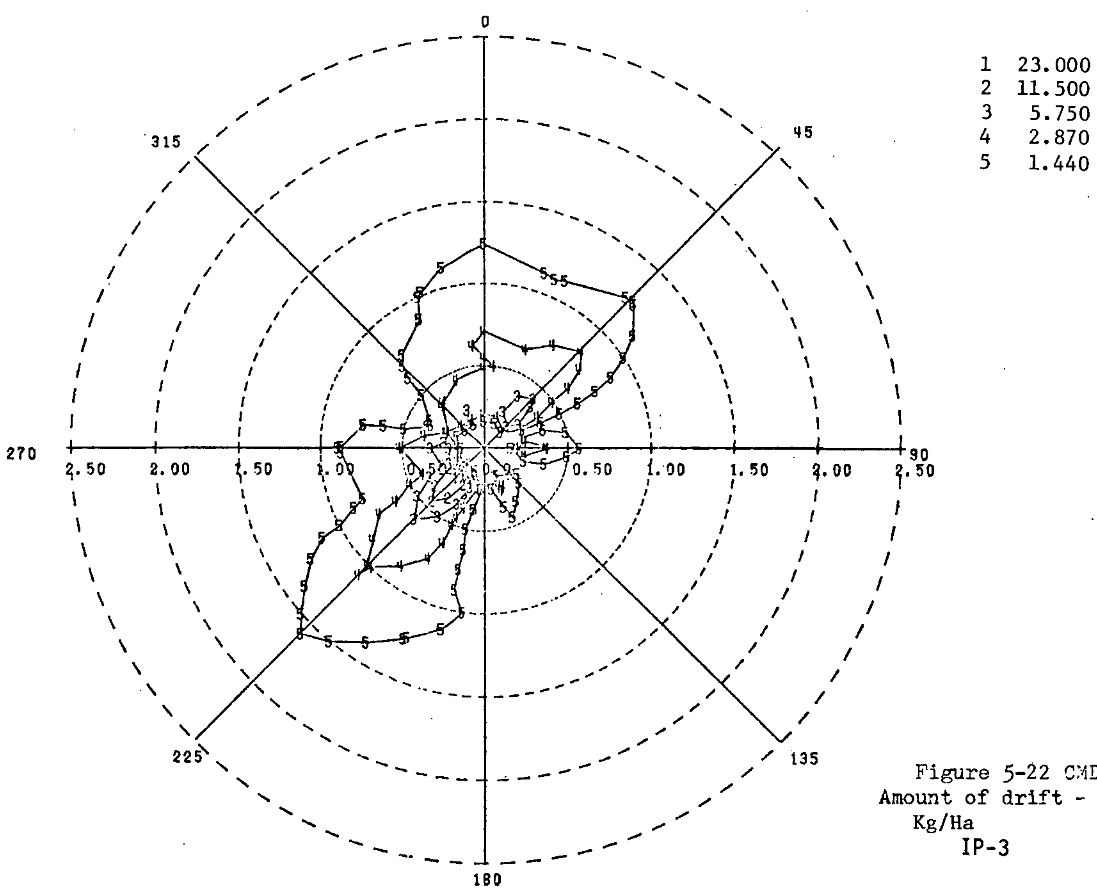

Figure 5-22 CMDT
Amount of drift - July
Kg/Ha
IP-3

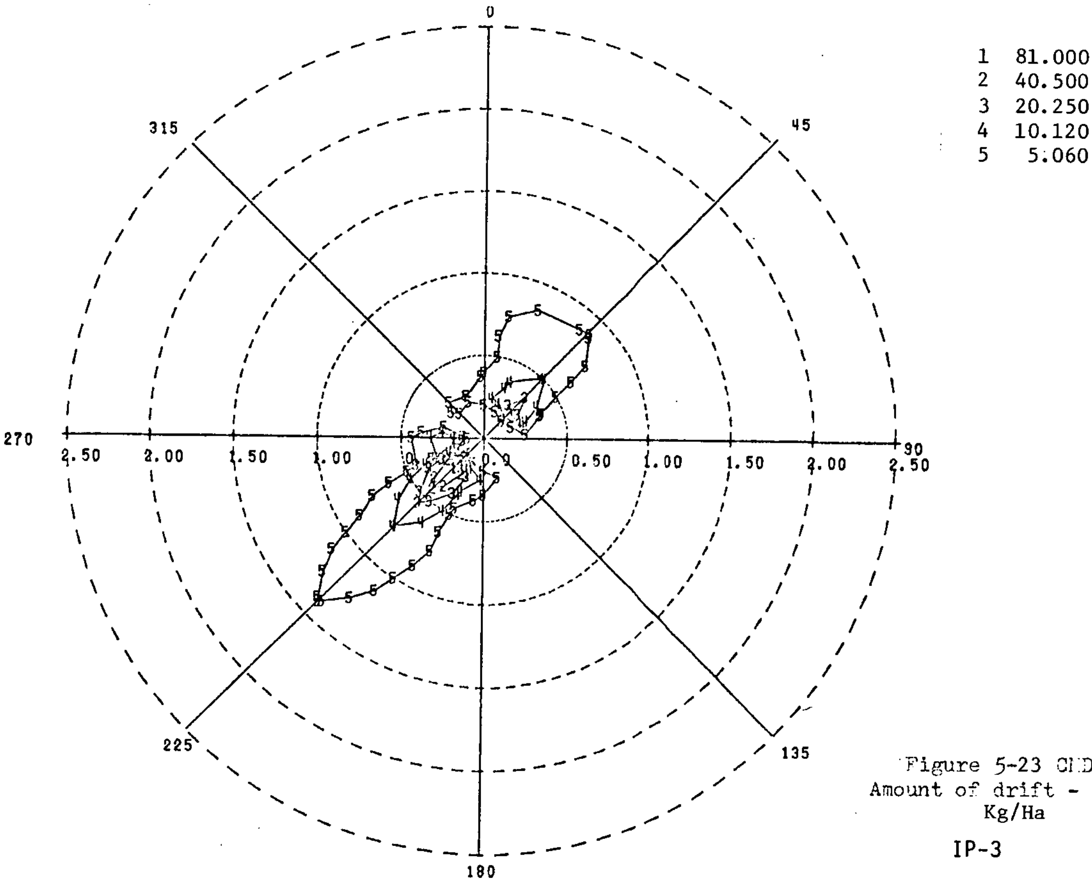

Figure 5-23 CHDT
Amount of drift - August
Kg/Ha

IP-3

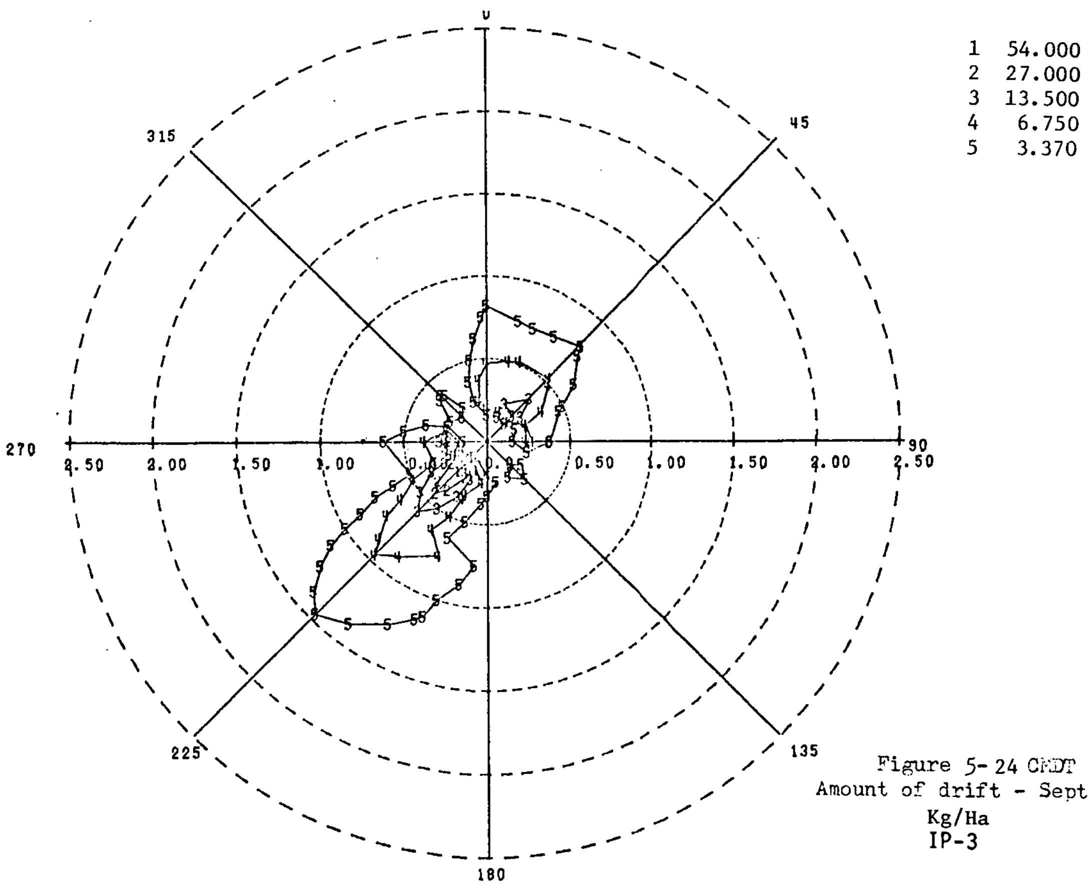

Figure 5-24 CHDT
Amount of drift - September
Kg/Ha
IP-3

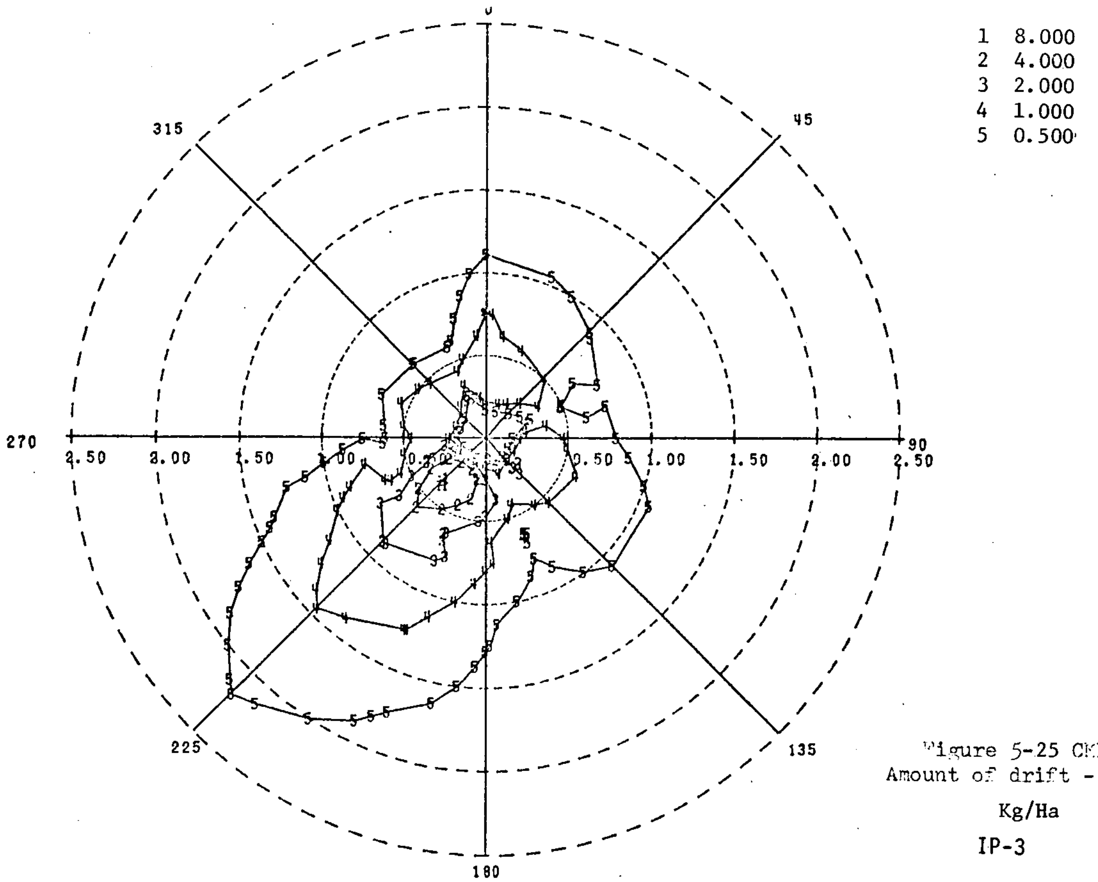

Figure 5-25 CKDT
Amount of drift - October
Kg/Ha
IP-3

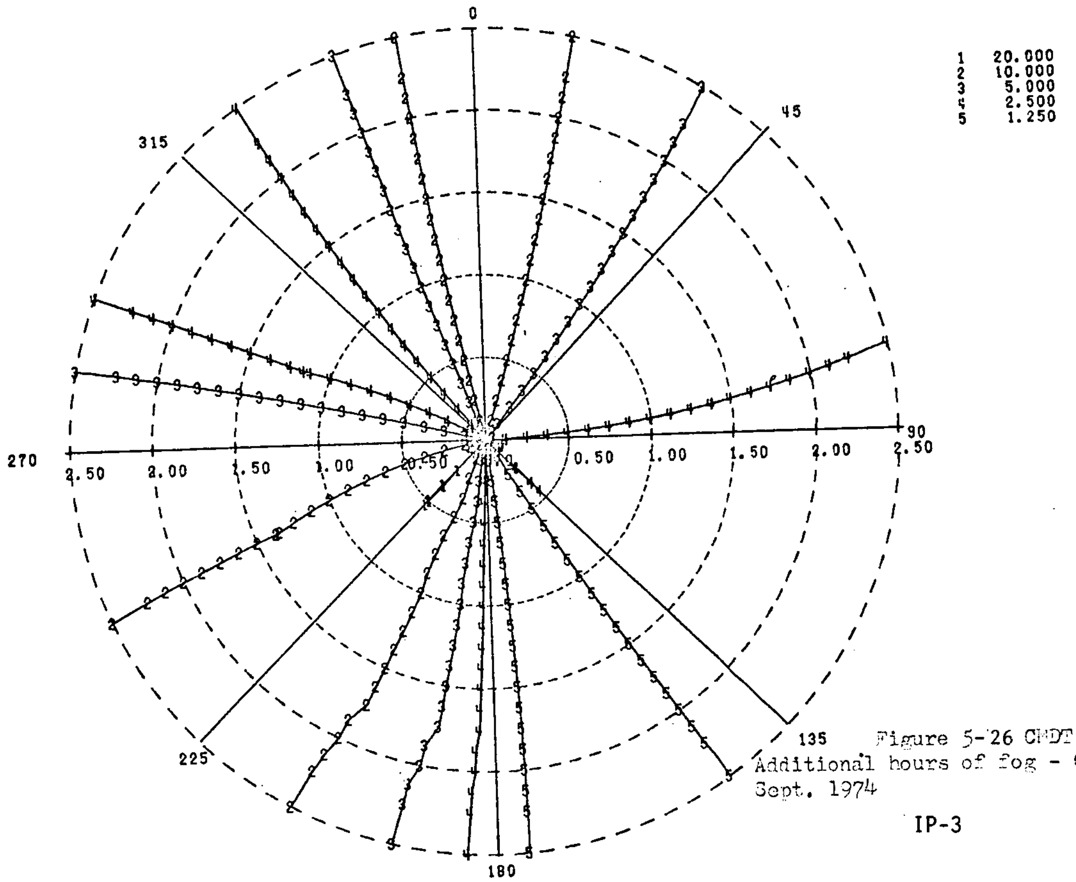

Figure 5-26 CMDT
Additional hours of fog - Oct. 1973-Sept. 1974

IP-3

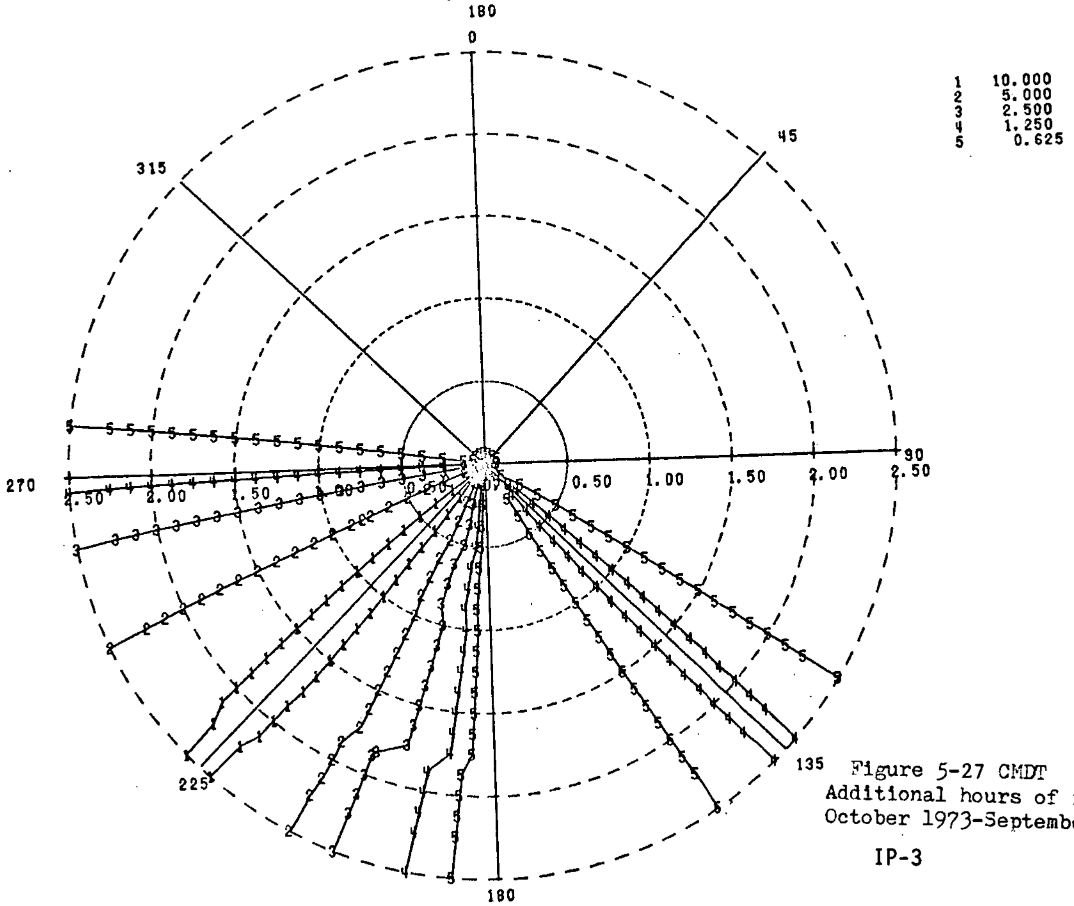

Figure 5-27 CMDT
Additional hours of ice
October 1973-September 1974

IP-3

TABLE 5-7

MAXIMUM CUMULATIVE DRIFT DEPOSITION FOR CIRCULAR MECHANICAL DRAFT COOLING TOWERS AT INDIAN POINT*

Period	Maximum at One Mile Kg/Ha	lb/acre	Maximum at Two and One-Half Miles Kg/Ha	lb/acre
Year	21	19	4.0	3.6
Oct.	1.6	1.4	.38	.33
Nov.	.084	.075	.017	.015
Dec.	.12	.11	.014	.013
Jan.	.18	.16	.032	.028
Feb.	1.1	1.0	.14	.13
March	.00039	.00035	.00011	.00010
April	.000028	.000025	.0000056	.0000050
May	.014	.013	.0020	.0018
June	1.2	1.1	.19	.17
July	2.9	2.6	.53	.48
Aug.	7.6	6.8	1.5	1.3
Sept.	6.4	5.7	1.1	1.0

*By choosing the midpoint of a line connecting the centers of the two tower clusters as the reference point, a reasonable description of the drift resulting from CMDCTs at both units can be obtained by doubling the magnitude of these cumulative drift deposition predictions. (See Section C.2 below for a discussion of this estimate.)

The staff's predictions of average aerosol salt concentrations in $\mu g/m^3$ for the full year of onsite data are presented in Figure 5-28. These values are significantly lower than any recorded values that are known to have caused damage to plants.

The complete set of single unit calculations for the CMDCT is presented in Appendix A to this statement.

c.2 Two Unit Calculations

The staff followed the same procedure for the case of CMDTs for both units as that presented in Section b.2 for NDCTs at both units. The composite contours are presented as Figures 5-29 through 5-33. Overlays of the composite curves on the single unit curves are presented in Figures 5-32 and 5-33 for the cumulative year and the month of August. The high degree of correlation again demonstrates the validity of using the single unit calculations by translating to the geometric center of the cooling tower configuration and doubling the magnitude of the isopleths while ignoring the details around the center of the figure. The staff, under these conditions, thus adopts the single unit calculations of Appendix A for both drift deposition and aerosal salt concentration with doubled values for the isopleths as a reasonable representation of the drift levels from operation of CMDCTs at both Unit No. 2 and Unit No. 3.

For the NDCT case, the staff also accepted without alteration the single unit fog and ice predictions as reasonable estimates for two unit operation because of the separation between the towers. This position is also taken for the case of the CMDCTs at both units. The actual hours of plume interaction near the ground sufficient to cause ground fog in the absence of fogging predicted for a single tower are judged to be negligible.

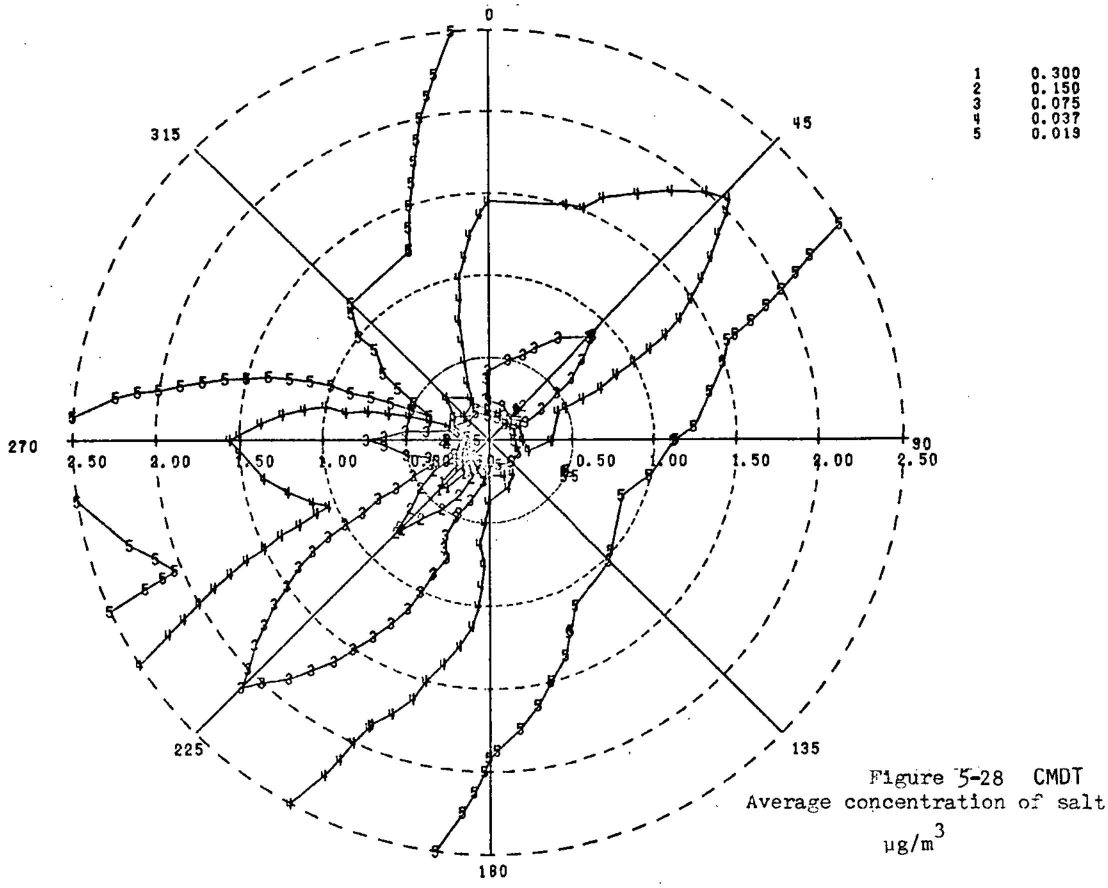

Figure 5-28 CMDT
Average concentration of salt in air
$\mu g/m^3$

IP-3

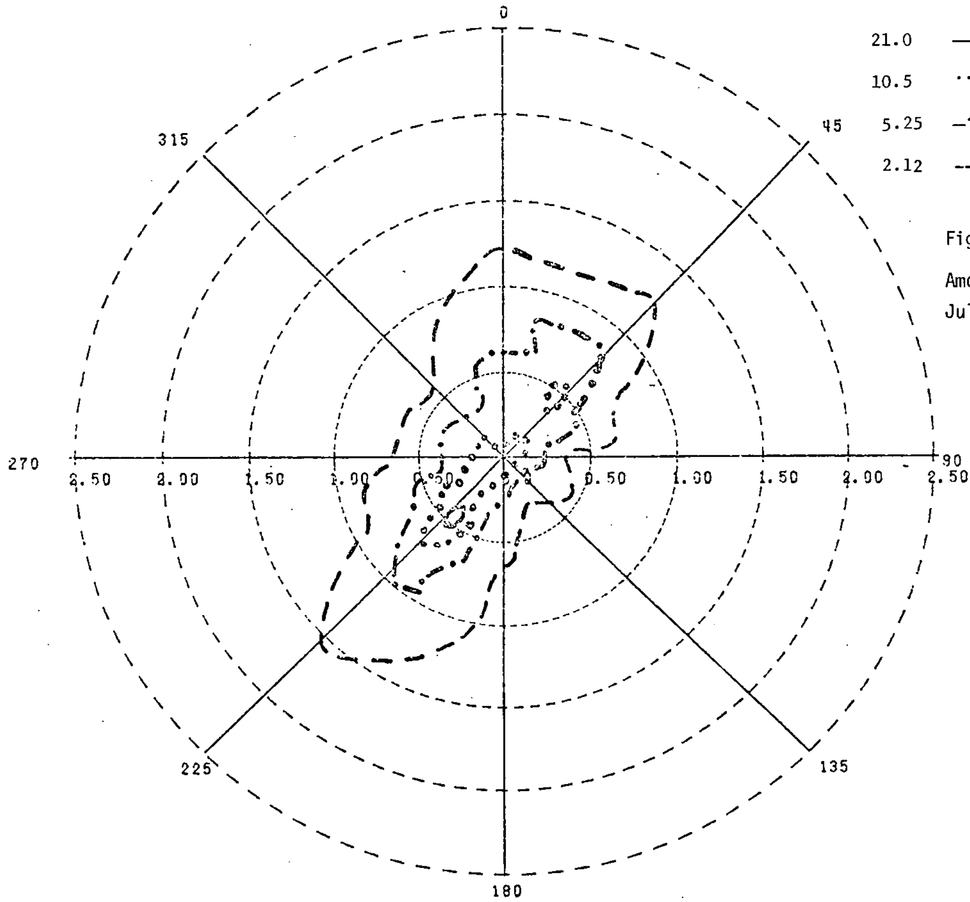

Figure 5-30

Amount of Drift--
July Kg/Ha

IP-3

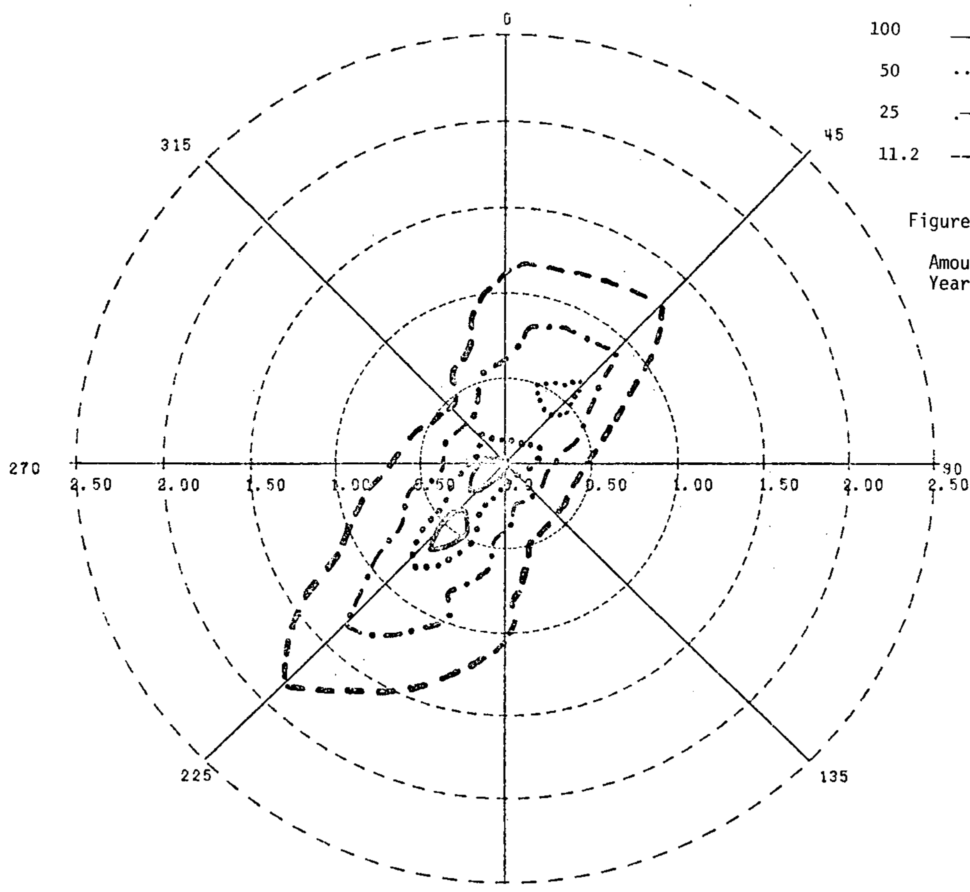

Figure 5-29 2 CMDCT

Amount of drift--
Yearly Average Kg/Ha

IP-3

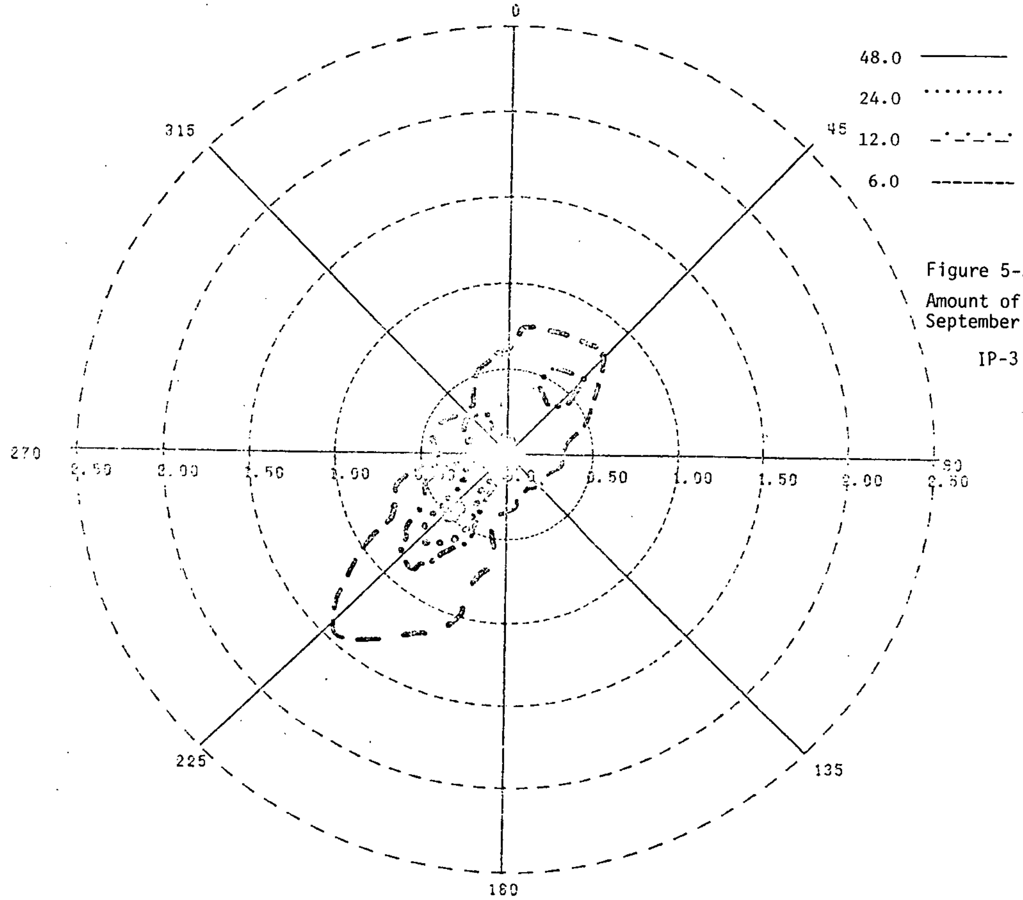

Figure 5-32 2 CMDCT
Amount of Drift
September Kg/Ha

IP-3

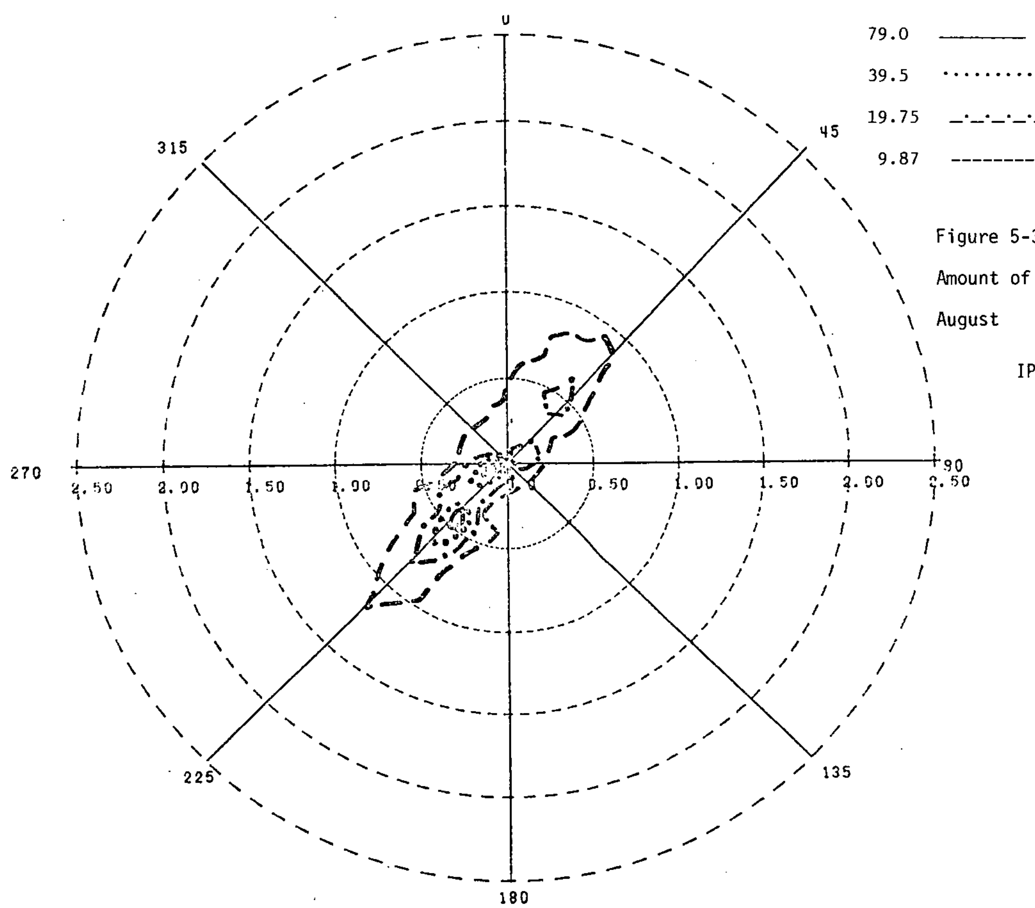

Figure 5-31 2 CMDCT

Amount of Drift--

August Kg/Ha

IP-3

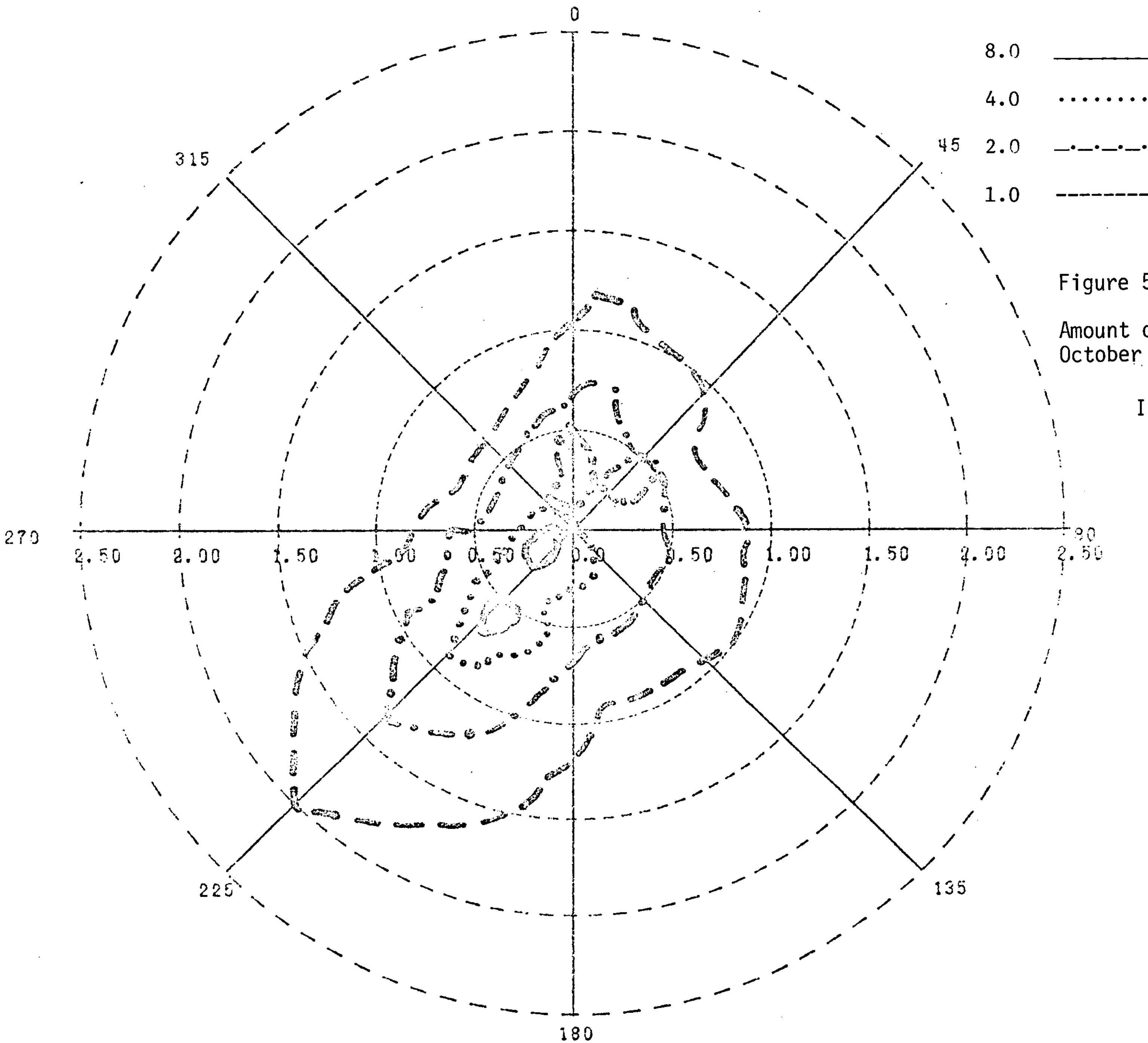

Figure 5-33 2 CMDCT

Amount of Drift
October Kg/Ha

IP-3

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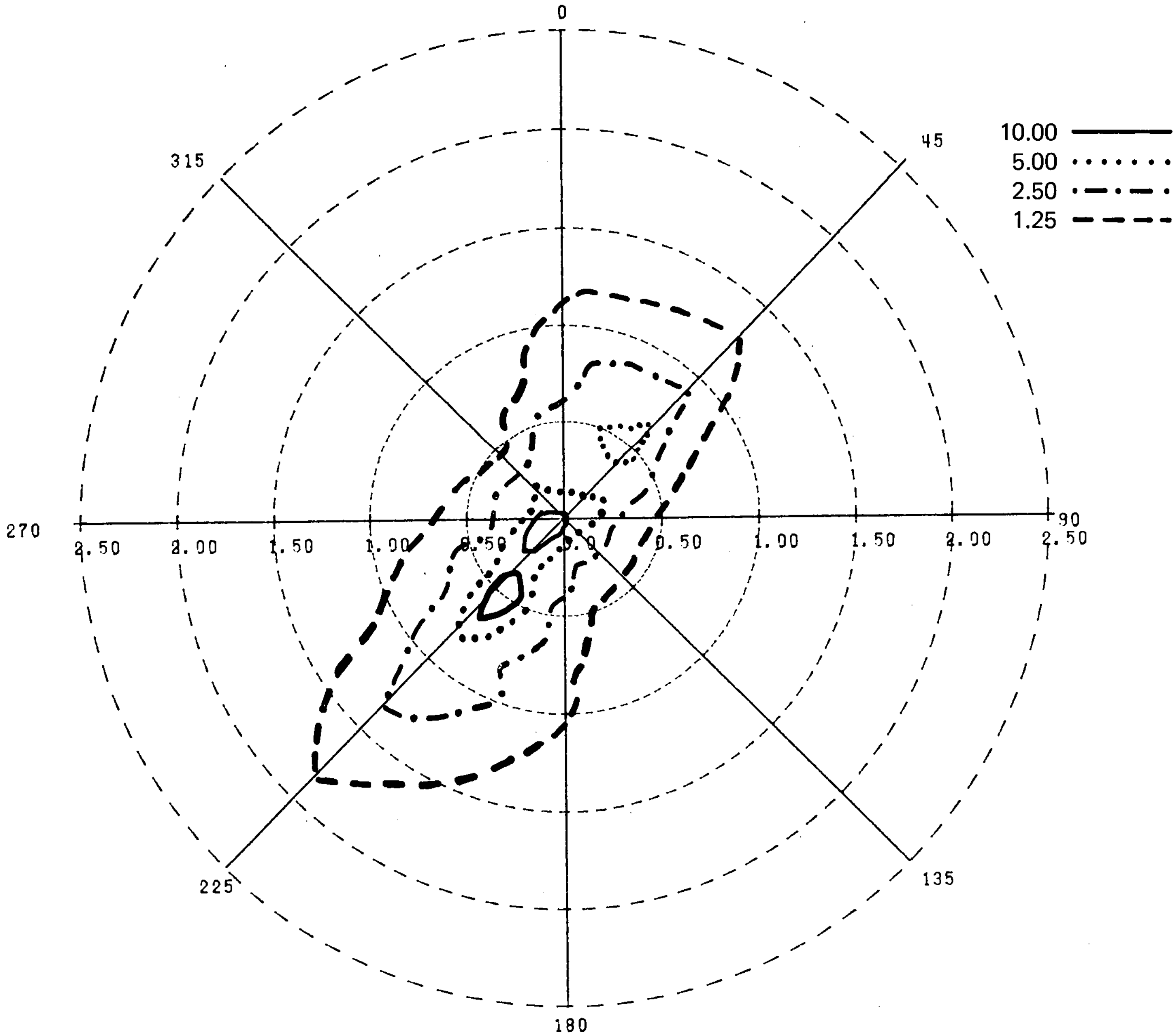

FIGURE 5-34 (A) 2 CMDCT AMOUNT OF DRIFT YEARLY AVERAGE KG/HA

IP-3

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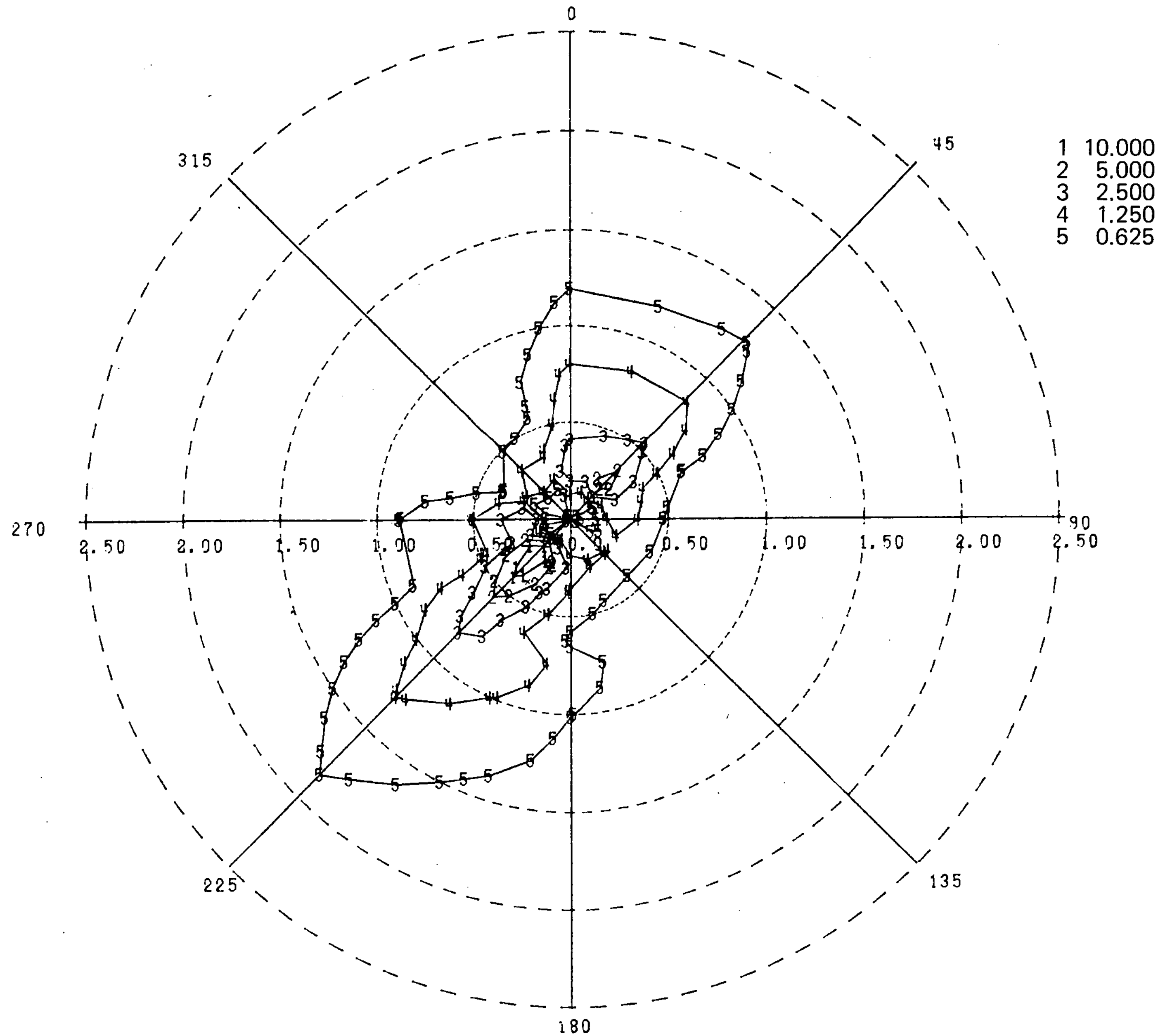

FIGURE 5-34 (B) SINGLE CMDCT AMOUNT OF DRIFT YEARLY AVERAGE KG/HA

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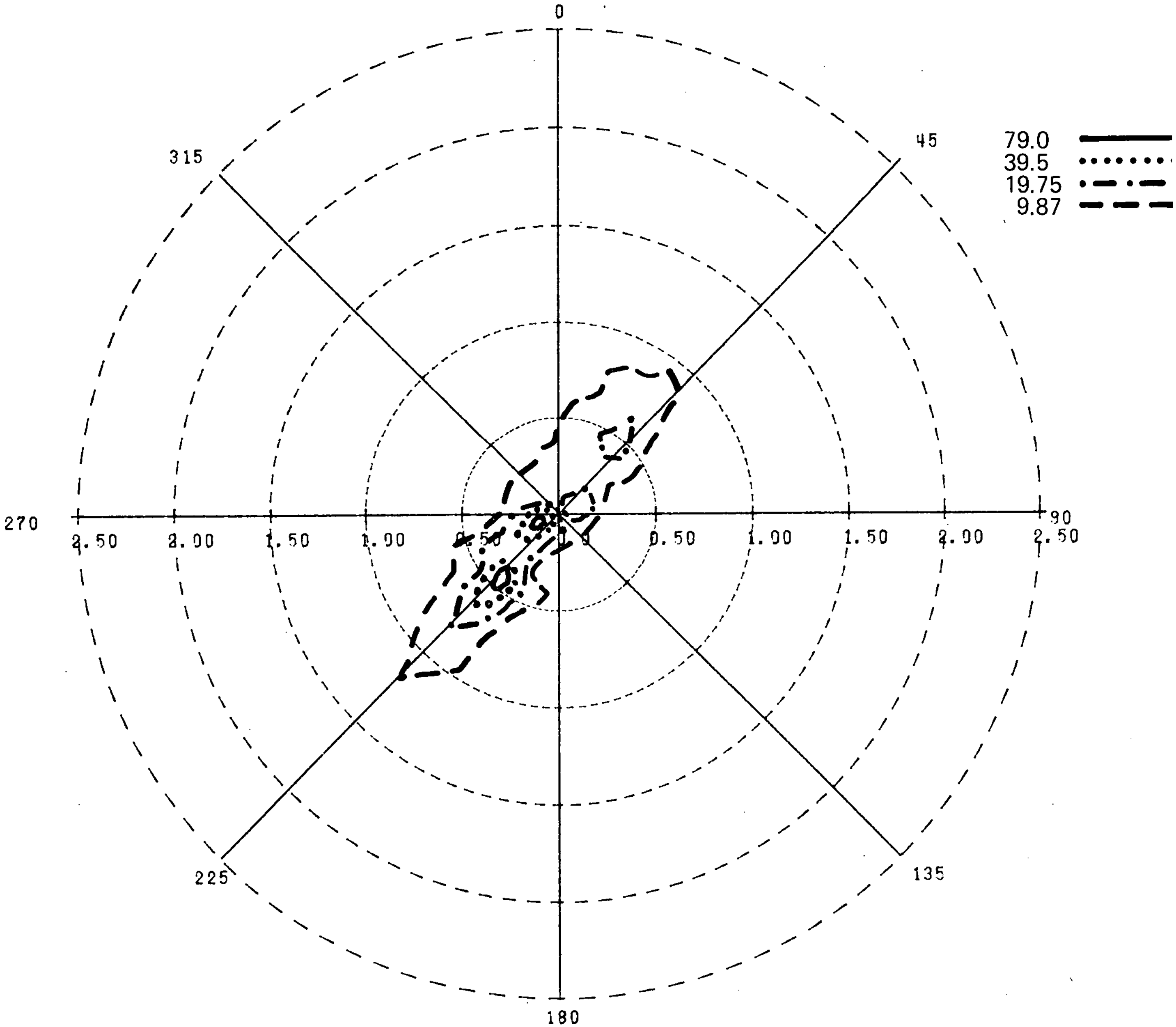

FIGURE 5-35 (A) 2 CMDCT AMOUNT OF DRIFT AUGUST KG/HA

IP-3

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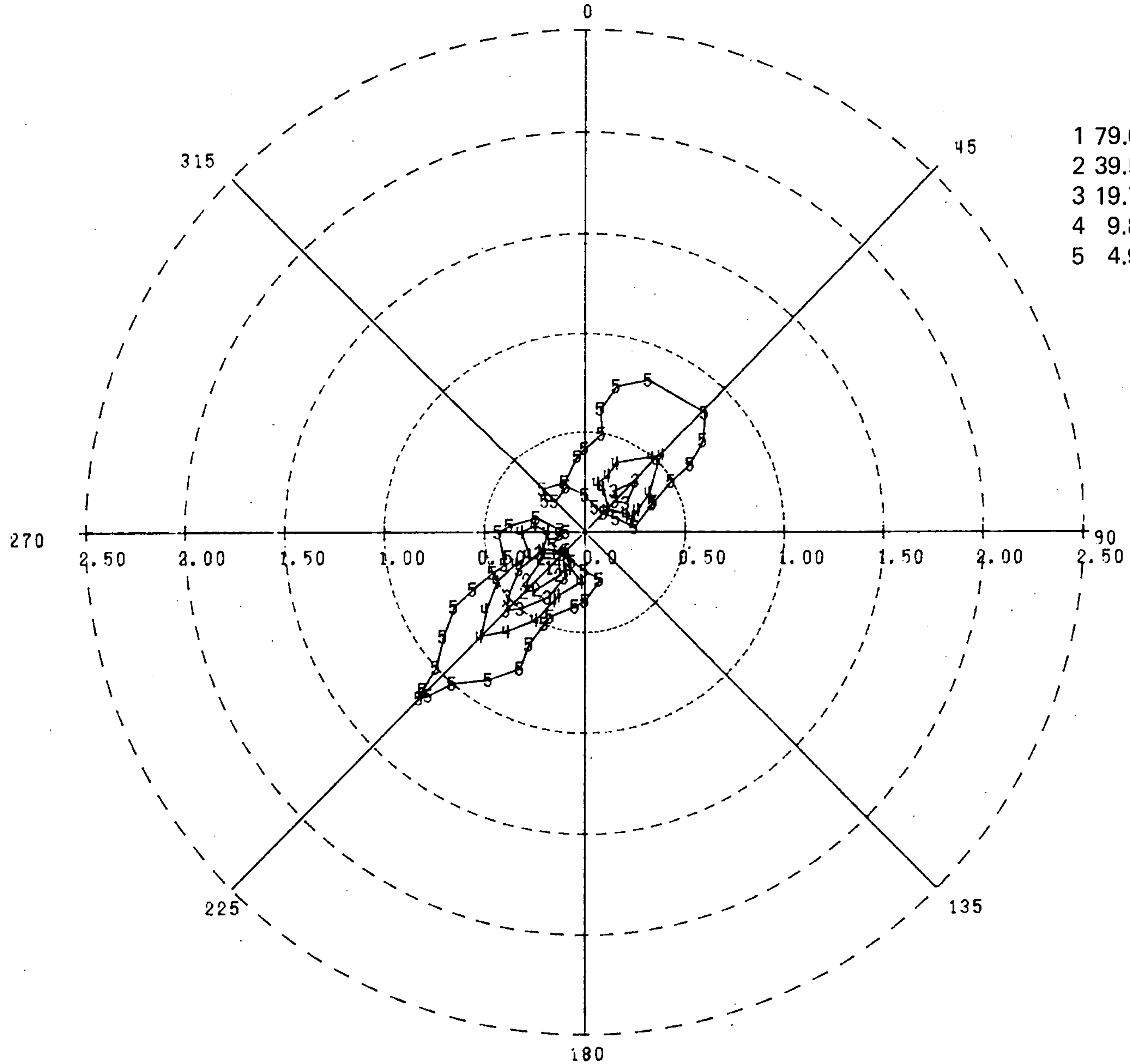


FIGURE 5-35 (B) SINGLE CMDCT AMOUNT OF DRIFT AUGUST KG/HA

IP-3

The applicant has considered three other configurations: a natural draft cooling tower for Unit No. 2 with either CMDCTs, LMDCTs or FANDCTs for Unit No. 3 (Appendix B to ER on CCC for IP Unit No. 3). These calculations indicate little difference between the linear and circular mechanical draft options for drift while indicating that the fan assisted tower is a significant improvement with respect to drift (though still not as good as two NDCTs). The staff's predictions for CMDCTs are about the same as the applicant's CMDCT calculations for Unit No. 3. It would not be unlikely for the applicant to predict approximately double the figures presented here by the staff for the case of CMDCTs at both units. The major discrepancies lie onsite and are most likely within the error of the models and their data. Evaluation of the environmental effects would not be significantly altered by this difference.

5.1.3.4 Effects of Cooling Tower Drift on Exposed Surfaces

Deleterious effects on onsite electrical equipment and structures by increasing corrosion attack on exposed surfaces may result from the saline drift from the cooling towers. The rate of corrosion is dependent on the types of structural materials and the amount of salt accumulated on their surfaces. The amount of salt deposition from each cooling tower alternative was discussed in Section 5.1.3. In addition, the distance from the source, the wind speed and direction, the time the droplets remain upon the surface, the relative humidity and the amount of precipitation also influence the rate of corrosion of exposed surfaces. The information available about the adverse effect of salt drift upon structures is based upon experimental data and experience.[54] The AEC report prepared by Westinghouse discusses such experience with existing saltwater cooling towers.

The corrosion rate caused by natural sea drift falls off rapidly with increasing distance from the sea. Studies[70] show that in coastal areas, the corrosion rates of iron, stainless steel, and aluminum decrease by factors of 10, 3 and 21, respectively, as the distance increases from about 25 m (80 ft) to about 250 m (800 ft) inland. High precipitation rates tend to wash off the salt and, thus, reduce the corrosion rate, but high humidity and fog keep the surface wet and enhance corrosion. Structures in warm areas, with long periods of exposure to sunshine, experience less corrosion due to the fast evaporation of the droplets.

In the case of saltwater cooling towers, the incremental adverse effects of salt deposition at distances greater than about 0.5 km (0.3 miles) downwind are expected to be insignificant. Some adverse effects are expected only in the immediate proximity of the tower and within the boundaries of the plant. These effects are due to localized phenomena, e.g., blowout in the case of counterflow towers and the wake effects. Blowout consists of a spray of droplets removed from the water falling into the tower basin, and is carried out by air movement in the lower portion of the tower. Hence, metal structures, high-voltage power lines and buildings must be protected by suitable coatings, as reported by saltwater cooling tower users. Metal, concrete, wood, painted and asphalt surfaces in the vicinity of the cooling tower should be properly protected to avoid saline damage. Also, parking lots should not be placed at short distances downwind of the tower.

5.2 TERRESTRIAL IMPACTS AND LAND EFFECTS

5.2.1 Effects of Excavation, Grading and Construction on the Local Plant Communities and Wildlife

Construction of cooling towers at the Indian Point site requires grading and excavation for tower support structures and piping. The nature of the limestone substrate would require a certain amount of blasting. Addition of the Unit No. 3 natural draft cooling tower system will expand the total area now utilized for the three unit generating station (including auxiliary facilities and the Unit No. 2 cooling tower) from 20.6 to 27.1 Ha (51 to 67 acres) or about 28% of the 96.7 Ha (239 acre) Indian Point site. Additional clearing of 1000 ft. of forested area would be required for siting and construction access. Areas to be cleared consist primarily of well-developed mixed oak and eastern hemlock stands. These areas contain wildlife, including squirrels, chipmunks, various types of woodland birds common to deciduous forests of the eastern United States (e.g., red-eyed vireo, redstart, eastern wood peewee) that have become accustomed to the nearby long-termed construction activities at the site.

The slight reduction of local plant communities due to cooling tower construction will not cause unacceptable damage to local wildlife populations because there are adequate areas of similar habitat to be found in the surrounding areas including the large, county-owned, Blue Mountain Reservation area, approximately one mile east of the site.

5.2.2 Effects of Drift on Surrounding Plant Communities and Wildlife from CCC System Operation

5.2.2.1 Botanical Effects of Drift

The botanical consequences of saline deposition depend on the amounts deposited and on the distribution of salt-tolerant and intolerant plant species. It is accepted by both the applicant and staff that salt deposition from drift in the amounts expected at Indian Point will not create saline soils and that botanical damage because of soil contamination is unlikely. The only significant pathway for potential botanical injury is by direct foliar interception of drift particles from the atmosphere.

The difference between the two pathways is important since, if soil contamination were important, it could lead to a chronically deteriorating biota over the life of the plant while foliar contamination could result in a series of damaging episodes which were largely independent of one another. In many such cases, foliar recovery could take place between episodes. The situation would not be a progressively deteriorating one unless the damaging episodes were repeated in sufficiently rapid succession to prevent foliar recovery in the intervals.

Damaging episodes could occur during periods of high relative humidity, high river salinity and extended drought periods. These conditions might be fulfilled simultaneously during late summer and early autumn months. The frequency of rainfall is important because rain may often wash salt from leaves, preventing foliar injury.

The applicant has evaluated the salt tolerance of a variety of plant species which occur in the vicinity of the Indian Point Station. Other salt sensitive species not evaluated might exist in the Indian Point vicinity. The present analysis, however, has been done for the most sensitive known species which is a conservative approach. Decisions based on the present analyses are not likely to have consequences worse than presently visualized even if a new sensitive species were to become known. Results of screening indicate that only three species are sufficiently intolerant of foliar salt deposition to be considered potentially a risk from cooling tower saline drift. These species are white ash, flowering dogwood, and Eastern hemlock. Hemlock appears to be the most sensitive of the species tested.

The criterion of damage used by the applicant to judge salt tolerance was the appearance of leaf lesions, marginal necrosis in leaves of broad leaf plants or needle yellowing and loss in hemlock and other conifers. The staff also wishes to point out that second order effects such as induced flowering or leafing out could be significant, either physiologically or physically (winter kills) to trees suffering from salt damage. However, the appearance of such symptoms does not imply that the affected plant will necessarily die but only that an observable effect has been produced. Death of affected vegetation becomes likely if repeated complete or partial defoliation takes place in rapid succession. Two or more episodes of complete defoliation in any one year would likely result in death of susceptible plants but this is unlikely to occur. A single episode of extended rainless periods occurring during the months of high salinity could result in "brownout" and partial defoliation of the susceptible species. (The applicant has suggested 14 days without rain as a reasonably possible period - ER-CC-2) Such an event occurring in late summer or early autumn would be aesthetically objectionable; however, it is likely that production of new leaves would be normal the following spring since drift deposition will be minimal at this time.

The staff has conducted a survey of sensitive tree species in the areas of Verplanck and Buchanan which are most likely to receive the largest saline deposits from either natural draft or mechanical draft towers. The data obtained are adequate to establish the magnitude of possible consequences of salt damage for the purpose of decision making. Feasibility of restoration is all that is established by the data. Results of the survey,which covered 87 homes,are shown in Table 5-8.

More than 44% of the properties surveyed have at least one of the salt sensitive species. Dogwood and hemlock are the most prominent while ash occurred in only four lots in the survey. Dogwood constitutes 11.0% of the total number of ornamental trees in the Verplanck and Buchanan areas and hemlock constitutes 9.4%.

The staff survey which was performed on August 25, 1975, found that some vegetation in the area including hemlock and dogwood showed signs of foliar necrosis resembling "salt burn" in the absence of any cooling tower drift. Damaged trees were scattered at infrequent intervals throughout the survey area. Cause of the damage is unknown. Preoperational surveys would be required prior to cooling towers being constructed in order to separate pre-existing damaged trees from drift-related damaged trees after operation with the cooling tower began. A vegetation survey was conducted by the applicant in the summer of 1973. (See Appendix D to the ER-CC-2.)

TABLE 5-8

SUMMARY OF STATISTICS ON SALT-SENSITIVE VEGETATION
IN THE TOWNS OF BUCHANAN AND VERPLANCK, NEW YORK

Total properties	87
Total properties having at least 1 individual of the salt sensitive tree species	39
Percentage	44.8%
Number of lots having dogwood	27
Percentage	31.0%
Number of dogwood on 87 lots	53
Average/lot	0.61
Number of lots having hemlock	18
Percentage	20.6%
Number of hemlock on 87 lots	45
Average/lot	0.52
Number of lots having ash	4
Percentage	4.6%
Number of ash on 87 lots	4
Average/lot	0.046
Number of lots having both dogwood and hemlock	7
Percentage	8.0%
Number of lots having at least one tree	81
Percentage	93.1%
Number of trees on 87 lots	480
Average/lot (all lots)	5.5
Average/lot (with trees)	5.9
Percent of total trees; dogwood	11.0%
Percent of total trees; hemlock	9.4%
Percent of total trees; dogwood and hemlock	20.4%
Number of lots having hemlock hedges (row plantings of hemlock consisting of many individuals trained in the shape of a hedge rather than the typical open grown shape)	2
Percentage	2.3%

5.2.2.2 Applicant's Estimates of Damage Thresholds

As described in Appendix E of the applicant's ER-CC-2, the Boyce Thompson Institute, under contract to the applicant, has estimated threshold rates of saline deposit which will cause foliar lesions or other observable foliar symptoms on a variety of plants grown in the environs of Indian Point. Studies were conducted in closed chambers using seedlings of various species. Saline aerosol was sprayed into the chambers which contained plants and the aerosol was exhausted continuously for treatment periods of 4-6 hours per experiment. Salt deposition inside the chambers was measured with collecting plates covered with parafilm which were placed close to the tops of the tree species. After an experimental run, the parafilm was removed and rinsed and the total chlorine deposited was determined by chemical analysis. Results were expressed in units of $\mu g/cm^2$. It was assumed that leaves intercepted the same amount of deposit as the collectors.

The chamber experiments served to establish the rank order of salt sensitivity of plant species and provided estimates of the amounts of salt required to produce visible foliar damage. It was established that foliar damage was a function of ambient relative humidity both during the time of exposure and afterward. Maximum toxicity occurred at about 85% relative humidity, but toxicity decreased by half for 50% relative humidity.

The experiments served as the basis for estimating thresholds of salt damage in the field around cooling towers although the experimental conditions differ in some important ways from field conditions. Within the experimental chambers, for instance, the background aerosol content of the air approached or exceeded 1500 $\mu g/m^3$ of salt while in the field it is expected from staff modelling that onsite aerosol concentrations on the order of 0.2 to 0.8 $\mu g/m^3$ would prevail in the vicinity of two natural draft cooling towers and concentrations of 0.5 to 2.3 $\mu g/m^3$ would be found in the vicinity of mechanical draft towers. During the chamber experiments, the amounts of salt actually deposited on surfaces was within the range expected in the field. It is a commonly encountered difficulty with chamber experiments that chamber conditions often cannot be simultaneously adjusted to resemble field conditions.

Another difference between the chamber experiments and expected field conditions was that the experiments were carried out utilizing acute doses of salt which were delivered over 4-6 hour intervals to approximate field conditions where continuous but smaller dose rates are expected.

Based on the chamber experiments, the applicant has estimated that the threshold of salt damage to hemlock foliage is in the range of 40-100 Kg/Km^2 (0.36-0.89 lbs/acre) and 100-600 Kg/Km^2 (0.89-5.3 lbs/acre) for dogwood and ash. These estimates require the assumptions that: (1) high background concentration of non-deposited aerosol which prevailed in the chambers has no effect in causing visible foliar damage; and (2) the dose rate of salt to leaves is insignificant in comparison to the total dose as a factor in producing visible damage to leaves.

Failure of either or both assumptions would lead to the conclusion that the actual field threshold level of salt damage to vegetation is higher than determined in the chamber experiments. In the staff's view, the substantive experimental and computational facts are the following: (1) the empty chambers would have air concentration of 2000 $\mu g/m^3$ of Cl, (2) the chamber with plants have air concentration of 1500-1700 $\mu g/m^2$, and (3) air in the field has less than 1 $\mu g/m^3$ of salt near a natural draft cooling tower. These facts support the conclusion that (1) the plants would have acted as an agent of removal for aerosal which may not have been measured by plates which passively collect deposited particles and (2) the chamber conditions were substantially different from expected field conditions. Further deductive results from these facts are that the plants received higher than the nominal exposures to salt and that thresholds for salt damage were thereby set lower than necessary for accurately estimating field damage.

Neither the applicant nor the staff has tested the validity of the assumptions and, therefore, the question remains open. Evidence provided by Cassidy[48] suggests the strong possibility that aerosol salt particles enter plants through stomata (small pores in the leaf which function in gas and water exchange). Thus, it is possible that plants may be contaminated not only by gravitational deposition of particles on leaf surfaces but also by entry of particles into stomata (FES-CC-2, p. 8-5, 8-6). In view of these findings, the possibility exists that the plants were contaminated by two pathways instead of one in the chamber experiments and that the true salt dose to the plants was higher than the nominal dose. While the magnitude of added dose due to stomatal entry cannot be estimated from the existing experiments, it is evident that the high aerosol concentrations cannot be discounted. It, therefore, seems likely that the threshold dose for damage to foliage has been underestimated. Other reports indicate that vegetational damage occurs in the range of aerosol concentrations from 10 $\mu g/m^3$ to 100 $\mu g/m^3$ of salt.[50-52,54]

5.2.2.3 Estimate of Botanical Injury from a NDCT

a. Applicant analysis

The applicant has prepared a map of potential botanical injury due to 2 NDCT's drift based on threshold rates measured in the Boyce Thompson experiments (Figure 6.11 in the applicant's

ER-CC-3, reproduced in this statement as Figure 5-36). Threshold contours on the maps closely follow the 100 and 200 Kg/Km^2 drift contours from the computer model. It was indicated by the applicant, however, that threshold values were selected from experimental results which were obtained at a humidity which would maximize injury (85%). This is probably unnecessarily conservative since most ambient humidities fall below this value and thus salt effects may be at least a factor of two less than the maximum.

b. Staff analysis

Allowing for a factor of two as an overestimate of potential damage, the drift contours of damage compress to include only the area enclosed by the 200 Kg/Km^2 (1.8 lbs/acre) contour of Figure 5-1. Considering further the low probability having 14 rainless days, the ability of vegetation to survive foliar injury and partial defoliation, and the probable conservative thresholds established by the chamber experiments, the staff believes it is likely that no permanent damage to vegetation will occur due to saline drift from a natural draft cooling tower. Symptoms of foliar salt burn could occur occasionally within the 200 Kg/Km^2 contour in some years.

The staff has modelled the Unit No. 2 and Unit No. 3 drift fields for NDCT's using the ORFAD model. Results are similar to the applicant's with respect to distribution and deposition rates of salt. See Figures 5-6 through 5-10 and Figures 5-14 through 5-20. The agreement between the models is adequate for the environmental assessment. The staff model also shows that the salt deposition levels do not exceed reasonable threshold levels for damage to vegetation offsite except in very localized areas. The staff model confirms the conclusions based on the applicants model that no permanent damage to vegetation will occur with operation of an NDCT.

5.2.2.4 Estimate of Botanical Injury from MDCT

Potential botanical injury from linear MDCT and wet/dry MDCT is more likely than for a NDCT because the drift particles fall closer to the towers at higher rates of deposition than is the case for a NDCT. There is no difference in the staff estimates of risk from MDCT's and WDMDCT's since the latter are most likely to be operated in wet mode during the critical months (late summer-early fall). When wet/dry MDCT's are operated in all dry or partially dry modes, salt drift is reduced; however, this will occur primarily during periods of plant dormancy and low river salinities.

a. Applicant analysis

The applicant's prediction of potential botanical injury takes in a large area of Montrose, Peekskill, Buchanan and Verplanck (Figure 5-37). It also includes areas of park land on the west side of the Hudson River. In the applicant's assessment the area of potential damage is enclosed by the 80-100 Kg/Km^2 (0.7-0.9 lb/acre) contour (Figure 5-2).

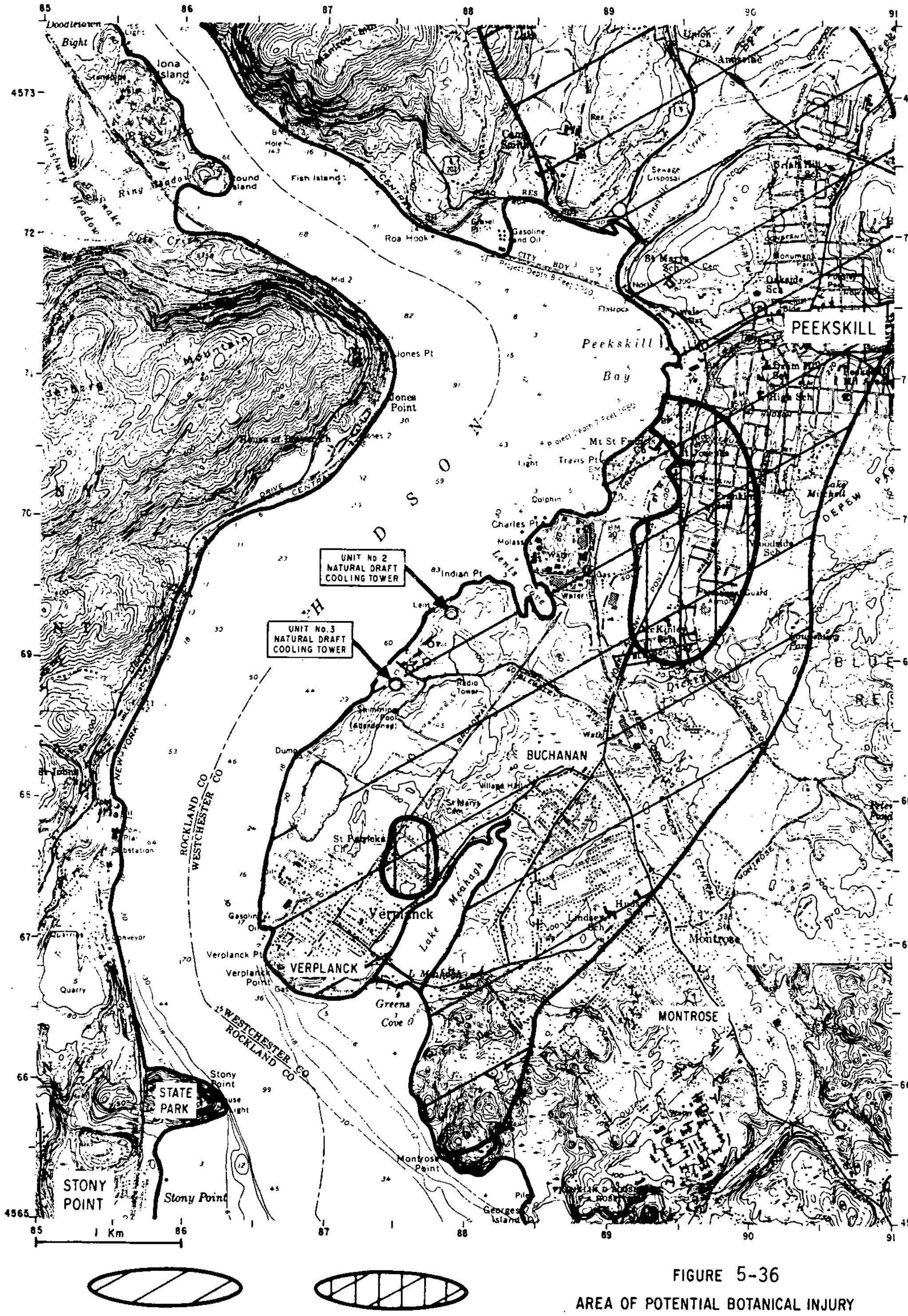
b. Staff analysis

The threshold chosen appears unnecessarily conservative in the staff's view. The staff believes that thresholds for the appearance of foliar symptoms will occur at levels of salt deposition from 2 to 10 times higher than the 1 lb/acre level for reasons stated in the analysis of botanical injury.

The prediction of actual damage cannot be made with great precision but the staff believes that if foliar symptoms occur, they will be found within the area enclosed by the 200 Kg/Km^2 contour. This does not imply that the vegetation of the entire enclosed area will be affected but only that symptoms are more likely within the area than outside of it.

The drift contours greater than 200 Kg/Km^2 tend to cluster parallel to the east bank of the Hudson River because of the prevailing winds in the river valley. Any foliar symptoms which might occur will most likely be confined to land areas close to the river and extending perhaps 2 miles above and 1 mile below the location of the towers.

The vegetation at risk within this area is primarily flowering dogwood and hemlock. The land use within this area consists of single family residences, manufacturing plants interspersed with scattered wood lots with forest to the west. In the staff survey of vegetation in the potentially affected areas, it was found that approximately 11% of the ornamental trees were dogwood and 9% were hemlock. White ash was a minor component of the vegetation. There were about 550 ornamental trees per 100 homesteads in this area but only the dogwood and hemlock are at risk from drift. Thus, there are about 60 individual dogwood trees and 52 hemlocks per 100 households in the area



ALL HEMLOCKS POTENTIALLY INJURED; 5-20 % OF DOGWOOD AND WHITE ASH POTENTIALLY SLIGHTLY INJURED.

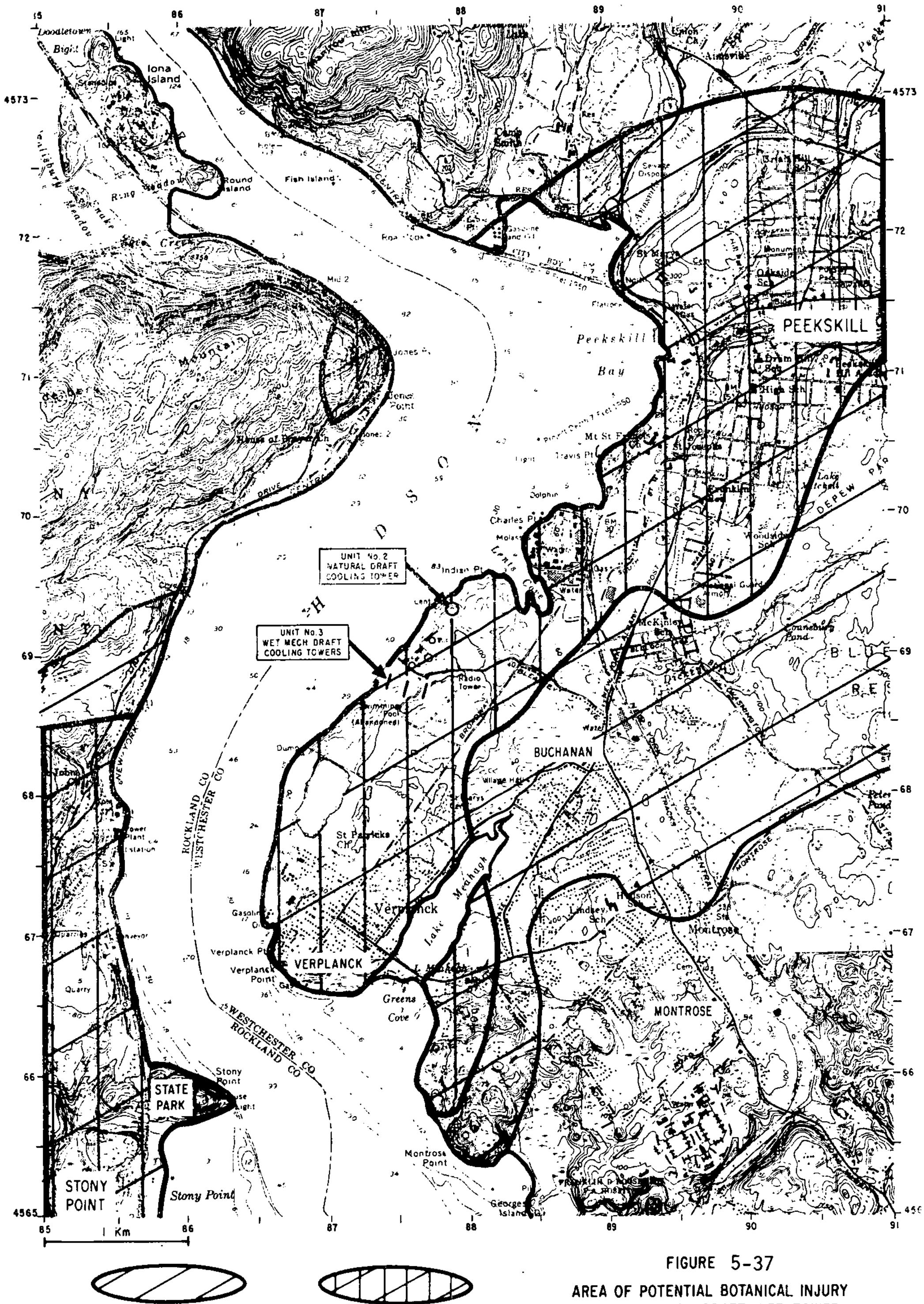
ALL HEMLOCKS POTENTIALLY INJURED; 20-100% OF DOGWOOD AND WHITE ASH POTENTIALLY INJURED.

Ref. ER-CC-3, Fig. 6-11

FIGURE 5-36

AREA OF POTENTIAL BOTANICAL INJURY
UNIT 2 - NATURAL DRAFT WET TOWER
UNIT 3 - NATURAL DRAFT WET TOWER
14 DAY DROUGHT

Figure 5-36



ALL HEMLOCKS POTENTIALLY INJURED; 5-20 % OF DOGWOOD AND WHITE ASH POTENTIALLY SLIGHTLY INJURED.

ALL HEMLOCKS POTENTIALLY INJURED; 20-100% OF DOGWOOD AND WHITE ASH POTENTIALLY INJURED.

Ref. ER-CC-3, Fig. 6-12

FIGURE 5-37

AREA OF POTENTIAL BOTANICAL INJURY
UNIT 2 - NATURAL DRAFT WET TOWER
UNIT 3 - LINEAR MECHANICAL DRAFT
WET TOWER - 14 DAY DROUGHT

Figure 5-37

of potential damage. Cost of replacement of a single tree 4 inches in diameter and 20 feet tall was found to be about $300. The total replacement value of the trees at risk would, therefore, be $18,000 for dogwood and $15,600 for hemlock per 100 households in the drift area. The staff notes that the data from its survey establishes only the feasibility of restoration. The cost data are not adequate, nor are they intended to be used for detailed financial planning.

The replacement cost would be incurred only if all of the sensitive trees in the affected area actually died. This is unlikely in expected weather conditions. The applicant has indicated, and the staff concurs, that damage symptoms (leaf scorch, or needle yellowing in hemlock) would most likely be observed during periods of extended drought (14 or more rainless days in the applicant's analysis during August or September. These symptoms in themselves do not signal the imminent death of the tree, however. Most species of trees have substantial ability to recover from damaging episodes and the staff expects that most trees will put forth new normal leaves in the spring following such an episode.

Death of trees will occur if repeated severe damage or defoliation takes place in a single season or if severe drought persists for several seasons. Two 14-day rainless episodes in one year or a single month long episode carries with it the significant probability of death for some trees. Long-term weather records for the vicinity of Indian Point indicate that a single 14-day rainless period has a probability of occurrence of 0.4 in any one year and that the longest rainless period on record in the New York area is 27 days. (ER-CC-3, p. 6-29.)

The staff concludes that during years of normal weather no significant offsite effects of drift from mechanical draft cooling towers will be observed. During years which have extended rainless periods (2 weeks in duration), such as during August or September, symptoms of damage could be found on dogwoods and hemlocks within the 200 Kg/Km^2 contour. This would appear to an observer as scattered "brownout" of the affected species. Recovery of most trees would be observed the following spring. On a much less frequent schedule, periods of long extended drought or successive years of drought or insect or disease interactions could result in the death of some trees. This could happen on the order of once or twice at most during the remaining life of the plant if linear MDCTs of either the wet or wet/dry design were selected (ER-CC-3, p. 6-34).

The staff, therefore, does not expect wholesale destruction of vegetation or denuding of the environment in the vicinity of MDCT. The situation is likely to be much more subtle with occasional brownouts and infrequent death of a few trees taking place. Replacement of affected trees is both technically and monetarily feasible since the number of trees involved is relatively small.

The risk of serious damage to vegetation from drift emitted from MDCT is finite but confined to the immediate area of the towers. Damage to hemlocks, dogwoods and other species onsite could occur. The level of risk on an annual basis to offsite vegetation is small although death of some trees could occur in infrequent episodes. Potential drift effects would, therefore, not prohibit the utilization of MDCT's at the Indian Point site if there were adequate provision for monitoring of drift and vegetation and for restoration of damage that actually occurs.

The risk of offsite vegetation damage from these towers is nevertheless greater than would be incurred with NDCT's. In the interest of preventing damage to vegetation as opposed to the possible necessity of carrying out small restorative actions, the staff concludes that NDCTs are preferable to wet or wet/dry MDCT on the Indian Point site with respect to the single factor of vegetative injury from drift.

5.2.2.5 Estimate of Botanical Injury from Fan-Assisted Natural Draft (FANDCT and) Circular Mechanical Draft (CMDCT) Towers

The staff feels that the assessment of an NDCT and MDCT's effectively envelopes the effects of drift which might be expected from FANDCT's and CMDCT's. No drift effects from the latter towers are expected to fall outside the upper and lower bounds of risk estimates for the former types.

FANDCT's would be similar in impact to a NCDT because release of drift particles and plume would take place at sufficiently high altitude (250 to 300 feet or more) to permit some evaporation of drift particles and strong dispersion before particles reach the ground. The principal difference in performance is that drift from a FANDCT would be expected to fall somewhat closer to the tower at a somewhat higher deposition rate than for an NDCT. It is doubtful that any area would receive even as much as a factor of two increase of drift in comparison to a NDCT. Considering the conservatism used by the applicant in assessing biological effects, the staff believes that the somewhat increased localized drift levels associated with a FANDCT would not be important. A FANDCT like the NDCT would be essentially without biological consequences and would be almost as acceptable for the Indian Point site as the NDCT.

Impacts of circular mechanical draft towers would be similar to but possibly somewhat less than ordinary MDCT's because of somewhat greater plume buoyancy with CMDCT's.

The staff has performed a detailed analysis of drift deposition for CMDCT using the computer program ORFAD. The analysis was based on the assumption that two CMDCTs of 13 fans each would be used for Unit No. 3 and one NDCT at Unit No. 2. Results for July through October, which are the critical months of interest and overall annual deposition patterns for CMDCT's at Unit No. 3, are given in Figures 5-29 through 5-33. The predicted patterns of deposition are similar to those obtained by the applicant in its assessment of MCDT's. Most of the saline drift will be deposited either in the river or along its east bank for a short distance inland. The applicant's combined salt deposition for a NDCT at Unit No. 2 and CMDCT's at Unit No. 3 are given in Figure 5-38, while Figure 5-39 shows distribution of drift from CMDCT's alone for comparative purposes (ER-CC-3).

Rates of salt deposition may exceed 79 Kg/Ha (71 lbs/acre) on site in August which is the month with the largest salt deposition. This exceeds the threshold for potential visible damage to most onsite species. Deposition diminishes to less than 20 Kg/Ha (18 lbs/acre) approximately 1 Km (0.75 mi) from the tower and falls off rapidly thereafter (Figure 5-21). Offsite damage to vegetation would most likely occur in the northeast-southwest corridor shown by the isopleths but is unlikely elsewhere. The area at risk is about 1 mile up and down the river from the towers and extends less than 1/2-mile inland from the river.

The staff concludes that the risk of environmental damage from CMDCT's is similar to that for MDCT's on the Indian Point site. During years of normal precipitation, the staff expects limited damage to offsite vegetation. If prolonged drought occurred during the critical months, lasting on the order of two weeks, symptoms of "salt scorch" or "brownout" might appear on dogwood and hemlock needles may yellow and fall. Recovery would in most cases be expected the following spring. If extremely protracted drought or several successive years of drought took place, death of some trees could be expected.

The results from the staff model for CMDCT's show that the area of risk is similar to that for MDCT's. The number of trees within the area amounts to about 60 dogwoods and 52 hemlocks per 100 households. As with MDCT's there is essentially no risk of wholesale destruction of offsite vegetation or denudation of even small portions of the offsite environment if CMDCT's are selected. Substantial replacement of onsite vegetation with more salt-tolerant species could be expected.

Considering that there are relatively few offsite trees actually at risk, that available estimates of damage thresholds for saline deposits probably are conservative and that restoration at low cost is feasible, the staff concludes that the possibility of damage to offsite vegetation would not in itself prohibit the selection of CMDCT's for Indian Point Unit No. 3. Because some risk exists, however, the staff would require a thorough monitoring program and provisions by the applicant for restoration of irreversible damage to vegetation if CMDCT's were selected.

5.2.2.6 Effects of Drift Aerosols

a. Effects of Drift Aerosols on Human Populations

Release of aerosols on local populations have been predicted by the staff to obtain maximum monthly values (August) for CMDT of 1.9 $\mu g/m^3$ and 0.4 $\mu g/m^3$ for NDCT. The highest offsite annual values for CMDT and NDCT were calculated by the staff to be approximately 0.4 $\mu g/m^3$ and 0.08 $\mu g/m^3$, respectively (Figures 5-28, 5-13). Aerosol generated from Indian Point cooling tower systems will consist predominately of NaCl. Dautrebande and Capps report[55] that NaCl aerosols by themselves appear to be competely devoid of irritant action on mammalian respiratory systems. NaCl aerosols can interact synergistically with SO_2 and other similarly irritating substances to enhance the effects of these irritating substances. The action of NaCl with this substance is nonspecific and other inert particulates have been found to have the same action.[55,56]

The staff calculates that NaCl represents 1.6% of the total settleable particulate at the site prior to the cooling tower operation (ER-CC-2, Appendix A, Table 14.2). Operation of a single NDCT would increase NaCl by 0.4 $\mu g/m^3$ in the air for the highest monthly value. In NDCT's at Unit Nos. 2 and 3, this value was assumed to be double, 0.8 $\mu g/m^3$. CMDT operation is predicted to increase NaCl by 1.9 μ/cm for a similar period or 2.3 $\mu g/m^3$ including an NDCT at Unit No. 2. This will result in a maximum increase of the total settleable aerosol particulate of 6.0% due to an NDCT at Unit No. 2 and a CMDCT at Unit No. 3. The staff concludes that this is a minor increase in the total particulate inventory in the atmosphere. Considering that the action of NaCl is nonspecific in respiratory irritations, no increases in human respiratory irritations are expected.

The average offsite incremental relative humidity (RH) due to two NDCT's was found to be about 0.02%-0.03% (in %RH above ambient RH) (ER-CC-3, Appendix A, Section 2.3). The ambient RH for the

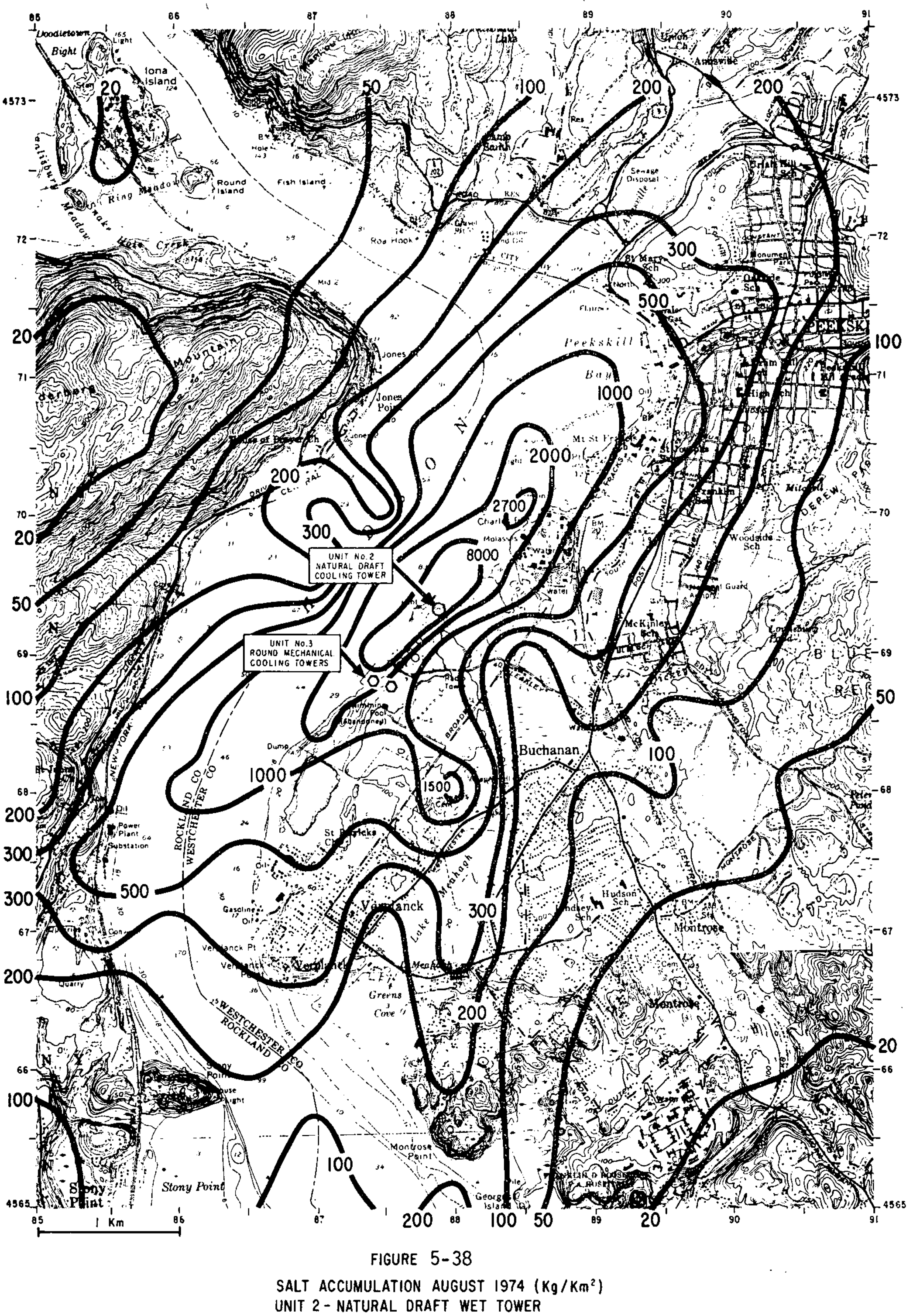


FIGURE 5-38

SALT ACCUMULATION AUGUST 1974 (Kg/Km²)
UNIT 2 - NATURAL DRAFT WET TOWER
UNIT 3 - ROUND MECHANICAL DRAFT WET TOWER
DRIFT SALINITY 7000 ppm

Ref.: ER-CC-3, Fig. 6-8 (Corrected)

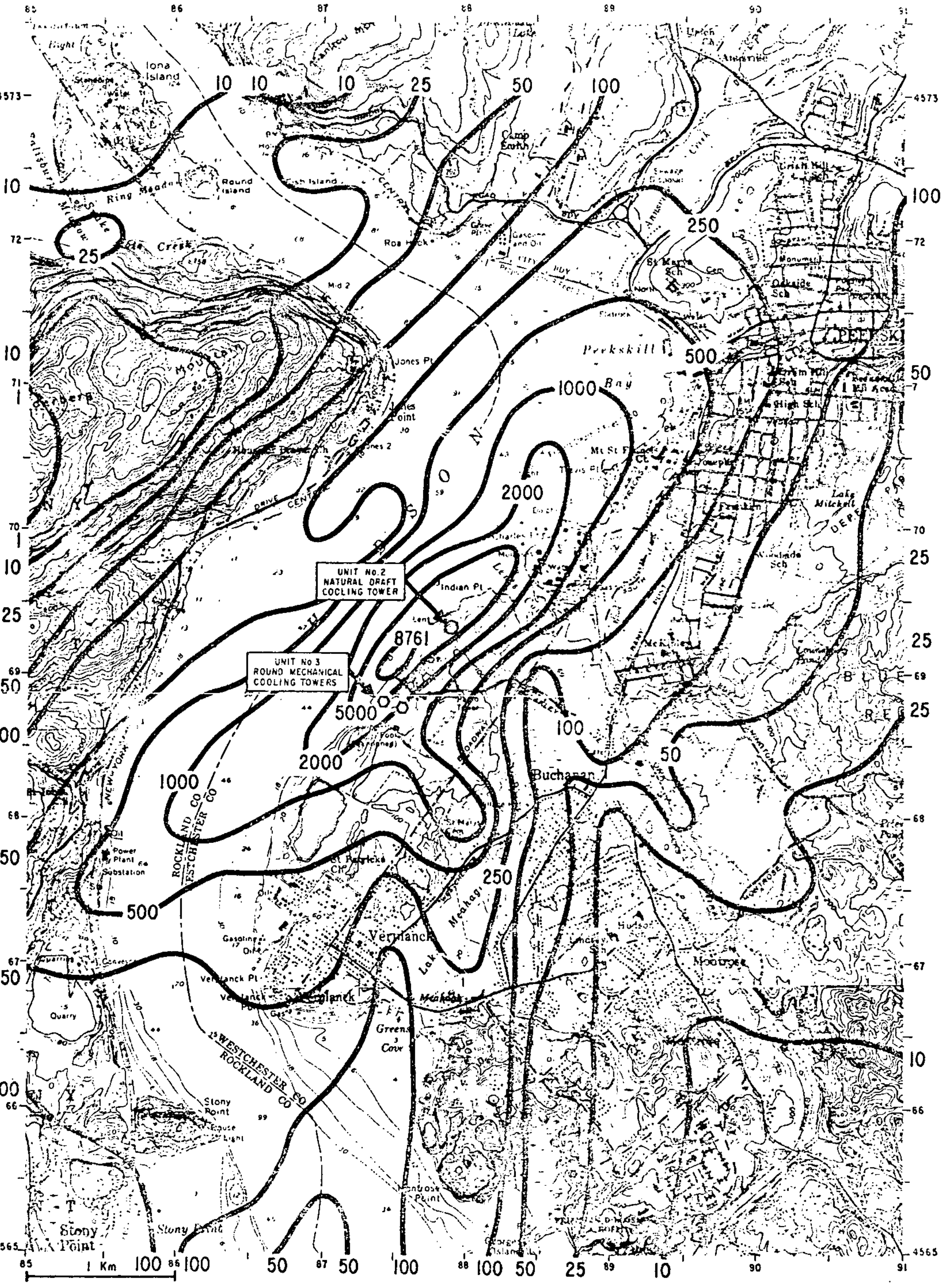


FIGURE 5-39
ACCUMULATED SALT DRIFT DEPOSITS
Kg/Km^2/Mo, AUGUST 1974

Unit 2-Natural Draft Cooling Towers
Unit 3-Two Round Mechanical Draft Wet Towers

Ref.: ER-CC-3, App. B, Fig. 5.17 (corrected)

site sharply fluctuates on a daily and monthly basis. Often the changes range from 50-90% (RH). The staff concludes that the contributions of moisture from any type of cooling tower operation will be insignificant in comparison to the daily fluctuations in the local moisture regime.

NDCT's will not contravene the New York State ambient air quality standard for settleable particulates of 0.3 mg/sq cm/mo. The staff wishes to note, however, that it is not clear whether this standard was intended to include the deposition of highly soluble particles (identical to those which occur naturally) such as atmospheric droplets containing salts found in Hudson River water from which makeup water for cooling towers is taken.

The staff further concludes that State and Federal primary suspended particulate concentrations standards will also be met throughout the predicted drift field.

The staff has analyzed data submitted to it by the New York State Department of Environmental Conservation (FES-CCC-2, pp. B-47) and concurs with that agency's assessment that airborne metal contaminants and potentially toxic chemicals (e.g., chromium, PCB's) will not exceed nor even approach threshold limit values normally applied to industrial hygiene.

b. Effects of Cooling Towers on Bird Migration

The staff has analyzed data from operating plants on bird collisions with cooling towers located near or along migratory flyways. From the data collected and analyzed, the staff finds no evidence to conclude that cooling towers and meteorological structures present a hazard to bird populations. However, the NDCT staff recommends routine monitoring of a selected tall structure such as one NDCT be undertaken at the Indian Point site for the purpose of recording large episodic occurrences of bird mortalities, if they occur at all. The staff believes it is prudent to monitor for verification of the analysis even though serious effects are not expected.

5.2.2.7 Summary of Drift Effects of Cooling Towers

The staff has assessed five cooling tower designs as possible alternatives to once-through cooling for Indian Point Unit No. 3 with respect to the possible damage to vegetation. These include natural draft, fan-assisted natural draft, circular mechanical draft, linear mechanical draft, and wet-dry mechanical draft cooling towers. Major conclusions of the assessment are the following:

(1) None of the five cooling tower options incur the risk of wholesale destruction of offsite vegetation or denudation of the environment.

(2) None of the five cooling tower options will produce progressive long-term deterioration of vegetation due to cumulative salinization of soils.

(3) If any damage to offsite vegetation occurs, it is likely to be episodic and noncumulative.

(4) The critical months for risk of vegetative damage are July, August, September, and October of each year because of the possible simultaneous occurrence of factors necessary for damage. These factors are: (a) high river salinities, (b) fully developed, actively metabolizing vegetation, and (c) possibility of extended drought.

(5) Visible damage to offsite vegetation is expected to be slight or nonexistent for any of the five cooling tower options during years of normal frequency and amounts of rainfall. In years of moderate late summer drought, leaf scorch might be observed for any of the mechanical draft options. Such damage would be reversible and spring recovery would be expected. Death of dogwoods and hemlocks and possibly other species could occur in the offsite vicinity of both linear and circular mechanical draft towers in years of prolonged drought or if severe drought occurred in successive years.

(6) The total number of trees at risk is relatively small, and replanting of trees after a severe damaging episode would be both technically and financially possible.

(7) Although none of the cooling tower options carry the risk of catastrophic offsite damage, there are differences in damage potential among them. The staff ranks the options as follows in order of the least to greatest risk of foliar damage from drift:

(a) Natural draft

(b) Fan-assisted natural draft

(c) Circular mechanical draft

(d) Mechanical draft and wet-dry mechanical draft.

Unit Nos. 2 and 3 Considered Together

The effect of cooling towers for both Unit Nos. 2 and 3 has been discussed in previous sections. The consequences of drift from both units would be to increase the environmental area at risk and to increase the frequency of the appearance of foliar symptoms.

With two towers of similar design, the offsite drift contours were assumed to be double their indicated values. Most of the land enclosed by these contours, however, is within the range of uncertainty in the prediction of damage thresholds. The drift contours should, therefore, be interpreted in a manner somewhat equivalent to a statistical confidence interval. Any damage which might occur would most likely be found within the bounds of the contour. It is not valid to suggest that damage, however, will occur on the entire area of the contour.

Even with both units, no catastrophic offsite damage is expected with any of the alternatives. Natural draft towers for both units would have the least risk of biological damage and linear wet or wet-dry mechanical draft towers would have the greatest risk of damage.

The staff has concluded that from the standpoint of potential damage from saline drift, natural draft towers for both units would have the least biological effect and would, therefore, be the preferred choice. Fan-assisted natural draft towers for both units would have only slightly greater risks and would, therefore, be nearly as acceptable as NDCT's with regard to the single factor of drift.

Circular or linear mechanical draft towers would create a zone of risk extending one to two miles above and below the location of the cooling towers along the river and extending inland to cover most of Verplanck, the western half of Buchanan and most of Peekskill. Some risk of vegetative damage would also exist on the western bank of the river. In each case, the risk is not of catastrophic dimensions; nevertheless, late summer browning of some leaves and occasional death of plants is possible within the zones specified. In zones of highest deposition along the river, damage could include other species as well as dogwood and hemlock. Circular mechanical draft towers could have somewhat less severe consequences than linear towers. Localized episodic damage and death of sensitive plants could be expected within the zone of risk with CMDCTs. The level of risk to vegetation is not sufficient in the staff's view to rule out the use of any of the mechanical draft designs for both units at Indian Point although the use of NDCT's would give the greatest assurance of freedom from injury to vegetation.

5.2.2.8 Summary of Aerosol Effects of Cooling Towers

The natural ambient aerosol salt background for the eleven-month sampling period at the Indian Point site ranged from 0 to 6.15 μg/m^3 and averaged approximately 1.0 μg/m^3. The staff agrees with the applicant's evaluation that the predicted aerosol salt concentrations for NDCT represent a very conservative assessment of saline aerosol values (ER-CCC, IP-2, p. 6-15). The applicant's model estimated that the highest annual aerosol concentration for one NDCT will be 5.6 μg/m^3, approximately 1 mile southeast of the towers. The staff estimated highest onsite monthly values for NDCT and CMDCT of 0.4 μg/m^3 and 1.9 μg/m^3, respectively. For Unit Nos. 2 and 3 considered together, two NDCT's were predicted to produce onsite 0.8 μg/m^3 and one NDCT with one CMDT would produce 2.3 μg/m^3. The average annual values are significantly lower as shown in Figures 5-5 and 5-20. Estimations for linear mechanical draft towers are believed to be somewhat higher than values predicted for CMDCT. If a two-fold difference is assumed, the highest monthly aerosol concentration for linear mechanical draft would be less than 5 μg/m^3. The fan-assisted natural draft and wet-dry mechanical draft options were assumed to produce aerosol salt concentrations within the range of natural draft and linear mechanical draft towers. Aerosol salt values for all types of cooling towers appear to peak over a period of time during the summer and early fall.

It has been reported that the minimum monthly long-term average level of airborne salt needed to affect the distribution and growth of plants is approximately 10 μg/m^3.[56-60] Based upon the applicant's and staff's predicted aerosol values, salt damage to biota from operation of any type

of cooling system would not appear to be a problem. However, it is apparent that predictions based upon salt deposition methods do indicate a potential for damage to certain types of flora under certain conditions as discussed in the preceding section.

5.2.3 Effects of Excess Moisture on the Biota

5.2.3.1 Induced Fog

The staff estimates that two NDCT's may add a maximum average annual addition of about 20 hours of ground fog (Figure 5-11) directly north of the towers in an area primarily over the Hudson River. This value is considered to be an overestimate of what could be reasonably expected (Section 5.1.3.3). The linear MDCT's are predicted by the applicant to increase the annual fog occurrence by 82 hours (Section 5.1.2.2). The CMDCT's are predicted to add similar amounts of ground fog as those predicted for the staff's NDCT estimates (Figure 5-26). The staff estimates that wet/dry MDCT would add the least amount of additional hours of fog of all options considered. The FANDCT's were assumed to have additional fog occurrence values similar to a NDCT and CMDCT's. The applicant states that the natural fog occurrences at the Indian Point site are less than 2 percent annually (ER-CC-2, p. 6-13). The natural ground fog is not known to adversely affect plant or animal species found in the area. Increases in moisture due to added periods of ground fog may, however, trigger increases in the incidences of plant disease. Since the period of record of onsite meteorological data represents only one year, the staff cannot determine the natural background variation or "noise" for ground fog occurrences. The staff cannot accurately ascertain whether the predicted increases in fog occurrence from the various cooling options fall within or significantly exceed the natural background "noise". Based on these uncertainties, the staff concludes that there is some risk of increases in plant diseases to onsite vegetation and to a lesser degree to offsite vegetation. MCDT's would have the greatest risk, but the risk to vegetation is not sufficient in the staff's view to rule out the use of any MDCT's for both Units. The use of a NDCT would have the greatest assurance of freedom of injury to vegetation from excess moisture. It is the staff's position that potential increases in plant disease will occur primarily during the spring months of March, April, and May when most plants commence active growth. The areas most likely to receive the highest additions of excess moisture and, therefore, the greatest potential for plant disease, are located primarily onsite.

5.2.3.2 Icing

The staff calculated the additional number of hours of ice attributed to the NDCT and CMDCT's systems (Figures 5-12 and 5-27). The applicant submitted predictive calculations on icing for the NDCT and CMDCT. A MDCT system was predicted by the applicant to cause 30 hours of icing during the month of February onsite. Circular MDCTs are estimated by the staff to cause a maximum annual average of 26 hours of icing (winter months only) which would be restricted primarily to the onsite environs. The staff estimated that a NDCT would add an average of 11 additional hours of icing on an annual basis.

The staff concludes from these data that some damage may occur to vegetation from operation of linear MDCT's and circular MDCT's. The NDCT, FANDCT, and wet/dry MDCT were assumed by the staff to have the least risk of biological damage from icing.

The extent of the damage attributed to icing from the linear MDCT and circular MDCT options will be limited to areas south of the towers and primarily to onsite vegetation. Such damage will consist of losses through breakage of branches and limbs of vegetation. This 'pruning' action will be initially selective since weak and diseased parts of vegetation will be most likely the first to break under the strain of ice loading. Since vegetation is relatively dormant during the winter, such 'pruning' action will not seriously hinder the affected flora's survival chance. The staff believes that none of the cooling tower options will cause unacceptable offsite damage due to icing.

5.2.4 Land Required for Each Cooling Tower

The applicant has submitted estimated land requirements for various alternative cooling system designs for Unit No. 3. The estimated land required for an NDCT at Unit No. 2 has been calculated to be 16 acres (FES, CC-2, Table 5-21). Based upon the range of these values (Table 5-9), the staff does not consider the utilization of acres for NDCT, MDCT, W/DMDCT, FANDCT AND CMDCT cooling tower siting as having an unacceptable impact on total land use for the entire site. Approximately 1000 feet of forested shoreline will be disturbed in order to build Unit No. 3 tower. Reforestation on appropriate areas to replace this wooded area should be considered by the applicant.

TABLE 5-9

ESTIMATES OF LAND REQUIREMENT AND TURBINE BACKPRESSURE OF
ALTERNATIVE CLOSED-CYCLE COOLING
SYSTEMS FOR INDIAN POINT
UNIT NO. 3

Type of Alternative Closed-Cycle Cooling System	Land Area Acres	Turbine Backpressure(1) Inches Hg
Mechanical Draft Dry Cooling Tower(2)	20	10.0
Natural Draft Wet Cooling Tower	7	4.0
Linear Mechanical Draft Wet Cooling Tower	15	4.0
Mechanical Draft Wet/Dry Cooling Tower	17	4.0
Round Mechanical Draft Wet Cooling Tower	11	4.0
Fan-Assisted Natural Draft Wet Cooling Tower(2)	11	4.0
Natural Cooling Ponds(2)	3,000	2.5
Spray Ponds - Fixed Pipe(2)	100	2.5
Spray Canal - Powered Module(2)	55	2.5

(1) Based on "Maximum Calculated" Turbine conditions with 74°F wet-bulb temperatures and 10°F TTD.

(2) These alternatives have been determined to be not feasible for backfitting at Indian Point Unit No. 3.

SOURCE: Ref. ER-CC-3, TABLE 2-1.

5.2.5 Noise Impacts of Alternative Closed Cycle Cooling Systems

5.2.5.1 Existing Conditions

The applicant conducted a sound level survey in the vicinity of the Indian Point Unit No. 2 during December 1973. The purpose of this survey was to sample the existing sound levels at a variety of locations in Buchanan, Verplanck, Peekskill, and on the western site of the Hudson River opposite the Indian Point site. From the samples recorded at the various sampling stations, sound-level isopleths were to be estimated for the area. This estimation procedure would allow the applicant to approximate the existing acoustic environment in the site vicinity without the presence of cooling towers.

The applicant selected a total of eleven sampling sites, including three sites on the western bank of the Hudson River (See Figure 5-40). The collected data were statistically analyzed by the applicant and the A-weighted ambient sound levels which were exceeded 10, 50, and 90% of the time (i.e., L_{10}, L_{50}, and L_{90}) were estimated for each sampling location. In addition, the A-weighted 24-hour equivalent sound levels and the A-weighted day-night equivalent sound levels were determined for each sampling location. These levels are shown in Table 5-10.

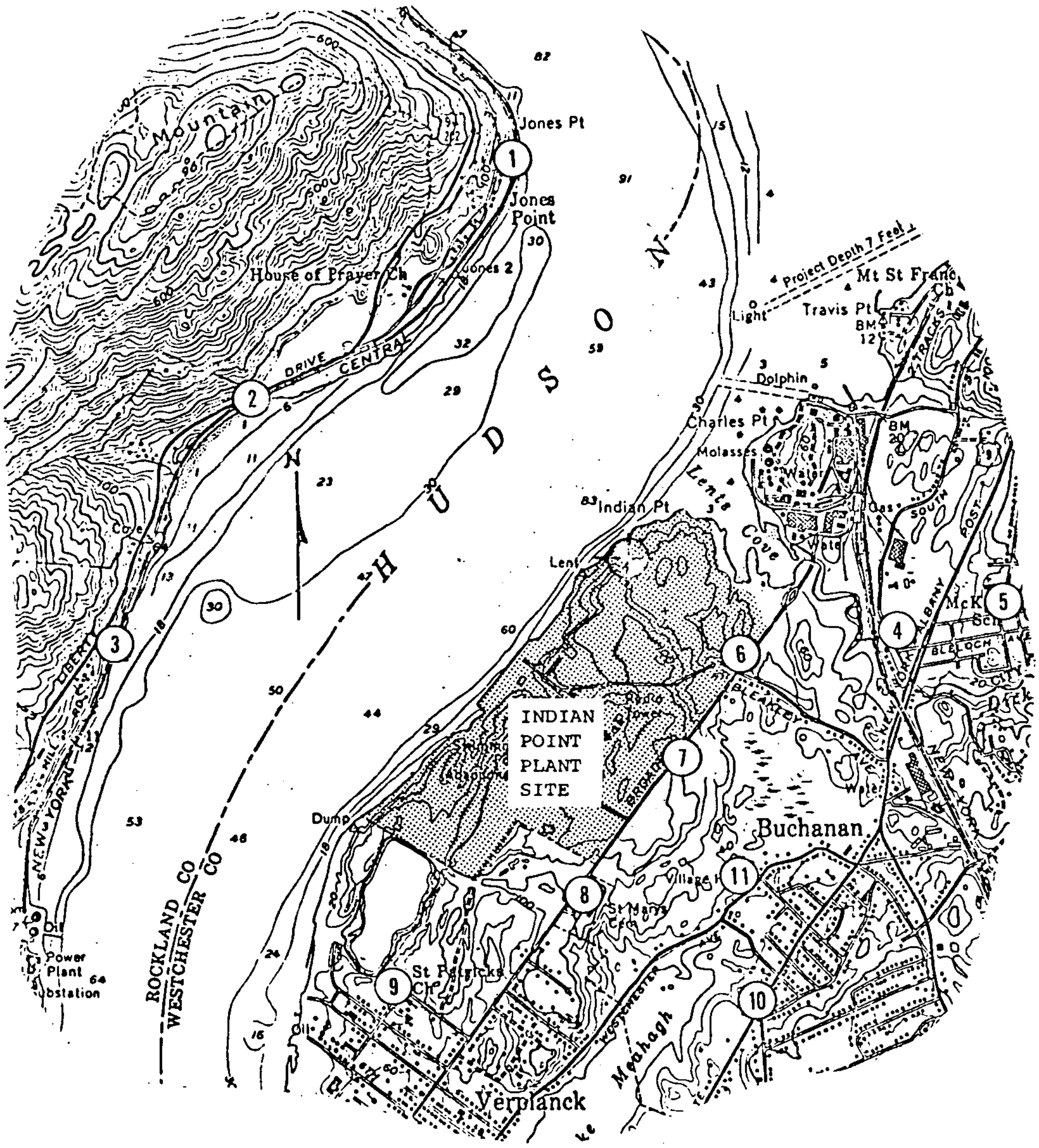


Fig. 5-40 Location of the eleven measurement sites for existing community noise evaluation

Ref.: ER-CC-2, App. G, Fig. 1

TABLE 5-10

AMBIENT SOUND LEVELS IN THE INDIAN POINT

UNIT NO. 3 AREA, DECEMBER 1973

Sampling Location No.	Time Period	Sound Level, dBA re 2×10^{-5} N/m2				
		L_{10}	L_{50}	L_{90}	L_{eq}	L_{DN}
4	Day	65	59	56	64.5	63.5
	Night	56.5	54	47.5	51.0	
5	Day	65	56	52	64.5	63
	Night	50.5	45.5	42.5	46	
6*	Day	65.5	56	48.5	62.5	61.5
	Night	53	46.5	44.5	49	
7*	Day	68	51	44	63	62
	Night	48	42	40	49	
8*	Day	67.5	57.5	44.5	62.5	<65.5
	Night	60.5	44	38.5	58	
9	Day	50	46	44	47.5	50.5
	Night	47	41	37	43.5	
10*	Day	61.5	46.5	41.5	57	58
	Night	66	54	50.5	49.5	
11*	Day	52	46	40	49	52
	Night	48	43.5	37	44.5	
1, 2, 3	Day	59.5	49.5	43	52.5	55
	Night	49.5	46.5	26.5	47	

*Denotes sampling location within the limits of Village of Buchanan.

SOURCE: Ref. 1, Section 5.2.5.1.

The applicant then used these data to construct day-night equivalent sound level isopleths for the site and the general vicinity. The resultant diagram, which the applicant considers to represent the ambient acoustic environment of the area prior to the operation of a natural draft wet cooling tower, is presented as Figure 5-41.

The staff has analyzed the base line acoustic program and has found it acceptable.[72]

As a result of an earlier applicant study[73] and staff review[72], a natural draft wet cooling tower has been chosen as the preferred closed cycle cooling system to be installed at the Indian Point Unit No. 2 site. After public hearings, the Atomic Safety and Licensing Board also approved the use of a natural draft cooling tower (LBP-76/43, NRCI-76/11, 598 (Nov. 1976) and LBP-76/46, NRCI-76/12, 659 (Dec. 1976)) and the Appeal Board confirmed (ALAB-399, 5 NRC 1156 (May 1977)) this decision. The predicted operations phase offsite acoustic environment has been estimated, accounting for the ambient sound levels, those sound levels arising from the operation of the cooling tower, atmospheric absorption of sound and the plant and topography barrier effects. The isopleths of constant day-night equivalent sound levels are shown in Figure 5-42. The predicted equivalent sound levels at the Indian Point Plant area (including operation of the cooling tower at IP-2) have been taken from the earlier staff review of closed cycle cooling for IP-2[72] and are reproduced in Table 5-11. These levels and isopleths form the expected ambient acoustic environment against which the operational acoustic effects of the operation of alternative closed cycle cooling systems at the Indian Pint Unit No. 3 may be compared. It should be noted, however, that, for the reasons cited in the staff's review of the applicant's base line acoustic

Ref.: ER-CC-2, App. G, Fig. 10a

Figure 5-41

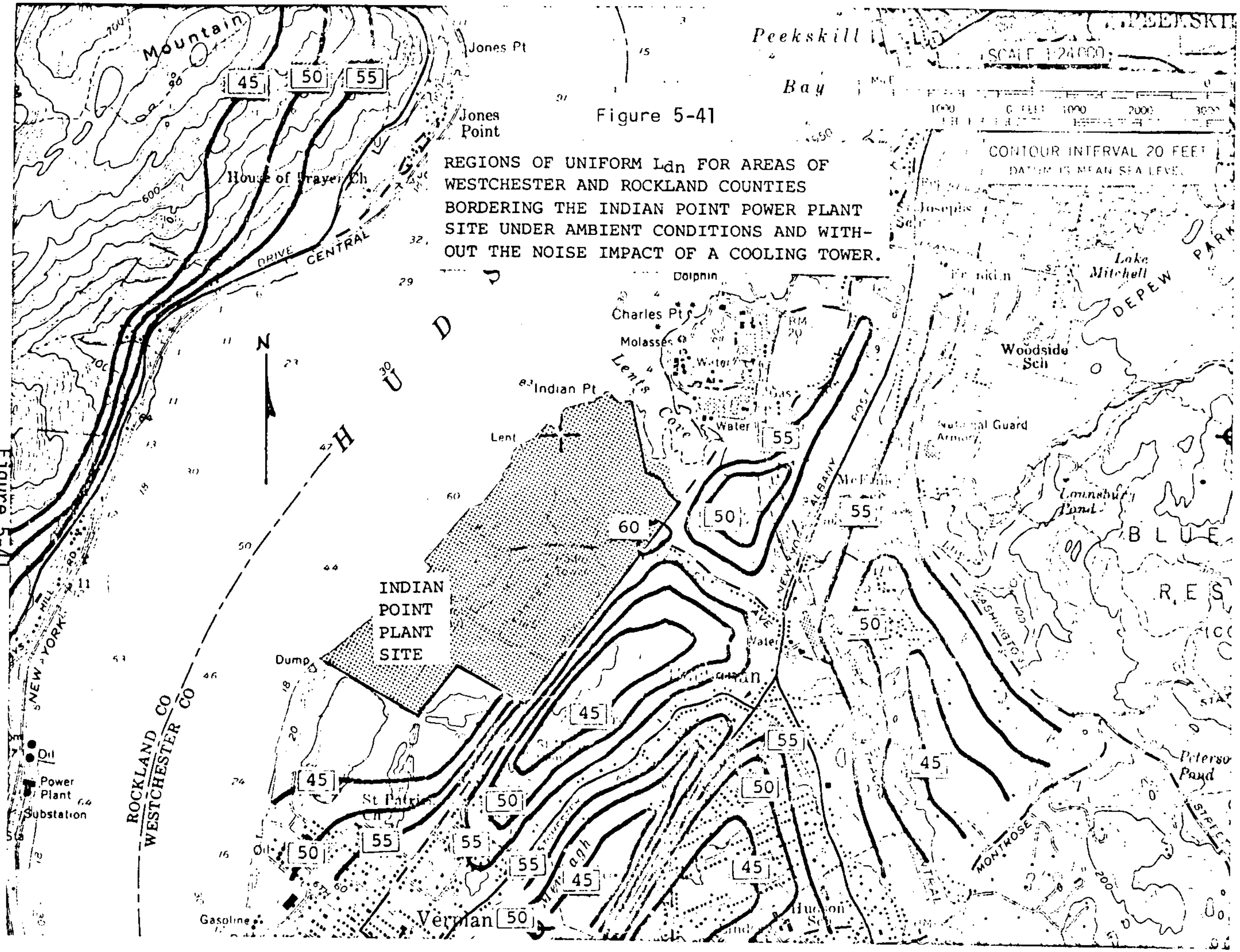


Figure 5-41

REGIONS OF UNIFORM L_{dn} FOR AREAS OF WESTCHESTER AND ROCKLAND COUNTIES BORDERING THE INDIAN POINT POWER PLANT SITE UNDER AMBIENT CONDITIONS AND WITHOUT THE NOISE IMPACT OF A COOLING TOWER.

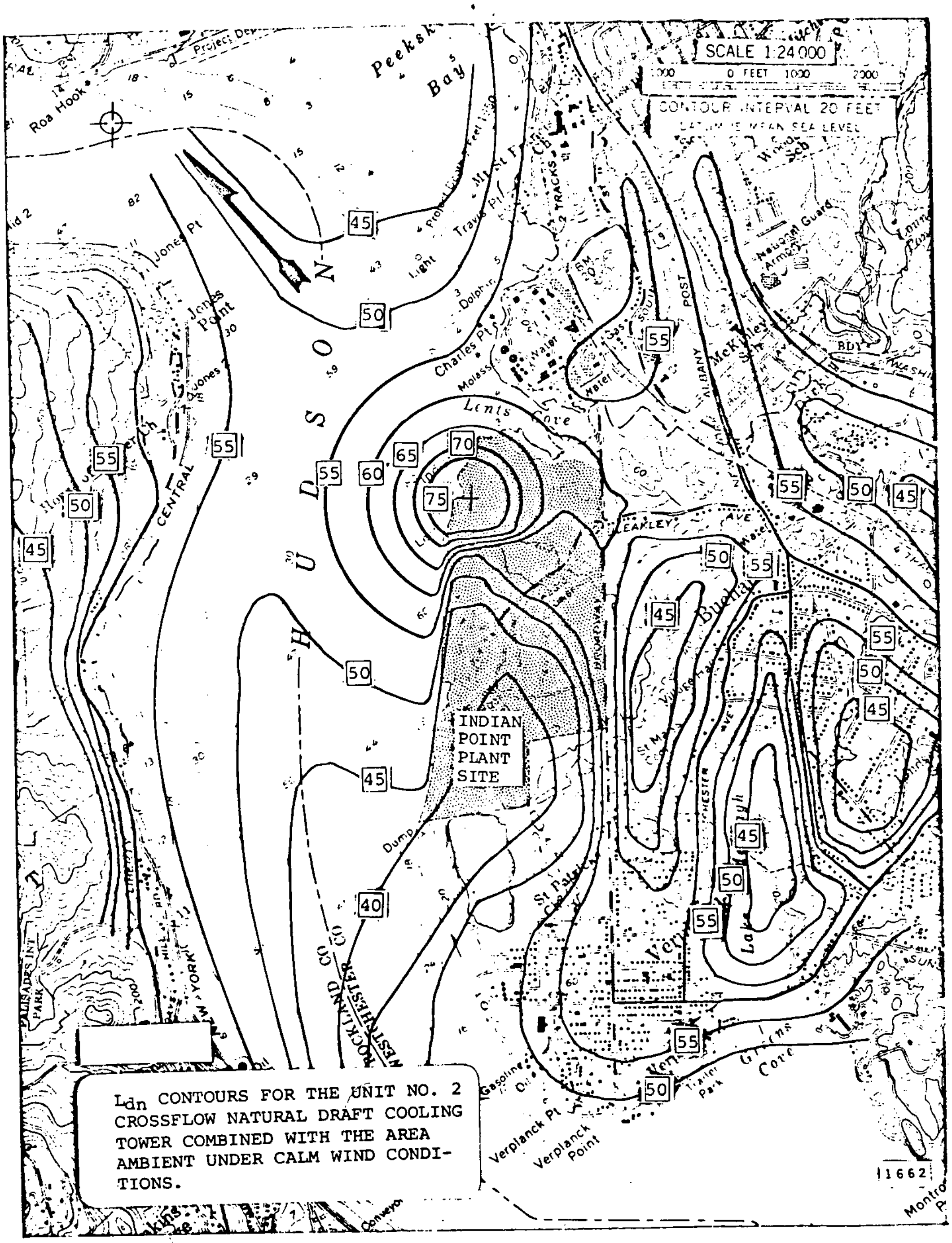


Figure 5-42

Ref. ER-CC-3 App. C, Figure 1

TABLE 5-11

INDIAN POINT PLANT AREA SOUND LEVELS - UNIT 2 PREFERRED

CLOSED CYCLE COOLING SYSTEM OPERATING

Sampling Location Number	Predicted Sound Levels, dBA re 2×10^{-5} N/m^2 Under Operation of a Crossflow NDCT @ IP-2			
	24 hr Eq. Sound Level, L_{eq}	Daytime Eq. Sound Level, L_D	Nighttime Equivalent Sound Level, L_N	Day-Night Equivalent Sound Level, L_{DN}
4	62.6	64.5	51.6	63.7
5	62.5	64.5	47.0	63.1
6*	60.7	62.6	50.2	61.9
7*	61.1	63.0	49.5	62.1
8*	61.3	62.5	58.0	65.5
9	46.7	47.7	44.1	51.0
10*	55.4	57.0	49.5	58.0
11*	48.0	49.2	44.9	52.4
1, 2, 3	51.3	52.6	47.4	55.3

*Denotes sampling locations within the limits of the Village of Buchanan.

SOURCE: Ref. 1, Section 5.2.5.4.

survey in conjunction with closed cycle cooling at IP-2,[72] variations in these levels and isopleth diagrams for the general area of Peekskill and Buchanan could and should be expected.

The acoustic environment predicted to exist when construction of the preferred closed cycle cooling system for IP-3 is initiated (i.e., assuming operation of an NDCT at IP-2) can be described in terms of various criteria.

This environment is predicted to have an L_{DN} range of from 51 dBA to 65.5 dBA with a difference between daytime and nighttime equivalent sound levels ranging from 3.6 to 17.5 dBA. These data indicate an acoustic environment similar to that found in other residential communities with heavy traffic.[57] There are two distinct areas in the survey region with respect to acoustic characterization: (1) the region encompassing sampling locations Nos. 9, 10, and 11 is typical of the "normal suburban residential" category, and (2) the region encompassing the remaining sampling locations on the east side of the Hudson River (i.e., locations No. 4 through No. 8) are typical of the "noisy urban residential" category.

Further classification of the existing environment around the Indian Point Plant site is possible by considering the Department of Housing and Urban Development (HUD) non-transportation related "guidance criteria" for outdoor noise levels in residential areas.[67] The existing daytime acoustic environment for location Nos. 4 through 8 have equivalent sound level readings in the "normally unacceptable" range (i.e., $L_{eq} > 62$ dBA), while the remaining stations fall into the "normally acceptable" or "clearly acceptable" categories. (See Figure 5-43.) All locations fall into the aforementioned "acceptable" categories when the nighttime equivalent sound levels are considered. The 24-hour equivalent sound levels calculated for ambient conditions indicate a pattern similar to the daytime situation except that locations Nos. 6, 7, and 8 are no longer in the "normally unacceptable" category, but are now in the "normally acceptable" category.

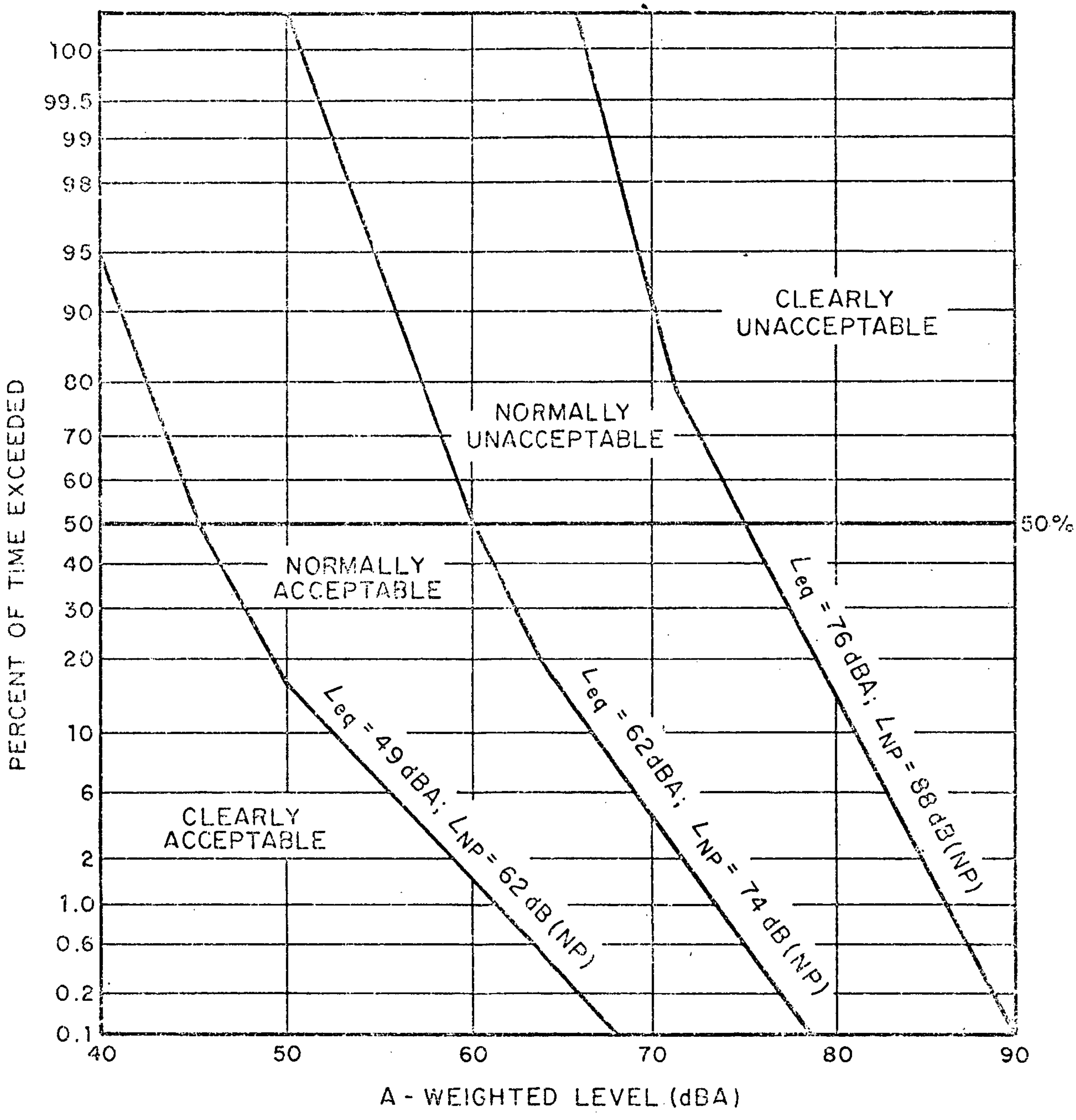


FIG. 5-43 PROVISIONAL CRITERIA RELATING NPL TO COMMUNITY NOISE ACCEPTABILITY

Ref.: T. J. Schultz, "Technical Background for Noise Abatement in HUD's Operating Programs," BBN Report 2005, September 1970.

5.2.5.2 Construction Phase Acoustic Environment

The applicant's estimates of sound levels for both onsite and offsite activities related to construction of the various alternative closed cycle cooling systems at IP-3 are the same as those made for the construction of the closed cycle cooling system at Unit No. 2. This was done because of the similarity in site characteristics, resulting in estimates for the completion time of the various phases of system construction being approximately equal. The applicant also assumed that the construction periods for the two cooling systems would not overlap.

Onsite construction sound levels were estimated to be similar for all cooling tower types considered.

The staff has reviewed the methodology utilized by the applicant in deriving the predicted sound levels expected at the site boundary due to onsite construction activities. Although the exact types and amounts of equipment operating an any one time is difficult to estimate, the approach taken by the applicant is considered reasonable by the staff. The sound level at 15 m (50 ft.) from the equipment types are within the range normally expected as taken from available data.[59,74] Using these source sound level estimates (i.e., 92-103 dBA), the staff examined the resulting predicted sound levels at the plant property line with respect to the recommendations for limitations on sound entering residential and commercial/industrial areas from construction activities proposed by the New York State Department of Environmental Conservation.[59] It was found that these recommended limitations would not be exceeded due to the onsite construction activities (primarily due to the site topography, affording a natural barrier between the construction site and the plant border to the east and south).

The staff also considered acoustic impact offsite due to the removal and delivery of materials associated with the construction of a closed cycle cooling system at the Indian Point Unit No. 3 site. Offsite sound levels were judged to be of the same magnitude for all tower types considered, with the duration of the offsite truck traffic being dependent on the tower type considered. Natural draft cooling tower offsite construction vehicle activity is expected to be at its maximum for approximately one year, while mechanical draft cooling tower offsite construction activity is expected to be at its maximum for approximately six months. The staff has examined the basis used by the applicant for estimating truck traffic (i.e., source) sound levels and finds that it is within field results for the anticipated vehicle type and service,[59,75] and with the recommended maximum levels published by the Society of Automotive Engineers, Inc.[76] The resultant estimates given by the applicant for sound generation by truck traffic to and from the site during the construction phase are judged to be reasonable.

The staff considers offsite acoustic impact associated with the construction of a closed cycle cooling system at the Indian Point site to be short duration, and not of such magnitude so as to affect the existing ambient equivalent sound levels in areas around the site away from transportation routes. There would be unavoidable increases in sound levels along the transportation arteries to and from the site, such as Bleakley Avenue, Broadway Avenue, and New York-Albany Post Road due to increased truck traffic. The applicant's estimate of day-night equivalent sound levels during construction is presented in Figure 5-44.

The staff recommends that the following precautions be taken by the applicant to minimize the offsite acoustic impacts during the construction phase:

1. Equip all equipment used at the site during the construction phase with the required necessary noise suppression equipment according to federal and state regulations and procedures.

2. Limit blasting activities to the minimum necessary and schedule such activities between the hours of 8 A.M. and 5 P.M. during normal work days. Short duration deviations from this practice are permissible due to unusual manpower or equipment scheduling problems.

3. Limit all other noise producing activities to the minimum necessary.

5.2.5.3 Operational Phase Acoustic Environment

The applicant has considered the design and operation of various cooling towers sufficient to serve the needs of Indian Point Unit No. 3. All evaluations were made on the basis that Indian Point Unit No. 2 would have the preferred closed cycle cooling system installed, this being a natural draft wet cooling tower. For IP-3, the applicant specifically evaluated crossflow and natural draft wet towers and linear mechanical draft wet towers.

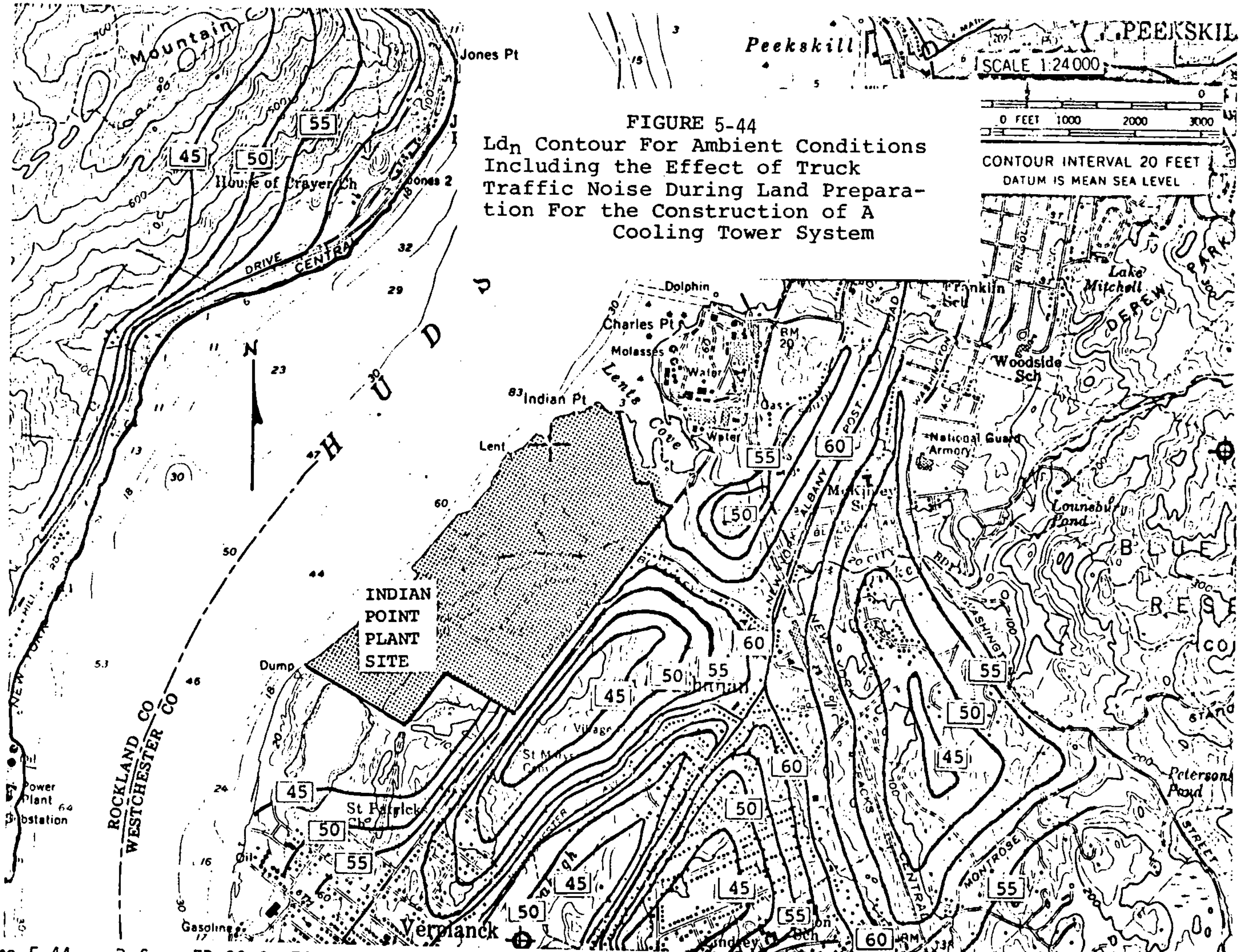


FIGURE 5-44
Ld_n Contour For Ambient Conditions Including the Effect of Truck Traffic Noise During Land Preparation For the Construction of A Cooling Tower System

Figure 5-44

Figure 5-44 Ref.: ER-CC-3, Figure 6-29

Circular mechanical draft wet towers, linear mechanical draft wet/dry towers and fan-assisted natural draft wet towers were considered indirectly via assumptions based on their similarity to other systems for which field data and/or predictive techniques are available. Circular mechanical draft wet towers are expected to generate sound sufficiently similar so as not to produce noticeably different offsite sound levels than linear mechanical draft wet towers. The linear mechanical draft wet/dry towers would require more cooling cells and thus would be expected to produce offsite sound levels slightly greater than the linear mechanical draft wet towers. The fan-assisted natural draft cooling towers have been estimated, in the absence of published data, to produce offsite sound levels the same, or as much as 5-10 dBA higher than those from linear mechanical draft wet towers.[77] These assumptions are acceptable to the staff.

The methodology used by the applicant in predicting the sound levels at various offsite locations due to the towers alone consists of techniques widely used in the industry.[60,61] These techniques have been subjected to field tests in the past and have been found to be accurate, with the exception of one technique which has recently been said to overestimate sound levels from natural draft towers.[62,78] The staff believes that the natural draft cooling tower sound level analysis as presented by the applicant is conservatively high. The staff believes that the applicant has employed the analytical techniques correctly.

The combined effects of attenuation via atmospheric absorption, attenuation due to barrier effects and ground cover, effects due to humidity and the existing ambient acoustic environment were considered by the applicant to produce estimates of the resultant acoustic environment under operation of the cooling towers at the site. The staff has reviewed the techniques employed and finds them to be in accordance with recommended procedures which have been used in field verification programs.[63,64] The staff, therefore, believes the resultant acoustic environment predicted by the applicant to be a reasonable approximation to the actual conditions to be experienced under system operation.

Figures 5-45, 5-46, and 5-47 provide the applicant's estimates of the various cooling system offsite sound emission contours adjusted for attenuation without consideration of the ambient sound levels around the site.

Limits on the sound emanation from any facility or activity other than transportation facilities or temporary construction work within a Planned Industrial District have been established by the Buchanan Zoning Ordinance,[58] Parts 54-22.e(2)(b) and 54-22.f(3) dated November 1970. The allowable limits, in terms of the sound level measured in various octave bands, are given in Table 5-11. The original limits were specified in terms of octave band frequencies no longer preferred by the American National Standards Institute. (See ANSI S1.6-1967 and ANSI S1.11-1966.) The sound levels corresponding to the newly preferred octave band center frequencies are also given in Table 5-12 along with the allowable unweighted and A-weighted overall sound levels.

When the sound levels attributable to the operation of cooling towers at IP-3 alone are examined at the plant site boundaries (other than with the river), Figure 5-45 and 5-46 indicate that the natural draft cooling towers will not exceed the overall sound level limit of 65 dB (48 dBA) $re^2 \times 10^{-5}$ N/m^2. In fact, the levels are considerably below the limits and are also below the levels recorded for the ambient environment. The sound levels at the plant boundaries for the linear mechanical draft wet cooling towers, shown in Figure 5-47 indicate a region along the eastern boundary (i.e., Broadway Avenue) where the sound level is predicted to equal or slightly exceed the limit of 48 dBA $re^2 \times 10^{-5}$ N/m^2 of the Zoning Ordinance. The area along this stretch of Broadway Avenue is currently zoned for "planned industry".[58]

The predicted sound levels in the octave bands have been examined against the limits of the zoning ordinance for locations along the eastern boundary of the site. The crossflow and counterflow natural draft cooling tower options for Unit No. 3 are not predicted to exceed the zoning ordinance octave band sound levels in any residentially zoned area. The 4000 Hz and 8000 Hz octave band sound level limits are predicted to be equalled or slightly exceeded at a point north of Bleakley Avenue along Broadway Avenue. The linear mechanical draft cooling tower option for Unit No. 3 is predicted to exceed the octave band sound levels centered at 250 Hz and above along Broadway in the vicinity of the Buchanan substation.

Figures 5-45 through 5-47 depict the acoustic environment from a constant and continuous sound power source at IP-3 in the absence of the ambient sound power sources (including IP-2). These levels represent the 24-hour equivalent sound levels offsite due to the IP-3 cooling towers alone. Table 5-13 shows these predicted 24-hour equivalent sound levels. These levels may be combined with the 24-hour equivalent sound levels predicted for the site vicinity under operation of the preferred closed cycle cooling system for IP-2 to produce the resultant overall 24-hour

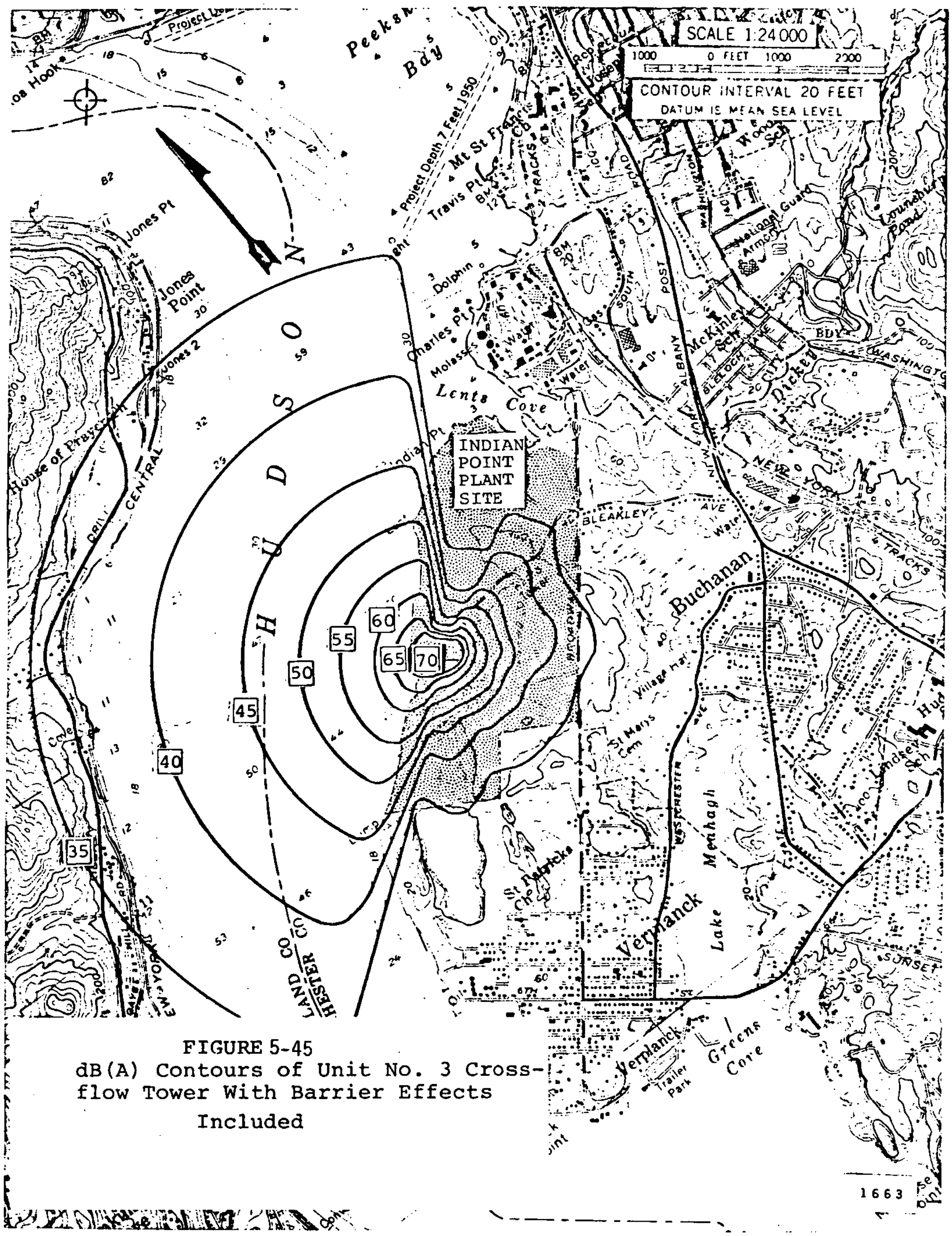


FIGURE 5-45
dB(A) Contours of Unit No. 3 Cross-flow Tower With Barrier Effects Included

Ref. ER-CC-3 Figure 6-17.

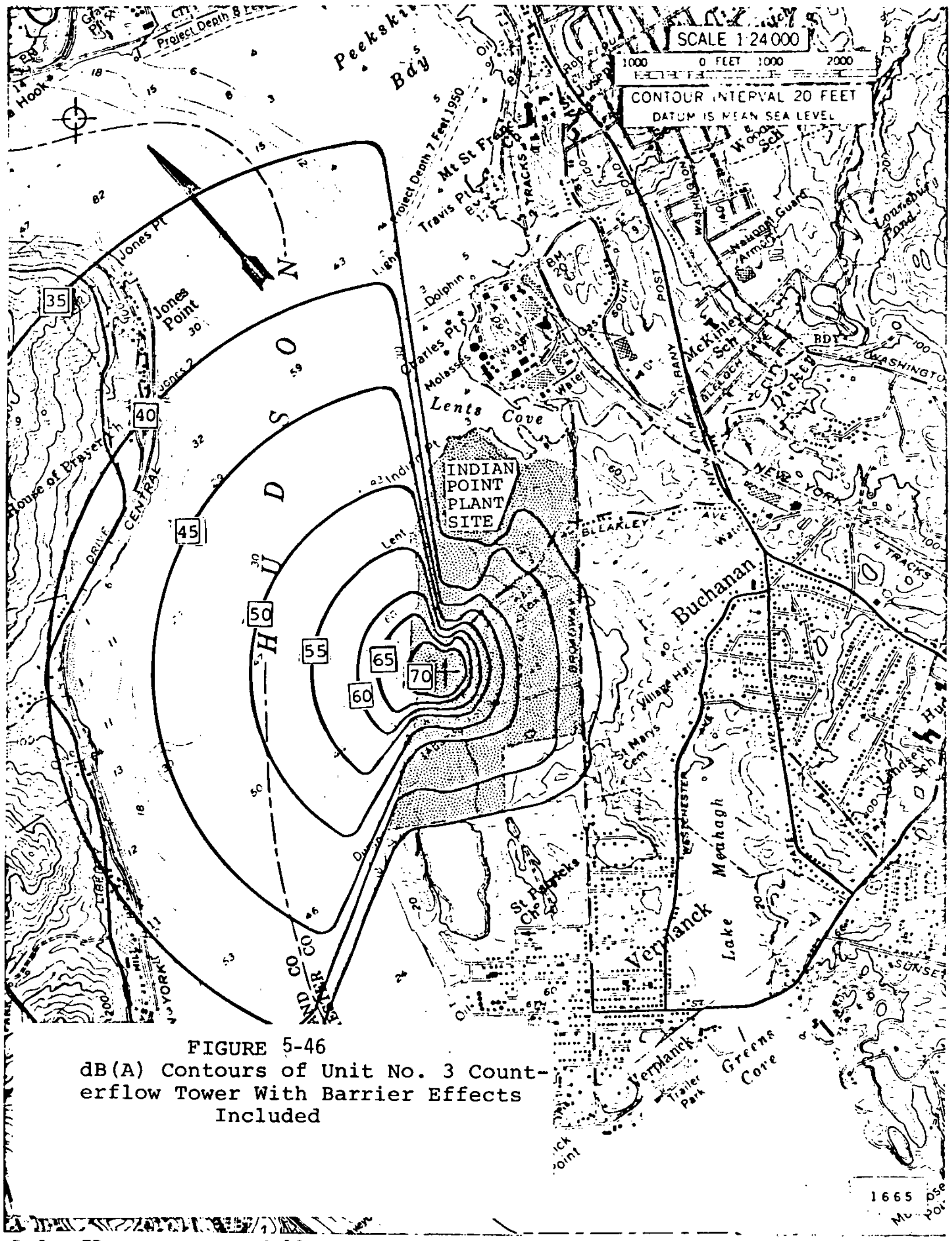


FIGURE 5-46
dB(A) Contours of Unit No. 3 Counterflow Tower With Barrier Effects Included

Ref. ER-CC-3, Figure 6-18.

Figure 5-46

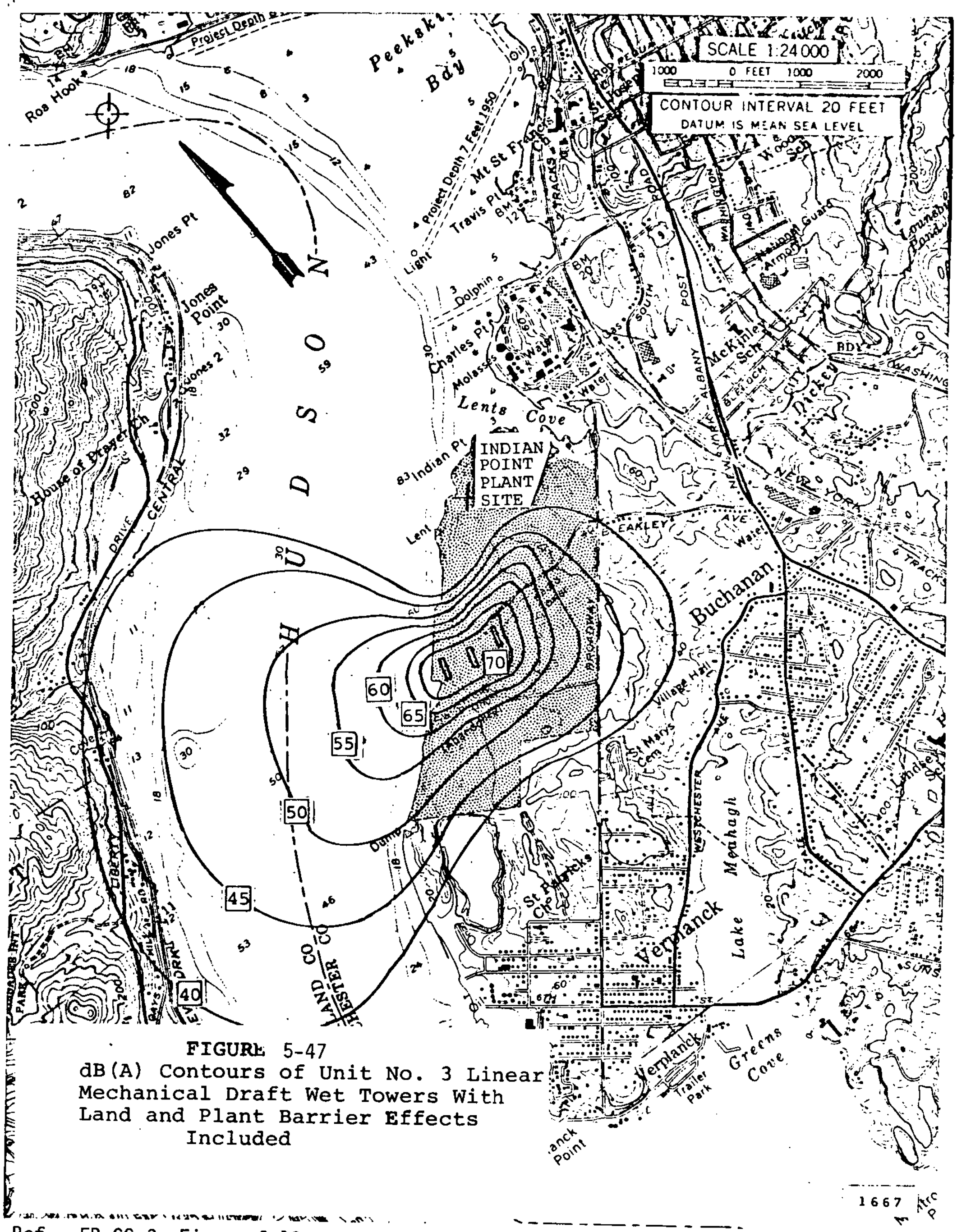


FIGURE 5-47
dB(A) Contours of Unit No. 3 Linear Mechanical Draft Wet Towers With Land and Plant Barrier Effects Included

Ref. ER-CC-3, Figure 6-19.

TABLE 5-12

ALLOWABLE AND PREFERRED SOUND LEVELS

Octave Band Limits - Hz	Allowable Sound Levels, dB re 2×10^{-5} N/m^2	Preferred Octave Band Center(1) Frequencies, Hz	Allowable Sound Levels, dB re 2×10^{-5} N/m^2
20 - 75	65	31.5	(2)
75 - 150	65	63	62.5
150 - 300	50	125	54
300 - 600	45	250	49
600 - 1200	40	500	44
1200 - 2400	40	1000	40
2400 - 4800	35	2000	39
4800 - 10000	35	4000	35
		8000	35

Overall Allowable Sound Level - 65.5 dB or 48 dBA (computed from octave band levels) re 2×10^{-5} N/m^2

(1) See ANSI 51.6-1967 USA Standard Preferred Frequencies and Band Numbers for Acoustical Measurements.

(2) This value is subject to interpretation due to the large range of the originally specified octave band limits.

TABLE 5-13

PREDICTED RANGE OF OPERATIONAL 24 HR. EQUIVALENT SOUND LEVELS

FOR VARIOUS COOLING TOWER OPTIONS AT INDIAN POINT UNIT NO. 3

Sampling Location No.	24 Hr. L_{eq} Range or Value, dBA re 2 x 10^{-5} N/m^2 [1]		
	Cross Flow Nat. Draft	Center Flow Nat. Draft	Linear Mech. Draft Wet
1	<35	35-39	<<40
2	35-38	40-43	40 max
3	35-38	40-43	41-44
4	<35	<35	<40
5	<35	<35	<40
6*	35 max	35 max	40-43
7*	35-39	35-39	45-49
8*	35 max	35-37	40 max
9	<35	<35	<40
10*	<35	<35	<40
11*	<35	<35	<40

[1] Data obtained from predicted sound level isopleths. Data assumes continuous and constant cooling tower operation at IP-3 only.

*Denotes sampling location within the limits of the Village of Buchanan.

equivalent sound levels. These levels are presented in Table 5-14. The predicted increases over the expected ambient (i.e., with closed cycle cooling at IP-2) are negligible for the natural draft cooling tower options on both sides of the Hudson River and are below 1 dB for the linear mechanical draft wet cooling tower option. Because the data in Table 5-13 represent constant and continuous cooling tower operation, these levels also represent the nighttime equivalent sound levels of the tower alone (L_N). A comparison of the expected ambient including IP-2 and the operational conditions including IP-3 is made in Table 5-15. A maximum increase of 0.5 dB is predicted for either of the natural draft cooling tower options on the eastern shore of the Hudson River under operational conditions. The linear mechanical draft wet cooling tower is predicted to produce a nearly 3 dB increase at Location 7 on the eastern shore of the Hudson River with increases on the order of 1 dB at Locations 5, 6, 9 and 11.

5.2.5.4 Offsite Acoustic Effects from Operation

The predicted increases in offsite sound levels due to the operation of a closed cycle cooling system at IP-3 in addition to the operation of the preferred closed cycle cooling system at IP-2 were shown in the previous section to be small. The lowest increases are predicted for the natural draft cooling tower options. Inspection of these data indicates that the operational acoustic environment will not result in any changes in the acceptability rating as established by the HUD "guideline criteria" described in Section 5.2.5.1 for any sampling location when considering either the 24-hour equivalent sound level or the nighttime equivalent sound level. This result is consistent regardless of tower type considered.

TABLE 5-14

COMPARISON OF INDIAN POINT SITE AREA 24 HR. EQUIVALENT SOUND LEVELS; PREDICTED LEVELS UNDER IP-2 ONLY VERSUS IP-2 PLUS IP-3 CLOSED CYCLE COOLING SYSTEM OPERATION

Sampling Location No.	24 Hr., L_{eq}, Unit 2 Only dBA re 2 x 10^{-5} N/m^2	Unit 3 Operational 24 hr., L_{eq}, dBA re 2 x 10^{-5} N/m^2 [1]		
		Cross Flow Nat. Draft	Counter Flow Nat. Draft	Linear Mech. Draft Wet
4	62.6	62.6	62.6	62.6
5	62.5	62.5	62.5	62.5
6*	60.7	60.7	60.7	60.7
7*	61.1	61.1	61.1	61.4
8*	61.3	61.3	61.3	61.3
9	46.7	47.0	47.0	47.5
10*	55.4	55.4	55.4	55.4
11*	48.0	48.2	48.2	48.6
1, 2, 3	51.3	51.5	51.9	52.0

[1] Derived by combining the maximum predicted L_{eq} for each tower type with the calculated L_{eq} resulting from operation of NDCT at IP-2.

*Denotes sampling location within Village of Buchanan.

TABLE 5-15

COMPARISON OF INDIAN POINT SITE AREA NIGHTTIME EQUIVALENT SOUND LEVELS; PREDICTED LEVELS UNDER IP-2 ONLY VERSUS IP-2 PLUS IP-3 CLOSED CYCLE COOLING SYSTEM OPERATION

Sampling Location No.	Predicted L_N Ambient Plus Unit 2 Only dBA re 2 x 10^{-5} N/m^2	Unit 3 Nighttime Equivalent Sound Level[1] dBA re 2 x 10^{-5} N/m^2		
		Cross Flow Nat. Draft	Counter Flow Nat. Draft	Linear Mech. Draft Wet
4	51.6	51.7	51.7	51.9
5	47.0	47.3	47.3	47.8
6*	50.2	50.3	50.3	51.0
7*	49.5	49.9	49.9	52.3
8*	58.0	58.0	58.0	58.1
9	44.1	44.6	44.6	45.5
10*	49.5	49.7	49.7	50.0
11*	44.9	45.3	45.3	46.1
1, 2, 3	47.4	47.9	48.7	49.0

[1]Derived by combining the maximum predicted L_N for each tower with the calculated L_N resulting from operation of NDCT at IP-2.

*Denotes sampling location within the Village of Buchanan.

It has been reported[65] that the threshold for the detection by the human ear of a change in sound level is approximately 1 dB. Therefore, it is questionable whether or not the operational acoustic environment would be judged by residents to be more noisy. In addition, Stevens[66] cites practical experience in stating that a change in the noise patterns in an area of less than 5 dB would not likely result in a change in the community reaction to the noise.

Precise consideration of the speech interference characteristics of the ambient and operational offsite acoustic environment is difficult in the absence of frequency spectra information. However, EPA reports[57] that normal conversation between individuals who are two meters apart is 95% intelligible when "urban community noise" levels are somewhat in excess of 60 dBA. Therefore, present outdoor verbal communication under the previously mentioned conditions may be degraded for sampling locations Nos. 4 through 8.

For the operational environment as depicted in Tables 5-14 and 5-15, EPA reports[57] that normal voice satisfactory conversation with a sentence intelligibility of 95% can be expected at distances of from approximately 1.5 meters to 7 meters. This range is not noticeably different from that expected for the preoperational phase of closed cycle cooling at IP-3.

A consideration also bearing on the likely interference with offsite speech by cooling towers is the frequency spectrum typical of the tower types involved. Speech acoustic energy is found mainly between 100 and 6000 Hz[57] with the most important cue bearing energy falling between 500 and 2000 Hz. Generalized spectra reported by Dyer and Miller;[60] and Wang,[79] for mechanical draft cooling towers indicate that their acoustic energy is found mainly below this frequency range. For this reason and the anticipated similarity between the predicted IP-3 preoperational and operational offsite acoustic conditions, the degradation of offsite speech intelligibility in residential areas is expected to be low for mechanical draft cooling towers. On the other hand,

natural draft cooling towers have a considerable fraction of their overall acoustic energy output in the frequency range important in human speech communication.[61] Attenuation of sound by the atmosphere is partially dependent on the frequency of the generated sound. High frequencies are attenuated to a greater extent than low frequencies under identical physical and meteorological conditions and distance traveled by the sound wave. The distances involved between the cooling tower and the offsite environment, the barrier effects of the site topography, the sound power level of the cooling tower and the existing background noise for the Indian Point area are such that little degradation of offsite speech intelligibility is expected from the operation of this tower type. The operational presence of cooling towers can be expected to smooth out the variations in overall nearby offsite sound levels. This would tend to maximize the interference properties of the noise with respect to verbal communication. However, based on the difference between the ambient and predicted operational day-night equivalent sound levels (explained below) and on information presented by EPA[57] (See Figure 5-48), the staff believes that the offsite speech intelligibility would decrease by 5% or less in any offsite area.

The staff also considered the ambient and predicted offsite acoustic environment in terms of the EPA defined day-night equivalent sound level, L_{DN}.[57] This descriptor has also been used by the applicant for the Indian Point case.

The predicted day-night equivalent sound level contours for operation of the preferred closed cycle cooling system at IP-2 and the operation of various closed cycle cooling systems at IP-3 are presented in Figures 5-49, 5-50, and 5-51.

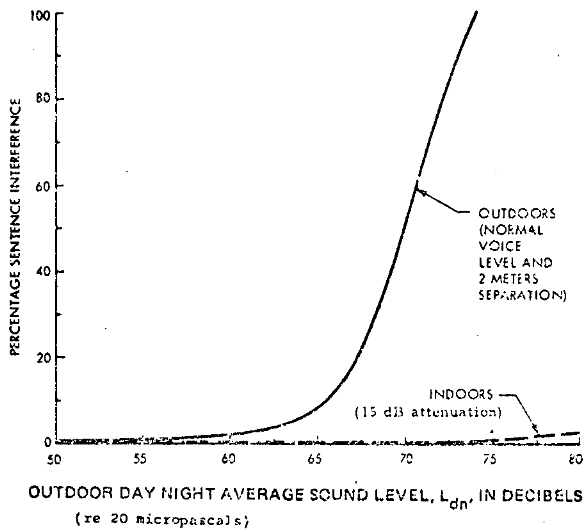
The EPA has established an "identified level" necessary to protect public health and welfare with an adequate margin of safety.[57] This level does not consider technical feasibility or economic costs for its achievement. It has been set at a maximum L_{DN} of 55 dBA for outdoor activity interference. The presence of this outdoor level would estimate a maximum indoor L_{DN} of 45 dBA after allowing for a typical attenuation via structure walls of from 10 to 15 dB. The Buchanan Zoning Ordinance calculated limit of 48 dBA would result in a maximum allowed L_{DN} of 54.4 dBA.

Table 5-16 predicted ambient L_{DN} for the operation of the preferred closed cycle cooling system at IP-2 only and operation L_{DN} for operation of closed cycle cooling system at IP-2 and IP-3 for each tower type based on the predicted sound levels for each measurement location. The maximum increase in L_{DN} for these locations on the east side of the Hudson River is predicted by calculation for location No. 9 and is as follows:

Crossflow NDCT	0.5 dB
Counterflow NDCT	0.5 dB
Linear MDCT	1.3 dB

The largest increase in L_{DN} for the west side of the river is predicted for the linear mechanical-draft case. This increase is predicted to be 1.3 dB. (The exact location for this increase is unclear due to grouping of the original data for this side of the river, these data being used as a computational base for the predicted acoustic environment.) These increases will not result in either of the two ambient measurement locations, which do not exceed the EPA "identified level" of L_{DN} = 55 dBA, (i.e., locations 9 and 11, under IP-2 operation) to exceed this limit under IP-2 and IP-3 operational conditions.

In addition to the changes in the predicted day-night equivalent sound levels for the measurement location shown in Table 5-16, Figures 5-49 through 5-51 indicate that changes are to be expected in the area immediately to the south of the southern site boundary between Broadway Avenue and the Hudson River. The changes are evident primarily in the "designed industrial district M-D" as shown on the Cortlandt Zoning Map. The magnitude of the expected change for much of this area is up to 5 dB, with small areas immediately adjacent to the site (e.g., at the southwest site boundary and the river shoreline), ranging to 8-10 dB, for the case of either type of natural draft cooling tower at IP-3. These same areas are expected to experience somewhat larger increases - 10 dB for the central portion of the area and up to 10-15 dB immediately adjacent to the southwest site boundary - for the case of the linear mechanical draft wet cooling towers at IP-3. However, even with these increases, the operational day-night equivalent sound levels for this industrial district will remain in the range of from below 45 dBA to approximately 50 dBA for the case of either type of natural draft cooling tower at IP-3 and from below 45 dBA to approximately 56 dBA for the case of linear mechanical draft wet cooling towers at IP-3.



NOTE: Percentage interference equals 100 minus percentage intelligibility, and L_{dn} is based on $L_d + 3$.

Figure 5-48 Maximum percentage interference with sentences as a function of the day/night average noise level.

Ref.: U.S. Environmental Protection Agency "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety." U.S. EPA 550/9-74-004, Appendix D, March 1974.

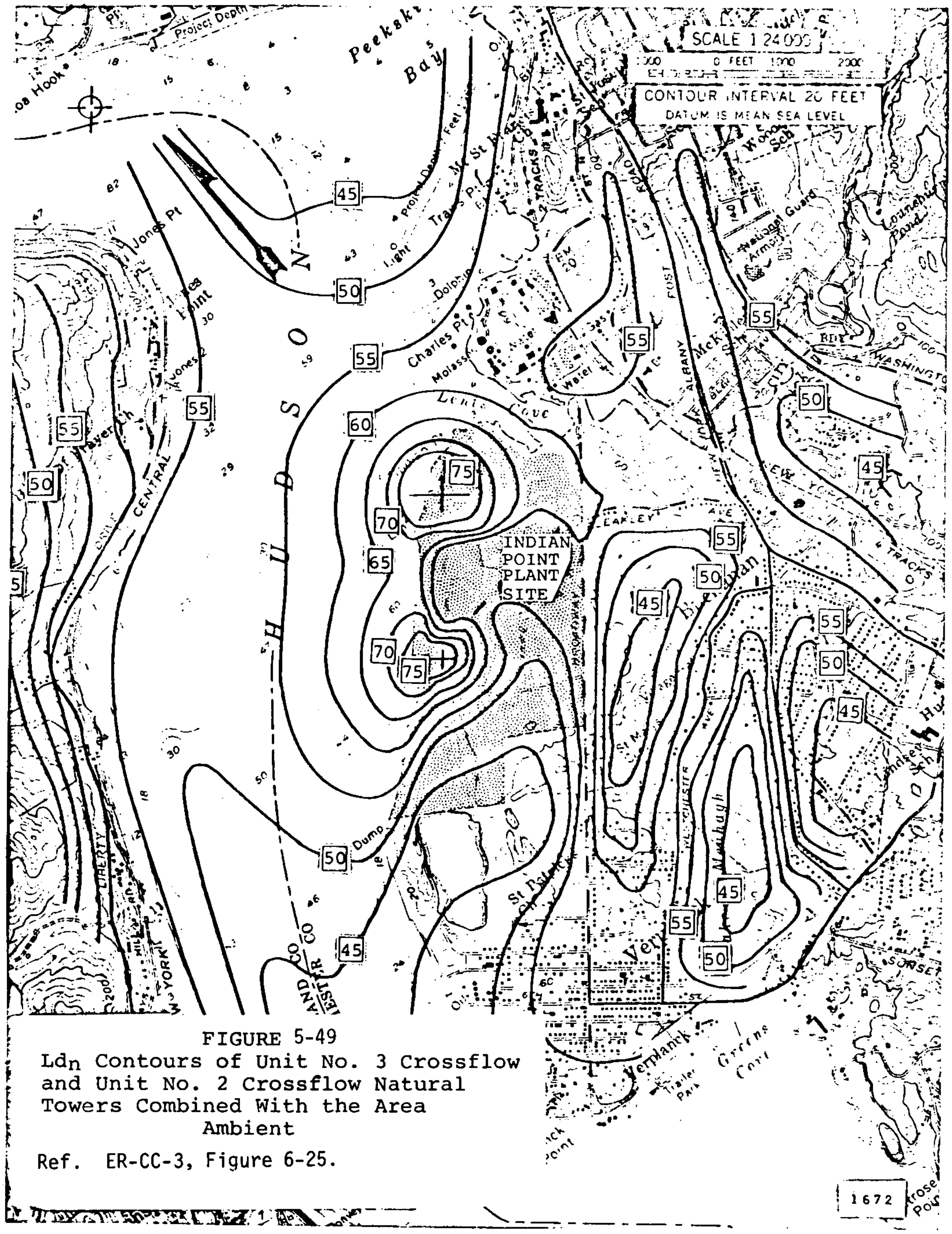


FIGURE 5-49
Ld$_n$ Contours of Unit No. 3 Crossflow and Unit No. 2 Crossflow Natural Towers Combined With the Area Ambient

Ref. ER-CC-3, Figure 6-25.

Figure 5-49

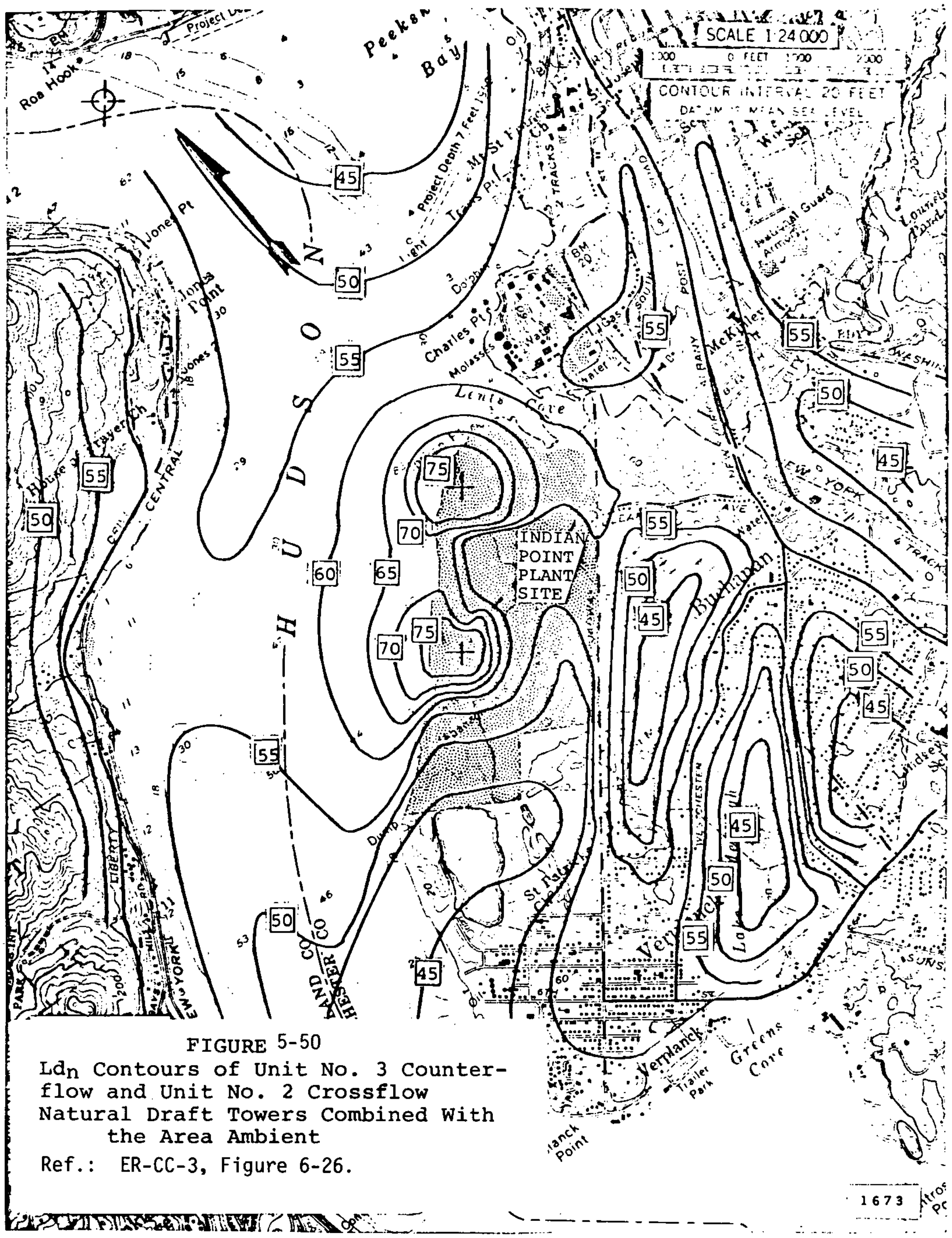


FIGURE 5-50
Ld$_n$ Contours of Unit No. 3 Counter-flow and Unit No. 2 Crossflow Natural Draft Towers Combined With the Area Ambient
Ref.: ER-CC-3, Figure 6-26.

Figure 5-50

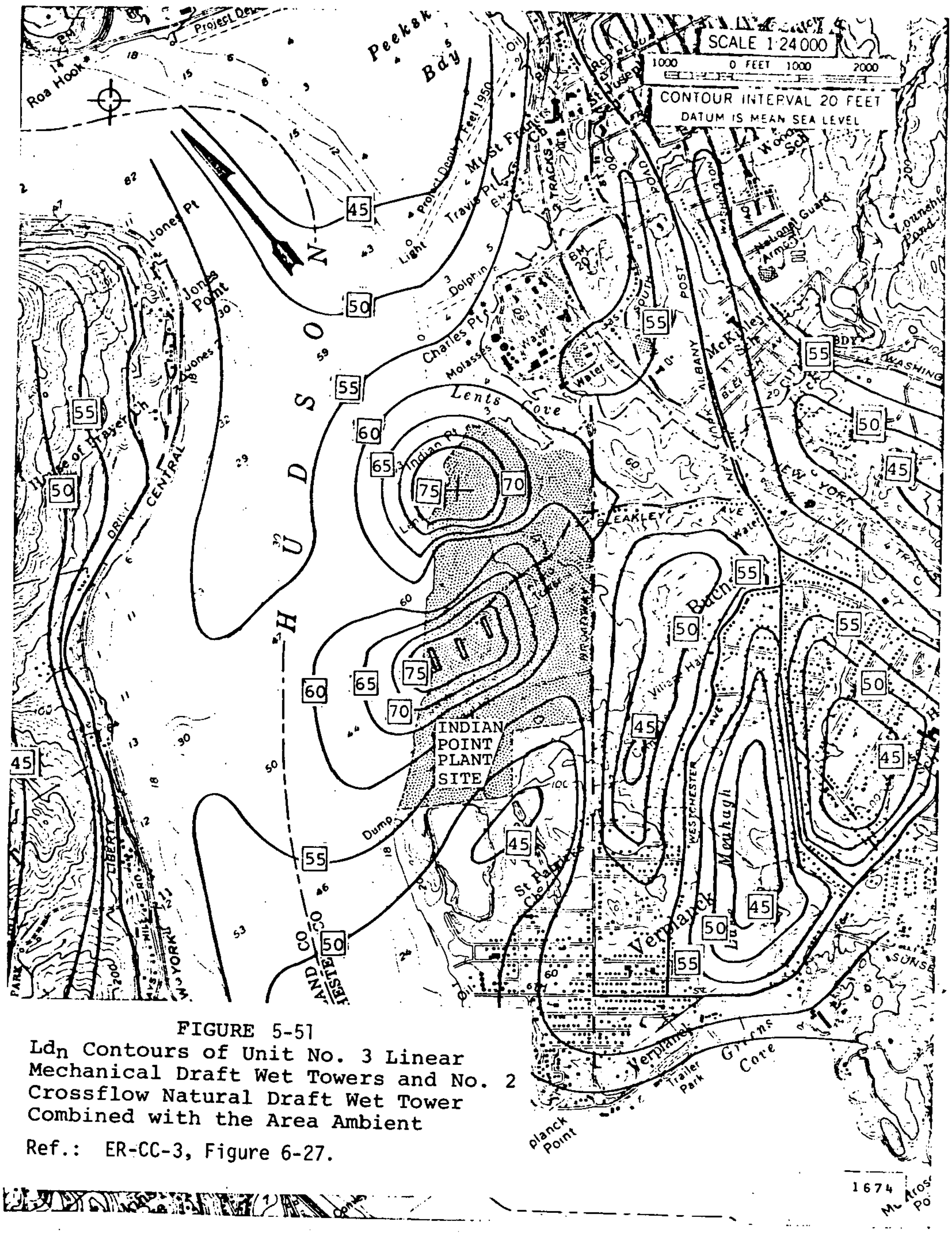


FIGURE 5-51
L_{dn} Contours of Unit No. 3 Linear Mechanical Draft Wet Towers and No. 2 Crossflow Natural Draft Wet Tower Combined with the Area Ambient

Ref.: ER-CC-3, Figure 6-27.

Figure 5-51

TABLE 5-16

COMPARISON OF INDIAN POINT SITE AREA DAY-NIGHT EQUIVALENT SOUND LEVELS: PREDICTED LEVELS UNDER IP-2 ONLY VERSUS IP-2 PLUS IP-3 CLOSED CYCLE COOLING SYSTEM OPERATION

Sampling Location No.	Predicted L_{DN} Ambient Plus Unit 2 Only dBA re 2×10^{-5} N/m^2	Unit 3 L_{DN}, dBA re 2×10^{-5} N/m^2 [1]		
		Cross Flow Nat. Draft	Counter Flow Nat. Draft	Linear Mech. Draft Wet
4	63.7	63.7	63.7	63.8
5	63.1	63.1	63.1	63.2
6*	61.9	61.9	61.9	62.1
7*	62.1	62.2	62.2	62.9
8*	65.5	65.5	65.5	65.5
9	51.0	51.5	51.5	52.3
10*	58.0	58.1	58.1	58.3
11*	52.4	52.7	52.7	53.4
1, 2, 3	55.3	55.6	56.3	56.5

[1]Derived by combining the maximum predicted L_{DN} for each tower type with the calculated L_{DN} resulting from operation of NDCT at IP-2.

*Denotes sampling location within Village of Buchanan.

The residential area along Broadway Avenue south of the site, designated as "one family residential R-15" on the Cortlandt Zoning Map is predicted to experience increases in day-night equivalent sound levels of less than 5 dB for natural draft towers at IP-3 and up to 5 dB for linear mechanical draft wet towers at IP-3. These changes are manifested by changes primarily in predicted positions of the 45 dBA and, to a lesser extent, the 50 dBA L_{DN} contours. There is no predicted change in the location of the 55 dBA L_{DN} contour for this area.

It is helpful to examine the predicted L_{DN} with respect to various community response criteria. The EPA has prepared a summary of annoyance surveys and community reaction surveys which relate these factors to the day-night equivalent sound level.[57] The bases for the results of the summary was "the disturbance of essential daily activities." The results are reproduced in Figure 5-52. The data indicate that an L_{DN} = 55 dBA there would be less than 1% household complaints but 17% of the people may feel highly annoyed by the noise; that at an L_{DN} = 60 dBA, 2% of the households may complain and 23% of the people may be highly annoyed; and a L_{DN} above 65 dBA could mean that 5% of households may complain and 33% of the people would be highly annoyed.

In another study reported by EPA,[57] an L_{DN} of 62 dBA was the average of values reported for community reactions described as follows: "sporadic complaints," "widespread complaints or single threat of legal action," and "several threats of legal action or strong appeals to local officials to stop noise." A mean L_{DN} value of 55 dBA was characterized by "no reaction." When the data for this study was normalized to account for residual noise levels (i.e., noise levels in the absence of the intruding noise), previous noise exposure, seasonality and tonal or impulse qualities, the community reactions were distributed according to Figure 5-53. This same normalizing procedure is proposed by the New York State Dept. of Environmental Conservation.[69] When this normalization procedure is applied to the predicted day-night equivalent sound levels for the operation of closed cycle cooling at IP-3, the estimated community reaction falls within the "sporadic complaints" classification (for normalized day-night equivalent sound levels of 55-65 dBA). This result is applicable to the cases of either type of natural draft cooling tower and the linear mechanical draft wet cooling tower. This same result would be expected for the IP-3 preoperational condition as well.

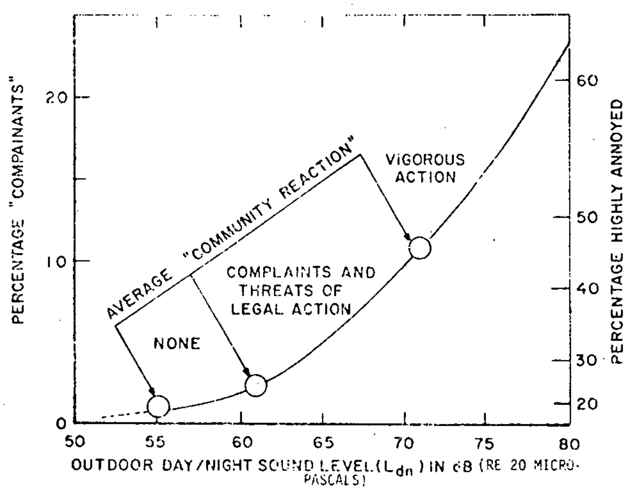


Figure 5-52 Summary of annoyance survey and community reaction results.

From: Ref. 57

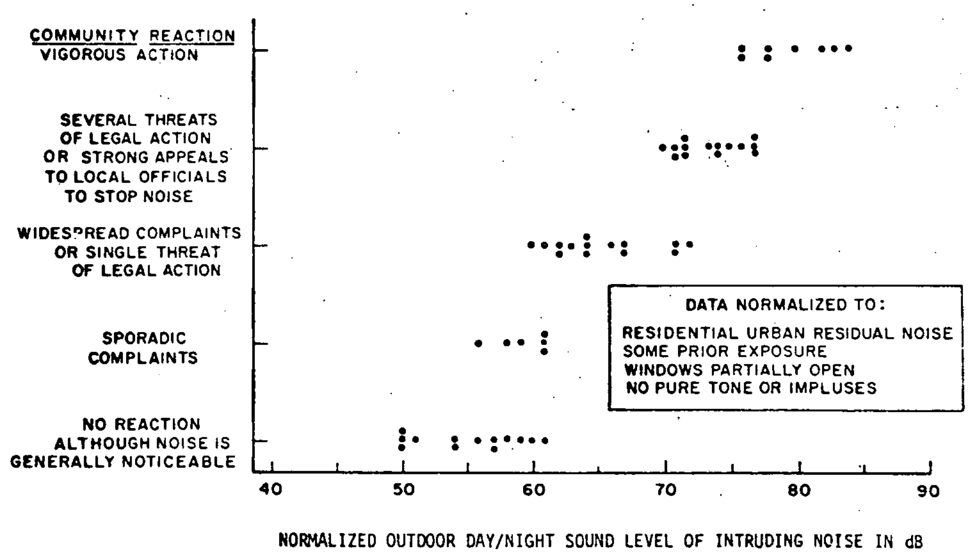


Figure 5-53 Community Reaction to Intensive Noises of Many Types as a Function of the Normalized Outdoor Day Night Sound Level of the Intruding Noise [D-3]

From: Ref. 57

The EPA study further estimates that "no community reaction to intruding noise is expected on the average, when normalized day-night sound level of an identifiable intruding noise is approximately 5 dB less than the day-night sound level that exists in the absence of the identifiable intruding noise." This criterion is met for the sampling locations on the eastern shore of the Hudson River for either type of natural draft cooling tower and would be met on the western shore for the crossflow natural draft cooling tower. This criterion would not be met at all locations on the eastern shore nor the western shore for the linear mechanical draft wet cooling tower at IP-3. Where this criterion is not met, the estimated reaction would be sporadic complaints. The next plateau of adverse community reaction generally occurs at an L_{DN} of 70 dBA or greater. The predicted IP-3 operational acoustic environments will in no case cause the landward offsite areas to exceed this criterion.

5.2.5.5 Staff's Conclusion on the Assessment of the Offsite Sound Levels

The staff has examined the predicted offsite acoustic environment under the operation of various alternative closed cycle cooling systems at the Indian Point Unit No. 3 site, given the operational presence of the preferred alternative closed cycle cooling system at Indian Point Unit No. 2. This system, a single crossflow natural draft cooling tower, was evaluated and assessed by the staff against the existing acoustic environment in an earlier document.[72] For those locations where reliable data have been collected during the base line survey (i.e., sampling locations No. 1 through 11), the incremental increases in equivalent sound levels due to the addition of a closed cycle cooling system consisting of either crossflow or counterflow natural draft cooling towers or linear mechanical draft wet cooling towers at IP-3 are small when compared to the predicted operational acoustic environment for IP-2 alone. For these areas, the predicted increases range from below to slightly above the threshold of detectability for two sounds under practical conditions.[65] All of these predicted increases, however, are below the amount considered likely to cause a change in community reaction to environmental noise.[66]

In addition to the use in this analysis of a descriptor of environmental noise related to public health and welfare, L_{DN}, which considers the likely threshold of annoyance, the staff has considered a specific activity interference characteristic of the predicted operational environment: speech interference. The staff believes that overall, degradation of outdoor verbal communications under normal (as previously defined) conditions will be limited due to the operation of a closed cycle cooling system at IP-3. The offsite area previously identified[72] to be most impacted in this regard due to the presence of the preferred closed cycle cooling system at IP-2 (the park land immediately northeast of the Indian Point site boundary) will not be noticeably affected by the addition of a closed cycle cooling system at IP-3.

Both the applicant's and the staff's analysis predict that the greatest change in the offsite acoustic environment due to the addition of closed cycle cooling at IP-3 would occur in the areas immediately to the south of the site boundary, between Broadway Avenue and the Hudson River, primarily in the "designed industrial district M-D" as shown on the Cortlandt Zoning Map, and along the western shore of the Hudson River. These areas are not as heavily populated as other areas around the site. In addition, the resultant predicted sound levels are not in the range associated with outdoor activity interference.

The staff believes that it is important to note that the possible noise impacts, changes in acoustic environment, and changes in resident reactions discussed in this section are not absolute quantities, but are experiential norms and are subject to variation. (Responses to environmental noise are subjective.) The studies referenced in this discussion are generally applicable. However, these surveys were conducted in different locales, with different background environmental noises. Therefore, variations from the exact predicted results should not be considered unusual. The staff believes that the following factors will be important in the community reaction to the operational acoustic environment:

(a) Character of the sound; the cooling tower sound will be audible offsite as "white sound"; that is, it will have a broad spectrum, be free of beats and impulses, will be constant in level and will be continuous. This type of sound can often serve as a mask against other inconstant intruding sounds and can easily blend into the background sounds and be easily acclimated to.

(b) Prior experience with environmental noise; the site is characterized by relatively high ambient sound levels. In addition, major transportation arteries, industrial development and the continuing construction taking place at Indian Point site contribute to the community's noise exposure. Increases in environmental sound levels are often more easily tolerated by communities with previous exposure to high sound levels than those communities with no such experience.

(c) Prior experience with the noise generator; as mentioned above, the construction at the Indian Point site has continued over a substantial period of time. The relationship between the applicant and the community in the past (due to such activities) could greatly influence the future reactions and could cause a reaction to be out of proportion with the relative change in acoustic environment.

(d) Value of the noise source and its alternatives to the community; the community's reaction to the operational acoustic environment versus the reduced effects on the Hudson River fishery will be important in the degree and nature of community reaction.

None of these factors can be analyzed with certainty as to their effect on variations in the community reactions predicted by the staff.

In summary, the staff analysis has shown that both the ambient and predicted operational acoustic environments are such that a sizeable fraction of the people exposed should judge both environments as unacceptable and would be highly annoyed at such environments. "Complaints and threats of legal action" would also be expected in both environments.

The staff analysis indicates that the operational acoustic environment will be less desirable than the ambient acoustic environment. The linear mechanical draft wet towers are predicted to have a slightly greater effect on the offsite sound levels than either the crossflow or counterflow natural draft towers.

Circular mechanical draft wet cooling towers are predicted to have similar offsite sound levels as the linear mechanical draft wet towers, while the linear mechanical draft wet/dry towers and the fan assisted natural draft wet towers are predicted to produce slightly higher and 5-10 dB higher levels than the linear mechanical draft wet towers, respectively.

5.3 PLUME VISIBILITY AND INTERACTION

5.3.1 Plume Visibility

Since all evaporative systems add large quantities of heat and water vapor to the atmosphere from limited areas per unit of time (the flux density from cooling towers is three orders of magnitude greater than that for once-through cooling systems), they have a higher potential to alter local weather conditions than does a once-through cooling system.

5.3.1.1 Natural Draft Cooling Towers (NDCT)

The primary atmospheric effect created by the operation of NDCT is the generation of visible plumes aloft.[1-13]

Observations at operational NDCT's indicate that the visible plume usually begins inside the tower itself due to condensation of water vapor into the effluent air stream, a process not discussed in most papers and models on cooling tower plumes. The warm, saturated air leaving the tower mixes with cooler, drier ambient air. Because of the nonlinear relationship between saturation vapor pressure and air temperature, the mixture of these two bodies of air will be super saturated and the excess moisture will continue to condense in the form of an elevated visible plume. Because of its vertical momentum and buoyancy, the visible plume usually continues to rise well above the top of the tower where it either disappears due to evaporation or merges with an existing cloud layer.

The size and extent of the visible plumes are dependent on the meteorological conditions and the operating characteristics of the cooling tower. Under certain weather conditions (low temperature, high humidity, moderate wind speed, and a stable atmosphere), the visible plume from a cooling tower may extend several miles. Colbaugh et al.[10] have measured plumes extending 10 miles (16 km) in Kentucky. Even longer plumes (up to 20 miles) have been observed in Ohio.[6,7] The plume finally becomes invisible after the plume mixes with the drier air in the atmosphere.

The length and other dimensions of the plume such as its plume rise, width, depth, and height of base above ground will depend primarily on existing weather conditions (air temperature, saturation deficit, wind speed, and atmospheric stability). Because the tendency of water vapor to condense increases with lower temperatures, the plumes will be most pronounced during the winter season. Bierman et al.[13] published the first report on the climatology of plume lengths. They measured the length of the plume from a cooling tower complex for an 1800 MWe fossil plant in Pennsylvania for six months in 1969 (January 31st through July). These pictures were taken

during the early morning hours, normally the time of day with the longest visible plumes. It was found that the plumes evaporated completely on 81.5% of all days during the period of study. Of these, 87.3% disappeared within five stack heights or 1625 ft. of the tower, and only 2.6% extended more than 15 stack heights or 4875 ft. The plume merged with an existing overcast on 16.5% of all days. On the remaining days (2.0%), the plumes were classified as "special cases", such as cloud-building. Smith et al.[6] made 244 plume rise and length measurements at three power plants (Ohio and West Virginia), November 1973 through August 1974. Of these, 163 or 65% disappeared within a half-mile of the plant. Only 16 or 6.5% extended to distances greater than two miles. Later data indicate one plume extended 20 miles.[7]

A more complete climatology of plume lengths was made at the coal-fired plant at the Ratcliffe-on-Soar power plant in England.[8,14] This plant uses eight towers to cool four 500-MWe fossil units. Photographs were taken three times (about 0900, 1400 and 1700 local time) each day for one year (some of photographs were not usable due to a variety of problems, including fog and merging of the cooling tower stack plumes). The plume length measurements were subdivided into three length classes and by relative humidity class. On a seasonal basis, 50% of the measured plumes were persistent (that is, longer than 900 meters) in winter, but only 10% in summer. Persistent plumes were not observed at high wind speeds (10 meters per sec (mps) or higher), but neither were high humidities. Moore[8] concludes that relative humidity (measured at 12 meters) is as good a predictor of plume length as can be determined by a complicated equation given in Reference 14.

a. Applicant's Analysis of Plumes

The applicant has used a computer model as described in Appendix A of Appendix B of the ER-CC-2 to estimate the climatology of plume lengths from the proposed natural draft cooling tower for Unit No. 2.[15,16] Initial plume rise was computed using Eq 4.32' from Briggs.[17] The model used the Halitsky non-condensing plume model for that portion of the plume from the tower exit downwind to the distance where the jet effect disappears.[16] Beyond this point, moisture and heat are dispersed using the usual Gaussian dispersion equations. One year (October 1, 1973 through September 30, 1974) of onsite meteorological data plus the design characteristic curves for the proposed tower (Figs. 1a and 1b in Appendix B of Ref. 22) were used in the calculations. This is the same model as that used to compute the frequency of surface fog.

The results of these calculations are given in Figs. 2-1 and 2-2 of Appendix B of the applicant's ER-CC-2 and reproduced here as Figures 5-54 and 5-55 and show the frequency in hours as isopleths of visible plumes extending to distances of 3 and 10 miles, respectively. The figures show that long plumes will be most frequent SSW of the towers, over the bank of the Hudson River.

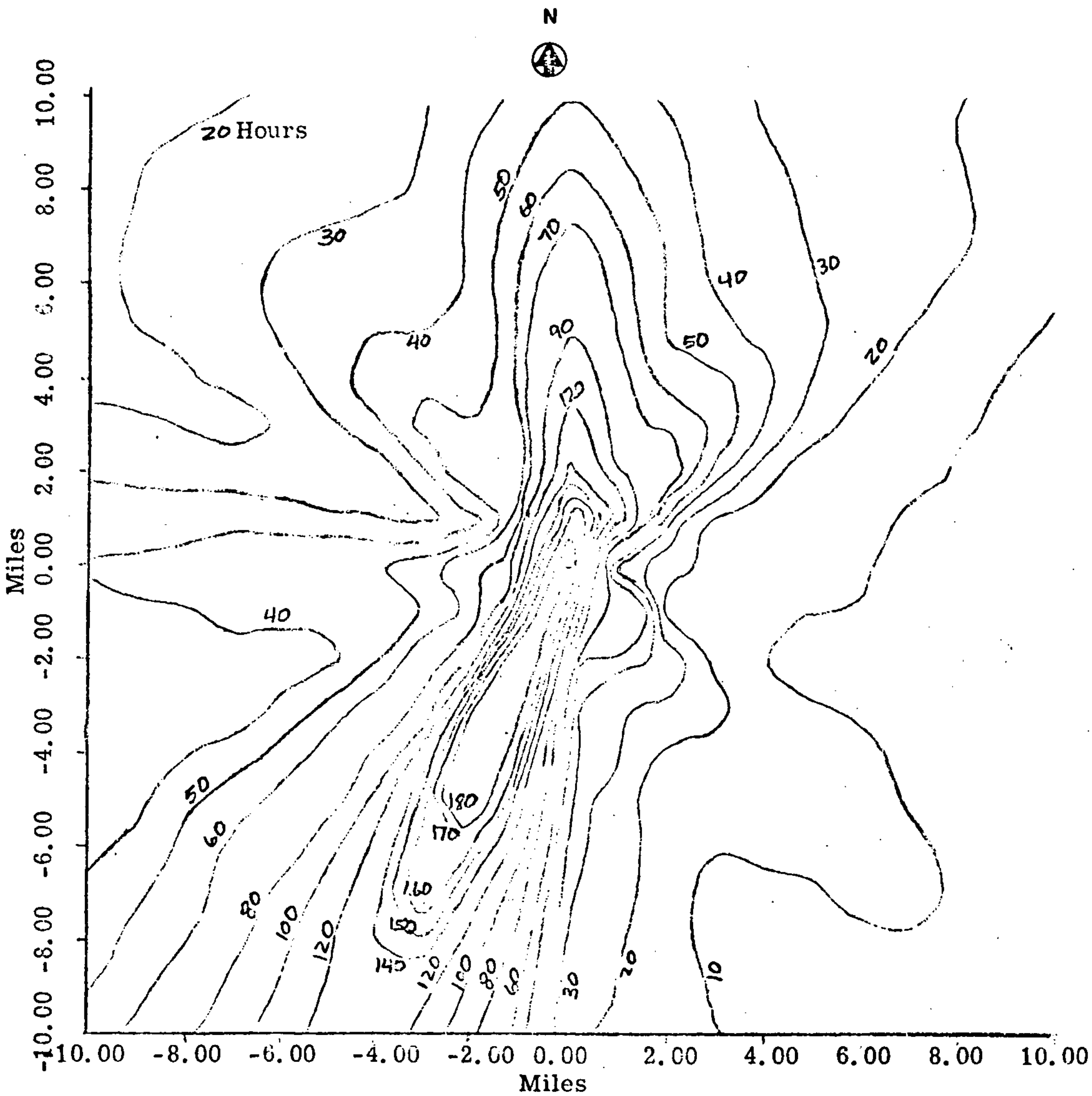
b. Staff's Analysis of Plumes

The staff has examined the model and finds that it is a reasonable one, consistent with the state-of-the-art in plume modeling.[19] Based on observed plume lengths in England[2] and in the United States[6,7,10,13] the staff concludes that the model tends to overestimate plume lengths. However, the staff does agree with the applicant that the plumes will never reach the ground and cause surface fogging, that long plumes will frequently occur with periods of natural precipitation or cloud cover, will not have significant adverse effect on the biota of the region, and will not interfere with aircraft flying. The visual impact of the tower and their visible plumes will be the primary adverse impact. See Section 6 for discussion of the visual impact of the tower and plume.

5.3.1.2 Linear Mechanical Draft Cooling Towers (MDCT's)

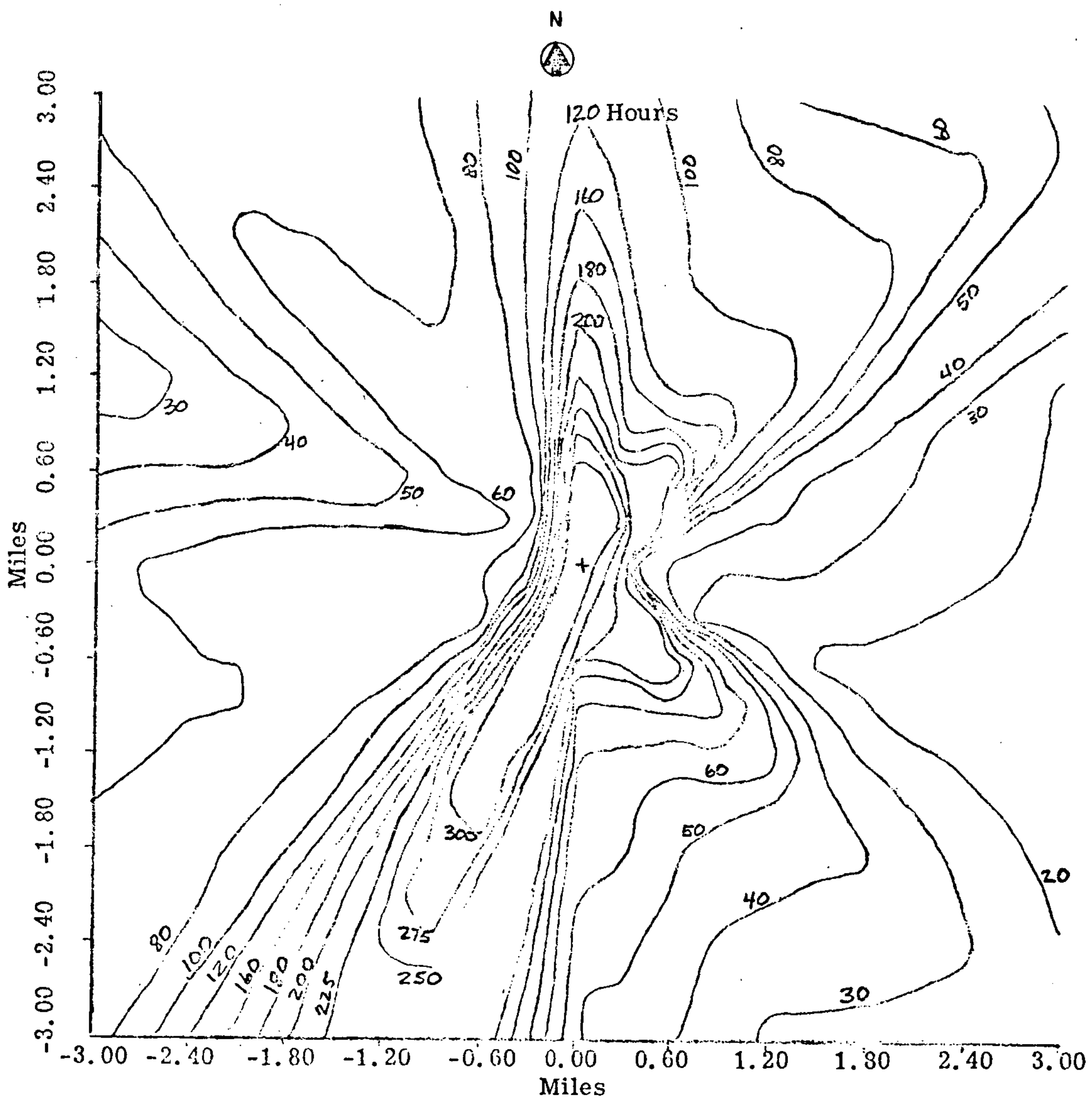
Mechanical draft cooling towers (MCDT's) are also able to produce long visible plumes.[20-22] As with natural draft towers, the length of the visible plume created by MDCT's will depend on plant factors as well as local weather conditions (including orientation of the long axis of the tower with wind direction). Hanna and Perry[21] report that plumes from a MDCT in Tennessee frequently "formed a stratus deck just below the main stratus deck, and that the man-made cloud could be seen extending tens of kms to the horizon. It would be interesting to see if rainfall were increased beneath this cloud." Under most meteorological conditions, the water droplets in the visible plume will evaporate within a few hundred feet of the towers. Under other conditions (especially periods with low air temperatures, high humidity, perhaps light rain or drizzle, moderate wind speeds and stable atmosphere) the visible plume may extend for several miles. Other than the appearance of an extended plume, the main impact of the elevated plume is the reduction of sunshine reaching the shaded area. The decrease in incoming radiation at ground level is not expected to be significant because of the shifting shadow, the small area affected, and natural conditions (long plumes will frequently occur during periods of natural cloud cover). Visible plumes will be more frequent and longer in winter than during the other seasons, and the minimum size and the

Figure 5-54
Isopleth of Number of Hours Visible Plume
Extends Distance Downwind in Each Direction
(0-10 miles)
(Period of Record-October 1, 1973 through August 31, 1974)



Ref.: ER-CC IP-2, Fig. 2-2, App. B

Figure 5-55
Isopleth of Number of Hours Visible Plume
Extends Distance Downwind in Each Direction
(0-3 miles)
(Period of Record-October 1, 1973 through August 31, 1974)



Ref.: ER-CC IP-2, Fig. 2-1, App. B

lowest frequency of long plumes will occur in summer. On the daily cycle, plumes will be longest just before and after sunrise, and shortest in midafternoon.

a. Applicant's Analysis of Plumes

The applicant has developed its own computer model[23] for predicting certain plume effects such as fogging, icing, and drift rates; however, the fogging part of the model also does not compute expected plume lengths. The fogging part of the model uses the Briggs plume rise equation[17] to calculate initial plume rise and the standard Gaussian dispersion equations to compute the increases of surface humidity. The staff considers that the fogging and plume length portions (but not the drift portion) of this model to be unrealistic in that aerodynamic effects, the primary cause of surface fog, are ignored. The model also incorrectly assumes that ice and not fog will occur whenever surface temperatures are below freezing and the moisture added by the tower exceeds the saturation deficit. Dense fog is produced under these weather conditions.[24]

b. Staff Analysis of Plumes

The staff has not computed the extent of the visible plume from MDCT's at Indian Point Unit No. 3. However, the staff does expect that visible plumes aloft will be common outside the plant boundary, but these plumes would be shorter and lower and the long plumes would be less frequent that those from NDCT's.

5.3.1.3 Wet/Dry Mechanical Draft Cooling Towers (W/D MDCT's)

The extent of the plume from the wet/dry MDCT will be small compared with a wet MDCT. During weather conditions when a plume will form, the dry section of a wet/dry tower would be in operation. Thus the plume would not be visible upon exit of the warm air from such a cooling tower.

5.3.1.4 Circular Mechanical Draft Cooling Towers (CMDCT)

Longer and higher plumes are expected from circular mechanical draft cooling towers (CMDCT) than from MDCTs of a conventional layout, due to their better aerodynamic shape (less downwash) and more concentrated initial state (less entrainment). The plumes would be shorter and lower than those from NDCTs.

5.3.1.5 Fan-Assisted Natural Draft Cooling Tower (FANDCT)

The plume from a FANDCT would extend approximately the same distances as from a NDCT except the plume would be lower since the FANDCT is shorter than the NDCT. Since the fans would force the plume to rise faster, the plume would tend to rise to higher elevations than those from NDCTs.

5.3.2 Plume Interaction

It has been argued on theoretical grounds that the water droplets in a visible cooling tower plume interact with ambient SO_2 or merge with fossil-fueled stack gases, that sulfuric acid would be formed, and that this "acid mist" would fall to the ground and cause damage to people, vegetation and structures.

Hundreds of wet cooling towers, both natural draft and mechanical draft, have been operating at fossil-fired power plants for decades both in the United States and Europe without any reports of significant adverse impacts due to "acid mist" from cooling tower plumes.[11,25] While the lack of reports of damage is certainly not proof that the phenomenen does not occur (since no systematic observations have been made), the problem is probably a minor one at most. This conclusion is in agreement with a recent EPA report[25] and studies in England.[8]

The statement above does not mean that acid rain or mists due to the use of high-sulfur fuels do not occur or is not a problem. The real question is "How does the presence of a cooling tower plume <u>alter</u> the SO_2 cycle in the atmosphere?" The stack gases from a fossil plant already contain <u>all of</u> the ingredients needed to cause acid droplets and acid rain. In other words, the problem of cooling tower plume interactions is the effect of a perturbation on an existing chemical process that goes on at all fossil-fueled plants, with or without cooling towers. Limited data collected in England indicate the acids droplets observed aloft in a NDCT plume were due mostly to ambient SO_2 entrained into the plume and not due to merging of the plant's stack and tower effluents.[26] Acid drops with pH values between 2 and 3 have been observed in the visible plume (but not at the ground) from a natural draft cooling tower in Pennsylvania.[27]

The nearest large SO_2 source is the oil-fired superheater for Indian Point Unit No. 1, which uses about 0.3% sulfur fuel. The stack gases are discharged from a 390-ft MSL stack. The applicant has concluded that the plume from the superheater will only infrequently merge with the plumes from either mechanical draft or natural draft cooling tower plumes, due to differing heights of release and expected plume rise. The staff agrees with this analysis.

The staff expects no significant changes in the SO_2 cycle as a result of adding a wet cooling tower to the Indian Point Unit No. 3.

5.4 HYDROLOGIC AND AQUATIC EFFECTS

5.4.1. Depletion of Surface Water and Ground Water Resources

The operation of the cooling towers at Indian Point Unit No. 3 would require a total makeup water supply of about 30,000 gpm which includes about 15,000 gpm for blowdown and 15,000 gpm for evaporation and drift. This supply will come from the Hudson River which has tidal flows of 180,000 cfs. Another 30,000 gpm is used for the service water system. The use of a total amount of 60,000 gpm is more than an order of magnitude lower than the total amount of 870,000 gpm used for the once-through cooling and service water system. As stated on page V-49 of the FES for IP-3, the once-through cooling system involves only a negligible consumption of water within the Indian Point facilities. Although there will be evaporation of 15,000 gpm from the tower, there should be no significant depletion of surface water during operation of Indian Point Unit No. 3 with cooling towers.

Intrusion of salts from the cooling towers drift at Indian Point Unit No. 3 into the surrounding groundwater is considered to be highly improbable. The only public water supply served by wells averages about 550 gpm. A few wells, serving private homes, are still in use along the fringes of the area. Both the Stoney Point system wells and private wells are in unconsolidated deposits with depths ranging from 35 to 50 feet. However, on both sides of the river, the ground elevations are considerably higher than at the plant site, and groundwater would flow directly to the river.

5.4.2. Water Quality Effects

The major change in quality of plant effluent will be the concentration of dissolved substances due to evaporation in the 600,000 gpm of circulating water system. The applicant has tentatively selected a cooling system blowdown rate of 15,000 gpm which would limit the blowdown concentration to twice the intake concentration (concentration factor of two). The purpose is to limit the building of solids in the circulating water and to reduce deterioration and corrosion of the cooling tower structure. The applicant has shown in its Table 6-2 and 6-3 (ER-CCC, IP-2) the chemical composition of the Hudson River, blowdown with no dilution and blowdown with dilution from the service water system and with 318,000 gpm of the once-through cooling system water from Unit No. 1.

Sulfuric acid, which may be added at a rate of 0.5 gpm (of 66° Baume concentration) for control of scaling in the circulating water system, will increase the sulfate ion concentration in the blowdown by an additional amount which represents about five percent of the total blowdown concentration. This amount is 890 ppm maximum concentration and 254 ppm average concentration of sulfate ion. This increase is negligible relative to variations in ambient concentrations. The ptt of the blowdown will be regulated such as to be kept within applicable water quality standards.

The proposed chlorine concentration of the blowdown (less than 0.5 ppm free available chlorine) is higher than that permitted by the existing Environmental Technical Specifications for the facility (0.5 ppm maximum total residual chlorine concentration). However, the amount of total residual chlorine released will be much smaller for closed cycle operation. Issuance of a NPDES permit for the new discharge will require that the permitting authority determine whether a limitation which is more stringent that the EPA Effluent Guidelines and Standards, in accordance with 40 CFR Part 423, is necessary to protect aquatic life. The applicant proposes to discharge chemicals at average concentrations for 9 months of the year with only intermittent chlorination treatment. However, during the three summer months, discharges of maximum concentrations of total residual chlorine are expected. Sulfuric acid would also be used primarily during the summer months. See Tables 5-17 and 5-18 for the maximum and average chemical composition of all discharges to the Hudson River along with dilution with the service water and the Unit No. 1 circulating cooling water.

TABLE 5-17

CHEMICAL COMPOSITION VALUES OF BLOWDOWN
CORRESPONDING TO MAXIMUM CHEMICAL CONCENTRATION
OF HUDSON RIVER *1

(Blowdown Rate: 15,000 gpm)

	Conc., mg/l or ppm of X			
Chemical, X	Hudson R.	Blowdown (No Dilution)	Diluted Upper Limit*2	Blowdown Lower Limit*3
Bicarbonate	82	78	81	82
Calcium	82	164	109	85
Chloride	3,020	6,040	4,027	3,145
Magnesium	184	364	245	192
Potassium	60	120	80	62
Silica	4	8	5	4
Sodium	1,700	3,400	2,267	1,770
Sulfate	420	890	577	439
Residual Chlorine	--	<0.5	<0.17	<0.02

*1 Chemical treatment includes intermittent chlorination and sulfuric acid feed of about 1/4 gpm.

Hudson River maximum chemical concentrations is assumed to occur during three (3) summer months.

*2 Dilution flow is 30,000 gpm service water from Indian Point No. 2.

*3 Dilution flow is 30,000 gpm service water from Indian Point No. 2 together with 318,000 gpm circulating water from Indian Point No. 1.

TABLE 5-18

CHEMICAL COMPOSITION VALUES OF BLOWDOWN
CORRESPONDING TO MAXIMUM CHEMICAL CONCENTRATION
OF HUDSON RIVER *1

(Blowdown Rate: 15,000 gpm)

	Conc., mg/l or ppm of X			
Chemical, X	Hudson R.	Blowdown (No Dilution)	Diluted Upper Limit*2	Blowdown Lower Limit*3
Bicarbonate	67	134	89	70
Calcium	36	72	48	37
Chloride	74	148	99	77
Magnesium	46	92	61	48
Potassium	17	34	23	18
Silica	--	--	--	--
Sodium	40	80	53	42
Sulfate	127	254	169	132
Residual Chlorine	--	<0.5	<0.17	<0.02

*1 Chemical treatment includes intermittent chlorination. Hudson River average chemical concentration is assumed to occur nine months annually.

*2 Dilution flow is 30,000 gpm service water from Indian Point No. 2.

*3 Dilution flow is 30,000 gpm service water from Indian Point No. 2 together with 318,000 gpm circulating water from Indian Point No. 1.

5.4.3 Blowdown Impacts

5.4.3.1 Biotic Effects

The results of the applicant's bioassay studies winter and summer conditions of the chemical concentration of the blowdown to be discharged to the Hudson River are given in Appendix F of the ER-CC. The applicant's evaluation of cooling tower blowdown effects on the striped bass and white perch indicates that river salt concentrations of three to four times would be necessary before acute or chronic effects of the blowdown, prior to dilution, could be detected in these species. For both species, the incipient LC_{50}, the concentrations at which lethal toxicity to the average fish ceases on chronic exposure, was also 2.8 - 3.6 times the maximum discharge concentration range from the cooling tower. The applicant's plans to operate the cooling tower with a concentration factor of two plus dilution of the blowdown of at least the service water of 30,000 gpm prior to discharge to the river should provide an adequate margin for environmental protection of the aquatic biota in the Hudson River.

By limiting the discharges of total residual chlorine and the pH due to the sulfuric acid added to the circulating water system to be within applicable effluent guidelines on water quality standards, no significant impact on the aquatic biota in the Hudson River would be expected.

5.4.3.2 Thermal Discharges

The blowdown water upon discharge will contain a certain amount of heat which is the product of the flow rate of the blowdown and the enthalpy difference between the blowdown and the river

water. The yearly average temperature increase of the blowdown of 15,000 gpm is estimated to be about 14.8F°. Thus, the total heat from the blowdown and from the service wastes amounts to 110 million Btu per hour and 100 million Btu per hour, respectively. In comparison, the once-through cooling dissipates about 7350 million Btu per hour.

5.4.4 Biological Effects of Impingement and Entrainment

Backfitting of the existing once-through cooling system at Indian Point Unit No. 2 to closed cycle operation will require the installation of two new pumps in one of the six existing intake bays to provide a tower makeup flow of about 30,000 gpm (3.5% of open cycle flow). The makeup intake system will be similar to the existing service water system (30,000 gpm) which will remain intact. For closed cycle operation, if impingement occurs, it will occur at the screens of the makeup and service water systems. Limited observations to date indicate that impingement is negligible at the service water intake. Because of the similarities of the two systems, and the smaller volume of water used and lower screen velocities relative to open cycle cooling, the staff believes that fish loss resulting from closed cycle operation will not result in an unacceptable impact on the river fishery.

Organisms capable of passing through the 3/8-inch mesh screens will be entrained in the makeup and service water systems. Phytoplankton, zooplankton and fish eggs and larvae entrained in the condenser cooling system will experience mortalities approaching 100% because of the extreme temperature and chemical stresses of the condenser cooling system. Some survival of service water entrained organisms is expected. Even 100 percent mortality of entrained organisms including striped bass larvae in both systems would result in absolute losses below levels of concern relative to once-through cooling.

5.5 RADIOACTIVE RELEASE EFFECTS

5.5.1 Radioactive Liquid Releases

With the incorporation of the modified radioactive waste treatment at Indian Point Unit No. 2 in February 1975, the total amount of liquid radioactive wastes released to the environment is limited to 5 curies per year from each Unit, excluding tritium. The amount of tritium released is estimated to be 350 curies per year. These values are about half those provided by the applicant in its ER-CCC, IP-2, namely, 9.58 curies per year of liquid ratioactive releases, excluding tritium and 608 curies per year of tritium. Without Unit No. 1 in operation, the applicant estimated the percentages of 10 CFR Part 20 limits for tritium releases to be about 0.37% and for other liquid radioactive effluents to be about 9%, assuming dilution from the cooling tower blowdown ranging from 11,847 gpm to 14,111 gpm plus 30,000 gpm service wastes. However, if one uses the staff's calculated annual release of 5 curies of radioactive liquid effluents and the 30,000 gpm of service water and 15,000 gpm of blowdown for dilution, for either Unit No. 2 or Unit No. 3 the radiological dose to an individual from fish consumption is estimated to be about 0.82 millirem per year since the annual radiological doses from liquid effluents described in Section V.E.2 of the FES for IP-3 were based on the assumption that only water flow of about 100,000 gpm was available for dilution in the discharge canal. Dose estimates for swimming in the Hudson River were also found to be less than 0.01 millirem per year for an individual assuming he would swim in the river 1% (1 hr/day for 3 months each year) of the year. Thus all radionuclide concentration will be within the requirements of 10 CFR Part 20 and doses to individuals from ingestion of fish and swimming in the Hudson River resulting from such concentrations will be negligible in comparison with the background levels of radioactivity.

5.5.2 Radioactive Gaseous Releases

Since there will no change in the dilution of the radioactive gaseous releases because of the operation of the cooling tower, there will be no change in the concentration of the radioactive gases released compared with what had been estimated previously. See Section V.E. from the FES for IP-3 for complete discussion of the radioactive effluents released to the environment and the corresponding radiological doses.

5.6 CONCLUSION

Drift

The staff concludes that effects of saline drift on local vegetation are unlikely to have major consequences for any of the cooling towers considered. Risk of damage exists with some towers but it is not of sufficient magnitude or extent to rule out further consideration of any tower type. Differences, nevertheless, exist among tower designs with respect to potential injury to vegetation. In general, the mechanical draft options which include rectangular, circular and wet/dry types have greater risk of damage than the natural draft configurations. The staff ranks the alternatives with respect to the single factor of saline drift in order of least to greatest risk of vegetation damage as follows:

1. Natural draft
2. Fan-assisted natural draft
3. Circular mechanical draft
4. Linear and wet/dry mechanical draft

The staff has considered the frequency of drought lasting 14 days in its analysis. Drought is considered to be a factor in enhancing botanical injury; however, the influence of this factor should not be overstated. A single drought episode of 14 days does not in itself signal the onset of unacceptable consequences. The significance of drought is that it is simply one of the interacting factors in this analysis. If drought periods occur more than once in a season or if a series of dry years occur, the stress naturally increases. This factor interacts with others, however. If either type of mechanical draft towers or FANDCT were selected, higher drift levels combined with successive or extended drought episodes would increase the risk to vegetation and widen the area at risk. Small increases in the frequency of natural mortality of sensitive plant species are also possible offsite in a corridor about one-half mile to the east of the river and extending about a mile to the northeast and to the southwest of the mechanical draft tower location. A gradual shift in species composition from salt sensitive to nonsensitive plants within this corridor is a possible long-term effect anticipated. The staff concludes that the natural draft tower is the preferred alternative with respect to the single factor of minimizing risk to vegetation from saline drift but that the magnitude and extent of risk from the other types is not sufficient to rule them out of consideration.

Weather Modification

The staff concludes that the potential for fogging and icing is not sufficiently large to cause rejection of any of the towers considered. Differences among these exist, however, and the staff ranks the towers in the order of least to highest probable effect as follows:

1. Wet/Dry Mechanical Draft
2. Natural Draft
3. Fan-Assisted Natural Draft
4. Circular Mechanical Draft
5. Linear Mechanical Draft

The differences in potential effect among the first three types are sufficiently small to be considered negligible. Only relatively few additional hours of ground fog and ice are expected annually from alternatives 4 and 5 and thus are not as important as other factors in system selection.

On the basis of the single factor of fog and ice, the wet/dry mechanical draft tower is the preferred alternative; however, the advantages are not sufficient in the staff's view to override environmental or cost advantages of other tower types.

Noise

When considering the offsite sound levels of various cooling tower options for the Indian Point site alone (i.e., without accounting for ambient noise conditions), the ranking of tower types in order of increasing sound level is as follows:

1. crossflow natural draft cooling towers

2. counterflow natural draft cooling towers

3. linear mechanical draft cooling towers

NOTE: No operational data on sound levels from circular mechanical draft cooling towers or fan-assisted natural draft towers is available to the staff. However, the staff believes that circular mechanical draft cooling towers would be ranked with linear mechanical draft towers and that the fan-assisted natural draft towers would be ranked between the mechanical draft and the other natural draft tower types. No further qualification is presently possible.

Under the criterion mentioned above, all three tower types would appear to violate the provisions of the Buchanan Zoning Ordinance along the northeast site boundary (i.e., along the park boundary). Only the mechanical draft cooling towers would exceed the provisions of the Buchanan Zoning Ordinance at location #6 (Broadway and Bleakley Avenues). The EPA "identified level"[61] for outdoor activity interference of L_{DN} = 55 dBA would be exceeded for all three tower types listed above for the offsite area northeast of the site beyond Lents Cove and encompassing a portion of the Standard Brands property. This "identified level" would also be exceeded in the mechanical draft cooling tower case only, at the intersection of Broadway and Bleakley Avenues, along a portion of Bleakley Avenue and along the west bank of the Hudson River near and to the south of Jones Point.

When the criterion of amibient sound levels plus the operational cooling tower sound levels is applied to the eastern shore of the Hudson River at the sampling locations used by the applicant, no ranking of tower types can reasonably be made, since sound levels are not expected to be noticeably different between tower types. This is true when comparing either the unweighted 24-hr L_{eq} or the weighted L_{DN} equivalent sound level.

Applying the same criterion to the remaining offsite areas yields a ranking of tower types, in order of increasing sound levels as follows:

1. natural draft cooling towers

2. linear mechanical draft wet cooling towers

This ranking was dictated because of higher offsite operational sound levels for the mechanical draft tower on the western shore of the river opposite the site and in the area immediately northeast of the site extending beyond Lents Cove into the Standard Brands property. Although natural draft towers will have lower sound levels in these areas, no further distinction can be made between natural draft tower types.

The EPA "identified level" for outdoor activity interference was equalled or exceeded under ambient conditions for all but two sampling locations. None of the tower types will cause this level to be exceeded in either of the locations where it is not already exceeded. This level is equalled under ambient conditions on the western shore of the river. All three tower types will cause this level to be exceeded on the western shore. Only the mechanical draft tower is expected to noticeably increase the sound level on the western shore of the river.

A threshold for change in community reaction to environmental noise has been estimated by Stevens[70] to be 5dB. Using this criterion for the operational cooling tower case and considering all offsite areas, mechanical draft wet cooling towers would be ranked at or slightly above the threshold and natural draft tower types would be ranked below the threshold. When this criterion is applied to residential areas only, no tower type would be ranked above the threshold.

Environmentally Preferred Alternatives

Major potential environmental effects of cooling towers which were considered are deposition of saline salt, noise, and fogging and icing. Detailed consideration of these factors in relation to five cooling tower designs leads to the conclusion that none of these factors are likely to be of sufficient magnitude to cause rejection of any of the cooling tower types.

The staff finds that the natural draft or fan-assisted natural draft towers have a balance of impacts which make them the preferred choices. There is little basis for selection between the two alternatives on environmental grounds and the choice could logically be based on engineering, or cost, considerations. Any of the low profile mechanical draft towers could be used with only small reductions in overall environmental quality relative to the natural draft designs if engineering, cost, or aesthetic factors presented appreciable advantages over the natural draft types.

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6. SOCIO-ECONOMIC ANALYSIS OF CLOSED-CYCLE COOLING SYSTEMS

6.1 SCOPE

This chapter summarizes the staff evaluation of direct project costs and social and economic impacts of the five alternative closed-cycle cooling systems for Indian Point Unit No. 3. The potential impacts of alternate closed cycle cooling systems for Unit No. 3 are evaluated with consideration given to the construction and operation of a single natural draft cooling tower for IP-2. Evaluation of direct project costs considers both front-end capital costs and operation and maintenance costs over the life of each alternative system. Front-end capital costs include all labor, materials, equipment, escalation and financing costs as well as the cost of replacement energy and replacement capacity during down time required to cut-in a cooling tower. Costs over the operating life of each alternative includes maintenance and other operating expenses, carrying cost of capital, replacement of deficient energy due to system derating and the carrying cost of capital for replacement capacity needed because of system derating. The evaluation considered likely technical performance and reliability of each system. The analysis of direct project costs is based on information from seven sources; the applicant in the ER-CC for IP-2 and IP-3, the FES for IP-2 (OL) and IP-3 (OL), the FES for IP-2 selection of preferred closed cycle cooling system), vendors of cooling towers, and other operating utilities.

An assessment of potential social and economic impacts from construction and operation of the several closed cycle cooling systems for IP-3 alone and IP-2 and IP-3 combined is also presented in the following sections. These potential impacts are associated with modifications in terrestrial or aquatic ecology, physical disruption of human activity during construction and operation, visual aesthetics of towers and plumes, and changes in private and public finances. Impacts have been evaluated in terms of economic and social stress or disruption caused within the surrounding communities.

6.2 DIRECT PROJECT COST AND PERFORMANCE OF ALTERNATIVE SYSTEMS

6.2.1 Overview of Direct Project Costs and Cost Assumptions

The staff's method of computing direct project costs is to evaluate the major costs attributed to alternative CCC towers for IP-3 on both a present discounted value and an annualized value basis. Project costs consist of four major factors; (1) capital cost, (2) annual operating cost, (3) cost of replacing loss of peak generating capability and average annual loss of generating capability, and (4) down-time cost from cooling system tie-in.

1. Capital cost includes the cost of the basic cooling tower components, site preparation, overhead charges, and escalation and contingency factors. Carrying charges (sometimes referred to as an annual fixed charge) on capital investment over the estimated lifetime of the facility are also included in capital costs but treated separately.

2. Annual operating cost is composed of parts replacement, overhaul, labor, etc., associated with the maintenance of efficient cooling system operation.

3. Cost of replacing loss of peak generating capability and average annual loss of peak generating capability is the cost of obtaining an alternative source of energy to replenish any reduction of net plant capability below its rated capability. Replacement energy may be obtained by the additional operation of existing capability, installation of supplementary capability, purchased power, or some combination thereof.

4. Downtime cost from cooling system tie-in is the cost of providing replacement energy in the event that a complete outage of the generating facility is required in order to switch over from an existing cooling system. Downtime cost from cooling system tie-in is unique to the Indian Point facility where a closed cycle cooling system is to be retrofitted to the existing plant.

The staff's methodology for determining the total project costs of alternative cooling towers is to discount the above costs to a present value (i.e., to the year in which the project is to commence) and compute their sum. In addition, it is the staff's policy to express each cost, as well as total project cost, as an annualized value representing a constant stream of revenue requirements over the estimated useful life of the facility. The general formulation of present discounted value and its mathematical relationships to annualized value are as follows:

Present Value:

a. the present value of a future revenue or expenditure, say x, incurred t years from today is

$$x \cdot e^{-rt},$$

where r is the appropriate discount rate or opportunity cost of capital.

b. the present value of a uniform series of future revenues or expenditures, Y, incurred continuously over t years is

$$\int_0^t Ye^{-rt}dt,$$

where r is the appropriate discount rate or opportunity cost of capital.

Annualized Value:

the future series of continuous revenues, over t years, which will recover a present value PV is

$$PV \left(\int_0^t e^{-rt}dt\right)^{-1},$$

where r is the appropriate discount rate or opportunity cost of capital.

This methodology was applied by the staff in its evaluation of alternative closed cycle cooling towers for IP-2 and is set forth in detail in the FES for CCC systems for IP-2.[1]

In the following sections of this statement the staff presents its cost analyses of alternative closed cycle cooling systems for IP-3. The analyses differ in several respects from the applicant's analyses as presented in its environmental report. Differences primarily arise from the use of different discount rates, years over which costs are discounted and annualized, and costs included in the analysis. Whereas the applicant used a discount rate based on a 15-3/8% cost of capital, it is the staff's current policy to use a discount rate of 10% in environmental statements for investor-owned utilities. This rate is based on an average rate of return on new investments.[2]

6.2.2 Natural Draft Cooling Tower (NDCT)

6.2.2.1 Highlights of Design Features And Scheduling Important To Cost-Benefit Analysis

See Section 2.4.3.1 for a description of the NDCT.

Significant advantages of NDCT's include: (1) energy from the power plant is not required to move air through the tower, hence, there is no decrease in net plant generating capability resulting from fan operation; (2) noise emanating from the tower is lower than evaporative towers employing mechanically induced draft; and (3) plume discharge high above the base terrain reduces environmental impacts related to increased fogging, icing, humidity, and salt deposition. Significant disadvantages of NDCT's include relatively high capital costs compared to other wet evaporative cooling towers, and visual intrusion on surrounding landscape due to the height and mass of the tower.

The applicant has selected the NDCT as its preferred alternative closed cycle cooling system for both IP-2 and IP-3 based on economic and environmental evaluations of five closed cycle cooling systems. In addition to the NDCT, other alternatives included in the evaluations were linear mechanical draft wet cooling towers, circular mechanical draft cooling towers, wet-dry cooling towers, and a fan-assisted natural draft cooling tower. Each alternative is evaluated in detail

in subsequent sections of this statement. In order to satisfy IP-3 cooling requirements, a single NDCT has been designed by the applicant to meet the thermal criteria in Table 6-1.

The single tower would be 565 feet high and have a base diameter of 460 feet.

TABLE 6-1

THERMAL DESIGN CRITERIA FOR AN NDCT, IP-3

Condenser heat load	$7,350 \times 10^6$ Btu/hr
Cooling water flow	600,000 gpm
Cooling water range	25°F
Cooling tower approach	16°F
Design summer wet-bulb temperature	74°F
Design summer relative humidity	55%

SOURCE: Consolidated Edison Company of New York, Inc., Economic and Environmental Impacts of Alternative Closed Cycle Cooling Systems for Indian Point Unit No. 3, Volume 1, January 1976, Table 3-1.

6.2.2.2 Cost Estimates

a. Capital Cost

Shown in Table 6-2 is the applicant's estimated capital cost of an NDCT for IP-3. The total estimated capital cost at completion of construction on April 15, 1982 is $107,000,000. Using the annual carrying charges of 22.3% as reported by the applicant in Table 6-3, the staff found the present value capital cost (1978) and annualized cost (1978 through 2005) to be $145,313,000 and $15,403,000 respectively.

These costs, however, include taxes which are transfer payments within the economy and which the Atomic Safety and Licensing Board, in its Initial Decision for IP-2 (September 9, 1973) ruled should not be used in determining carrying charges on capital.[3] [4] Following this decision, the staff believes that it is also appropriate to exclude real estate taxes during construction from the estimated capital cost. Excluding all taxes, the staff recalculated the capital cost estimate of an NDCT and the annual carrying charges as a percent of capital cost. These are estimated to be $102,000,000 and 16.7% respectively. The corresponding present value capital cost (1978) is $103,737,000 and annualized cost is $10,996,000 for an NDCT.

b. Annual Operating Cost

Once the closed cycle cooling system is operational, ongoing annual expenditures (annual operating costs) are required to maintain efficient cooling system operation. The applicant estimates annual operating costs for a single NDCT to be $150,000 per year.[5] The present discounted value (1978) of the annual operating costs for an NDCT is estimated by the staff to be $1,404,000, including escalation at 5% per year.

c. Cost of Replacing Loss of Peak Generating Capability from Plant Derating

Table 6-4 compares the IP-3 peak generating capability for a once-through cooling (IP-3 is licensed to begin operation with this mode of cooling) and the proposed NDCT closed cycle cooling system after allowing for increased turbine exhaust pressures at elevated cooling water temperatures and consumption of additional energy due to cooling system load. An NDCT will result in an incremental reduction of peak generating capability on the order of 77.5 MWe.

The applicant has assigned a cost to the loss of peaking capability by assuming that gas turbines would be installed as replacement capacity at $330 per kW (installed in 1981). Using the carrying charges on gas turbines reported by the applicant in Table 6-2, the staff found the present value (1978) of the replacement capacity cost to be $35,511,000. The annualized cost distributed over the remaining useful life of the facility is estimated at $3,764,000. Excluding taxes from carrying charges reduces the present value cost to $25,543,000 and the annualized cost to $2,708,000.

TABLE 6-2

CAPITAL COST ESTIMATE OF CLOSED CYCLE NATURAL DRAFT WET COOLING TOWER, IP-3

Description	Installation Company	Installation Contractor	Material	Total
Furnish and Erect Cooling Tower		$10,600,000		$10,600,000
Amertrap Clean System		3,300,000		3,300,000
Furnish and Install Piping and Mechanical System	$ 41,400	2,196,000	$ 4,149,200	6,387,400
Structural - Civil Work	7,400	17,630,700		17,638,100
Electrical Work		1,169,300	1,480,200	2,649,500
Real Estate Tax During Construction			4,677,200	4,677,200
PROJECT MANAGEMENT & INSPECTION	1,346,400			1,346,400
OTHER DIRECT COST	188,200		35,700	223,900
TOTAL DIRECT COST	1,583,400	34,896,800	10,342,300	46,822,500 (TDC)
	ENGINEERING & SUPERVISION:		13% of (TDC)	5,478,900 (A)
	ADMINISTRATION & SUPERVISION:		3% of (TDC)+(A)	1,428,700 (B)
	PAYROLL TAXES & PENSIONS:		29% of (L)+(A)	2,048,100 (C)
	INTEREST DURING CONSTRUCTION:		18.89% of (TDC) +(A)+(B)+(C)	10,525,300
TOTAL PROJECT COST				66,303,500 (TPC)
	ESCALATIONS:	39.49% of (TPC)		23,987,700 (E)
	CONTINGENCY:	20% of (TPC) + (E)		16,707,800
TOTAL ESTIMATED COST				$107,000,000

SOURCE: Consolidated Edison Company of New York, Inc.,"Economic and Environmental Impacts of Alternative Closed Cycle Cooling Systems for Indian Point Unit No. 3,"Vol. 1, January 1976, Table 5-1.

TABLE 6-3

ANNUAL CARRYING CHARGES AS A PERCENT OF CAPITAL COST

Item	Cooling Tower (At Indian Point No. 3)	Gas Turbine (At Indian Point)
Return	11.7	11.8
Depreciation	4.2	4.0
Federal Income Tax	2.1	2.8
Allowance for Replacements	.5	.5
Insurance	.3	.1
Property Taxes	2.2	2.2
Sub-Total	21.0	21.4
Gross Revenue Taxes	1.3	1.4
Total Fixed Charges	22.3	22.8
Total Fixed Charges Excluding All Taxes[a]	16.7	16.4

[a]Staff's estimate

SOURCE: Consolidated Edison Company of New York, Inc.,"Economic and Environmental Impacts of Alternative Closed Cycle Cooling Systems for Indian Point Unit No. 3,"Vol. 1, January 1976, Table 5-13.

TABLE 6-4

INCREMENTAL REDUCTION OF IP-3 MWe CAPABILITY DURING SUMMER PEAK CONDITIONS,[a] NDCT

Item	Once-through Cooling	NDCT
Turbine Exhaust Pressure (inches mercury absolute)	2.35	4.30
Net Turbine Capacity, MWe	1054	994
Normal Plant Auxiliary Load, MWe	35	35
Incremental Cooling System Load, MWe	0	17.5
Net Generating Capability, MWe	1019	941.5
Incremental Reduction of Peak Generating Capability, MWe	0	77.5

[a]Operated at maximum calculated load with a 79°F river water temperature and a 77°F wet-bulb temperature.

SOURCE: Consolidated Edison Company of New York, Inc., Economic and Environmental Impacts of Alternative Closed Cycle Cooling Systems for Indian Point Unit No. 3, Vol. 1, January 1976, Table 3-2.

The staff believes that the applicant's proposed installation of gas turbines as replacement capacity is an uneconomically large commitment of resources. The staff's opinion is based on the applicant's planned capacity, load, and reserve margins for summer peaks as shown in Table 6-5. As is indicated, the applicant reports relatively high generating reserves through 1985, with the lowest generating reserve margin of 29% planned for 1984. Moreover, the incremental loss of 77.5 MW results in a less than one percentage point decline in generating reserves over the years 1981 through 1985. Since the incremental loss of peak generating capability due to alternative closed cycle cooling systems (alternative cooling towers are discussed in subsequent sections) would not lower reserves to an unacceptable level, the staff does not support the installation of gas turbines as replacement capacity. This conclusion is consistent with the staff's position taken in the IP-2 FES.

In addition to the loss of peak generating capability, a closed cycle cooling system alternative for IP-3 will cause an average annual loss of generating capability below that which is available with once-through cooling. Average annual loss of generating capability is the result of (1) high turbine exhaust pressures associated with the heat transfer mechanism of closed cycle cooling systems designed for IP-3 and (2) consumption of additional energy to operate closed cycle cooling system equipment. The applicant's estimates of lost generating capability for the proposed NDCT closed cycle cooling system under annual average wet-bulb temperatures are shown in Table 6-6.

The energy cost is the cost of an alternative source of energy to replace the average annual loss of generating capability. Additional electric energy was reported to be available from within the applicant's system, through the operation of oil-fired steam generators at an incremental system cost of 31 mills per kWh for fuel in 1982. Since this cost is an annual cost incurred over the remaining life of the facility, it is expected to increase with increasing fuel costs. In order to take into account the rising price of fuel, the staff has escalated future energy costs at an annual rate of 5%. Based on a plant capacity factor of 69.2%,[6] the staff estimated the present value energy cost to be $58,924,000. The annualized energy cost is approximately $6,246,000.

d. <u>Downtime Costs from Cooling System Tie-in</u>

The applicant reports that IP-3 would not operate during the seven month period (from September 15, 1981 to April 15, 1982) required for tie-in to closed cycle cooling. However, the staff feels that the tie-in period could be effectively utilized for refueling and/or other maintenance required of IP-3 and that a five month outage of IP-3 would be a more reasonable penalty to assign to alternative closed cycle cooling systems. In this case the maximum loss of power due to the outage is approximately 1033 MW x 3,696 hr. or 3817 X 10^6 kWh.

Replacement energy for the IP-3 tie-in outage is reported by the applicant to be available through the additional operation of existing plants on the system and some increase in the dispatch of capacity under firm purchase contract from other utilities. The applicant reported that 97.6% of the replacement capacity is to be supplied from existing plants at a cost of 29.5 mills/kWh, the remaining 2.4% is available as firm purchases at a cost of 15.9 mills/kWh.[7] A weighted average of two results in a replacement energy cost of 29.2 mills/kWh. Total cost of replacement energy for the downtime period takes into account the fuel cost savings realized with IP-3 out of service and is determined by the staff as follows:

Maximum energy loss: 3817 x 10^6 kWh	
Incremental production cost (per kWh):	
Cost of replacement energy	$0.0292
IP-3 fuel cost	.0077
Incremental cost	$0.0215
Total cost of replacement energy for downtime:	
3817 x 10^6 kWh x $0.0215/kWh = $82,066,000	

The present value (1978) cost is $54,984,000 and the annualized cost is $5,828,000.

Since the tie-in period for closed cycle cooling is scheduled for the fall/winter period of 1981/1982, the outage of IP-3 during the summer peak load period is avoided. However, the applicant reports that outage will require delay and rescheduling of maintenance of other units on the system as planned for the October 1981 to May 1982 period. And unless firm purchases can be arranged during this period, the outage may require that some of the planned maintenance be deferred. The magnitude of this impact is relatively uncertain at this time and in any event is difficult to quantify. In fact, the applicant was not able to isolate this impact specifically, but reports that the costs of maintenance are integrated into the total system operating costs.

TABLE 6-5

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC., PLANNED CAPACITY, LOAD, AND RESERVE

SUMMER MEGAWATTS										
MAXIMUM INSTALLED NET CAPABILITY	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Thermal (Oil Fired)	7001	7001	6936	6747	6747	6693	6693	6573	6573	6210
Thermal (Coal Fired)°	0	0	0	0	0	0	0	0	0	0
Thermal (Other)	0	0	0	0	0	0	0	0	0	0
Thermal (Gas Turbines)	2165	2224	2234	2255	2255	2255	2255	2255	2255	2255
Thermal (Diesel)	0	0	0	0	0	0	0	0	0	0
Thermal (Nuclear)	873	873	873	1033	1033	1033	1033	1033	1033	1033
Hydro (Conventional)	0	0	0	0	0	0	0	0	0	0
Hydro (Pumped Storage)	0	0	0	0	0	0	0	0	0	0
TOTAL CONTROLLED SOURCES	10039	10098	10043	10035	10035	9981	9981	9861	9861	9498
*NET CAPACITY TRANSACTIONS	607	407	1025	993	981	965	1554	1796	1619	2508
TOTAL CAP. FOR LOAD OF AREA	10646	10505	11068	11028	11016	10946	11535	11657	11480	12006
COINCIDENT PEAK LOAD***	7845	7440	7560	7785	8050	8355	8665	8675	8900	9125
GROSS MARGIN	2801	3065	3508	3243	2966	2591	2870	2982	2580	2881
GROSS MARGIN-% OF LOAD	35.7	41.2	46.4	41.7	36.8	31.0	33.1	34.4	29.0	31.6

WINTER MEGAWATTS										
MAXIMUM INSTALLED NET CAPABILITY	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Thermal (Oil Fired)	7125	7125	7058	6865	6865	6805	6805	6685	6685	6322
Thermal (Coal Fired)	0	0	0	0	0	0	0	0	0	0
Thermal (Other)	0	0	0	0	0	0	0	0	0	0
Thermal (Gas Turbines)	2735	2794	2804	2825	2825	2825	2825	2825	2825	2825
Thermal (Diesel)	0	0	0	0	0	0	0	0	0	0
Thermal (Nuclear)	873	873	873	1033	1033	1033	1033	1033	1033	1033
Hydro (Conventional)	0	0	0	0	0	0	0	0	0	0
Hydro (Pumped Storage)	0	0	0	0	0	0	0	0	0	0
TOTAL CONTROLLED SOURCES	10733	10792	10735	10723	10723	10663	10663	10543	10543	10180
*NET CAPACITY TRANSACTIONS	67	-29	116	13	-72	-79	1197	1047	1938	1745
TOTAL CAP. FOR LOAD OF AREA	10800	10763	10851	10736	10651	10584	11860	11590	12481	11925
COINCIDENT PEAK LOAD***	4905	4985	5045	5195	5345	5570	5550	5700	5850	6000
GROSS MARGIN	5895	5778	5806	5541	5306	5014	6310	5890	6631	5925
GROSS MARGIN-% OF LOAD	120.2	115.9	115.1	106.7	99.3	90.0	113.7	103.3	113.4	98.8

*In accordance with New York Power Pool Agreement Section 104.

SOURCE: Rpt. of Member Electric Systems of N.Y. Power Pool and the Empire State Electric Energy Research Corp, pursuant to Article VIII, Section 149-b of the Public Service Law, Vol. 2, Apr. 1, 1976, p. 183.

TABLE 6-6

AVERAGE ANNUAL LOSS OF IP-3 GENERATING CAPABILITY,[a] NDCT

	Once-through Cooling	NDCT
Net Turbine Capacity, MWe	1068	1052
Normal Plant Auxiliary Load, MWe	35	35
Cooling System Load, MWe	0	17.5
Net Generating Capability, MWe	1033	999.5
Average Annual Loss of Net Generating Capability, MWe	0	33.5

[a]Operated at maximum calculated load and (1) 65°F wet-bulb temperature and 74°F river water temperature for a three month summer and (2) 35°F wet-bulb temperature and a 49°F river water temperature for a nine month non-summer.

SOURCE: Consolidated Edison Company of New York, Inc., Economic and Environmental Impacts of Alternative Closed Cycle Cooling Systems for Indian Point Unit No. 3, Vol. 1, January 1976, Table 3-3.

6.2.3 Fan-Assisted Natural Draft Cooling Tower (FANDCT)

6.2.3.1 Highlights of Design Features Important to Cost-Benefit Analysis

See Section 2.4.3.4 for a detailed description of the FANDCT.

The applicant has provided an economic and environmental evaluation of the FANDCT in its environmental report, but maintains that the FANDCT is not a viable alternative for IP-3 and that the evaluation can only be considered hypothetical until the performance and reliability of the tower can be substantiated. The staff considers the FANDCT to be a viable alternative for IP-3 (See Section 2.4.3.4).

In order to meet IP-3 cooling requirements, the applicant reported that two FANDCT's, each 205 feet high and 267 feet at the base, would be required. Each tower would have twenty-four 132 HP fans around the periphery of their base. The two towers would be designed to meet the same thermal criteria as the natural draft cooling tower (see Table 6-1).

6.2.3.2 Cost Estimates

a. Capital Cost

The estimated capital cost for two FANDCT's is reported by the applicant to be $108,000,000 at completion of construction on April 15, 1982 (see Table 6-7). Including taxes in carrying charges, the staff estimated the present value (1978) and annualized capital cost to be $145,949,000 and $15,471,000 respectively.

Excluding real estate taxes, the staff estimated the capital cost to be $102,220,000. When taxes are excluded from carrying charges (see Table 6-3) the present value capital cost is $103,961,000, which translates into a annualized cost of $11,020,000.

b. Annual Operating Cost

In addition to maintenance of the tower structure and fill material, annual operating costs for a FANDCT include maintenance of fan motors. These costs are estimated by the applicant to be $150,000 (for structure) and $50,000 (for fan-motors) per year per tower, or $400,000 per year for both towers.[7] Allowing for escalation of 5% per year, the staff estimates that the present value operating cost for both towers is approximately $3,744,000.

TABLE 6-7

CAPITAL COST ESTIMATE OF CLOSED CYCLE FAN ASSISTED NATURAL DRAFT COOLING TOWERS

Description	Installation Company	Installation Contractor	Material	Total
Furnish and Erect Cooling Tower		$8,900,000		$8,900,000
Amertap Clean System		3,300,000		3,300,000
Furnish and Install Piping and Mechanical System	$61,000	4,143,400	$4,982,800	9,187,200
Structural - Civil Work	8,400	15,211,600		15,220,000
Electrical Work		1,884,100	2,277,800	4,161,900
Real Estate Tax During Construction			4,701,300	4,701,300
Project Management & Inspection	1,353,300(L)			1,353,300
Other Direct Cost	171,000		68,900	239,900
Total Direct Cost	1,593,700	33,439,100	12,030,800	47,063,600 (TDC)
Engineering & Supervision: 13% of (TDC)				5,507,100
Administration & Supervision: 3% of (TDC)(A)				1,436,100 (B)
Payroll Taxes & Pensions: 29% of (L)+(A)				2,059,200 (C)
Interest During Construction: 18.89% of (TDC) +(A)+(B)+(C)				10,579,600
Total Project Cost				66,645,600 (TPC)
Escalation: 39.49% of (TPC)				24,111,500 (E)
Contingency: 20% of (TPC)+(E)				17,242,900
Total Estimated Cost				$108,000,000

SOURCE: Consolidated Edison Co. of New York, Inc., Economic & Environmental Impacts of Alternative Closed Cycle Cooling Systems for Indian Point Unit No. 3, Vol. 1, January 1976, Table 5-5.

c. Cost of Replacing Loss of Peak Generating Capability and Energy from Plant Derating

Incremental reduction of IP-3 peak generating capability due to two FANDCT's as presented in Table 6-8 is estimated to be 79.5 MW. Including taxes in carrying charges for gas turbines (see Table 6-3), the present value and annualized replacement capacity cost at $330 per kW is estimated by the staff to be $36,428,000 and $3,861,000 respectively. Excluding taxes results in a present value cost of $26,202,000 and an annualized cost of $2,777,000.

The energy cost required to replace the average annual loss of IP-3 generating capability due to the FANDCT system is calculated on the basis of a 35.5 MW derating shown in Table 6-9. Using an incremental cost of 31 mills/kWh and a 69.2% plant capacity factor (see Section 6.2.2.2c), the present value energy cost is estimated by the staff to be $62,442,000. The annualized energy cost is $6,619,000.

d. Downtime Costs from Cooling System Tie-in

Tie-in to a FANDCT system would be expected to take place on the same time scale as required for a natural draft cooling tower. Therefore, the downtime costs for replacement energy would be the same as that reported for a natural draft cooling tower in Section 6.2.2.2.d.

6.2.4 Linear Mechanical Draft Cooling Tower (LMDCT)

6.2.4.1 Highlights of Design Features Important to Cost-Benefit Analysis

For a description of the LMDCT refer to Section 2.4.3.2.

Advantages of the LMDCT's relative to a single natural draft cooling tower, include: (1) small visual changes in surrounding landscape due to its low profile, (2) lower capital costs and (3) less dependence on ambient wet-bulb temperatures for cooling tower performance, hence, better thermal control than natural draft cooling towers. Important disadvantages associated with LMDCT's are (1) relatively high maintenance expenses, (2) appreciable power consumption due to fan operation, (3) greater plant deratings resulting from increased turbine exhaust pressures, (4) noise emissions generated by fan blade movement and fan motors, (5) reduced thermal performance due to the occurrence of recirculation and interference under certain meteorological conditions, and (6) more potential environmental problems related to increased ground-level fogging, icing, and humidity and greater salt deposition rates.

The applicant considers the LMDCT as a feasible closed cycle cooling system for IP-3 and has retained it for detailed economic and environmental analyses. A LMDCT system for IP-3 would be required to meet the same thermal design criteria as a natural draft cooling tower (see Table 6-1) with the exception of cooling tower approach, which would be 17°F (as opposed to 16°F). Three towers would be required for IP-3. Each tower would measure 75 feet wide and 68 feet high; two of the three towers would be 360 feet long and one would be 320 feet long. Each longer tower would contain nine 200 HP fan motors, the 300 foot long tower would have 8 such fans.

6.2.4.2 Cost Estimates

a. Capital Cost

Estimates for the cost of three LMDCT's for IP-3 are presented in Table 6-10. Using a 22.3% carrying charge (i.e., including taxes) on capital, the $155,000,000 estimated total cost can be converted to a present value (1978) cost of $210,501,000 or an annualized cost of $22,313,000.

The staff's recalculated capital cost of LMDCT's with real estate taxes excluded is $143,112,000; which translates into a present value cost of $145,549,000 and an annualized cost of $15,428,000 (using the carrying charge excluding taxes as shown in Table 6-3).

b. Annual Operating Cost

In total, the three LMDCT's contain 26 cells, i.e., twenty-six 200 HP fan motors. The annual maintenance of each cell is estimated to cost $13,000–$17,000 per year per cell for the structure and $4,000 per year per fan motor.[8] Therefore, the annual cost of maintaining the entire system is approximately $442,000. The present value operating cost is $4,137,000, including annual escalation of 5%.

TABLE 6-8

INCREMENTAL REDUCTION OF IP-3 MWe CAPABILITY DURING PEAK CONDITIONS,[a] FANDCT

	Once-Through Cooling	FANDCT
Turbine Exhaust Pressure (inches mercury absolute)	2.35	4.30
Net Turbine Capacity, MWe	1054	994
Normal Plant Auxiliary Load, MWe	35	35
Incremental Cooling System Load, MWe	0	19.5
Net Generating Capability, MWe	1019	939.5
Incremental Reduction of Peak Generating Capability, MWe	0	79.5

[a]See Footnote a, Table 6-4.

SOURCE: See Table 6-4.

TABLE 6-9

AVERAGE ANNUAL LOSS OF IP-3 GENERATING CAPABILITY,[a] FANDCT

	Once-Through Cooling (MWe)	FANDCT (MWe)
Net Turbine Capacity	1068	1052
Normal Plant Auxiliary Load, MWe	35	35
Cooling System Load	0	0
Net Generating Capability	1033	997.5
Average Annual Loss of Net Generating Capability[b]	0	35.5

[a]See Footnote a, Table 6-6.

[b]Evaluated on the basis of multiple speed fan for operation.

SOURCE: See Table 6-6.

TABLE 6-10

CAPITAL COST ESTIMATE OF CLOSED CYCLE LINEAR MECHANICAL DRAFT WET COOLING TOWERS

Description	Installation Company	Installation Contractor	Material	Total
Furnish and Erect Cooling Tower		$7,100,000		$7,100,000
Amertap Clean System		3,300,000		3,300,000
Furnish and Install Piping and Mechanical System	$52,300	3,663,500	$4,966,900	8,682,700
Structural - Civil Work	8,400	32,040,000		32,048,400
Electrical Work		4,040,800	3,657,500	7,698,300
Real Estate Tax During Construction			6,762,000	6,762,000
Project Management & Inspection	1,949,700			1,949,700
Other Direct Cost	171,000		81,400	252,400
Total Direct Cost	2,181,400	50,144,300	15,467,800	67,793,500 (TDC)
Engineering & Supervision: 13% of (TDC)				7,934,100 (A)
Administration & Supervision: 3% of (TDC)(A)				2,069,000 (B)
Payroll Taxes & Pensions: 29% of (L)+(A)				2,933,500 (C)
Interest During Construction: 18.89% of (TDC) +(A)+(B)+(C)				15,233,400
Total Project Cost				95,963,500 (TPC)
Escalation: 39.49% of (TPC)				34,721,900 (E)
Contingency: 20% of (TPC)+(E)				23,314,600
Total Estimated Cost				$155,000,000

SOURCE: Consolidated Edison Co. of New York, Inc., Economic & Environmental Impacts of Alternative Closed Cycle Cooling Systems for Indian Point Unit No. 3, Vol. 1, January 1976, Table 6-10.

c. Cost of Replacing Loss of Peak Generating Capability and Energy from Plant Derating

Three LMDCT's are reported to decrease IP-3 peak generating capability by 82.5 MW (see Table 6-11). The cost of replacing this lost capacity by installing an equivalent gas turbine capacity as proposed by the applicant is $27,225,000 or $330/kW in 1981. Including taxes in carrying charges on gas turbines, the staff estimates the present value and annualized capability cost to be $37,802,000 and $4,007,000 respectively. Excluding taxes from carrying charges reduces these costs to $27,191,000 and $2,882,000.

Table 6-12 shows the annual average loss of IP-3 generating capability due to a LMDCT system to be 48.5 MW. Replacing the loss of energy by additional operation of oil fired steam generators on the applicant's system (see Section 6.2.2.2.c), results in a present value energy cost of approximately $85,308,000 or an annualized energy cost of $9,043,000.

If multiple speed fans are used in conjunction with the LMDCT's, the applicant reports that the annual fan horsepower would be two-thirds that of constant speed fan operation.[9] Multiple speed fan operation would reduce the annual average derating to 47.2 MW. This mode of fan operation is estimated by the staff to reduce the present value energy cost to $83,021,000 and the annualized energy cost to $8,800,000—an annual savings of approximately $243,000.

d. Downtime Costs from Cooling System Tie-in

Downtime costs for an LMDCT system are estimated to be the same as those reported for a natural draft cooling tower in Section 6.2.2.2.d.

6.2.5 Circular Mechanical Draft Cooling Tower (CMDCT)

6.2.5.1 Highlights of Design Features Important to Cost-Benefit Analysis

For a description of the CMDCT refer to Section 2.4.3.3

The applicant has provided the staff with a detailed economic and environmental analyses of CMDCT's for IP-3. However, the applicant feels that the CMDCT is not a proven alternative for IP-3 and the results of the analyses must be considered hypothetical. The staff, however, disagrees with the applicant's assessment of the CMDCT's and considers them to be a viable closed cycle cooling system option for IP-3 (see Section 2.4.3.3).

Thermal design criteria for a CMDCT system for IP-3 are the same criteria as those listed for a linear mechanical draft cooling system in Section 6.2.4.1. In order to meet IP-3 cooling requirements, two CMDCT's would be required; the dimensions of each tower being 67 feet high with a base diameter of 285 feet. Each tower would contain thirteen 200 HP fans arranged in a circular cluster atop the tower.

6.2.5.2 Cost Estimates

a. Capital Cost

The applicant's estimated capital cost of two CMDCT's is shown in Table 6-13 to be $103,000,000. Including taxes in carrying charges (see Table 6-3), the staff estimated the present value (1978) and annualized capital cost to be $139,881,000 and $14,827,000 respectively.

The staff's estimated capital cost, excluding real estate taxes, is $97,957,000, which translates into a present value capital cost (excluding taxes from carrying charges) of $99,625,000. The corresponding annualized cost is $10,560,000.

b. Annual Operating Cost

Annual operating costs for CMDCT's are estimated by the applicant to be $200,000 per tower.[10] This includes $150,000 per year for maintenance of the tower structure and $50,000 per year for maintenance of fan motors. For both cooling towers, the annual operating cost of $400,000 expressed as a present value cost (including escalation at 5% per year) is $3,744,000.

c. Cost of Replacing Loss of Peak Generating Capability and Energy from Plant Derating

Loss of IP-3 peak generating capability[11] and of annual average generating capability[12] due to two CMDCT's is the same as that reported for linear mechanical draft cooling towers in Section 6.2.4.2.c (also see Tables 6-11 and 6-12).

TABLE 6-11

INCREMENTAL REDUCTION OF IP-3 MWe CAPABILITY DURING SUMMER PEAK CONDITIONS, LMDCT's

	Once-Through Cooling	Linear Mechanical Draft Cooling Towers
Turbine Exhaust Pressure inches Mercury absolute	2.35	4.40
Net Turbine Capacity, MWe	1054	992
Normal Plant Auxiliary Load, MWe	35	35
Incremental Cooling System Load, MWe	0	20.5
Net Generating Capability, MWe	1019	936.5
Incremental Reduction of Peak Generating Capability, MWe	0	83.5

[a]See Footnote of Table 6-4.

SOURCE: Consolidated Edison Co. of New York, Inc., Economic and Environmental Impacts of Alternative Closed-Cycle Cooling Systems for Indian Point Unit No. 3, Volume No. 1, January 1976, Table 3-2.

TABLE 6-12

AVERAGE ANNUAL LOSS OF IP-3 GENERATING CAPABILITY, LMDCT's[a]

	Once-Through Cooling	Rectangular Mechanical Draft Cooling Towers
Net Turbine Capacity, MWe	1068	1040
Normal Plant Auxiliary Load, MWe	35	35
Cooling System Load, MWe	0	20.5
Net Generating Capability, MWe	1033	984.5
Average Annual Loss of Net Generating Capability, MWe	0	48.5

[a]See Footnote of Table 6-6.

SOURCE: Consolidated Edison Co. of New York, Inc., Economic and Environmental Impacts of Alternative Closed-Cycle Cooling Systems for Indian Point Unit No. 3, Volume No. 1, January 1976, Table 3-3.

TABLE 6-13

CAPITAL COST ESTIMATE SUMMARY OF CLOSED CYCLE CIRCULAR MECHANICAL DRAFT WET COOLING TOWERS

Description	Installation Company	Installation Contractor	Material	Total
Furnish and Erect Cooling Tower		$7,000,000		$7,000,000
Amertap Clean System		3,300,000		3,300,000
Furnish and Install Piping and Mechanical System	$61,000	4,023,900	$4,982,800	9,067,700
Structural - Civil Work	8,400	15,174,000		15,182,400
Electrical Work		2,155,600	2,361,800	4,517,400
Real Estate Tax During Construction			4,505,200	4,505,200
Project Management & Inspection	1,296,800			1,296,800
Other Direct Cost	171,000		58,000	229,000
Total Direct Cost	1,537,200	31,653,500	11,907,800	45,098,500 (TDC)
Engineering & Supervision: 13% of (TDC)				5,277,100 (A)
Administration & Supervision: 3% of (TDC)(A)				1,376,100 (B)
Payroll Taxes & Pensions: 29% of (L)+(A)				1,976,100 (C)
Interest During Construction: 18.89% of (TDC) +(A)+(B)+(C)				10,138,400
Total Project Cost				63,866,200 (TPC)
Escalation: 39.49% of (TPC)				23,106,000 (E)
Contingency: 20% of (TPC)+(E)				16,027,800
Total Estimated Cost				$103,000,000

SOURCE: Consolidated Edison Co. of New York, Inc., Economic & Environmental Impacts of Alternative Closed Cycle Cooling Systems for Indian Point Unit No. 3, Vol. 1, January 1976, Table 5-4.

The possible use of multiple speed fans in conjunction with CMDCT's is reported by the applicant to reduce annual fan horsepower requirements.[13] Multiple speed fan operation would reduce the annual average derating of IP-3 from 48.5 MW (for constant speed fans) to 47.2 MW.[14] Dollar savings for multiple speed fan operation is reported in Section 6.2.4.2.c.

d. Downtime Costs From Cooling System Tie-in

Downtime costs from CMDCT system tie-in are identical to the natural draft alternative discussed in Section 6.2.2.2.d.

6.2.6 Wet-Dry Mechanical Draft Cooling Towers (WDCT)

6.2.6.1 Highlights of Design Features Important to Cost-Benefit Analysis

See Section 2.4.2 for a description of the WDCT.

Compared to completely wet evaporative cooling towers, the most significant advantages of WDCT's include: (1) less dense, less visible plume discharged from the fan cyclinders; (2) reduced deposition; and (3) less visual change of surrounding landscape due to its less visible plume. Disadvantages of WDCT's include: (1) high turbine exhaust pressures, hence, greater plant deratings; and (2) high maintenance costs. Disadvantages of the WDCT's, compared to natural draft cooling towers include: (1) greater noise emissions resulting from fan operations; (2) higher capital costs; and (3) greater power consumption.[15]

WDCT's were considered by the applicant to be a feasible alternative closed cycle cooling system for IP-3 and were retained for detailed economic and environmental evaluation. In determining the number and size of these towers needed to meet IP-3 cooling requirements, the applicant used the same thermal criteria as specified for linear mechanical draft cooling towers. Based on these criteria, three WDCT's would be required for IP-3. Two of the three towers would be 430 feet long and one tower would be 480 feet long. Each tower would be 70 feet wide and 74 feet high. The total number of fans for the three towers would be 28, each at 200 HP.

6.2.6.2 Cost Estimates

a. Capital Cost

Table 6-14 shows the applicant's total estimated capital cost of three WDCT's for IP-3 to be $178,000,000. Including taxes in carrying charges on capital, the staff estimated the present value (1978) and annualized capital cost to be $241,736,000 and $25,624,000, respectively.

Excluding real estate taxes from Table 6-14, the staff estimated the capital cost to be $168,463,000, which can be expressed as a present value capital cost (excluding taxes from carrying charges) of $171,332,000. The appropriate annualized cost is $18,161,000.

b. Annual Operating Cost

The applicant estimates annual operating costs for the WDCT's to be $20,000 per cell which is comprised of $16,000 per year for the tower structure associated with each cell and $4,000 per year per fan motor.[16] Annual costs of maintaining the WDCT system at $20,000 per cell is $560,000. The present value operating cost is estimated by the staff to be $5,242,000, escalating at 5% per year.

c. Cost of Replacing Loss of Peak Generating Capability and Energy from Plant Derating

WDCT's are expected to decrease the peak generating capability of IP-3 by 83.5 MW (see Table 6-15). If replaced by an equivalent amount of gas turbine capacity at a cost of $330 per kW and including taxes in carrying charges on gas turbines (Table 6-3), then the present value capability cost as estimated by the staff is $38,261,000. The annualized cost is $4,056,000. Excluding taxes from carrying charges reduces these costs to $27,521,000 and $2,917,000.

The average annual loss of IP-3 generating capability due to the operation of WDCT's is shown in Table 6-16 to be 49.5 MW. As was discussed in Section 6.2.2.2.c, make-up energy for IP-3 is reported to be available within the applicant's system at an incremental generating cost of 31 mills per kWh. Using a plant capacity factor of 69.2%, the staff's calculation of present value energy cost is $87,067,000, including escalation of 5% per year. This translates into an annualized cost of $9,229,000.

TABLE 6-14

CAPITAL COST ESTIMATE OF CLOSED CYCLE MECHANICAL DRAFT WET/DRY COOLING TOWERS

Description	Installation Company	Installation Contractor	Material	Total
Furnish and Erect Cooling Tower		$10,200,000		$10,200,000
Amertap Clean System		3,300,000		3,300,000
Furnish and Install Piping and Mechanical System	$52,300	3,748,500	$4,966,900	8,767,700
Structural - Civil Work	8,400	37,350,000		37,358,400
Electrical Work		4,043,800	3,699,200	7,743,000
Real Estate Tax During Construction			7,746,400	7,746,400
Project Management & Inspection	2,231,600			2,231,600
Other Direct Cost	171,000		82,700	253,700
Total Direct Cost	2,463,300	58,642,300	16,495,200	77,600,800 (TDC)
	Engineering & Supervision: 13% of (TDC)			9,081,100 (A)
	Administration & Supervision: 3% of (TDC)(A)			2,368,100 (B)
	Payroll Taxes & Pensions: 29% of (L)+(A)			3,347,900 (C)
	Interest During Construction: 18.89% of (TDC) +(A)+(B)+(C)			16,435,400
Total Project Cost				109,833,300 (TPC)
	Escalation: 39.49% of (TPC)			39,736,900 (E)
	Contingency: 20% of (TPC)+(E)			28,429,800
Total Estimated Cost				$178,000,000

SOURCE: Consolidated Edison Co. of New York, Inc., Economic & Environmental Impacts of Alternative Closed Cycle Cooling Systems for Indian Point Unit No. 3, Vol. 1, January 1976, Table 5-3.

TABLE 6-15

INCREMENTAL REDUCTION OF IP-3 MWe CAPABILITY DURING SUMMER PEAK CONDITIONS,[a] WDCT

Item	Once-Through Cooling	WDCT
Turbine Exhaust Pressure (inches mercury absolute)	2.35	4.40
Net Turbine Capacity, MWe	1054	992
Normal Pland Auxiliary Load, MWe	35	35
Incremental Cooling System Load, MWe	0	21.5
Net Generating Capability, MWe	1019	935.5
Incremental Reduction of Peak Generating Capability, MWe	0	83.5

[a]Operated at maximum calculated load with a 79°F river water temperature and a 77°F wet-bulb temperature.

SOURCE: Consolidated Edison Company of New York, Inc., Economic and Environmental Impacts of Alternative Closed Cycle Cooling Systems for Indian Point Unit No. 3, Vol. 1, January 1976, Table 3-2.

TABLE 6-16

AVERAGE ANNUAL LOSS OF IP-3 GENERATING CAPABILITY,[a] WDCT

Item	Once-Through Cooling	WDCT
Net Turbine Capacity, MWe	1068	1040
Normal Plant Auxiliary Load, MWe	35	35
Cooling System Load, MWe	0	21.5
Net Generating Capability, MWe	1033	938.5
Average Annual Loss of Net Generating Capability, MWe	0	49.5

[a]Operated at maximum calculated load and (1) 65°F wet-bulb temperature and 74°F river water temperature for a three month summer and (2) 35°F wet-bulb temperature and a 49°F river water temperature for a nine month non-summer.

SOURCE: Consolidated Edison Company of New York, Inc., Economic and Environmental Impacts of Alternative Closed Cycle Cooling Systems for Indian Point Unit No. 3, Vol. 1, January 1976, Table 3-3.

By using multiple speed fans for WDCT operation it is possible to reduce the annual loss of IP-3 capability from 49.5 MW to 48.1 MW.[17] This mode of operation would reduce the present value and annualized energy cost to $84,604,000 and $8,968,000, respectively.

d. Downtime Costs from Cooling System Tie-in

Installation of WDCT's would result in a downtime cost identical to the installation of a natural draft cooling tower discussed in Section 6.2.2.2.d.

6.2.7 Summary of Project Costs and Performance of Alternatives

A cost summary of the five closed cycle cooling tower alternatives for IP-3 is tabulated in Tables 6-17A and 6-17B. Cost estimates based on calculations with taxes included are shown in Table 6-17A. Table 6-17B excludes all taxes from consideration. Capital cost, annual operating cost, capability cost, energy cost, and downtime cost are shown for each alternative as a present value (1978) cost and annualized cost (1978 through 2005). Total project cost is also derived for each alternative by summing over the five cost categories.

As is shown in Table 6-17A, the least costly closed cycle cooling tower in terms of total project cost is the NDCT, followed in ascending order by the FANDCT, CMDCT, LMDCT, and the WDCT alternatives. In comparing the CMDCT to the NDCT, it can be seen that the lower capital cost advantage of the CMDCT is more than offset by higher annual operating cost, capability cost, and energy cost. Also, the capital cost of the FANDCT's and an NDCT are nearly the same, although the operating cost, capability cost, and energy cost associated with the FANDCT are higher than the NDCT and result in a greater total cost for FANDCT's. LMDCT's and WDCT's do not offer any cost advantages over the NDCT, FANDCT's or CMDCT's.

Comparing Tables 6-17A and 6-17B, it may be noted that the exclusion of taxes from cost estimates results in a lower capital cost, capability cost, and hence total cost for all alternatives. However, the exclusion of taxes from the cost estimates does not alter the relative economic ranking of the alternatives as mentioned above.

The staff discussed the reliability impact of incremental losses of IP-3 peak generating capability due to alternative CCC systems in Section 6.2.2.2.c. The staff found that adequate generating reserve margins (during peak demands) would most likely be maintained within the applicant's system after allowing for deratings due to the CCC system. This led the staff to conclude that the proposed installation of replacement capacity (e.g., gas turbines) would not be economically warranted. As such, the capability cost for each alternative in Tables 6-17A and 6-17B would not be incurred and the total project cost would be lower by the appropriate amount. For example, the total project cost for an NDCT would be approximately $219 million, present value. Similarly, all alternatives in Tables 6-17A and 6-17B would be lower, but the relative economic ranking of the alternatives would not be affected.

6.3 EXTERNAL SOCIAL AND ECONOMIC IMPACTS OF ALTERNATIVE CLOSED CYCLE COOLING SYSTEMS

6.3.1 Description of the Impacted Communities

6.3.1.1 Physical Ambiance (landscape, weather, etc.)

The Indian Point site is surrounded on all sides by high ground ranging from 600 to 1,000 ft. above sea level. Along the winding Hudson River are steep, wooded slopes of the Dunderberg on the west bank and West Mountains to the northwest and Buckberg Mountain to the west-southwest. On the east side of the river where the site is located, the peaks are lower but include Spitzenberg and Blue Mountains. The site itself is hilly, rising to about 150 ft. above river level with no unique environmental values such as natural wildlife sanctuaries, caverns, rare and/or endangered species of plants or wildlife, etc. The Indian Point site is characterized by species of eastern deciduous hardwood.

The dominant overstory species on site and in surrounding areas are mixed-oak and eastern hemlock, hickory-oak, with some white pine, black cherry and maple. Understory species common to all areas include yellow poplar, sassafras, sumac, and catalpa.

The area immediately around and including Indian Point is zoned for heavy industry. The industries nearest the plant are a wall board factory and a yeast plant. Surrounding areas also include stone quarries, water reservoirs, parklands, recreational facilities, the New York Military Reservation (Camp Smith), and residential areas flanking the site, including Buchanan, Verplanck,

TABLE 6-17A

COST SUMMARY OF CLOSED CYCLE COOLING TOWER ALTERNATIVES FOR IP-3, INCLUDING TAXES
($1,000)

	Natural Draft Cooling Tower		Fan-Assisted Natural Draft Cooling Tower		Linear Mechanical Draft Cooling Towers		Circular Mechanical Draft Cooling Towers		Wet-Dry Mechanical Draft Cooling Towers	
	Present Value	Annualized Value	Present Value	Annualized Value	Present Value	Annualized Value	Present Value	Annualized Value	Present Value	Annualized Value
Capital Cost	145313	15403	145949	15471	210501	22313	139881	14827	241736	25624
Annual Operating Cost	1404	150	3744	400	4137	442	3744	400	5242	560
Capability Cost (incremental loss of peak generating capability)	35511 (77.5 MWe)	3764	36428	3861	37802	4007	37802	4007	38261	4056
Energy Cost (Average annual loss of generating capability)	58924	6246	62442	6619	85308	9043	85308	9043	87067	9229
Downtime Cost from Cooling System Tie-In: replacement energy	54984	5828			(same for all alternatives)					
TOTAL COST	296136	31391	303547	32179	392732	41663	321719	34105	427290	45297

TABLE 6-17B

COST SUMMARY OF CLOSED CYCLE COOLING TOWER ALTERNATIVES FOR IP-3, EXCLUDING TAXES
($1,000)

	Natural Draft Cooling Tower		Fan-Assisted Natural Draft Cooling Tower		Linear Mechanical Draft Cooling Towers		Circular Mechanical Draft Cooling Towers		Wet-Dry Mechanical Draft Cooling Towers	
	Present Value	Annualized Value	Present Value	Annualized Value	Present Value	Annualized Value	Present Value	Annualized Value	Present Value	Annualized Value
Capital Cost	103737	10996	103961	11020	143112	15428	99625	10560	171332	18161
Annual Operating Cost	1404	150	3744	400	4137	442	3744	400	5242	560
Capability Cost (incremental loss of peak generating capability)	25543 (77.5 MWe)	2708	26202 (79.5 MWe)	2777	27191 (82.5 MWe)	2882	27191 (82.5 MWe)	2882	27521 (83.5 MWe)	2917
Energy Cost (Average annual loss of generating capability)	58924 (33.5 MWe)	6246	62442 (35.5 MWe)	6619	85308 (48.5 MWe)	9043	85308 (48.4 MWe)	9043	87067 (49.5 MWe)	9229
Downtime Cost from Cooling System Tie-In: replacement energy	54984	5828	(same for all alternatives)							
TOTAL COST	244592	25928	251333	26644	314732	33623	270852	28713	346146	36695

Montrose and Peekskill. The deep valley location of the Indian Point site causes local micro-meteorological and climatogical conditions to be different within the valley than they are on the higher, surrounding ridges. At river level and 100 and 200 ft above river level, the winds are upstream by day and downstream by night more than a third of the time. Precipitation averages 46 in/year and is rather uniform month by month. Because of greater evaporation and soil retentiveness in summer and because of snow in winter, the flow of the Hudson River is not uniform through the year but is high in spring and low in late summer. Mean ambient air temperature near Indian Point varies from 28°F in January to 75°F in July.

6.3.1.2 Municipalities and Other Government Organizations in the Area

The region surrounding Indian Point considered for potential socio-economic impacts includes the municipalities of: Buchanan and Croton-on-Hudson, the town of Cortlandt, and the city of Peekskill, in Westchester County, New York; and the town of Stony Point, and the Villages of Haverstraw, and West Haverstraw in Rockland County, New York. The four Westchester County communities are geographically close-in to the site. The three Rockland County municipalities are situated just across the Hudson River within a few miles of the proposed cooling tower. In addition, the southwest portion of Putnam County and the southeast portion of Orange County were considered for visual impacts.

6.3.1.3 Population and Existing Land Use Patterns

The seven municipalities either in or around Indian Point reported a population in 1970 of 83,137. Table 6-18 presents 1970 population data and 1980 projected population figures by community. The four municipalities in Westchester County are expected to grow at a relatively low (0.7 percent) rate per year while those in Rockland County are anticipating an annual growth rate of approximately 3.9 percent.

Land use along the Hudson is varied. The area surrounding Indian Point is zoned for heavy industry and many industrial facilities are located near the proposed site (see Section 6.3.1.4). Good limestone has led to many quarries along the banks and an inactive one is presently adjacent to the site. Tracts of land fronting the Hudson River are also used by a number of institutions. The Veterans Administration Hospital at Montrose, the New York State Military Reservation (Camp Smith), and the West Point Military Academy are all within 10 miles of the site. Recreational outlets on the river are also present with several sections of the Palisades Interstate Park on the west bank, and parks and beaches on the east bank. Marinas, boat ramps, and fishermen's landings are also available. The city of Peekskill is one of the major landowners along the Peekskill Bay waterfront and is presently considering several proposals to develop and revitalize the area. Plans call for increased recreational, residential, and industrial use of the waterfront property.[18] The Penn Central Railroad and U.S. Highway 9 serve both banks of the river.

Electric power stations represent an important component of the industrial use of the Hudson River shoreline. Within ten miles of the cooling tower site there are a total of eight power stations either operating, in construction, or planned.

The Hudson River itself services both commercial and recreational interests. About 600 to 800 commercial ships and barges pass the Indian Point site each year. The cargo consists largely of petroleum products, dry goods, and molasses. Pleasure boating and sport fishing are also prevalent in the area.

The majority of the land to the east and to the west of the river within five miles of the site is zoned for parks and residential use. For example, on the west bank of the Hudson, Stony Point, Haverstraw, and West Haverstraw incorporate approximately 20,000 acres of which 56.5 percent are used for public parks and recreation, 20 percent are vacant, and 13 percent are zoned residential. The Palisades Interstate Park crosses through the town of Stony Point and contributes greatly to this regions' parks and recreation land use.[19] The total land area of the four Westchester County communities on the east side of the Hudson is 29,060 acres. The overall population density (number of persons per square mile) of this area is 1,235 which is slightly more than half the average density per square mile for all of Westchester.[20] However, this region is more densely populated than the west bank communities (955 per square mile) and slightly more committed to residential, commercial, and industrial land use.

TABLE 6-18

POPULATION - 1970 AND 1980 (PROJECTED) FOR
MUNICIPALITIES SURROUNDING INDIAN POINT

Municipalities		1970	1980
Westchester County[a]			
Buchanan		2,110	2,100
Cortlandt		24,760	27,900
Croton-on-Hudson		7,523	7,100
Peekskill		19,283	20,300
	Total	53,676	57,400
Rockland County[b]			
Haverstraw		8,198	10,000
Stony Point		12,705	20,000
West Haverstraw		8,558	11,000
	Total	29,461	41,000
TOTAL		83,137	98,400

[a]Westchester County Department of Planning, August 1975. Table 6, p. 9.

[b]1974 Rockland County Data Book, Rockland County Planning Board, New York, 1974, p. 20.

SOURCE: Interpolation of data from "Westchester's Population: 1975 - 85 Changing Profile."

6.3.1.4 Economic Activity

Economic activity around Indian Point includes heavy manufacturing, power generation, stone quarries, a fairly strong recreational sector, and commercial activity primarily emanating from Peekskill and its environs. Table 6-19 presents a list of major industrial employers and estimated number of employees for the seven municipalities. For the Rockland County communities, totals for all industrial employment are available.[21] As of 1971, Stony Point reported seven plants with 613 employees and the town of Haverstraw which includes the villages of Haverstraw and West Haverstraw contained 37 plants and 4,007 employees.

Industrial and commercial growth in the Westchester communities has generally been quite slow in recent years. However, there is currently considerable retail construction planned or in progress in the Route 6 area of Cortlandt, and in the Peekskill urban renewal area. Future industrial growth in Rockland county is not expected to be of any significant importance in the villages of Haverstraw and West Haverstraw, and the town of Stony Point[22] Rather, industrial growth is anticipated to occur away from village centers and onto major highways and industrial park complexes.

6.3.1.5 Labor Force and Employment

The three Rockland County Communities reported a labor force as of 1970 of 11,166 of which 3.8% were unemployed. This labor force was 62% male and 38% female. The vast majority of these workers, 77% are employed with Rockland County. Other important places of work are Manhattan 8%, and Westchester County 5%. Distribution of the labor force is given in Table 6-20.

Data on the 4 Westchester County communities indicate that most of their work force is employed within the county proper. In Buchanan and Peekskill, six percent and four percent respectively of the male labor force works in Manhattan. For Croton-on-Hudson and Cortland, the figures are 23 and 11 percent respectively. In general, the population within these municipalities is more heavily oriented to blue collar employment than is the population of the county as a whole. Of the male labor force of the county, 40 percent is employed in professional, technical, or managerial occupations. Comparable figures for the sub-region are: Peekskill 25%, Cortland 37%, Croton-on-Hudson 47%, and Buchanan 25%.

TABLE 6-19

MAJOR EMPLOYERS AND ESTIMATED NUMBER OF EMPLOYEES BY MUNICIPALITY

Employers	Estimated Number of Employees
Buchanan	
Consolidated Edison, Indian Point	700
Georgia-Pacific Corporation	120
Wedco Corporation	700
Cortlandt	
Leonore Doskow, Inc.	60
Croton-on-Hudson	
Croton Time Corporation	75
Prompt Maintenance Service, Inc.	200
Penn-Central	NA[a]
Peekskill	
Caldor, Inc.	200
The Ednalite Corporation	150
Geringer & Sons Manufacturing Corporation	130
Nan-Flower Lingerie, Inc.	100
Peekskill Star Corporation	75
Standard Brands, Inc.	150[b]
Wheeldex, Inc.	75
White Plains Iron Works, Inc.	160
Stony Point	
Kay Fries Chemicals, Inc.	180
Gabriel Manufacturing Company	72
U.S. Gypsum Corporation	180
West Haverstraw	
Modern Dust Bag Company	150
Label Products Company	80
Haverstraw	
Forte Manufacturing	70
New City Sportswear	100
Empire State Chain Company	110
Canvas & Leather Bag Company	75
Martin Marietta	107
Ward Pavement, Inc.	200
Colonial Sand & Stone Company	85
Louis Hornick & Company	300

[a]Employment figures unavailable.

[b]Estimate provided by Standard Brands, Inc. during telephone inquiry on June 1, 1976.

SOURCE: Legislature Profile, Westchester County, p. 2, and 1974 Rockland County Data Book, pp. 60-67.

TABLE 6-20

DISTRIBUTION OF ROCKLAND COUNTY'S LABOR FORCE BY EMPLOYMENT CATEGORY - 1970

Employment Category	Number of Jobs	Percentage
Service Trades	27230	34
Manufacturing & Mining	18160	23
Retail & Wholesale Trade	15648	19
Transportation & Community	5992	7
Construction	4874	6
Government	4705	6
Financial Service	4252	5
TOTAL	80861	100

SOURCE: Rockland County land use plan, Rockland County Planning Board, New York City, New York, 1973, p. 62.

Employment in the four Westchester Communities totalled 12,500 in 1972. This figure excludes self-employed and domestic workers. Median family income for the county was estimated at $17,400 for 1973, making it one of the highest in the country. Of the four communities, only Croton-on-Hudson and Cortland approximate this value. Peekskill was estimated to have the lowest median family income in the county at $14,200 and Buchanan, at $15,400 was about 11% below the county's median family income level.

6.3.1.6 Tax Revenues and Community Services

The basic support of local government is the combined county-town levy which is used to meet county and town legislative, judicial, and administrative costs. Among the major categories financed are public safety, parks and recreation, public works, debt redemption, and certain drainage and highway costs. In addition, county revenues support health and social services and the community college. Special purpose districts, such as those established to meet educational needs, fire protection, and sewer projects have their own tax rates, which are typically collected at the town level.

The village of Buchanan has experienced a dramatic tax windfall as a result of the nuclear plants located within its boundaries. The village reports for the 1975-76 period total assessed real property of approximately $75 million. Almost $72 million, or 95 percent, is attributed to real property owned by Consolidated Edison. This has effectively lowered the local citizens taxation rate to $1.70 per $100 based on an equalization rate of 32 percent.

6.3.1.7 Recreational Facilities

Much of the land within 15 miles of the site is presently used for parks and recreation and, consequently, a wide choice of recreational activity is available to local residents and visitors.

Certainly the most important recreational complex in the area is the Palisades Interstate Park Region which encompasses 17 state parks and several historic sites. Several of these facilities are situated either in or close to the towns of Stony Point and Haverstraw. These include the Bear Mountain State Park (5,068 acres), Harriman State Park (46,181 acres), Haverstraw Beach State Park (73 acres), Hightor State Park (511 acres), Hook Mountain State Park (661 acres), and the Stony Point Reservation (87 acres). Activities available throughout the park system include skiing, camping, hiking, golf, fishing, roller and ice skating, swimming, boating, tennis, and

bicycling. In 1974, attendance figures suggest that approximately 5-1/2 million people visited the parks' New York State facilities. Figures for those parks close to Indian Point are incomplete, but Table 6-21 lists results for those where data are available.

TABLE 6-21

1974 ATTENDANCE FOR SELECTED STATE PARKS IN PALISADES INTERSTATE PARK COMPLEX

State Park	Attendance
Bear Mountain	2,160,000
Harriman	1,933,000
Stony Point	27,450
Hightor	31,000

SOURCE: Attendance data provided by Palisades Interstate Park Commission.

The local communities also maintain park areas and recreational programs. These facilities are for the most part open only to town and village residents. For example, Stony Point has two developed town parks which offer scenic areas with picnic and play facilities. Haverstraw has two major town parks and the villages of Haverstraw and West Haverstraw also maintain village parks. Similar developments prevail on the Westchester side of the Hudson with considerable future expansion anticipated.

The total municipal park acreage within the four Westchester municipalities is 497 acres. Adding state and county facilities produces an overall park acreage of 3,072 acres with the following distribution by town: Buchanan 28; Cortlandt 2,047; Croton-on-Hudson 547; and Peekskill 450. Table 6-22 lists and describes the county parks and recreational facilities in this region.

Another important recreational aspect of the area is the opportunities presented by the Hudson River. Yacht clubs and marinas service many boating enthusiasts on the river and sport fishing is likewise important. Presently, the city of Peekskill is considering the establishment of a riverfront park and beach for its shore front.

The Indian Point site itself has also experienced shifts toward recreational land use. Consolidated Edison, the present owner, has transferred 14 acres at the northern edge of the site to the Village of Buchanan for development as a marina. Also, there are plans to maintain an 80-acre forested area and small lake for recreation in the northern portion of the site.

6.3.1.8 National and Historic Points of Interest in the Area

Relying on the applicant, the National Register of Historic Places has identified 40 historical places in the vicinity of Indian Point, 15 of which are designated National Historical Landmarks.[23] The closest of these are the Stony Point Battle Reservation on the west bank of the river about two miles downstream, the Palisades Interstate Park, west of the Stony Point area, and the Van Cortlandt Manor in Croton-on-Hudson. More distant important visitor attractions of significant historic and national interest include Hyde Park National Historic Site, West Point Military Academy, and Vanderbilt Mansion National Historical Site. In 1973, approximately 3 million people visited these places of interest.

The New York State Parks and Recreation Division for Historic Preservation provided the applicant with a listing of sites listed on the National Register of Historic Places.[24] The sites were divided into three categories and are given below.

TABLE 6-22

COUNTY AND STATE PARKS AND RECREATIONAL FACILITIES
ON WESTCHESTER SIDE OF IMPACT AREA

County Park	Acres	Facilities
Blue Mountain Reservation	1,586	Target range, trap and skeet, beach picnicking, hiking and nature study, ice skating, horsebackriding, fishing, refreshments, archery.
Colabaugh Pond (part of Briarcliff-Peekskill Parkway)	50	Undeveloped
Croton Gorge	97	Hiking and nature study, fishing, skiing, sledding.
Croton Point	504	Beach, picnicking, ball fields, family camping, fishing, refreshments, music and art camp.
George's Island	176	Picnicking, hiking and nature study, boating, fishing, boat launching.
Oscawana Island	161	Hiking and nature study.
State Park		
Old Croton Trailway	--	Hiking

SOURCE: Profile Legislative District Number 1, Westchester County Department of Planning p. 4.

Sites in the lower Hudson Valley from which the project is likely to be most visible:

St. Peter's Church, Van Cortlandville, Westchester County
Van Cortland Manor, Croton-on-Hudson, Westchester County
Lyndhurst, Tarrytown, Westchester County
Washington Irving House, Tarrytown, Westchester County
Hyatt-Livingston House, Dobbs Ferry, Westchester County
Jasper F. Cropsey House and Studio, Hastings, Westchester County
Dutch Reformed Church, Tarrytown, Westchester County
First Baptist Church, Ossining, Westchester County
Site of Old Croton Dam, Ossining Vicinity, Westchester County
Philipsburg Manor, Upper Mills, Westchester County
Philipse Manor, Yonkers, Westchester County
John Bond Trevor House, Yonkers, Westchester County
Untermyer Park, Yonkers, Westchester County
West Point Foundry, Cold Spring, Putnam County
Palisades Interstate Park, Rockland County and Orange County
Stony Point Battlefield, 9W, Rockland County
Terneur-Hutton House, West Nyack, Rockland County
Ft. Montgomery, Bear Mountain, Orange County
Ft. Montgomery Site, south of Ft. Montgomery, Orange County
New Windsor Cantonment, Temple Hill Road, Orange County
Dewint House, Tappan, Rockland County
Haskell House, New Windsor, Orange County
David Crawford House, Newburgh, Orange County
Dutch Reformed Church, Newburgh, Orange County
Mill House, Newburgh, Orange County
Montgomery-Grand-Liberty Streets Historic District, Newburgh, Orange County
Washington's Headquarters, Newburgh, Orange County
U.S. Military Academy, West Point, Orange County
Francis Hoyer House, W. Haverstraw, Rockland County

Sites beyond the Hudson Valley but in the general vicinity of the project:

John Jay Homestead, Katonah, Westchester County
Joseph Purdy Homestead, Purdys, Westchester County
Elephant Hotel, Somers, Westchester County
Bedford Village District, Bedford, Westchester County
Chappaqua Historic District, Chappaqua, Westchester County
Henry Garner Mansion, Garnerville, Rockland County
Delaware & Hudson Canal, Orange County
Sloat House, Sloatsburg, Rockland County

Sites beyond the Hudson Valley and not in the vicinity of the project:

St. Paul's Church, Mount Vernon, Westchester County
John Stevens House, Mount Vernon, Westchester County
Thomas Paine Cottage, New Rochelle, Westchester County
Caleb Hyatt House, Scarsdale, Westchester County
Reid Hall, Purchase, Westchester County
Old Croton Aqueduct Trailway, Westchester County
Square House, Rye, Westchester County
Westchester County Courthouse, White Plains, Westchester County
Bolton Priory, Pelham, Westchester County
Historic Track, Goshen, Orange County
Harriman Estate, Harriman, Orange County
Southfield Furnace Ruin, Tuxedo, Orange County
Knox Headquarters, Vails Gate, Orange County
Dutchess Quarry Cave Site
William Bull House, Campbell Hall, Orange County
Jackson Bull House, Campbell Hall, Orange County
1841 Goshen Courthouse, Goshen, Orange County
Ft. Decker, Pt. Jervis, Orange County
Quaker Meetinghouse, Smith Clove, Orange County

The staff has considered the potential visibility of two NDCT's from historic sites located within 10 miles of Indian Point. As a practical matter, it was not feasible to consider plume visibility in this portion of the staff analysis. It was determined that the towers will be visible from very few, if any, of the sites. The degree of visibility from the few sites from which the tower may be visible, will be minor. The degree of visibility from the First Baptist Church in Ossining and from the Francis Harper House in West Haverstraw has not been confirmed but is thought to be slight or nonexistent in both cases. The towers will be effectively obstructed from view from all sites, not including the two questionable sites, by intervening topology or vegetation. Even Stony Point Battlefield will be insignificantly impacted because of its heavily wooded condition. This site is 2.5 miles SW of the proposed tower site on the opposite bank of the Hudson River. In reaching its conclusions concerning visual impact on historical sites the staff depended on the viewshed map prepared by Jones & Jones, a viewshed map submitted by the applicant, other maps of the area, and personal inspection of a sample of sites by the staff.

The staff concludes that any visual impacts on the sites listed above will not cause any change in the quality of their characteristics that qualifies them under the National Register criteria.

Only two archaeologic sites in Westchester County are mentioned by Ritchie.[25] "Most of the sites spared by construction or other modern activities have been heavily molested by relic collectors over a very long period and relatively few have received attention from competent... archaeologists."

For many years before its acquisition by the applicant, the Indian Point area itself was a commercial amusement park. However, the staff feels that despite prior construction activities on the site, it is possible that significant archaeological resources do exist in the area that will be disturbed by construction of the cooling towers. Therefore, the staff requires that a qualified archaeologist conduct a literature and field survey of the area to be disturbed by construction activities. The results of this survey shall be submitted to the staff and to the State Historic Preservation Officer before construction activities associated with the closed-cycle cooling system begin.

6.3.1.9 Future Development and Planning Objectives of the Local Communities

Each municipality sets its own planning and zoning policy through the preparation of an overall land use plan, adoption of a zoning ordinance map, and enforcement of all pertinent codes and regulations. Basically, all development that occurs within each community is regulated by policy and administrative decisions made at the local level. The County Planning Boards assist many of the municipalities in the preparation of their master plans and zoning ordinances. Several of these communities now have their own planning staffs or planning consultants. The County Planning Boards' main planning function is one of review and assurance of compatibility with county and state plans. Table 6-23 presents the status of planning and zoning activity for the seven municipalities most directly impacted by the proposed cooling tower.

TABLE 6-23

STATUS OF PLANNING AND ZONING ACTIVITY IN SEVEN MUNICIPALITIES SURROUNDING INDIAN POINT - 1974a

Community	Master Plan	Zoning Ordinance	Site Plan Review	Subdivision Regulations
Buchanan	--	1969	--	XX
Cortlandt	1967	1968	--	1969
Croton-on-Hudson	1970	1970	--	1968
Peekskill	1967	1960	--	1960
Stony Point	1973	1961	--	XX
Haverstraw	1970	1972	XX	XX
West Haverstraw	1970	1972	XX	XX

[a] "--" denotes either none exists or unknown.
"XX" denotes existence but date of preparation unknown.

SOURCE: Profile Legislative District Number 1, Westchester County Department of Planning, p. 6, and 1974 Rockland County Data Book, Rockland County Planning Board, New York.

The Village of Buchanan has a Planning Board and has used the services of planning consultants since 1951. Preparation of a Village master plan was authorized in 1964, but never completed. The Village's zoning map, prepared in 1969, serves as the master plan. Consolidated Edison and Georgia-Pacific own the major portion of undeveloped land in the Village of Buchanan. Ultimate use of the remaining undeveloped land will determine criteria for future subdivision and planning. The remaining six communities have already adopted master plans and have either retained planning consultants or developed internal planning staffs.

The most active planning effort in the region appears to be occurring in the city of Peekskill. Here, development projects and proposals to revitalize the city are actively underway. Urban Renewal and Neighborhood Development projects affecting 340 acres have either recently been completed or are approaching completion. In addition, Peekskill has been the recipient of "701" funds for studies on zoning ordinances and the revitalization of the city's waterfront district.

It is difficult to generalize about the overall goals inherent in the master plans and development plans of the region. However, it appears that rapid growth is not anticipated in these communities and it is their hope that satisfactory controls can be imposed such that any growth that does occur will not be of a disruptive nature. Major emphasis is also placed on expanding the recreational base as well as preserving the physical amenities of the region.

6.3.2 Impacts During Construction

6.3.2.1 Impacts on Aquatic Biota

With adequate protection against erosion on and around the construction site during the period of construction any impact on aquatic biota will be minimal and thus will have no economic or social consequence.

6.3.2.2 Impacts on Terrestrial Biota

All closed cycle cooling tower alternatives will cause the alteration of various amounts of site acreage, as discussed in Section 5.2.4. None of the alternative cooling tower systems will totally eliminate the existing 80-acre forest. There have been no rare or endangered plant or animal species identified on the Indian Point site. The resulting reduction of forest habitat will be the primary impact to on-site wildlife. Cooling tower construction activities may cause some wildlife species inhabiting the remaining forested areas of the site to temporarily seek refuge in areas less influenced by human activity. Therefore, there may be some reductions in existing on-site wildlife populations due primarily to the reduction of habitat.

The staff believes the socio-economic consequences of the biota impacts during construction of any of the alternative closed cycle cooling systems will be minimal. Aside from cutting off visitor center pedestrian access to forested areas on site, little or no impact on human activity is anticipated in the region due to disruptions of terrestrial biota at the IP site during the construction period.

Expected socio-economic consequences are so slight that it is not possible to compare consequences of the several alternative cooling systems.

6.3.2.3 Impacts on the Human Environment

a. Stress on community services

The major potential sources of stress on community services are associated with the number of and activities of the construction workers and with the physical and financial impacts directly associated with construction activity. Estimated number of construction workers per year of construction, as well as engineering and management staff involved in the project, and total wages (in 1975 dollars) are presented in Table 6-23A. These workers will be drawn mostly from the New York City metropolitan area and thus will commute to the site daily. The relatively small number of workers involved, and the likelihood that few construction workers would relocate to one of the communities surrounding the facility indicate that the impact of construction workers on the community services will be insignificant except, perhaps, for an additional burden on the local streets and highways at the beginning and end of shifts. Construction activity will directly demand certain public services. There is, however, little chance of the local communities not being able to meet these demands.

b. Highways and traffic

Increased truck and automobile traffic is expected during the construction period. The applicant estimates that as many as 200 cars per day for commuting traffic and up to 100 or more truck passages per day will take place during the entire construction period.[26] The applicant points out that the increased volume of traffic will have to be handled to limit the congestion on vehicular arteries both on and off site. While the complete route to be taken by trucks is dependent upon the final decision of where to dispose of the spoils, crossing of Broadway and use of Bleakley Avenue to State Route 9 will likely constitute part of the route. The applicant should confer with the Village of Buchanan in determining the final truck route so that the Village can evaluate the adequacy of streets involved as well as the adequacy of traffic controls to maintain disruption from additional traffic at acceptable levels.

A sound emission impact study by Ostergaard Associates for the applicant indicates that the only construction-related noise of potential off-site concern is that of truck traffic along Bleakley Avenue and Route 9. There will be a noticeable increase in sound levels from truck traffic for a period of six months to a year, depending on which alternative cooling system is adopted.[27] The Ostergaard report points out the necessity of a 24-hour continuous pour of concrete for the tower basins requiring a continuous delivery of ready-mix by trucks. In the case of the natural draft and mechanical draft basins, the pour would continue for 92 hours. In the event that the construction period of IP-2 and IP-3 towers overlap, it is estimated that the day-night sound level will increase approximately three decibels (assuming a doubling of truck

TABLE 6-23A

ESTIMATED MANPOWER & TOTAL WAGES

PER YEAR OF COOLING TOWER CONSTRUCTION
(1975 dollars)

CATEGORY	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	TOTAL
ENGINEERING STAFF											
Average No. of Men	3	4	5	6	21	46	46	30	14	4	
Wages	$91,825	122,435	153,040	183,650	642,775	1,407,985	1,407,985	918,250	428,520	122,435	$5,478,900
MANAGEMENT STAFF											
Average No. of Men						5	8	8	8	3	
Wages						$ 210,375	336,600	336,600	336,600	126,225	1,346,400
CONSTRUCTION WORKERS											
Average No. of Men						55	146	222	180	20	
Wages						$2,097,410	5,567,660	8,465,895	6,864,240	762,695	23,757,900
											$30,563,200

SOURCE: Letter from William J. Cahill, Jr., Consolidated Edison Company of New York, Inc., to George W. Knighton, U.S. Nuclear Regulatory Commission, May 21, 1976, Docket number 50-286.

traffic for the construction period).[28] Complaints from residents along Bleakley Avenue are anticipated and the applicant will require trucks to comply with New York State vehicle noise emission regulations.[29]

c. Employment and income benefits

The staff anticipates that construction workers will not number more than several hundred (see Table 6-23A) and nearly all will commute from their present residences within the greater New York Metropolitan area. The number of skilled workers required is a small fraction of the total number available in the region, thus, little impact is anticipated on the total labor market. Wages will be distributed over the region in the same pattern as workers. Little of the payments to labor will go into the surrounding communities.

d. Impact of aesthetics on recreation, land uses, and plans for land and water use

Aesthetic impacts during the construction period will be mainly confined to the site. Construction activity will be visible from the river but hidden by trees from land locations outside of the applicant's property.

e. Summary comparison of impacts of alternative systems

Community and regional impacts during construction of a closed cycle cooling system will be quite limited no matter which alternative system is chosen. Although differences in community impacts do exist among the alternatives, these differences are not considered of major importance in the cost-benefit balancing of the alternatives. Construction time of 3.5 years for the natural draft tower and the much greater volume of excavation material and concrete and reinforcement bars will result in heavy truck traffic over a longer period of time than the other alternatives. The fan-assisted natural draft tower, having the second greatest volume of concrete, can be expected to rank second in terms of duration of traffic associated with delivery of concrete and other materials. The differences in noise duration among these two alternatives and the remaining three alternatives considered are of minor consequence relative to existing and past noise levels.

6.3.3 Impacts During Operation

6.3.3.1 Impacts on Aquatic Biota

The staff finds that operation of any one of the alternative closed cycle cooling systems will not result in unacceptable adverse impacts upon the aquatic environment (see Sections 5.4.3 and 5.4.4); therefore, the staff finds the socio-economic consequences of such impacts to be of little consequence, and no additional measures are required to migitate biotic impacts. Because of the limited level of biotic impacts, the staff has not attempted to differentiate among the alternative closed cycle cooling systems.

6.3.3.2 Impacts on Terrestrial Biota

Potential damage to terrestrial biota which may arise from operation of a closed cycle cooling system would be attributable to one or more of the following: salt drift, aerosol salt, and increased moisture including induced fogging and icing. Each of these potential sources of damage to terrestrial biota has been evaluated by the staff (See Sections 5.2.2 and 5.2.3.) Botanical injury and mortality from salt drift of dogwood and hemlock on site immediately surrounding the cooling tower is assessed to be possible during the operating life of the mechanical draft alternative closed cycle system. The level of damage from the NDCT and the FANDCT is assessed to be essentially nonexistent, both onsite and offsite. Offsite, the major source of potential damage to terrestrial biota would be salt drift from the mechanical draft alternatives. Even with the use of what the staff believes to be conservative assumptions and estimates which tend to show higher estimates of damage, the staff analysis shows an extremely small potential for severe damaging episodes for terrestrial biota over the life of a cooling system. However, the licensee should monitor the drift and salt deposition in the surrounding area and determine its significance; further, sensitive species of plants should also be monitored, as appropriate, to detect changes.

The staff concludes there is little possibility of botanical injury having social or economic consequence from operation of any of the cooling system alternatives. Among the five alternatives the greatest potential for damage was found for the MDCT and W/D MDCT. The area of potential risk was identified as approximately defined by the 200 kg/km^2 drift contour for August and September. This area is defined by a roughly elliptical shape with a major axis running through the cooling towers, parallel to the river in a SW-NE direction, extending 0.75 miles upstream and 1.0 miles downstream, and a 0.5 mile minor axis perpendicular to the major axis. Most of the area included is comprised of the applicant's property, the property of Georgia Pacific Corporation to the south, and the property of Standard Brands to the north. Potential impact on residential landscaping is confined to seven houses on Bleakley Avenue near Broadway and one house on Broadway just south of Bleakley Avenue. The probability of botanical injury on these properties over the life of a mechanical draft system is very small and would be confined to hemlock and dogwood which might be on the properties. The potential for botanical damage from the other cooling systems is even less than the mechanical draft.

6.3.3.3 Impact on the Human Environment

a. Aesthetics

The staff believes that the visual change resulting from construction and operation of a closed cycle cooling tower is potentially the most socially and economically consequential of the various possible environmental impacts. During two visits to the area, the staff found strong local concern over the visual impact of cooling towers and their plumes. (Also see comments in Chapter 8 of the IP-2 FES (NUREG-0042, August 1976) submitted by the Village of Buchanan, City of Peekskill, City of Peekskill Planning Commission and Senator Gordon.) A reconnaissance of the surrounding area indicated that although the NDCT might have the greatest visibility, each of the alternative towers would be visible to some degree from a number of neighborhoods in Peekskill, Buchanan, and across the Hudson River. The accompanying plume would tend to extend the range of visibility considerably. In addition to the concern expressed over the impact on the quality of the view from existing neighborhoods, concern was also expressed over the impact on the development potential of the Peekskill waterfront. In its analysis of aesthetic impacts, the staff has been guided by two underlying questions. (1) What will be the relative impact of each of the alternatives on the quality of the view scope as perceived by the viewing public? (2) What will be the economic impact of each alternative in terms of real estate values in the various visually impacted neighborhoods and the development potential of the Peekskill waterfront? While the answers to these questions remain incomplete due to the inadequacy of analytical techniques, nevertheless, the staff has evaluated the alternatives and concluded that of the three lowest cost alternatives--CMDCT, FANDCT, and NDCT--the CMDCT has an advantage over FANDCT and NDCT and that FANDCT has an advantage over NDCT.

The staff has taken an eclectic approach to evaluation of potential visual impacts. First hand experiences and observations of a number of staff members on a number of closed cycle cooling systems in this country and Europe were compiled. Hundreds of photographs of various cooling towers and plume conditions were examined. Several days were spent reconnoitering the vicinity of IP by automobile, foot, and light aircraft. In addition, the services of a landscape architectural and environmental planning firm (Jones & Jones, Seattle, Washington) were engaged to apply, on a limited experimental basis, a technique which had previously been developed to assess the visual change in a viewscope resulting from manmade intrusions to the landscape including nuclear power plant siting and transmission line routing.[30-40] The study examined the relative visual impact of the three alternatives CMDCT, FANDCT, and NDCT on a high visibility day with a severe plume configuration.[41] An evaluation was made for the three alternatives at Unit 2 alone and for Unit 2 and Unit 3 together. A team from Jones & Jones surveyed and photographed the Indian Point area during late August 1975. A viewshed map was constructed on the USGS 1:24,000 quadrangles for Peekskill and Haverstraw --Figure 6-1. Figure 6-1 shows those locations within six miles of the proposed Indian Point Unit No. 2 tower from which the top of a natural draft tower at 600 feet above sea level is visible assuming foreground trees and buildings do not obstruct the view. The viewshed map was used to identify areas from which to select representative viewpoints. The staff made a comparative analysis of the applicant's viewshed map for IP-3 (IP-3 ER) and the viewshed map for IP-2 shown in Figure 6-1

FIGURE 6-1 VIEWSHED OF INDIAN POINT VICINITY FROM RIM OF 565 FEET NATURAL DRAFT COOLING TOWER

Source: Jones & Jones

to determine the incremental increase in the viewshed due to two NDCT's (one at IP-2 and one at IP-3). Assuming an NDCT at IP-2, the staff found that the probable increase in areas exposed to a view of an additional NDCT at IP-3 would be insignificant. Thus, the staff feels that the viewshed presented in Figure 6-1 is a fairly accurate representation of those areas which would be exposed to a view of two NDCT's at the Indian Point site.

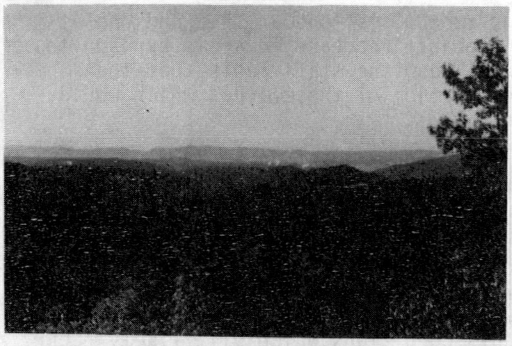
The Jones & Jones team visited nearly every heavily populated street and prominent viewpoint within the viewshed and within a six-mile radius of the tower sites. About sixty photographs were taken and screened on the basis of population density, distance, direction of view, observer position, and clarity of visual context. The ten viewpoints finally selected for evaluation are shown in Figure 6-1. Enlarged color prints of each viewpoint were made and retouched by a professional artist to depict the alternative cooling towers. The plumes depicted are severe and would more likely be observed during cold winter months than in milder months. The artist rendition of plumes superimposed on the photographs represents conditions which will likely occur considerably less than two percent of the hours of the year. The depicted plumes would most likely occur early on cold winter mornings under conditions of high relative humidity and moderate to high wind conditions. Plumes with the depicted degree of visibility are very unusual during other than winter conditions. Even during the winter, the slight warming of the air as the sun rises in the sky may slightly decrease the relative humidity of the air and visibility of the plume. Samples of the photographs used for the evaluation are reproduced in black and white as Figures 6-2(a) through 6-2(c).

Through previous testing and research it was determined that for evaluating change in visual quality, three components of visual quality are important: (1) the memorability of a scene, (2) its wholeness, and (3) the harmony of its parts.[42] These criteria are termed "vividness," "intactness," and "unity." By carefully defining and scaling these elements, Jones & Jones, using a panel of experts, is able to objectively index the visual quality of an overall landscape type or a given scene. Overall visual quality and its individual components are scored from 1 (very high quality) to 100 (very low quality). Standards to be used in scoring are well defined.[43]

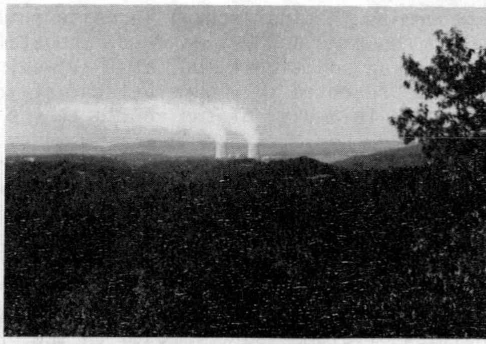
The Jones & Jones study indicates that the visual characteristics of plumes must be an important component in the total evaluation of the aesthetic impact of cooling towers. The severe plumes when the CMDCT is hidden from view were found to reduce the visual quality of viewscapes more than did the taller visible towers with less severe plumes. Because of the reaction of the panel of design experts to the severe plume, the CMDCT was rated behind the NDCT and the FANDCT by the panel. Due to the more modest size of the FANDCT, it was rated slightly less detracting from the quality of the viewscapes than the NDCT. The study did not explore the tendency for viewers to adjust their perception of a new element (plumes) as a negative element in the viewscape over time nor did the study explore change in the quality of viewscapes with less severe plumes. A complete evaluation of visual impact would then require an understanding of the difference in visual impact of various configuration of plumes each having different dynamic behavior and degree of visibility. Both the visual quality index evaluations of a given scene before towers and with towers would be expected to vary according to the existing meteorological conditions. A given view without towers would rate higher on a clear day than on a very hazy or rainy day; but, the reduction in visual quality from towers and plumes, with given characteristics, would likely be greater on the clearer day because of the greater contrast between plume and ambient atmospheric conditions. On rainy or hazy days, not only is the viewing distance reduced, but the plume and background conditions also tend to merge. A more thorough analysis requires the following steps: specification of several dozen categories of plume conditions with definitions based on the visual impact density and length of plume; development of a frequency distribution for the percentage of time each category would occur annually; evaluation of a sample of viewpoints from the region for each of the categories; and the weighting of results by the value placed upon the quality of viewing conditions by local residents and visitors. The justification for this weighting is based on the assumption that greater value is placed upon the viewing experience during periods when visibility is greater and during non-winter months. This assumption would also imply that interest in scenery and viewing experienced is diminished during periods when visibility is poor.

A study determining the location and frequency of visible plume was conducted by Pickard, Lowe and Associates for the applicant.[45] A computer model using site data and cooling tower characteristics was used to determine overhead visible plume length versus distance downwind for a two tower operation at the Indian Point facility. The results, presented here in Figures 6-3 and 6-4, show that, in the SSW direction, the plumes will extend approximately 2.5 miles for about 400 hours of the twelve month data period. Other directions are predicted to have a lower frequency of overhead visible plume. Although the appearance, including shape, rise, and length of a cooling tower plume, is constantly changing as a response to the dynamics of the atmosphere, observations of these plumes over long time periods show that general configuration categories can be established for various atmospheric conditions.

Monastery: 5-3/8 Miles N.E. of Proposed Tower



Before

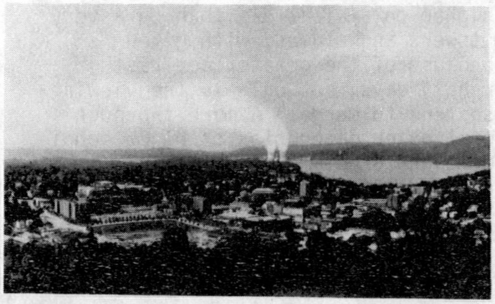


Natural Draft – Both Units 2 & 3

Hudson Overlook Apts.: 2-1/2 Miles N.E. of Proposed Tower

Before

Natural Draft – Units 2 & 3



Fan Assist Natural Draft – Units 2 & 3

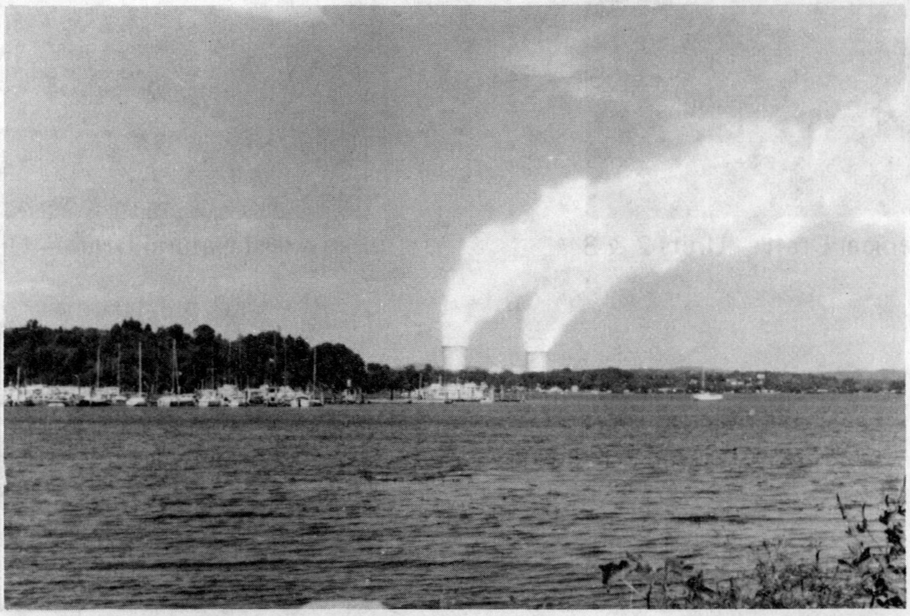
Circular Mechanical Draft – Units 2 & 3

FIGURE 6-2(A) ARTIST RENDITION OF ALTERNATIVE CLOSED-CYCLE COOLING SYSTEMS AND SEVERE PLUME FROM VARIOUS LOCATIONS IN THE INDIAN POINT VICINITY

Source: Photography and Retouching from Jones & Jones

Stony Point Marina: 3-3/8 Miles S.S.W. of Proposed Tower

Before



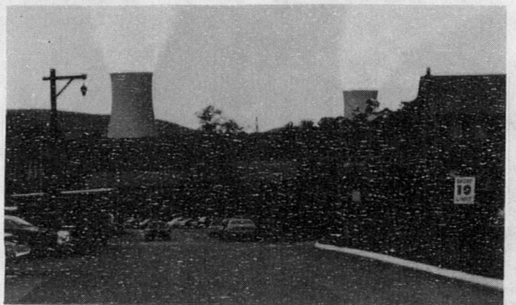
Natural Draft—Units 2 & 3

FIGURE 6-2 (B) ARTIST RENDITION OF ALTERNATIVE CLOSED-CYCLE COOLING SYSTEMS AND SEVERE PLUME FROM STONY POINT MARINA

Source: Photography and Retouching from Jones & Jones

Verplanck Apts.:
1-1/2 Mile S. of Proposed Tower

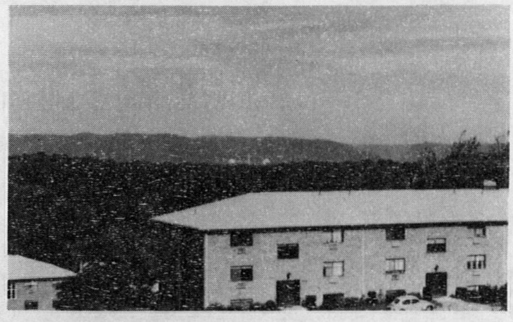
Before



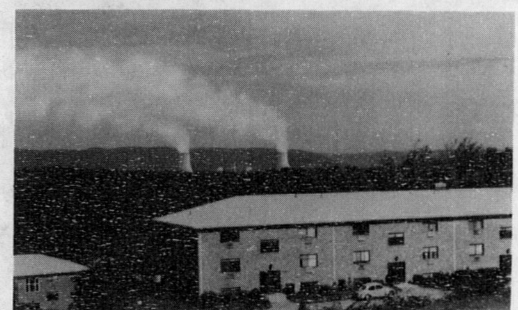
Natural Draft – Units 2 & 3

Circular Mechanical Draft – Units 2 & 3

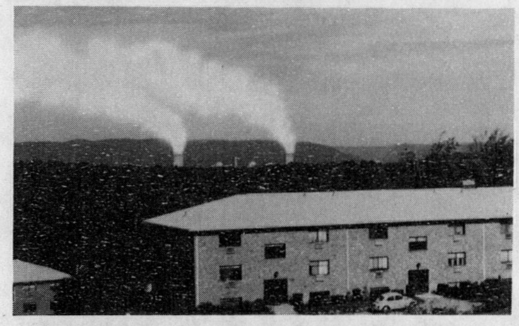
Baltic Apts.:
3-7/8 Miles S.E. of Proposed Tower



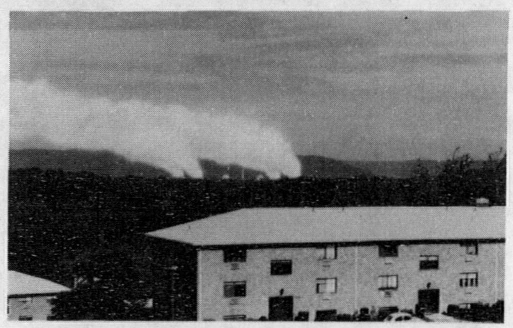
Before



Natural Draft – Units 2 & 3



Fan Assist Natural Draft – Units 2 & 3



Circular Mechanical Draft – Units 2 & 3

FIGURE 6-2(C) ARTIST RENDITION OF ALTERNATIVE CLOSED-CYCLE COOLING SYSTEMS AND SEVERE PLUME FROM VARIOUS LOCATIONS IN THE INDIAN POINT VICINITY

Source: Photography and Retouching from Jones & Jones

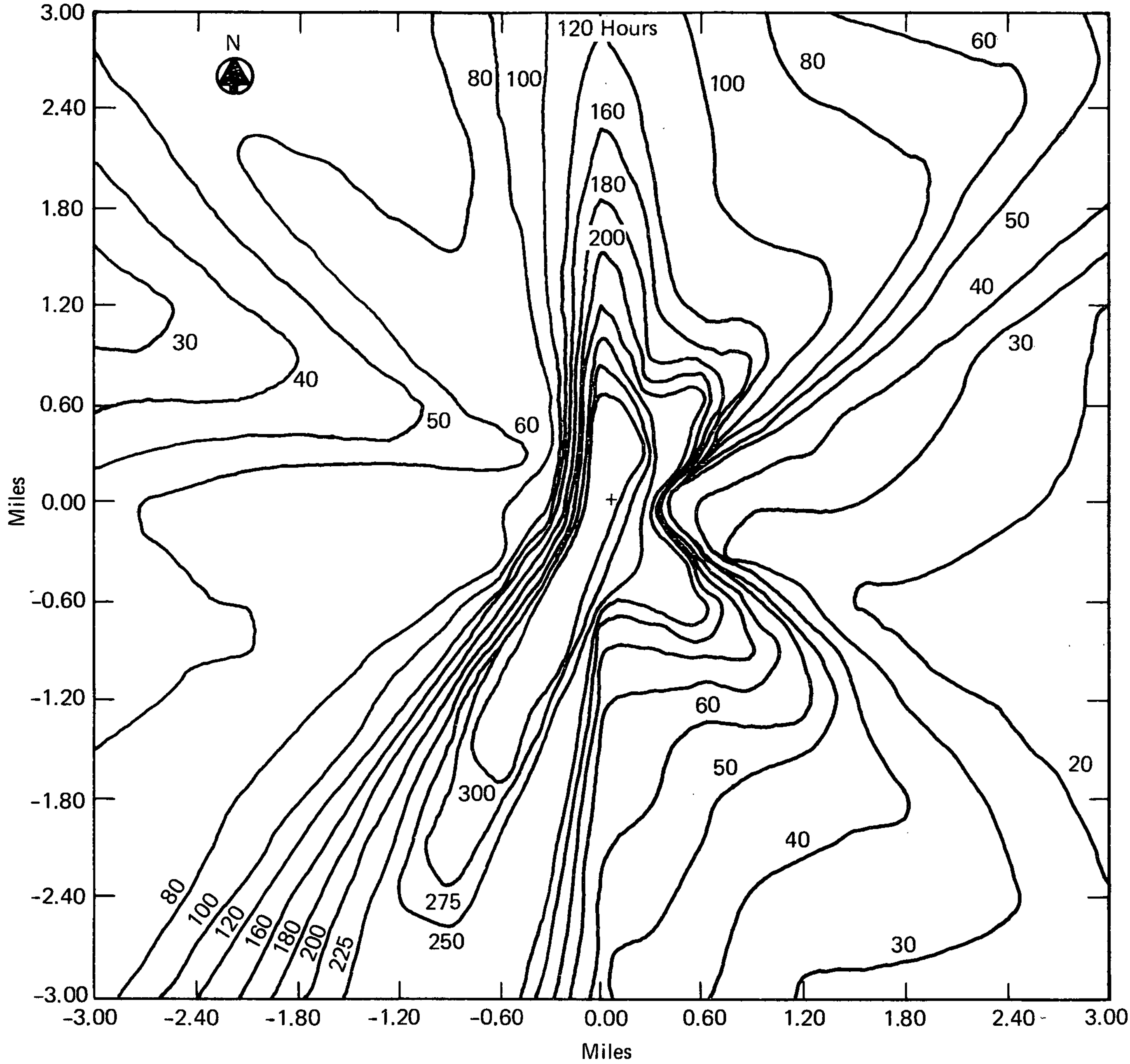


FIGURE 6-3 ISOPLETH OF NUMBER OF HOURS VISIBLE PLUME EXTENDS DISTANCE DOWNWIND IN EACH DIRECTION (0-3 MILES) (PERIOD OF RECORD – OCTOBER 1, 1973 THROUGH AUGUST 31, 1974)

SOURCE: Consolidated Edison Company of New York, Inc., Economic And Environmental Impacts of Alternative Closed-Cycle Cooling Systems for Indian Point Unit No. 3, Volume No. 2, January 1976, Figure 2-1.

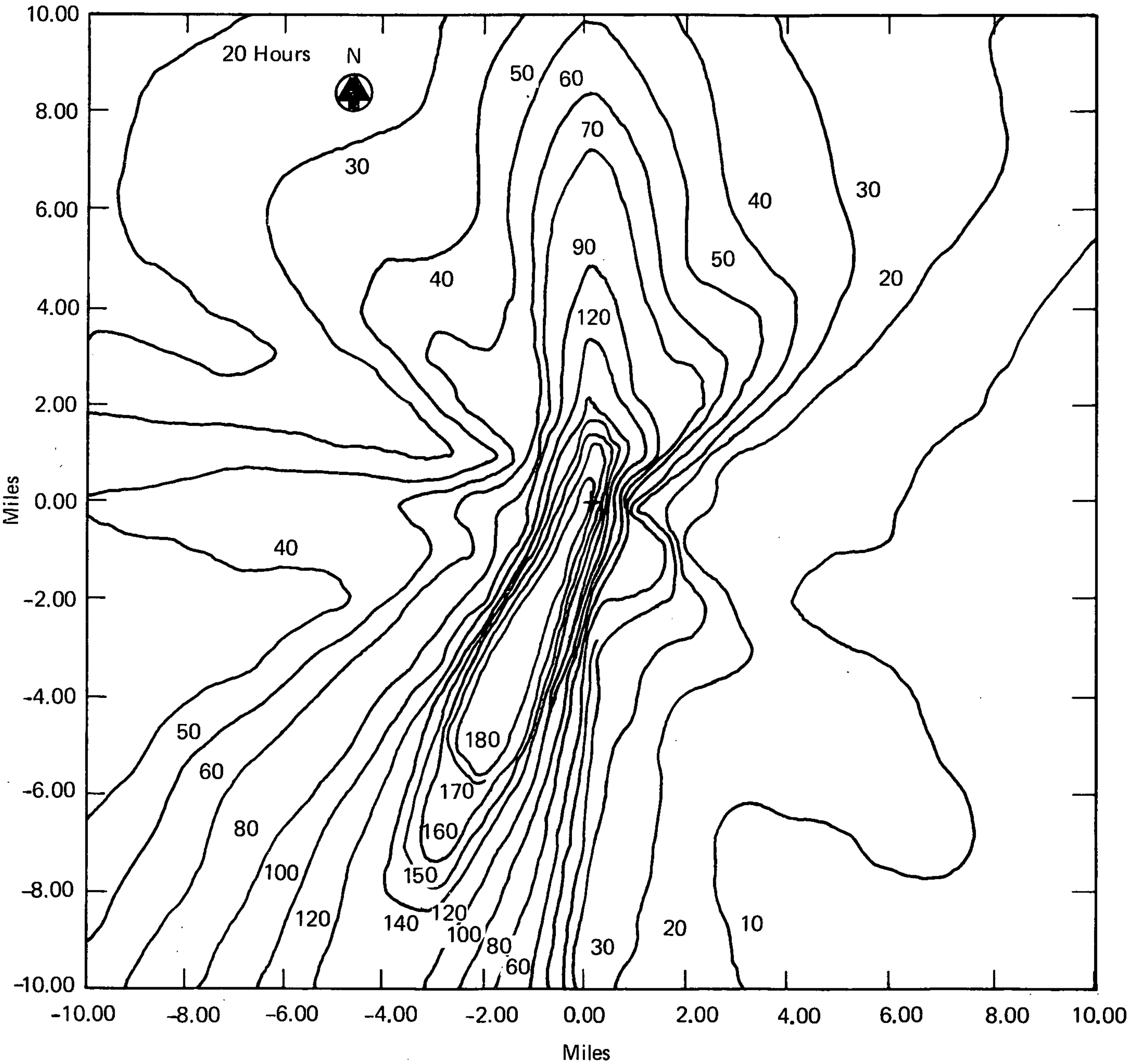


FIGURE 6-4 ISOPLETH OF NUMBER OF HOURS VISIBLE PLUME EXTENDS DISTANCE DOWNWIND IN EACH DIRECTION (0-10 MILES) (PERIOD OF RECORD – OCTOBER 1, 1973 THROUGH AUGUST 31, 1974)

SOURCE: Consolidated Edison Company of New York, Inc., Economic and Environmental Impacts of Alternative Closed-Cycle Cooling Systems for Indian Point Unit No. 3, Volume No. 2, January 1976, Figure 2-2.

Table 6-24 shows the frequency of occurrence for various combinations of wind speed and relative humidity from data collected at the 400-foot level at Indian Point. Figure 6-5 shows the schematics of the general types of visual plumes that might be expected to occur with these combinations. The longest and largest visible plumes would be expected when wind speeds are moderate and the atmosphere is very moist. However, as shown in Table 6-24, such conditions occur only 3 percent of the time at the site. The smallest and shortest plumes occur when the atmosphere is relatively dry. Such conditions exist 85 percent of the time at Indian Point. Light wind speeds and very moist atmospheric conditions usually indicate the presence either of fog or low stratus clouds which would visually obscure either the plume or both the plume and cooling tower. Therefore, no schematic is presented for the visible plume under these conditions. Only slight modification of the findings for a single natural draft tower are needed to accommodate an additional natural draft tower or other alternative systems under consideration. The most important change in plume appearance and behavior with an additional natural draft tower for Unit 3 would be the increased diameter of a single plume if both plumes merge, or occasionally, the parallel coexistence of two single plumes which do not visibly merge. Plume rise or length will not, however, be noticeably affected. Plumes from mechanical draft towers tend to be considerably lower and shorter than from natural draft towers. Plumes from circular mechanical draft towers would have a rise between mechanical and natural draft and the length would tend to be close to that from the natural draft tower. Plumes from the fan-assisted natural draft towers would behave much the same as plumes from the natural draft towers.

TABLE 6-24

FREQUENCY OF OCCURRENCE FOR WIND SPEED AND HUMIDITY CONDITIONS AT THE INDIAN POINT SITE

Relative Humidity	Wind Speed Conditions		
	Light (< 7 mph)	Moderate (8 - 18 mph)	High (> 19 mph)
Dry (< 85%)	28%	43%	14%
Moist (> 85% - 95%)	3%	3%	1%
Very Moist (> 95%)	4%	3%	1%

SOURCE: Based on meteorological data collected onsite at the 400-ft level during the period 8/73 - 7/74.

Figures 6-6 through 6-7(b) show a series of photographs of various plume conditions from several electric power stations in the United States and Germany. Figure 6-6 shows the plume from a single circular mechanical draft tower located in Gulfport, Mississippi, over the course of a day in September from 8:30 a.m. to 4:30 p.m. At 8:30 a.m., under high humidity conditions, low to moderate wind speed, and a low cloud cover, the plume was visible for several miles running just below the cloud cover at roughly 1,000 feet above ground level. From a mile distance, the plume was noticeable but did not present an overly strong contrast with the cloud cover. By 12:00 noon, the cloud cover had risen to considerably higher than 1,000 feet and plume visibility had increased to 15 miles. The plume continually varied in direction with a strong tendency to rise rapidly into the cloud cover with a slight SW bend. At 3:30 p.m., from a distance of three miles the plume was barely distinguishable from the cloud cover even though ground level visibility was 15 miles. At 4:30 p.m., under conditions of low to moderate humidity and a broken cloud cover over 2,000 feet the plume appears small and dissipates almost completely before reaching the cloud cover. Figure 6-7(a) shows several plume conditions from large natural draft towers located at Paradise, Kentucky, and Keystone, Pennsylvania. The Keystone pictures show the dense highly visible plumes typically existing during cool/high humidity winter conditions. Short, quickly dissipating plumes are shown to exist detached from the lower ground fog at the Paradise station. Figure 6-7(b) shows plumes associated with mechanical draft and smaller natural draft towers located at Michigan City, Indiana; Montour, Pennsylvania; Centralia, Washington; and Schmehausen, Biblis, and Bochum, West Germany. The plumes are all pictured on a

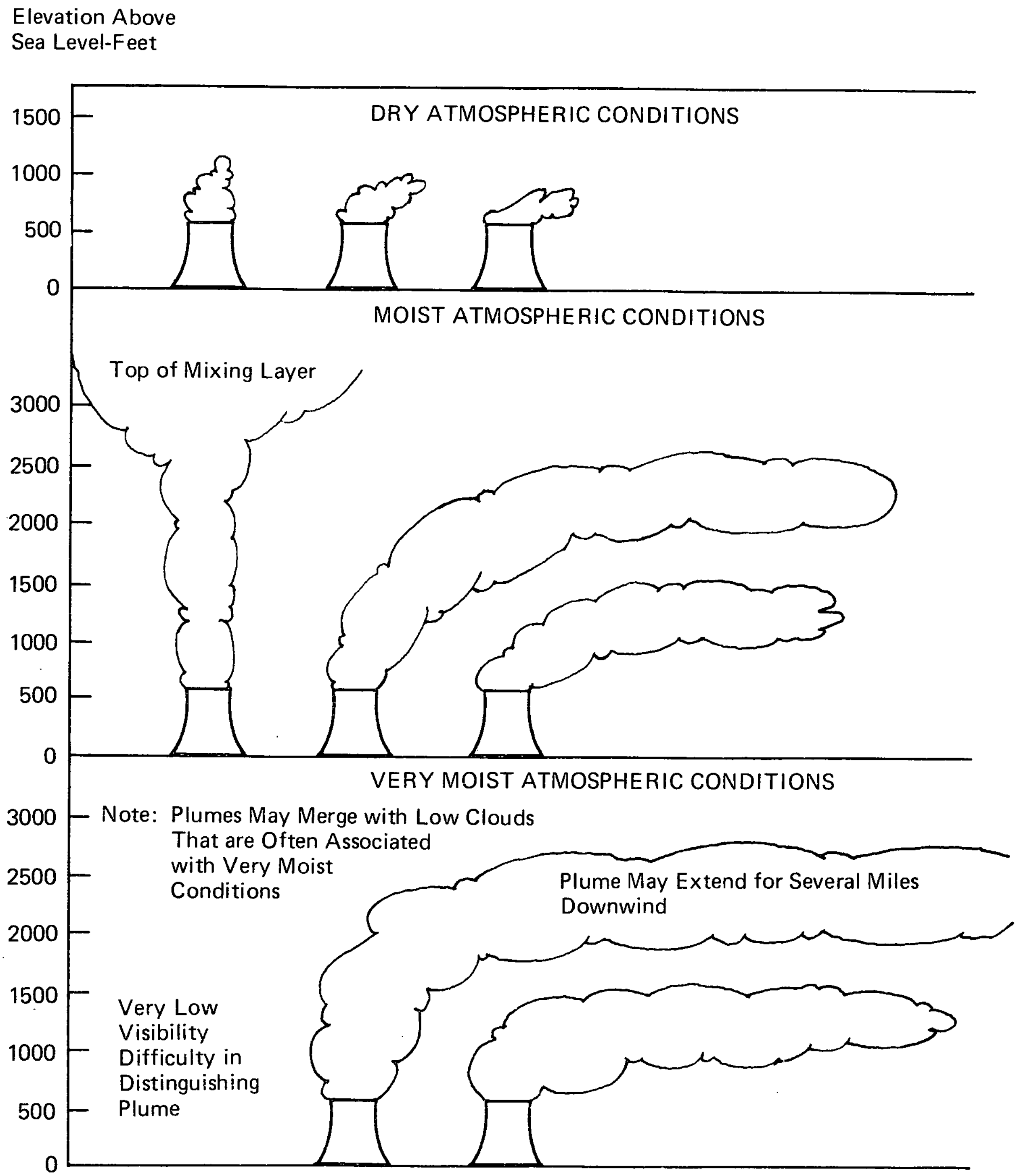
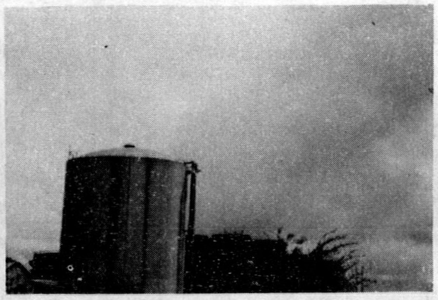


FIGURE 6-5 SCHEMATIC OF COOLING TOWER PLUME CONFIGURATIONS UNDER VARIOUS METEOROLOGICAL CONDITIONS

8:30 A.M./96% Rel. Humidity/73°F/Wind 6+ Knots ENE/4+ Miles Visibility

Looking N. Approx. 1 Mile From Cooling Tower



Looking S.E. Approx. 200 Yds From Cooling Tower

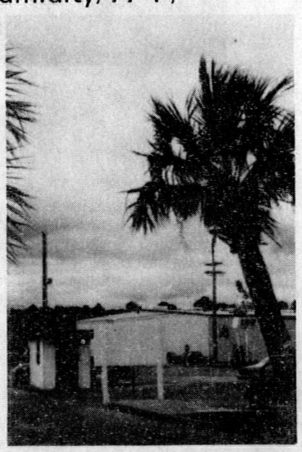
12:00 Noon/87% Rel. Humidity/76°F/Wind 12 Knots NNW/15 Miles Visibility

Looking Down on Tower From Roof of Turbine Building Spray Pond to Right

Continuation of Plume

3:00 P.M./79% Rel. Humidity/77°F/

Wind 12 Knots NNW
15 Miles Visibility
Plume in Center Above Treeline 3 Miles Distant



3:45 P.M./74% Rel. Humidity/79°F/

Wind 12 Knots NNW
15 Miles Visibility
Plume Slightly Right of Center View From Airplane 3.5 Miles Distant After Takeoff

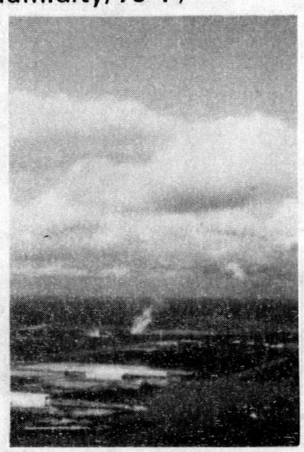
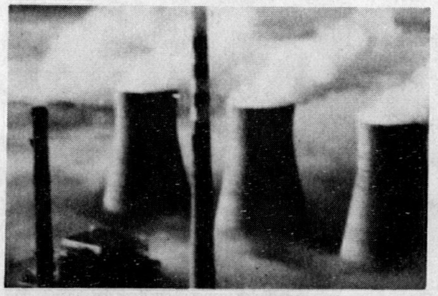


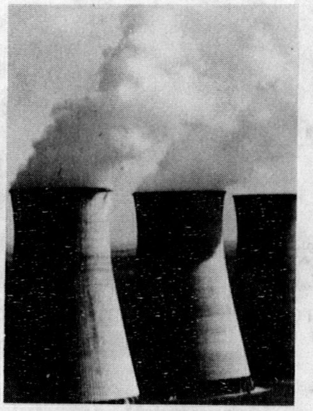
FIGURE 6-6 PLUME VARIATIONS FOR THE CIRCULAR MECHANICAL DRAFT COOLING TOWER BACK-FITTED TO MEET THE COOLING REQUIREMENTS OF A 500 MWe COAL FIRED GENERATING PLANT AT THE JACK WATSON STATION OF THE MISSISSIPPI POWER CO., GULFPORT, MISSISSIPPI, SEPTEMBER 12, 1975

Paradise, Kentucky

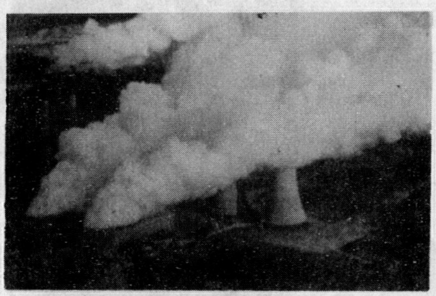


Light Plume Above Ground Fog
Viewed From 1000 Ft Above
Ground Level, September

Moderate
Plume
January

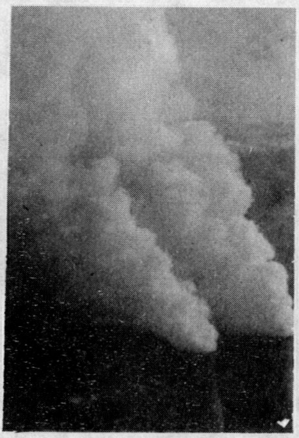


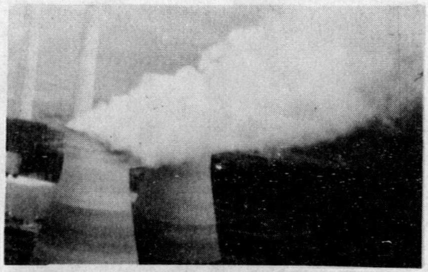
Keystone, Pennsylvania



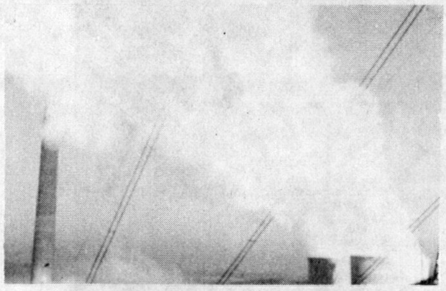
Aerial View of Very Severe
Winter Plume

Aerial View of
Very Severe
Winter Plume





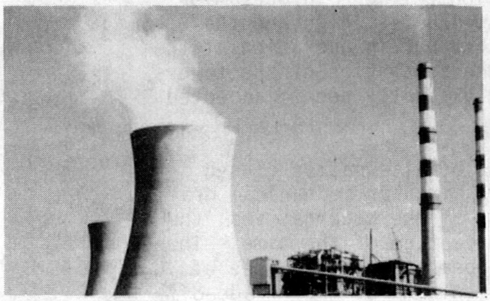
Aerial View of Moderate Plume



Moderate Plume

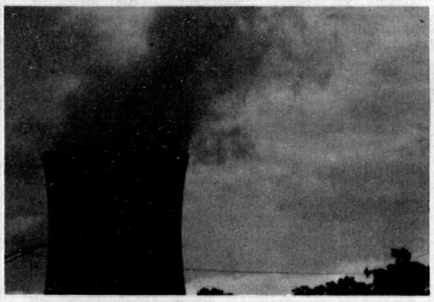
FIGURE 6-7(a) COOLING TOWER PLUME VARIATIONS UNDER A WIDE RANGE OF METEOROLOGICAL CONDITIONS

Montour, Pennsylvania



Slight Plume and Clear Sky, October

Michigan City, Indiana



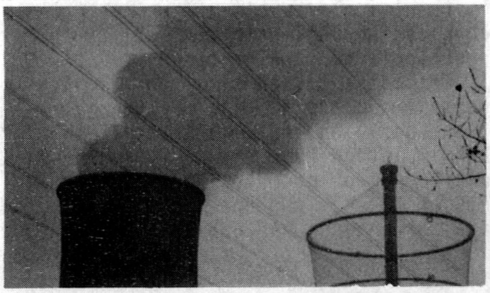
Slight Plume and High Overcast, July

Centralia, Washington

Moderately Heavy Plume and Low Clouds, April

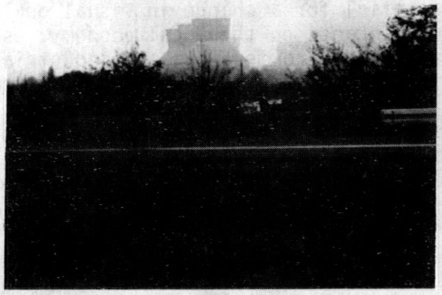
FEDERAL REPUBLIC OF WEST GERMANY

Schmehausen



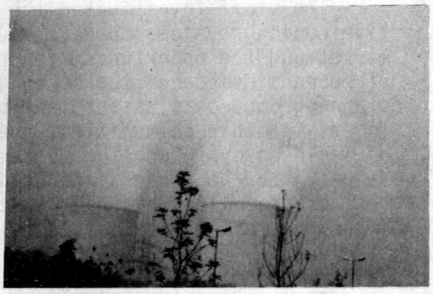
Hazy, Mid-afternoon, Moderate Plume, Early November

Bochum



Hazy, Early Afternoon, Moderate Plume, Early November

Biblis



Foggy, Thermal Inversion, Noon, Moderate Plume Blending With Fog, Early November

FIGURE 6-7(b) COOLING TOWER PLUME VARIATIONS UNDER A WIDE RANGE OF METEOROLOGICAL CONDITIONS

heavily overcast or hazy day. Under such conditions plumes tend to be less obtrusive, blending in with background conditions. It is observable from these pictures that even under conditions of low cloud and haze, plumes have considerable buoyancy and ,therefore, contribute little or nothing to ground level fog or haze.

In three staff studies ,(Three Mile Island, Arkansas and Zimmer) examining the regional impact of nuclear plant construction, the question of the aesthetic perception of cooling tower by local residents was investigated. Each facility has a hyperbolic natural draft tower. Three Mile Island has two 370 foot towers each for Units 1 and 2. The towers for Unit 1 were in operation during the staff visit. The natural draft tower for Arkansas Unit 2 is 475 feet high and the tower for Zimmer Unit 1 is 479 feet high. Both towers were completed but not in operation at the time of the staff study. In all three cases, no local opposition to the aesthetics of the towers was found. The towers at first are an object of intense curiosity but gradually become accepted as part of the landscape.

On the basis of the evidence presently available on visual impacts of alternative closed cycle cooling systems for the Indian Point site, the staff believes the circular mechanical draft alternative generally superior to the four other alternatives. For any of the alternatives, the plume taken alone will be a quite moderate visual intrusion a large percentage of the time. The tower structures, on the other hand, will show less change in visual appearance; the degree of visibility is principally due to the level of haze at the time of viewing. An obvious trade-off exists between the tall tower alternatives which provide an identifiable plume source and a large structure visible over a wide area much of the time and the short tower alternative which provides a less identifiable plume source and a much less visible structure. If the assumptions that local residents will adjust to a considerable degree to occasionally viewing heavy plumes with no observable source, and that the lighter more frequent plume would not be disturbing because of the lack of observable source are valid, then the short tower alternative will have the advantage. Where the linear mechanical draft and the circular mechanical draft are visible, the circular mechanical draft presents a more compact and pleasing design. It is not clear that everyone would penalize the tall structures as a completely unwelcome visual intrusion, especially relative to the alternative of plumes from an unseen source. Some undetermined percentage of the population would find the tall tower alternatives and especially the natural draft towers interesting or even pleasant to observe.

The staff investigated the potential for a change in visual quality resulting from alternative cooling systems to have adverse impacts on the local economy, especially the real estate market and the opportunity for residential, commercial, and industrial development. On the basis of reconnaissance of the surrounding communities, discussion with local officials, review of local planning documents, assessment of visual change, and knowledge of aesthetic impacts of cooling towers in other communities, the staff finds little evidence to support the position that existence of a closed cycle cooling system at Indian Point would have a perceptible impact on real estate values. In the three staff studies previously mentioned, no evidence was found to indicate that real estate values had been adversely impacted by existence of the plants or towers. No adverse impact on real estate values is known to have occurred in the case of the Schmehausen and Biblis stations.

The staff initially identified several established areas of Buchanan and Peekskill and the Peekskill waterfront, which is targeted for redevelopment, as potentially sensitive. These areas have relatively unobstructed views of the Indian Point site and are roughly within one to two miles of it. Some discontent among existing residents who will be impacted is highly probable, but the staff believes that the visual change from any of the alternative cooling systems will not be sufficiently severe to result in a relative deterioration of values or marketability of properties presently developed. The most significant potential impact involves the southern part of the Peekskill waterfront redevelopment area, what is now the Standard Brands property. Residential reuse is called for by the redevelopment plan. The most ambitious plan calls for luxury housing and marina development on this property. A natural draft tower combination at IP-2 and IP-3 would be a considerable visual intrusion to the site. A fan-assisted natural draft tower combination would be less of an intrusion, but still out of proportion with other elements of the viewscape. The structure of the circular mechanical draft towers would likely be in proper proportion to both structures at the Indian Point facility and other elements of the viewscape, as would linear mechanical draft towers, but the circular mechanical draft towers have a more attractive design than do the linear mechanical draft towers. Plumes from the Indian Point site would be reduced when the plumes are moving in a southerly direction. On the basis of visual impact on the residential redevelopment of the Standard Brands property, either the fan-assisted natural draft tower or the circular mechanical draft tower would be preferred.

For the IP area generally, the staff believes, of the three lowest cost alternatives, the CMDCT presents less of a visual intrusion and, therefore, is aesthetically preferred. However,

in view of the construction and operation of an NDCT at Unit 2, the staff feels that an NDCT at Unit 3 would be more in proportion to the elements of the viewscape and therefore less disruptive aesthetically than any of the other alternatives. Thus, considering the Unit 2 NDCT in place, the staff feels that the NDCT for Unit 3 is aesthetically preferred.

b. Noise

Staff evaluation of onsite and offsite noise levels for alternative cooling tower systems for both IP-2 and IP-3 is presented in Section 5.2.5. For the NDCT alternative (crossflow), the offsite location most affected is the area immediately adjacent to the plant site between Broadway Avenue and the Hudson River. The offsite residential area immediately to the south of the southern site border off Broadway Avenue is expected to experience increases in day-night equivalent sound levels of less than 5 dBA. Other areas affected by increased noise levels occur on the west bank of the Hudson River across from the plant site. Predicated increases in noise levels on the west bank are much less than 5 dBA. The topography of the site itself is such that there is a protective noise barrier running northest to southwest.

Predicted changes in noise levels are expected to occur in areas designated as industrial areas (Cortland zoning MD) and one-family residential areas (R-15) immediately adjacent to the southern border of the site. The west shore of river which is expected to experience increases in noise levels of less than 5 dBA is thinly settled and not likely to be further developed for residential use.

c. Drift and local weather modifications

Offsite corrosion from saline drift is not expected to be a problem for any of the alternative towers--see Section 5.1.3. The number of hours of fog is expected to increase somewhat directly north of the tower(s) over the Hudson River--see Section 5.2.3.1. The natural draft cooling towers will induce fog about 20 hours per year, linear mechanical draft cooling towers will induce fog 82 hours per year, and circular mechanical draft cooling towers will induce 26 hours of additional fog. Induced fog will tend to occur during periods of relatively low visibility and early in the morning; thus, the visual impact of additional fog will be quite small. Hindrance to boating in the area would also be quite minor. Because of the insignificance of the occurrence of induced fog, this is not an important consideration in selection of an alternative cooling system.

The staff has considered the potential for injurious effects of drift aerosol and humidity from the cooling towers on human health and finds no basis for concern. Operation of two NDCT's at Units No. 2 and 3 would increase aerosol by 0.8 $\mu g/m^3$ for the highest predicted month. For IP-3, CMDT's are predicted to increase aerosol by 1.9 $\mu g/m^3$ during a summer period. CMDCT's at IP-3 and a single NDCT at IP-2 is predicted to increase aerosol by 2.3 $\mu g/m^3$ during a summer period. This aerosol consists predominantly of NaCl. Dautrebande and Capps[47] report that NaCl aerosols by themselves appear to be completely devoid of irritant action on mammalian respiratory systems. NaCl aerosols can interact synergestically with SO_2 and other similarly irritating substances to enhance the effects of these irritating substances. The action of NaCl in this instance is non-specific and other inert particulates have been found to have the same action.[48] Considering that the action of NaCl is non-specific in respiratory irritations, no increase in human respiratory irritations is expected.

The average offsite incremental relative humidity (RH) due to NDCT was found to be about 0.02 to 0.03% (in % RH above ambient RH) (ER-CC-3, Appendix B, Section 2.3). The ambient RH for the site sharply fluctuates on a daily and monthly basis. Often the changes range from 50-90% (RH).

The staff concludes that the contributions of moisture to the total moisture regime from any type of cooling tower operation will be insignificant in comparison to the daily fluctuations in the local moisture regime.

d. Summary Comparison--Impacts of Alternative Systems

The staff has evaluated the possible social and economic impacts of operation of the five alternative closed cycle cooling systems for IP-3. In its analysis, the staff has considered the construction and operation of a single natural draft cooling tower at IP-2. Five areas of potential impacts investigated are visual aesthetics, noise, drift, and local weather modifications, and tax revenues. Visual aesthetics were found to be the most consequential category of impacts when both tower installations are considered. However, from an incremental standpoint, the staff judges that an additional natural draft cooling tower at IP-3 would be a marginally small visual intrusion to the landscape. Given that a natural draft cooling tower is installed at IP-2, a natural draft cooling tower at IP-3 would be more in proportion with the landscape and other structures than any of the other alternatives considered in the evaluation.

TABLE 6-25

ESTIMATED ANNUAL REAL ESTATE TAXES ON IP-3 CLOSED-CYCLE COOLING SYSTEM ALTERNATIVES DURING OPERATION ($1,000)

Item	TOWER				
	NDCT	FANDCT	LMDCT	CMDCT	WDMDCT
Full Valuation of Alternative Cooling Towers[a]	72,000	72,000	104,000	69,000	119,000
Town of Cortland Taxes Assessed Valuation (Equalization rate = 18.29%[b])	13,000	13,000	19,000	13,000	22,000
Taxes Collected by Town for:					
State of New York, $.80 per M	10	10	15	10	18
Town of Cortland, $4.34 per M	56	56	82	56	95
County of Westchester, $32.58 per M	423	423	619	423	717
Fire protection district (Verplanck), $1.22 per M	16	16	23	16	27
Water district, $9.49 per M	123	123	180	123	209
School district No. 3 (Montrose) $76.97 per M	1,001	1,001	1,462	1,001	1,693
Total	1,629	1,629	2,381	1,629	2,759
Village of Buchanan Assessed valuation (Equalization rate = 17%)[c]	12,000	12,000	18,000	12,000	20,000
Taxes, $17 per M	204	204	306	204	340
Total Taxes	1,833	1,833	2,687	1,833	3,099

[a]Full valuation of alternative cooling towers is estimated to be the present value (1978) capital cost of the cooling tower excluding carrying charges. The present discounted value capital cost as shown in Tables 6-17 and 6-18 includes direct costs (cooling structure, Amertap clean system, excavation for tower, tunnels and electrical work, etc.) and indirect costs (engineering and supervision, administration, payroll, escalation, contingency, etc.).

[b,c]Equalization rate for 1976.

REFERENCES FOR SECTION 6

1. United States Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Final Environmental Statement Related to Selection of the Preferred Closed Cycle Cooling System at Indian Point Unit No. 2, Docket No. 50-247, August 1976, Chapter 6.

2. United States Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Final Environmental Statement Related to Operation of Indian Point Nuclear Generating Plant Unit No. 3, Docket No. 50-286, February 1975, Volume 1, p. xi-60.

3. United States Atomic Energy Commission, Office of Information Services, Regulatory Adjudication Issuances September 1973 (RAI-73-9), October 1973, pp. 751-789.

4. Reference number 1, p. 8-15.

5. Letter from Carl L. Newman, Vice President, Consolidated Edison Company of New York, Inc., to George W. Knighton, Chief, Environmental Projects Branch No. 1, United States Nuclear Regulatory Commission, Re: Indian Point No. 3, July 2, 1976, Docket No. 50-286.

6. Reference number 2, p. xi-9.

7. Reference number 5.

8. Ibid.

9. Ibid.

10. Ibid.

11. ER, CCC IP-3, Table 3-2

12. Ibid, Table 3-3

13. Ibid.

14. Reference number 5

15. Reference number 1, p. 6-21

16. Reference number 5

17. Ibid.

18. Summary Report - 701 Waterfront & Uplands Study, Peekskill, New York, Raymond, Parish & Pine, Inc., March 1975, pp. 7-8.

19. 1974 Rockland County Data Book, Rockland County Planning Board, New York City, New York, 1974, p. 13.

20. Profile Legislation District #1 - Westchester County Department of Planning, p. 1.

21. Rockland County Land Use Plan, Rockland County Planning Board, New York City, New York, 1973, p. 64.

22. Ibid., pp. 36-39.

23. ER, Table 6-12.

24. Letter to Mr. Carl L. Newman, Consolidated Edison from Diane S. Waite, Division for Historic Preservation, New York State Parks and Recreation, dated August 1, 1975.

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28. ER, IP-3, Appendix C, p. 8.

29. ER, IP-2, Vol. I, p. 6-53.

30. J. B. Burnham, et al., A Technique for Environmental Decision Making Using Quantified Social and Aesthetic Values, BNWL-1787, Pacific Northwest Laboratories, Richland, Washington, February 1974.

31. P. L. Hendrickson, et al., "Measuring the Social Attitudes and Aesthetic and Economic Considerations Which Influence Transmission Line Routing," BNWL-1837, Pacific Northwest Laboratories, Richland, Washington, July 1974.

32. G. R. Jones, et al., "A Method for the Quantification of Aesthetic Values for Environmental Decision Making," paper presented at the Conference on Nuclear Power Plant Siting, American Nuclear Society, Portland, Oregon, August 25-28, 1974.

33. G. R. Jones, "Preliminary Report for Classification and Evaluation of Visual Landscapes," Landscape Architecture Research Office, Graduate School of Design, Harvard University, 1966.

34. G. R. Jones, "Techniques for Assessing and Quantifying Environmental, Aesthetic and Recreational Values and Impacts," Proceedings of a Conference on Recreation Planning for Federally Licensed Hydroelectric Projects, sponsored by The Bureau of Outdoor Recreation, the Pacific Northwest Utilities Conference Committee and the Federal Power Commission, Portland, Oregon, May 2-3, 1974.

35. G. R. Jones, et al., "A Method for the Quantification of Aesthetic Values for Environmental Decision Making," Nuclear Technology, Volume 25, No. 4, pp. 682-713, April 1975.

36. Jones & Jones, An Assessment of the Effects of the Bradley Lake Hydro-Power Project upon the Environmental, Aesthetic and Existing Recreation Resources of its Region, prepared for the Department of the Army, Corps of Engineers, Alaska District, Contract No. DACW85-73-0042, August 1975.

37. Jones & Jones, Scenic and Recreational Highway Study, State of Washington Legislative Transportation Committee, Olympia, Washington, 1975.

38. Jones & Jones, "Scenic Resources of the Upper Williams Fork Basin," Technical Report H of Preliminary Environmental Evaluation of Expanding Upper Williams Fork Basin Water Diversion System, for Denver Board of Water Commissioners by CH2M Hill, Project No. D8715.0, Volume II, Denver, Colorado, December 1974.

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40. Jones & Jones, "Visual Impact Assessment," in Foothills Project Environmental Impact Statement, 2 Volumes, Board of Water Commissioners, Denver, April 1974.

41. Jones & Jones, Visual Impact Study: Statement of Findings Alternative Closed-Cycle Cooling Systems Indian Point Nuclear Generating Plant, prepared for United States Nuclear Regulatory Commission, Seattle, November 1975.

42. Ibid., p. 14.

43. Ibid., pp. 14-29.

44. Ibid., p. 60.

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46. Summary Report - 701 Waterfront & Uplands Study, Peekskill, New York, Raymond Parish & Pine, Inc., March 1975.

7. EVALUATION OF PROPOSED ACTION

7.1 ENVIRONMENTAL EFFECTS

The major environmental impact of a natural draft wet cooling tower at the Indian Point site is one of visual impact or aesthetics as discussed in Section 6.3.2.3. The visual impact arises from the size of the structure and from the plume, when it is visible. The plume will present a more variable impact, depending on meteorological conditions.

A secondary environmental impact is the drift (and salt contained therein) produced by the cooling tower and distributed over the surrounding area. The drift produced by a natural draft tower would be distributed over a large area at lower concentrations.

Other possible adverse environmental effects of tower operation are considered to be negligible.

During construction, there will be increased traffic and noise.

The environmental impact on terrestrial biota will be minimal, and because the tower is to be constructed onsite, no additional offsite land will be required. Approximately 7 acres of onsite land will be required.

7.2 RELATIONSHIP BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

On the time scale reaching several generations into the future, the useful life of the nuclear station and the proposed cooling tower is considered short-term. The resources are dedicated to the production of useful electrical energy during the anticipated life-span. Except for a small decrease in electrical energy produced, the cooling tower will not change the productivity.

The staff concludes that the short-term commitment of resources associated with construction and operation of a natural draft cooling tower is not significantly greater than the commitment that would be required for any of the other CCC systems considered.

7.3 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

No special materials (such as uranium) are required for the natural draft cooling. Much, if not all, of the materials to be used are the same as those that have already been used at the site.

No additional land, over that already committed to the site, needs to be taken.

Approximately 7 acres of onsite land will be required for construction of a natural draft cooling tower.

The other resources required are human skill, talent, and labor and money required to design, build and operate the tower.

The staff concludes that the irreversible and irretrievable commitments are appropriate for the benefits to be gained, and the commitments associated with a natural draft cooling tower are not significantly greater than the commitments required for any of the other CCC systems considered.

7.4 COST-BENEFIT BALANCE

On the basis of the foregoing analysis, the staff finds that the choice of an alternative CCC system for IP-3 reduces to a consideration of drift, noise, and visual aesthetics. All other potential sources of either adverse or beneficial impacts are found to be small.

From a drift standpoint, the ranking of the three most likely alternatives (from best to worst) was natural draft, fan-assisted natural draft,and circular mechanical draft tower. In terms of noise, the same ranking occurred. When the visibility of the plume is considered, the ranking was in the reverse order; visibility of the structure also results in the ranking of circular mechanical draft, fan-assisted natural draft,and natural draft tower. The ranking in terms of total costs of the alternatives is (from least to most costly) natural draft, fan-assisted natural draft, and circular mechanical draft. The range of cost of these, however, is less than 10%. The engineering design of both the circular mechanical draft and fan-assisted natural draft would take up to a year's additional effort compared to the natural draft cooling tower. Since all of the techniques used in determining these rankings have varying degrees of uncertainty and subjectivity, the relatively small differences found do not warrant changing the applicant's selection of the natural draft cooling tower as the preferred system. Direct cost and the most important indirect economic and social impacts analyzed by the staff are summarized in Table 7-1.

On the basis of the evaluation and analysis set forth in this Statement and after weighing the environmental, economic, technical, and other benefits against environmental costs and risks and considering available alternatives, the staff concludes that the action called for under the National Environmental Policy Act of 1969 (NEPA) and 10 CFR 51, is issuance of an amendment to the Facility Operating License No. DPR-64 authorizing construction of a natural draft cooling tower as proposed by the licensee and evaluated by the staff.

TABLE 7-1

SUMMARY OF CONSEQUENTIAL ENVIRONMENTAL IMPACTS AND COST OF ALTERNATIVE CLOSED-CYCLE COOLING SYSTEMS FOR INDIAN POINT UNIT NO. 3

Tower Alternative	Present Value Direct Costs Excluding Taxes ($1,000)	Indirect Economic and Social Impacts			
		Aesthetics	Noise	Salt Drift	Other Community Impacts
Circular Mechanical Draft	271	Lowest overall impact, low profile, reasonably attractive design -- plume occasionally disturbing.	Similar to LMDCT	Moderate onsite. No important impact offsite.	Minor
Fan-Assisted Natural Draft	251	Impact less than NDCT. Structure less overwhelming and plume similar to NDCT.	Between LMDCT and NDCT.	Minor to moderate onsite. No important impact offsite.	Minor
Natural Draft	245	Greatest impact. Structure overwhelming even though plume removed from low-level view.	Least noise.	Minor onsite. No important impact offsite.	NDCT would have greatest volume of truck traffic during construction but disruption would be temporary and no greater than has been experienced during other IP construction.
Linear Mechanical Draft	315	Slightly worse than CMDCT. Structures not as attractive, take up more space and plume slightly more offensive.	Most noise.	Moderate onsite. No important impact offsite.	Minor
Wet/Dry Mechanical Draft	346	Competitive to CMDCT, structures have slightly greater impact than RMDCT. Plume same in summer--lighter in spring/fall--very light in winter.	Noise somewhat less than MDCT because fans do not operate all the time.	Moderate onsite No important impact offsite.	WDMDCT would generate more local tax revenue than any other alternative.

TABLE 7-1 (continued)

SUMMARY OF CONSEQUENTIAL ENVIRONMENTAL IMPACTS AND COST OF ALTERNATIVE CLOSED-CYCLE COOLING SYSTEMS FOR INDIAN POINT UNIT NO. 3

Tower Alternative	Present Value Direct Costs Excluding Taxes ($1,000)	Indirect Economic and Social Impacts			
		Aesthetics	Noise	Salt Drift	Other Community Impacts
General Comments	NDCT cost is: 2% less than FANDCT 10% less than CMDCT 30% less than LMDCT 40% less than WMDCT	Tall massive structure way out of proportion with other visual elements of local viewscapes. Visual impact of plumes varies over course of days and seasons.	Traffic impact confined to Bleakly Avenue--not a serious problem. Operating noise can be baffled at additional expense.	Any damage will be confined to onsite vegetation and metallic surfaces	Neither differences in volume of truck traffic nor differences in tax revenues is considered consequential for choice of system. Other impacts minor.

8. DISCUSSION OF RESPONSES RECEIVED

8.1 RESPONSES TO COMMENTS

8.1.1 Summary and Conclusions and Introduction

8.1.1.1 Selection of Preferred Alternative (DOE, B-3)

The staff does not perceive any inconsistencies in stating that the preferred closed cycle cooling system is the NDCT while also stating that two other types are also viable alternatives based on our evaluation but not as desirable as the NDCT. This makes clear the separation of those closed cycle systems which are, or could be made, viable for the Indian Point site from those which are clearly unsuited for the site.

8.1.1.2 Factors Used in the Selection of the Preferred Alternative (DOE, B-3)

Proximity of local populated areas, such as the Village of Buchanan, is one of the factors used in the selection of the preferred system. Proximity of roads, substations and other structures also enter into the evaluation.

8.1.1.3 Factors Affecting Selection of the Preferred Alternative (HUD, B-8)

Of the impacts of concern to HUD (community infrastructure, noise,and aesthetics) only noise impacts are generally subject to State and local legislation which could influence the placement and/or choice of closed cycle cooling systems. Significant community infrastructure and visual aesthetic impacts are considered by NRC to be mitigable within a cost-benefit framework.

8.1.1.4 License Conditions and Technical Specifications Provisions (PASNY, B-30)

At this time,the conditions contained in Summary and Conclusions paragraph 8 are the only license conditions or technical specifications that the staff recommends be imposed as a result of its selection of the preferred CCC system for Unit 3.

8.1.1.5 IP-2 Capacity (DEC, B-15)

The analyses contained in this Environmental Statement and in the FES-CCC-IP-2 were based on the licensed capacity of IP-2 and IP-3. If a request to increase these capacities is submitted to the staff, an assessment of the environmental impacts of the increases will be required. This assessment will include any increases in the impact of the heat dissipation system.

8.1.1.6 Chalk Point Study Report (PASNY, B-30)

The staff has never received a final report of the Chalk Point Study Program.

8.1.2 Description of Alternative Closed Cycle Cooling System

8.1.2.1 Spray Pond (Peekskill, B-26)

In order for a spray pond to eliminate the problem of visual impact associated with cooling towers, spray ponds would have to be installed at IP-2 as well as IP-3. As discussed in Section 2.3, this would require from 110 to 200 acres. Since the entire site, including land occupied by existing structures is only 239 acres, the staff concluded that spray ponds could not be built on the current station site. The staff further concluded that there were no environmental or economic advantages to spray ponds that were of sufficient magnitude to justify the environmental and economic cost of expanding the existing plant site.

8.1.3 Design, Construction and Operating Characteristics of Alternate Closed Cooling Systems

8.1.3.1 Use of Waste Heat (HUD, B-8; DOE, B-3; NYDEC, B-15)

There are few known applications for the use of such low grade heat. Process applications generally require higher temperatures than exist in the discharge stream. There has been some agricultural applications using the warm discharge streams for irrigation or for warming the soil by means of a buried pipe system. Such agricultural use does not appear to be feasible at Indian Point because of the nature of the terrain and land use. Con Edison has considered the use of waste heat from Indian Point and concluded that its use is impractical.

Although in principle development of aquaculture techniques appears promising, there are several problems in attempting it at Indian Point. Because the river is heavily travelled and the ship channel is on the Indian Point side, there is some question as to whether or not such activities could be physically accommodated close to the plant. This would force the activity to be located at some distance away. This does not appear to be practical.

The City of Peekskill, under a grant from the National Endowment for the Arts, carried out a study of potential uses of the waste heat from Indian Point but found no use sufficiently attractive and economical to pursue further (FES CCC IP-2, B-61).

The Atomic Safety and Licensing Board Chairman, by letter of November 9, 1976, requested the staff's evaluation of the report prepared by the City of Peekskill. Copies of the letter from Chairman Jensch and the staff's response are included as Appendix C.

8.1.3.2 Use of Once-through Cooling After Cutover to CCC (DEC, B-16, B-22, B-23; DOE, B-7)

The text has been clarified (see sections 1.3 and 1.4) as to the dates for cessation of once-through cooling. With the possible exception of certain emergency conditions, operation of Unit No. 3 will not be authorized under the operating license. If such a request were made, appropriate environmental analyses and licensing proceedings would be required before authorization could be given.

8.1.4 Schedule and Permits

8.1.4.1 Schedule of Required Approvals (HFRA B-27; PASNY, B-32)

See Sections 1.3 and 4.1.

8.1.4.2 The Date for Cessation of Once-Through Cooling for IP-2 Appears Incorrect (HFRA).

The correct date for cessation of once-through cooling is May 1, 1982, set by the Licensing Board in their order of June 14, 1978 (LBP-78-21, 7 NRC 1048).

8.1.5 Environmental Impacts of Feasible Alternative Closed Cycle Cooling Systems

8.1.5.1 Combined Effect of Cooling Towers at Units 2 and 3 (HUD, B-8; DEC, B-14, B-21)

In numerous places throughout the statement, the staff has considered the combined effect of various combinations of CCC systems at Units 2 and 3. (For example, Sections 5.1.3.2 and 5.1.3.3.)

8.1.5.2 Plume Impacts (HUD, B-8)

With respect to atmospheric effects, Section 5.1.1.3 concludes that the reduction in sunshine in the offsite area and the increase in precipitation, if any, from wet cooling towers will be insignificant. The evidence presented by the staff in Section 5.1.3.3 indicates that the NDCT alternative would produce less concentrated drift, ice, and fog in Verplanck than other closed-cycle systems. The NDCT was the preferred alternative because it produced the least damage to susceptible botanical species (Sections 5.2.2.7 to 5.2.3.2).

The staff agrees with HUD's characterization of the natural draft towers. However, NRC's choice of the preferred cooling system must be made after considering available alternatives and cannot be based on size or mass alone.

The task before NRC involves the selection of the optimal CCC system for Unit 3 based on a balancing costs and benefits; the purpose is not to choose between a closed-cycle system and a once-through cooling system. Given the environmental factors considered in Chapter 5, it is difficult for the staff to conclude that the NDCT is not the preferred alternative.

8.1.5.3 Combined Effects of Cooling Towers at Several Power Plants on the Hudson River (DEC, B-17)

EPA is currently conducting a public hearing to consider the cumulative environmental impacts of operation of Indian Point, Bowline, and Roseton power plants. The staff considers the EPA hearing to be a more appropriate forum for consideration of the cumulative impacts of the various power plants on the Hudson River.

8.1.5.4 Fan Assisted NDCT (DEC, B- 8)

Fan-assisted natural draft options have been discussed in Sections 5.2, 5.3, 6.2 and 6.3.

8.1.5.5 Salt Drift Effect (Buchanan, B-52; PASNY, B-32)

The staff analyses of the salt drift effects on vegetation establishes a risk perspective. The staff concludes that concerns for widespread catastrophic damage in the offsite environment are unfounded. The environment will not be denuded of vegetation regardless of which cooling tower option is chosen. Foliar symptoms similar to salt burn but unrelated to power plant operation already exist on a few trees in the vicinity of Buchanan and Peekskill. The possible effect of added salts in this environment could be to add somewhat to the frequency of occurrence of similar symptoms. A change in frequency of tree loss or foliar symptoms, if they occur at all, may or may not be apparent to a casual observer depending on their magnitude. Monitoring would, therefore, be required to establish with reasonable certainty whether a change actually takes place and, if it does, to quantify its magnitude. Monitoring programs would serve the important practical purpose of establishing a data base to aid in the equitable resolution of possible conflicts if any occur. (Refer also to FES-CCC-IP2, pp. 8-34 thru 39.)

IP-2 data had been submitted for MDCTs predicting highest drift deposition values if relative humidities exceed 90% for the entire month. The staff has utilized for the IP-3 evaluation hourly variations in humidity for MDCTs and other combinations. As indicated by the licensee's data for IP-3 MDCTs, maximum salt deposition values currently predicted for Indian Point MDCTs would not approach the values predicted previously by the Unit No. 2 licensee.

8.1.5.6 Federal Power Commission Pipeline Relocation (DOE, B-7; Peekskill, B-27)

If the pipeline has to be relocated, the applicant will be required to provide for staff review and approval an environmental assessment of the proposed relocation, including a map showing existing, proposed, and alternate pipeline locations.

8.1.5.7 Variation of Wind Speeds (DEC, B-17)

The variation of wind speed at three levels, measured totally within the valley, shows a gradual increase in wind speeds at points higher on the meteorological tower (from the 33-400 ft. level as shown in Table 1-4). Valley winds are strongly affected by the nature of large scale wind flows, as shown by Munn,[1] and under certain conditions may be increased or decreased subject to the orientation of the valley with respect to the large scale flows. Detailed local studies on the wind patterns in the Indian Point area have been reported on by Davidson[3] and Kaplin.[4]

8.1.5.8 Plume Induced Precipitation Study (DOE, B-3)

Lack of mention of the Science article was an oversight. The staff agrees that no great significance should be attached to the article.

8.1.5.9 Shadowing of Sunshine (HUD, B-8)

The staff has considered the shadowing of sunshine in Section 5.1.1.1 and concludes that data show no detectable changes in hours of bright sunshine due to operation of cooling tower complexes.

8.1.5.10 Plume Impacts (DEC, B-23)

In Section 5.1.1.3 the staff states, "The visible plume from wet cooling towers is a cloud that will reduce sunshine in the offsite area by at most an average of a few minutes per day." Section 5.1.3.3 discusses the staff's predictions of salt deposition and aerosol concentration. Based on the output of its models, the staff concludes that the NDCT would produce less saline drift than other alternatives and that the effect of drift from an NDCT on local vegetation would not be significant (Section 5.6).

Moreover, the staff maintains that its analysis yielded the optimum choice from among alternative CCC systems recognizing engineering, environmental, social, and economic impacts. The staff's analysis was guided by considerations of minimum levels of acceptability and the relative performance of alternatives.

8.1.5.11 Nocturnal Inversion (Parks, B-54)

Nocturnal inversion, due to surface energy radiation under clear sky conditions and light winds, can be quite variable in its thickness, frequency, and duration. Under clear sky conditions, the height and thickness increase with time. Munn[1] indicates that valley inversions are not intense as a result of air movement in the form of slope winds, and valley winds which aid in vertical mixing of the air. By definition, Huschke[6] identifies ground fog (radiation fog) has having a vertical extent of about six feet. Since this type of fog is indicative of the existence of a shallow inversion, we can infer the effect of a natural draft cooling tower plume drift as being limited to those locations where the plume intersects the terrain. Detailed Indian Point site micrometeorological studies, including upper air temperature measurements, were described in Halitsky,[5] as included in supplements to the Indian Point 3 FSAR.

8.1.5.12 Ground Fog (Parks, B-54)

The examples of cooling tower plumes given reflect level terrain observations. However, in rougher terrain areas, plume and ground intersection might be expected where the terrain rises to the plume height.

8.1.5.13 Meteorological Stagnation (Parks, B-54)

Meteorological stagnation over the Indian Point region has been observed about 70 days during the 1936-1970 period according to Korshover.[2] Of these 70 days, 16 cases with stagnation lasting four days or longer were identified. Subsidence inversions are caused by descending air which warms adiabatically, resulting in improved vertical mixing below the inversion. This aids in effluent dispersion. Air stagnation is not the result of warm frontal movement over an area as stated in the comment.

Considering the inherent nature of cooling tower plumes--their height and heat--the existence of air stagnation should have minimal effect on plume dispersal to a few kilometers.

REFERENCES

Meteorological References given in Sections 8.1.5.7, 8.1.5.11, and 8.1.5.13

1. Munn, R. E., "Descriptive Micrometeorology," Academic Press, N.Y., 1966.

2. Korshover, J., "Climatology of Stagnating Anticyclones East of the Rocky Mountains, 1963-1970," NOAA Technical Memorandum ERL ARL-34, Silver Spring, Maryland.

3. Davidson, B., "Summary of Climatological Data at Buchanan, N.Y., 1956-1957," NYU Tech Report 372.4, 1958.

4. Kaplin, E., "Meteorological, Upper Air and Ambient Salt Studies," York Research Corporation, Reports Y-8162 and Y-8166-2, 1974.

5. Halitsky, Jr., <u>et al</u>., "Wind Observations at Indian Point, November 26, 1969 - October 1979, NYU Technical Report No. TR71-3, 1971

6. Huschke, R. E., ed., "Glossary of Meteorology," American Meteorology Society, 1959

8.1.5.14 Salt Deposition Rate (DEC, B-18)

The licensee's highest offsite salt deposition rate was predicated to occur 1.2 miles south of the tower within the 200 kg/km^2 (2 kg/ha) isopleth. This single point deposition value was predicted to occur in an extremely small area, and considering the state-of-the-art of all salt deposition prediction models, it is reasonable to assume that a higher deposition rate may fall somewhere within the bounded 200 kg/km^2 (2 kg/ha) isopleth.

8.1.5.15 Drift Depositions (DEC, B-17)

The staff has presented extensive calculations of predicted drift depositions in Figures 5-6 to 5-35. The staff believes that the values presented in its own assessment are reasonable. A logical consequence of accepting cooling towers of any design is the concurrent acceptance of some bounded risk. The staff analysis has placed reasonable bounds on the risk associated with each tower option. Within these bounds, it is reasonable to expect that the specified contingency will be fulfilled on occasion since risk is a probabilistic concept. Further analysis yields the conclusion, however, that the consequences of error do not prevent maintenance of a high quality environment since restoration or rehabilitation would be possible.

8.1.5.16 Park on Plant Site (DOI, B-11)

The applicant has indicated that an 80-acre eastern deciduous hardwood forest located on the site may at some time in the future be developed into recreation area. However, specific plans for development of this area have not been prepared and probably will not be prepared until the proceedings on the CCC system at IP-3 are completed.

8.1.5.17 Rare and Endangered Species (DEC, B-18)

As stated in Section 6.3.2.2, no rare or endangered plants or animals have been identified on the Indian Point site. The short-nosed sturgeon has been impinged on the intake structure at IP-2 and IP-3. However, this fact relates to the decision to require a CCC system and not to the selection of the preferred CCC system.

8.1.5.18 Existence of Diseased Vegetation (Peekskill, B-27)

The staff has noted (Section 5.2.2.1) the existence of damaged trees and suggested pre-operational surveys to distinguish between pre-existing damaged trees and drift-related damaged trees after cooling tower operation.

8.1.5.19 Estimated Threshold Rates of Saline Deposit (PASNY, B-32)

The licensee indicates that the Boyce Thompson Institute (BTI) goal was to estimate the distribution of thresholds for a population of receptors under certain environmental conditions. The staff indicated that BTI chamber experiments served to rank order of salt sensitivity of plant species and provide estimates of the amounts of salt required to produce visible foliar damage. The staff has developed its analysis in subsequent subsections on this salt sensitivity ranking together with estimates of the amounts of salt required to produce visible foliar damage.

8.1.5.20 Background Concentrations of Chloride (PASNY, B-33)

In several experiments reported by the licensee, the staff points out that 1500 mg/m^3 of Cl is a higher concentration than is expected in the field. The staff believes this aerosol is properly termed background since the measured level of aerosol in the chamber exceeds the field aerosol levels known to cause damage by a factor of 10-15. The staff, therefore, termed this aerosol background since it is a variable which is a consequence of the experimental design but not part of the central purpose of the experiment which was the measurement of the effects of deposition (refer also to FES-CCC IP2, Response 5-15, p. 8-5).

8.1.5.21 Background Aerosol Concentrations (PASNY, B-33, B-34)

See Section 8.1.8 -- Response to Comment Number 12.

8.1.5.22 Draft pH (Parks, B-54)

The pH of the NDCTs drift is expected to range between pH 7.0 and 8.0. The pH of the BTI test aerosol is estimated to be within this range and, therefore, the staff does not believe a significant relationship exists between pH and calculated damage potential for saline mists.

8.1.5.23 Inversion and Stagnation (Parks, B-54)

The staff judges that 'inversions and stagnation' factors do not significantly alter its analysis and conclusions pertaining to botanical injury and aerosol effects on human populations.

8.1.5.24 Salt Effects (PASNY, B-34)

The data support the conclusion that there is a continuous relationship between ambient humidity and plant response under salt stress. The Boyce Thompson report stated: "The lowest exposures were conducted at the relative humidity level which had been found to maximize the injury from saline aerosol" (ER-CC-IP2, p. 6-23). The licensee submitted an analysis of biological damage indicating that maximum toxicities occurred at about 85% relative humidity and toxicities decreased by half for 50% relative humidity. Therefore, the staff believes that salt effects may be at least a factor of two less than the maximum indicated by the licensee's study.

8.1.5.25 Frequency of Droughts (PASNY, B-34)

The staff has considered the frequency of drought lasting 14 days in its analysis. Drought is considered to be a factor in enhancing botanical injury; however, the influence of this factor should not be overstated. The maximum drift deposition predicted by the staff for significant areas offsite amounts to only 4.50 kg/ha for the entire month of August for two NCDTs [Figure 5-20(A)]. Total foliar accumulation for a 14-day dry period is, therefore, only slightly greater than 2 kg/ha before rainfall at the end of the drought washes the leaves. For reasons previously stated, the staff does not consider the Boyce Thompson value of 1 kg/ha to be a realistic estimation of the distribution of threshold levels for vegetative damage. The true threshold could be a factor of 10 or more higher than this. Thus, a single drought episode of 14 days does not in itself signal the onset of unacceptable consequences. The significance of drought is that it is simply one of the interacting factors in this analysis. If drought periods occur more than once in a season or if a series of dry years occur, the stress naturally increases. This factor interacts with drift levels combined with successive or extended drought episodes would increase the risk for vegetation and widen the area at risk.

8.1.5.26 Salt Damage Impacts (DEC, B-18, B-19)

The prime areas for potential salt damage impacts are north and south of the Indian Point site, along the Hudson River. The staff places emphasis on impacts to privately owned trees because they are located in areas which were predicted to have the greatest potential for vegetative damage. The staff has calculated that areas east and north of Peekskill, including Bear Mountain State Park, will receive levels of salt drift insufficient to induce vegetative damage. Operational monitoring will be undertaken as indicated in Summary and Conclusions. Consideration has been given to prevention of drift damage by watering, and the staff has concluded that recommendations for the implementation of these types of actions are not warranted at this time because of the low drift levels predicted.

The staff has addressed the possible replacement through compensation of affected trees which might be injured beyond recovery in Section 5.2.2.4.b of this FES and page 8-8 of FES IP-2. The staff also agrees that salt injured vegetation may be more susceptible to insect or disease damage. The staff expects, however, that salt-induced 'insects or disease damage' will be indistinguishable from normal offsite background variations in disease and insect damage patterns (refer also to Section 5.2.2.1).

8.1.5.27 Contaminated and Toxic Materials (DOE, B-3)

A brief statement concerning contaminated and toxic materials data may be found in Section 5.2.2.6a.

8.1.5.28 Air Quality Standards (DEC, B-18)

The staff has evaluated the addition of salts to determine effects on settleable particulates and has determined that air quality standards are not violated. The DEC concurs with this assessment (page B-17).

8.1.5.29 Monitoring Programs (PASNY, B-29)

The staff's position is covered in Section 5.2.2.7(7) and 6.3.3.2. In addition, the staff has pointed out in this FES that restorative actions would be technically feasible although there would be probably no need for them. Monitoring programs could establish whether a need for restorative actions exists after commencement of operations.

The staff recommended in Section 5.2.2.6.b that bird monitoring should be undertaken on one selected tall structure at the Indian Point site. The staff believes that the proposed Unit 2 bird monitoring program fulfills this recommendations and, therefore, no additional bird monitoring requirements are warranted.

8.1.5.30 Icing (DEC, B-19)

The staff presented a range of hours of additional icing due to operation of each alternative closed-cycle cooling alternative in Sections 5.1.2, 5.1.3, and 5.1.3.

The major icing events were calculated by the staff to be onsite and to result from MDCT operation. The staff does not expect that any of the cooling tower options would create distinct wet land surfaces resembling bodies of water which could attract aquatic avian species such as loons and grebes.

The staff concludes that there would be extremely small risk of biological damage due to icing from operation of any of the cooling tower options.

8.1.5.31 Radiological Effluents (EPA, B-4; B-34)

In order to determine conformance with 10 CFR 50.34a and Appendix I to 10 CFR Part 50, the staff is presently evaluating the radioactive waste treatment systems installed at the Indian Point Station. This review will include the information presented in the licensee's submittal of March 14, 1978, "An Evaluation to Demonstrate the Compliance of the Indian Point Reactors with the Design Objectives of 10 CFR Part 50, Appendix I," and will address the concerns discussed in these two comments. Staff review is continuing.

8.1.5.32 Recommendations for More Extensive Experiments to Determine Damage Thresholds (DOI, B-12)

The staff has indicated that the estimated distribution of thresholds indicated in the Boyce Thompson Institute study may err on the low side. The staff, however, concluded that some offsite vegetative damage may occur under unique meteorological conditions. Further laboratory research, although useful, would not likely result in significant alteration of the staff's conclusions (Refer also to page 8-18, FES-CCC-IP-2.)

8.1.5.33 Offsite Noise Levels at Local Schools (DOI, B-11)

With regard to the offsite noise in schools, the closest school near Indian Point is approximately a mile away from the site (FES IP-2, related to operation of Unit No. 2). In FES-CCC-IP-2, the following statement was made with regard to noise (page 5-59):

> "Previous staff experience with the operation of cooling towers at a power plant where an extensive operational sound survey has been carried out is provided by the Vermont Yankee case (NRC Docket No. 50-271). In this situation, an elementary school, located approximately 1300 ft. from and facing the louvered face of linear mechanical draft wet cooling towers (2 eleven-celled towers oriented one behind the other in line-of-site from the school), has interior sound levels of 51 to 62 dBA regardless of window position, with the school not in session and the plant and towers fully operational. This acoustic environment was in excess of the recommended levels of noise criterion NC-25 of the Industrial Noise Manual, in excess of the "identified level" for this classification for the prevention of activity interference (L_{DN} = 45dBA), and was in excess of the recommended acceptable noise levels for educational classrooms proposed by previous investigators. However, when questioned, the school principal indicated that the cooling tower noise had never been reported as a problem at the school with regard to activity interference. The case history illustrates the variation possible when predicting response to a change in acoustic environment under various criteria." [Reference: U.S. Environmental Protection Agency, "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety," EPA Report No. 550/9-74-004, March 1974.]

8.1.6 Socio-Economic Impacts of Closed Cycle Cooling Systems

8.1.6.1 Visual Impacts (HUD, B-8; DEC, B-22)

The staff maintains that all of the major impacts of visible cooling towers have been analyzed, albeit with varying degrees of specificity and certainty. As for the "adverse" nature of tower impacts, the staff maintains that the NDCT alternative is the preferred option when considering overall environmental, social, and economic factors.

8.1.6.2 Viewpoint of Local Parties (DOI, B-10)

The staff feels that an adequate effort has been made to solicit the viewpoint of local parties concerning the selection of the preferred CCC system for Unit 3. The DES was sent to numerous local agencies and organizations (see Summary and Conclusions, p. iv) and to the local Public Document Room. In addition, any individual who requested a copy of any of the Environmental Statements associated with the Indian Point Station was sent a copy of the requested documents free of charge.

8.1.6.3 Length of Cutover Period (DEC, B-20; PASNY, B-35)

A comment by the State of New York (p. B-20) indicates that the NRC staff's estimate of a 5 month cut-over period could possibly be reduced further to three months. The NRC staff believes the 5 months down time is reasonable in view of the problems involved in backfitting.

8.1.6.4 Impact on Unit Reliability (DOE, B-5; PASNY, B-49)

The staff agrees with the Federal Power Commission (now the Federal Energy Regulatory Commission), Bureau of Power staff conclusion that there will be no loss of reliability to The New York Power Pool due to the installation of the closed cycle cooling system at Unit 3. The possible reduced reliability of the more complex cooling system could be eliminated due to the fact that Unit 3 could also use the existing once-through cooling system. (However, see Section 8.1.3.2.)

8.1.6.5 Fixed Charge Rate (EPA, B-4; PASNY, B-35, B-47, B-49)

The staff performed a sensitivity analysis to investigate the effects of changing the fixed charge rate on the cost shown in Table 6-17B. The capital cost and capability cost were adjusted to reflect an 8% fixed charge rate (a rate typical of a publically-owned utility which includes 6.5% for cost of money, 1.14% sinking fund depreciation, 0.35% interim replacements and 0.05% for insurance), and annual operating costs were adjusted to reflect a 5% escalation and a 6.5% discount rate. The total present value cost shown in Table 6-17B would be reduced 14% for natural draft, 13% for fan-assisted natural draft cooling tower, 13% for linear mechanical draft, 7% for the circular mechanical draft and 15% for wet-dry mechanical draft towers. Therefore, reducing the fixed charge rate to 8% and the discount rate to 6.5% does not alter the relative economic ranking of the cooling system.

8.1.6.6 Plume Visibility Impacts (PASNY, B-35)

In Section 6.3.1.8, the staff stated, "As a practical matter, it was not feasible to consider plume visibility in this portion of the staff analysis." The staff meant to imply that a plume viewshed analysis, similar to the analysis done for the tower, would require additional information (e.g., plume rise and density and a period for model development). Although the staff believes that such an analysis is conceptually possible, the staff is not aware of any existing validated models capable of producing a viewshed analysis.

8.1.6.7 701 Program (PASNY, B-36)

The "701" citation refers to Section 701 of the Housing Act of 1954, 40 USC 461, as amended by the Housing and Community Development Act of 1974, 42 USC 5301, et seq. The 701 program provides Federal funds to local and State governments for basic comprehensive planning.

8.1.6.8 Visual Impacts (DEC, B-21)

Viewshed maps for alternative cooling systems were not prepared. The staff believed it sufficient to prepare a viewshed map showing the most extensive level of intrusion.

The Pickard, Lowe and Associates (PLA) study cited by the DEC staff does not describe an impacted viewshed. Moreover, the information presented by PLA does not readily permit the development of a viewshed map.

8.1.6.9 Visual Impact on Historic and Recreational Resources (DOI, B-9, B-11)

The staff listed historic resources within the viewshed of the proposed natural draft towers and concluded that "any visual impacts on the sites listed above will not cause any change in the quality of their characteristics that qualifies them under the National Register criteria" (Section 6.3.1.8). In Section 6.3.1.7, the staff compiled a list of recreational facilities within 15 miles of the site. The staff concluded in Section 6.3.3.3 that for "the IP area generally, the staff believes, of the three lowest cost alternatives, the CMDCT presents less of a visual intrusion and, therefore, is aesthetically preferred."

The staff recognizes its responsibility to comply with various laws and regulations that pertain to historic preservation. The staff has contacted the Heritage Conservation and Recreation Service and the Advisory Council on Historic Preservation and will continue to work with these organizations to ensure that impacts on cultural resources are adequately considered.

8.1.6.10 Aesthetic Impact (DEC, B-14, B-21; Buchanan, B-52, B-53; Parks, B-54)

The staff states on page 6-46 that, "A natural draft tower combination at IP-2 and IP-3 would be a considerable visual intrusion to the site." The staff supports this conclusion on aesthetics primarily on the grounds that the tower structure would be out of proportion with the other elements of the viewscape. The staff's analysis of alternate cooling systems for IP-3 takes into account the existence of that tower at IP-2, and the staff's conclusion on tower aesthetics for IP-3 is stated on page 6-47, as follows: "However, in view of the construction and operation of an NDCT at Unit 2, the staff feels that a NDCT at Unit 3 would be more in proportion to the elements of the viewscape and, therefore, less disruptive aesthetically than any of the other alternatives." The viewscape that is considered by the staff in its Summary and Conclusions already contains a 565-foot NDCT. It is the staff's view that an additional NDCT tower at Unit 3 would represent only an incremental increase in intrusion, would balance the existing NDCT at Unit 2, and would exhibit the least displeasing plume character of any other option.

The staff evaluation of the impact of cooling towers on the human environment considered the issue of aesthetics (see Section 6.3.3.3 and Figure 6-1). As a result of this consideration, the staff concluded that the NDCT was the most visually intrusive and least aesthetically preferred of the closed cycle cooling systems. However, considering other environmental consequences and cost implications, the staff concluded that it could not find a basis upon which to change the applicant's preferred system.

8.1.6.11 Cooling Tower Impact Studies (DEC, B-20)

On page 6-46, the staff mentions three studies: Three Mile Island, Arkansas and Zimmer; the staff does not mention studies of Schmehausen and Biblis. As to the studies cited, these efforts were conducted by NRC staff in conjunction with other field studies. In each instance, conclusions were drawn primarily from interviews with local officials, businessmen, and the general public.

8.1.6.12 Jones and Jones Study (DEC, B-20)

The selective citation of text contained in the IP-2 FES has led NYSDEC to draw improper conclusions. In response to a question concerning the Jones and Jones study, the staff wrote the following:

> "The staff found the study useful in its impact assessment of alternate closed-cycle cooling systems on the human environment and, therefore, presented an overview of the technique and sample of photographs used in the study. However, the staff felt that the methodology, and thus conclusions, of the study contained

several deficiencies which precluded complete reliance upon the study (refer to Section 6.3.3.3(a)). Although the staff used portions of the study which it felt relevant, an independent assessment was conducted by the staff and used as the basis for the conclusions presented in the DES and FES" (FES-CCC-IP-2, page 8-21).

This more complete quotation should indicate that NRC's concerns were limited to specific aspects of methodology. To suggest that the study has an "apparent lack of value" is directly contradicted by the text.

8.1.6.13 Consultation With the State Historic Preservation Officer (DOI, B-10)

The staff has prepared several Environmental Statements associated with various aspects of the construction and operation of Units 2 and 3, including selection of a closed cycle cooling system for each unit. These Statements have been sent to the Department of the Interior, Advisory Council on Historic Preservation, and to the State Historic Preservation Officer for review and comment. The correspondence associated with the review of these various documents is too voluminous to be included in this Environmental Statement. However, the comments received by the staff from these, as well as from numerous other agencies, have been considered according to a weighing of social, economic and environmental costs and benefits which include heritage conservation.

8.1.6.14 Taxation (PASNY, B-29, B-35, B-47)

Since the Power Authority is exempt from Federal, State, and local taxation, the reference to an increased tax base has been deleted. In addition, in cases (e.g. Section 6.2.2.2.a) where costs estimates have been developed including and excluding taxes, the estimates which include taxes should be disregarded.

8.1.7 Evaluation of the Proposed Action

8.1.7.1 Decommissioning (DEC, B-21)

Decommissioning of Unit 3 is discussed beginning on page VIII-4 of the FES for Unit 3. The staff believes that it would be unrealistic to discuss in detail the decommissioning of the cooling towers considering the uncertainty of future plans for the site following decommissioning of Unit 3. It would be equally unrealistic to attempt to define the technological and economic conditions that will exist at a point 30 years in the future.

8.1.7.2 Scarce or Special Materials (PASNY, B-37)

The initial paragraph of Section 7.3 was not intended to imply that the Indian Point site is essentially a "lost cause". The paragraph simply states that significant quantities of scarce or special materials will not be required to construct the CCC system for Unit 3.

8.1.8 Responses to Comments by the Department of the Interior Concerning Selection of the Preferred CCC System at Unit No. 2 (B-10 through B-12)

Attached to their letter forwarding comments on this Environmental Statement the Department of the Interior included the comments that they had previously submitted relative to the Environmental Statement for selection of the preferred CCC system for Unit No. 2. In addition, they reiterated several of the concerns raised in those comments. In various parts of this section, the staff has responded to the concerns that were reiterated. However, the staff feels that the responses to DOI's comments contained in Section 8.2.5 of the FES-CC-IP-2 are still appropriate and adequate. These responses, slightly modified, are reproduced below:

"1. It would seem appropriate for the final statement to indicate to what extent these viewscapes have been made available for local comment.

The Draft Environmental Statement was transmitted with a request for comment to various local governmental organizations and representatives; refer to the detailed list in the introduction to Chapter 8. In addition, the NRC solicited comments from interested persons by a notice published in the Federal Register. General and detailed comments

received are reproduced in Appendix B of this FES according to the procedures outlined in the Introduction. Further, copies of the DES were placed in the local Public Document Room. Other requests for copies, either verbal or written, are honored, although no record is made of the requests.

2. Suggest discussion of impacts by proceeding radially outward from the cooling towers.

The staff feels that its assessment of potential impacts of the proposed project on parks, recreation areas, and historic sites is adequately presented in the DES and that the suggested modification would not generate additional information which would materially alter the staff's present assessment. Rather than discuss the visibility of every site by proceeding radially outward from the cooling towers, the staff assessed each site with the aid of topographical maps and by confirmation of the assessment using a sample of sites.

National and historic points of interest in and beyond the lower Hudson Valley from which the project is likely to be most visible are discussed in Section 6.3.1.8. Recreational facilities in the vicinity of Indian Point are discussed in Sections 6.3.1.7 and 6.3.3.3. The latter section contains the staff's appraisal of the aesthetic impact of alternative closed cycle cooling systems at IP-2 on the human environments.

3. Need for additional studies to ascertain reliability of threshold values for salt damage to vegetation.

The staff pointed out that the applicant's choice of field threshold values for salt damage to vegetation may be unnecessarily low because relevant variables in the experiments may not have been taken into account. The practical consequences of this choice, if the staff assessment is accurate, would be that the actual magnitude and extent of damage to vegetation would be less than the applicant's projections. In no case would actual damage be worse than projections. The applicant's analysis is, therefore, conservative, perhaps from its independent analysis that significant damage to vegetation is unlikely if natural draft towers are selected. Further experimental refinement of damage threshold values, though generally desirable, would be unlikely to modify the above conclusion for this case since added work would in all likelihood demonstrate that less damage would occur than is now predicted. The staff, therefore, does not recommend further experimental botanical studies for the purpose of resolving the issues in this case.

4. Cultural resources.

National and historic points of interest in and beyond the lower Hudson Valley from which the project is likely to be most visible are discussed in Section 6.3.1.8. Recreational facilities in the vicinity of Indian Point are discussed in Sections 6.3.1.7 and 6.3.3.3. The latter section contains the staff's appraisal of the aesthetic impact of alternative closed cycle cooling systems at IP-2 on the human environments.

5. Disposal of excavated materials.

See response to comments 25* and 26* by the NY Department of Environmental Conservation.

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*NY Department of Environmental Conservation 25,26. The possibility of disposing of the excavated material at the quarry on Con Edison's Verplanck site.

Although the staff understands that the excavated material is to be used to construct a road north of the site along the waterfront, the possibility of using the quarry should receive attention; this is particularly true if there be excavated material in excess of that used for the road.

(Footnotes not in IP-2 FES CCC.)

6. Groundwater.

Accidental releases to groundwater at the plant site will end up in the Hudson River and should not affect nearby wells because of the higher elevation of these wells. Only one municipal water supply within a 5-mile radius of the site utilizes groundwater. Because of the topography of the landscape, all releases along with the groundwater will flow to the river rather than to other land areas. Furthermore, no lowering or raising of groundwater levels is expected due to plant operation, because no well water on the site is available and no excess water from the facilities is expected to flood any local areas. All water would drain into the Hudson.

7. Fish and Wildlife.

See section 4.1 and the FES for Facility License Amendment for Extension of Operation with Once-Through Cooling for Indian Point Unit 2 (NUREG-0130).

In brief, the schedule has slipped an estimated nine months in accordance with the stipulation signed by all parties. Further, the staff concluded that, on balance, a two-year extension of once-through cooling is appropriate.

8. Recommendation against the use of asbestos in cooling towers.

Asbestos would only be used in the construction of the cooling tower in the standard form of asbestos boards, which is a common construction material in use throughout the United States. A prohibition of the use of this material for cooling tower construction prior to any finding by an appropriate governmental body that its use is hazardous and should be discontinued would be highly discriminatory. Such a variance from standard construction practices would substantially increase the cost of construction.

9. Use of amertap balls to clean the condenser tubes.

This system is supplemental to chlorination and would not constitute a complete replacement. This applicant will comply with EPA guideline effluent limitations for chlorine discharges.

10. Use of ORFAD model.

The staff agrees with the suggestion for additional runs. The ORFAD model was found in other cases to contain some errors; however, corrected calculations did not change conclusions. In addition, the NRC contracted with Environmental Systems Corporation for additional studies with a more sophisticated model which provided independent verification for the ORFAD results.

11. Figures 5-4 and 5-19 are confusing and difficult to read.

The staff agrees with this comment. Unfortunately, the copy from which the figures were made was not of the best quality and the computer code was set up in a way that now appears to lead to confusion. These defects could not be corrected in the time available, but the staff is making attempts at improving the manner of presentation of data in the future.

12. The staff has pointed out that the applicant's experimentally determined threshold...may be in error for two reasons.

See responses to comments 5-16* and 5-17* by Con Edison and to responses to comments by the Village of Buchanan."

8.2 LOCATION OF SIGNIFICANT TEXT CHANGES MADE IN RESPONSE TO COMMENTS

Termination Date for Open-Cycle Cooling at Unit 3 (PASNY, B-29)

In the Summary and Conclusions (paragraph 2), the date for termination of open-cycle cooling at Unit No. 3 has been changed from September 15, 1980 to September 15, 1982. However, the actual date will be determined by the provisions of the stipulation and the final decision of the EPA proceeding (see Sections 1.3 and 4.1).

Selection of Preferred Alternative (DOE, B-3)

The Summary and Conclusions have been altered to emphasize that a natural draft cooling tower is the preferred alternative.

Transfer of Operating Authority (PASNY, B-30)

Section 1.2 has been revised to reflect that operating authority for Unit 3 was transferred to the Power Authority March 8, 1978 (Amendment No. 12 to DPR-64).

Smaller Natural Draft Towers (DOI, B-10; Peekskill, B-26; PASNY, B-31)

The comment that smaller natural draft towers could be possible was intended to mean that since specific tower designs had not been finalized, it is possible that the final design will be smaller than the design described in the Environmental Statement. This statement has been deleted to reduce confusion.

Schedule (PASNY, B-31)

The detailed schedules contained in Section 4.1 and Figure 4.1 have been deleted.

Location of Parafilm-Covered Deposition Plates (PASNY, B-33)

Section 5.2.2.2 has been corrected to reflect the more precise location of collectors and relationship between parafilm collectors and leaves.

Archaeological Survey (DOI, B-9, B-11; ED, B-55)

Section 6.3.1.8 has been revised to include a requirement that archaeological survey be performed for the area to be distributed by construction of a CCC system at Unit No. 3. The results of this survey will be forwarded to the SHPO and State Archaeologist for review.

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*5-16 and 5-17 - Comments dealt with background aerosol concentrations and pathways of salt entry into leaves.

See response to comment 5-15 for a more complete discussion of pathways of salt entry into plants. The staff generally agrees with the physiological discussion as presented. Passage of salts through the cuticle and epidermous is a possible pathway of entry.

The size distribution of particles in the chamber experiments does not necessarily rule out stomatal entry, however. Pisek[7] et al., have tabulated stomatal measurements for temperate zone species which show widths over the range of 15-20 μm and lengths of from 16-55 μm for stomatal apertures in the open state among various species. Apertures of this size would admit a portion of the particles generated in the chamber experiments. If only 1-5% of the particles generated were of appropriate size the chamber atmosphere would contain 15-75 $\mu g/m^3$ of Cl (1500 x .05) from such particles. This is within the range of reported levels of salt (10-100 $\mu g/m^3$) which causes foliar damage.[8, 9, 10]

The staff's conclusion is that this is a realistic source of possible error which cannot be discounted and should have been ruled out experimentally. The consequences of such error if it exists is that the thresholds for damage would be higher than projected, not lower. The analysis is, therefore, conservative.

(Footnotes not in IP-2 FES CCC.)

Local Property Taxes (PASNY, B-36)

The staff agrees with this position and has deleted those sections 6.3.2.3.c and 6.3.3.3.d.

Evaluation of the Proposed Action (DEC, B-21; PASNY, B-36, B-37)

The staff has rewritten Section 7 to reflect a clearer interpretation of land use than had appeared in the DES.

Onsite Land Use (PASNY, B-37)

A brief discussion of the onsite land use associated with the preferred CCC system has been added to Section 7.1.

Selection of Cooling Tower Design (DOI, B-10)

Section 7 has been rewritten to more adequately reflect the fact that the purpose of this FES is to select the preferred CCC system.

APPENDIX A

RESULTS OF STAFF CALCULATIONS OF SALT DRIFT DEPOSITION, INDUCED FOGGING AND ICING AND SALT AEROSOL CONCENTRATION FROM OPERATION OF A NATURAL DRAFT COOLING TOWER AND A CIRCULAR MECHANICAL DRAFT TOWER AT INDIAN POINT UNIT NO. 2

APPENDIX A

The results of the staff's calculations for natural draft cooling towers (NDCT) are presented graphically as Figures A-1 through A-41. The results of the staff's calculations for circular draft cooling towers (CMDT) are presented graphically as Figures A-42 through A-83. The model (ORFAD) and tower parameters used for these calculations are described in Section 5.

The drift levels are presented in kilograms per hectare. To convert these numbers to pounds per acre, simply multiply by 0.892. All distances are given in miles. Fog and ice plots are not presented for months in which no additional hours of fog or ice conditions were reported. The concentrations of salt in air represent averages taken over the period indicated for each graph and are given in micrograms per cubic meter.

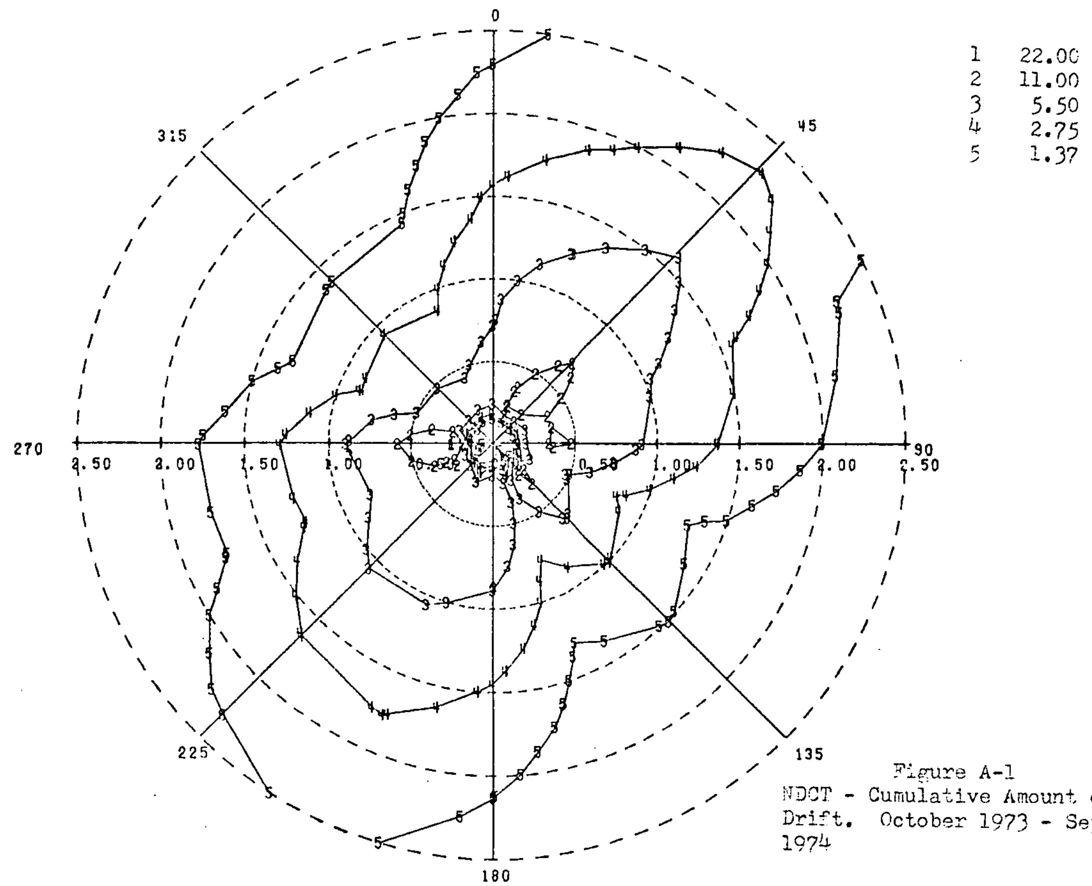


Figure A-1
NDCT - Cumulative Amount of Drift. October 1973 - September 1974

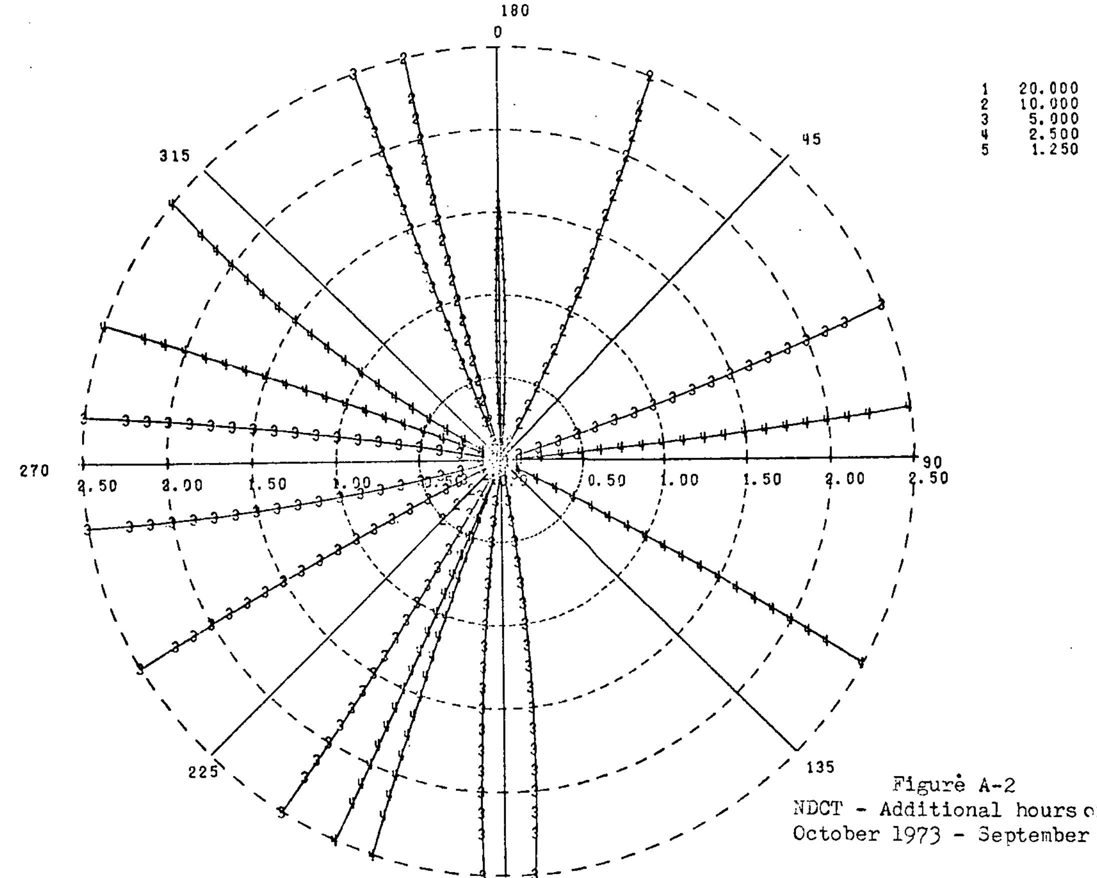


Figure A-2
NDCT - Additional hours of fog October 1973 - September 1974

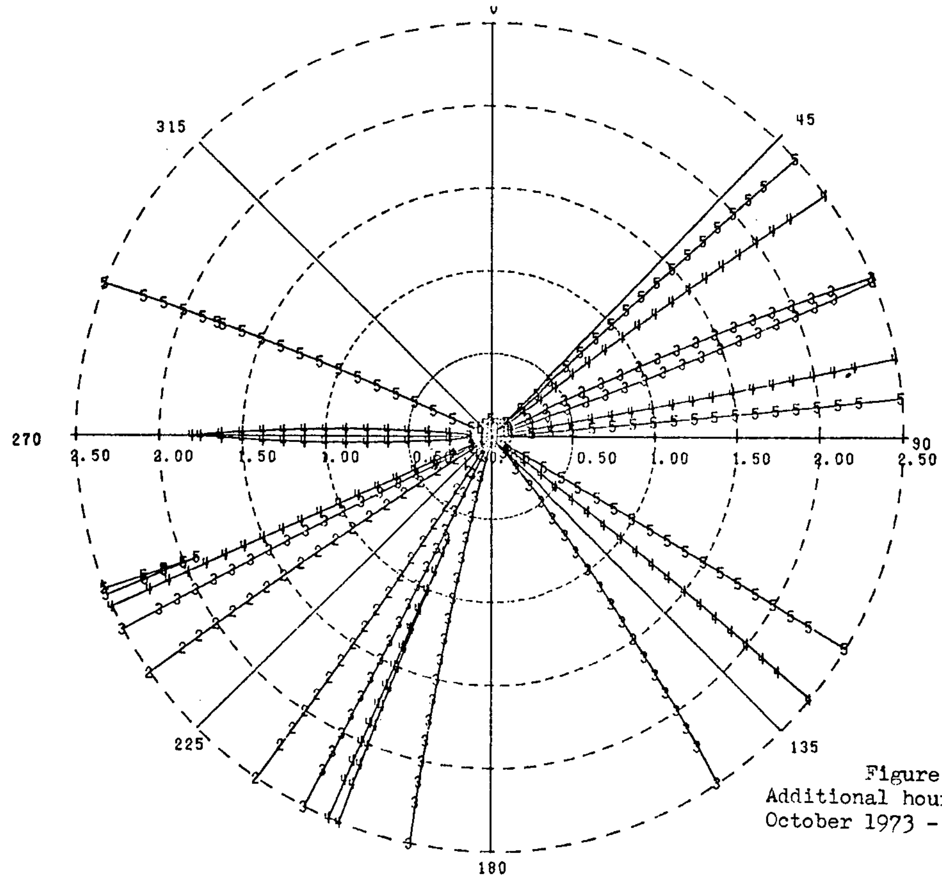


Figure A-3 NDCT
Additional hours of ice,
October 1973 - September 1974

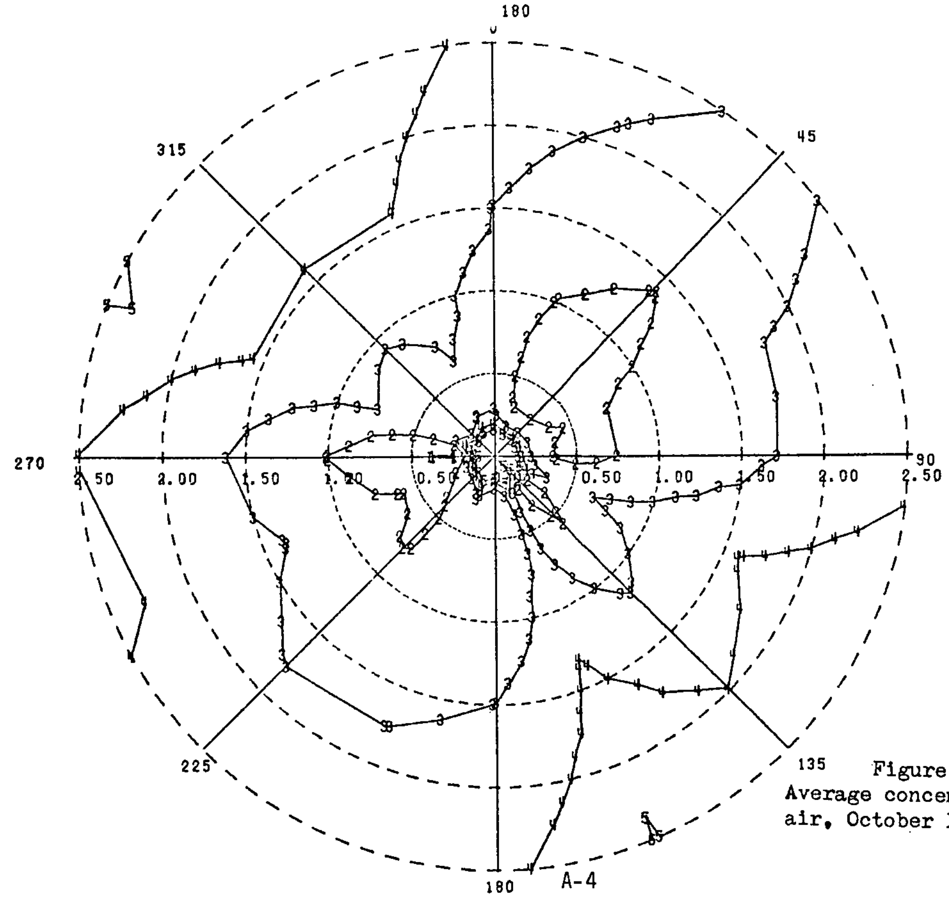


Figure A-4 NDCT
Average concentration of salt in air, October 1973-September 1974

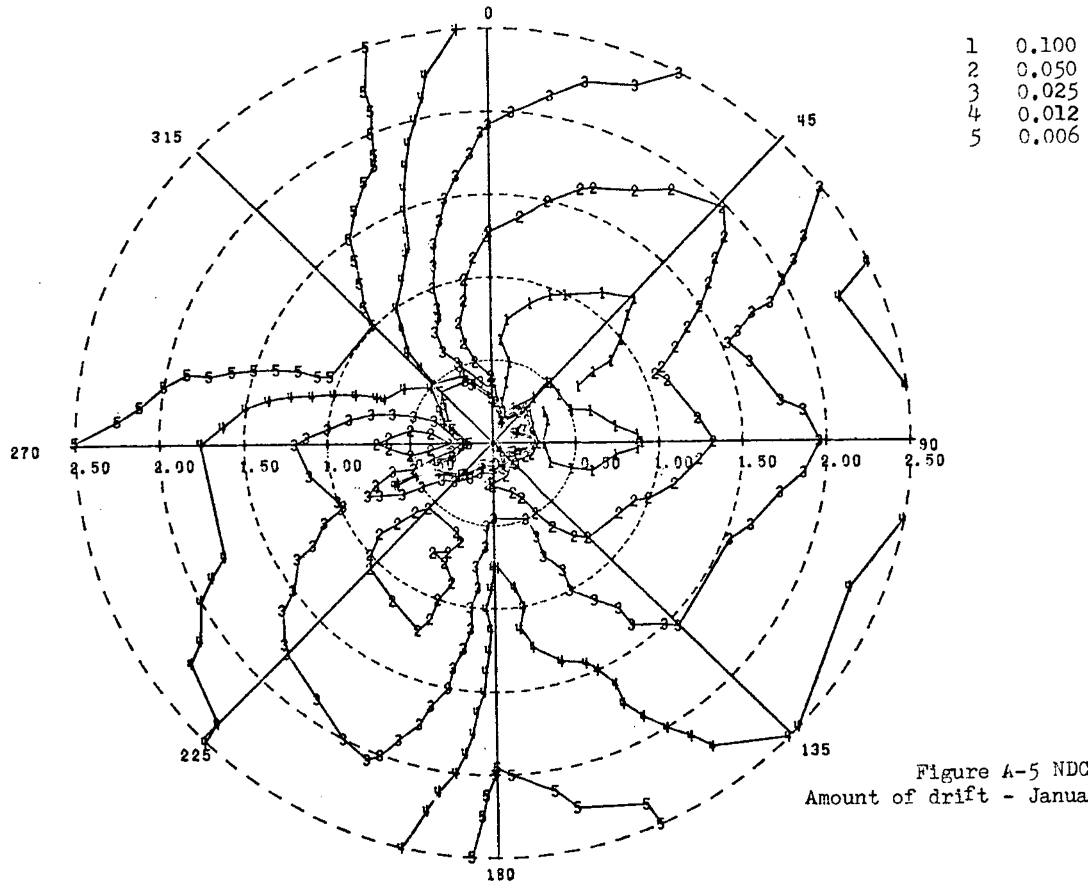


Figure A-5 NDCT
Amount of drift - January

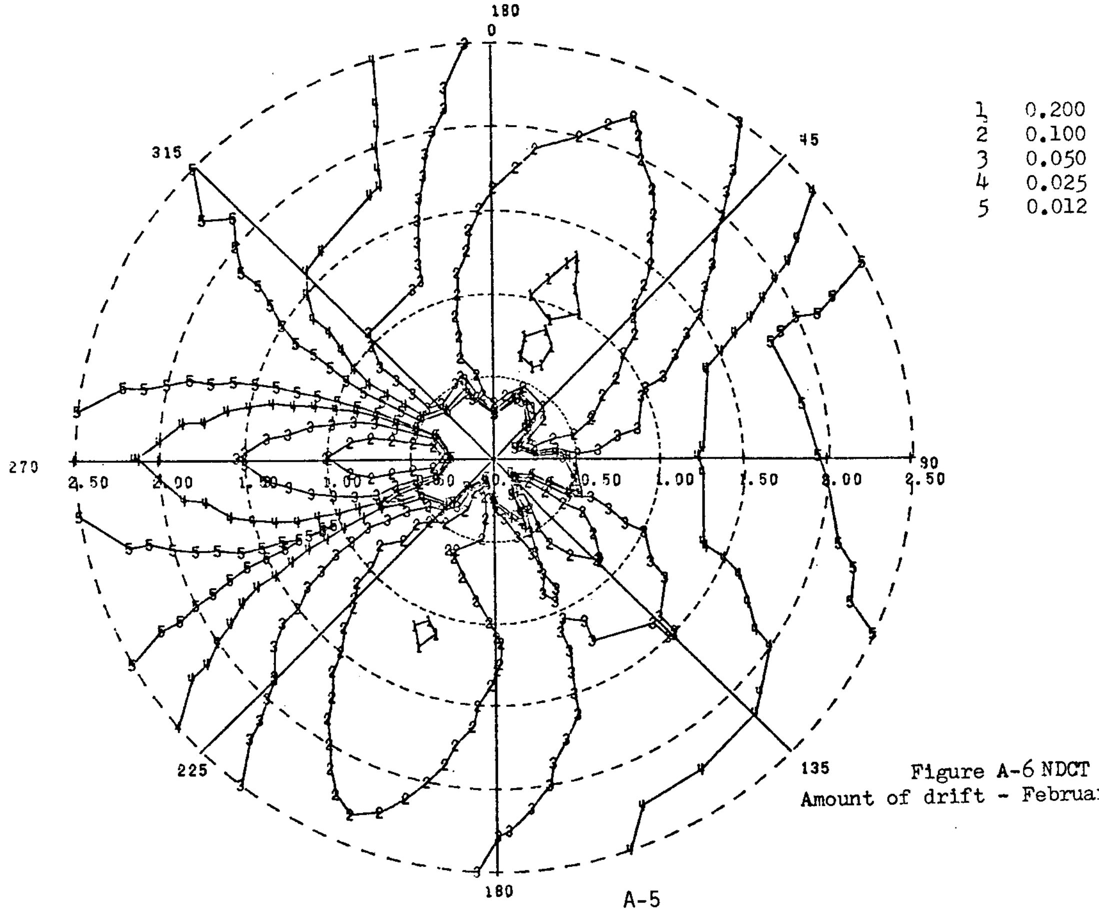
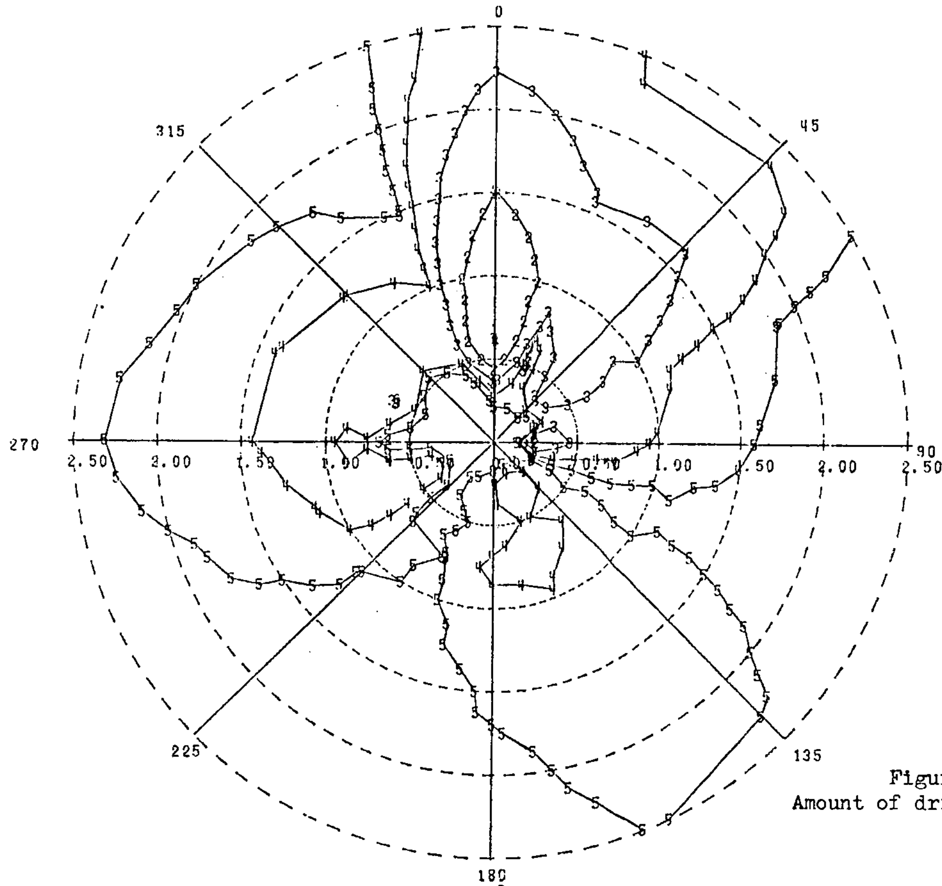
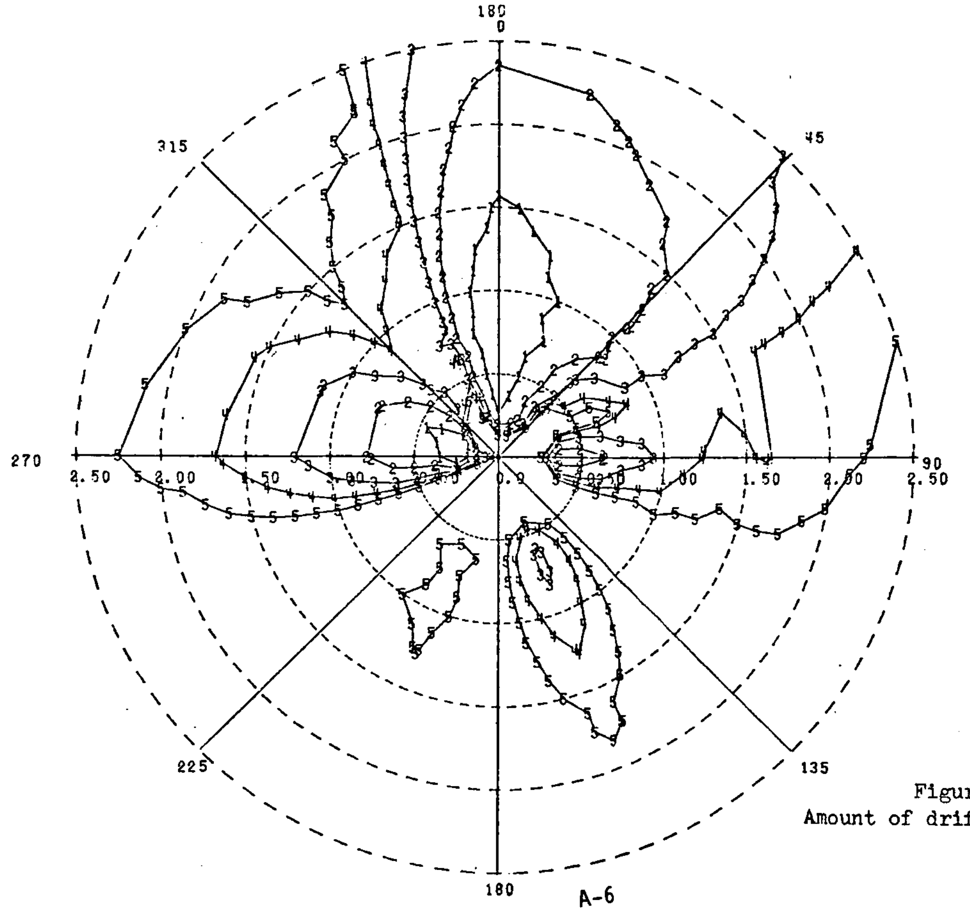


Figure A-6 NDCT
Amount of drift - February



1 0.000700
2 0.000350
3 0.000175
4 0.000088
5 0.000044

Figure A-7 NDCT
Amount of drift - March



1 0.0000100
2 0.0000050
3 0.0000025
4 0.0000012
5 0.0000006

Figure A-8 NDCT
Amount of drift - April

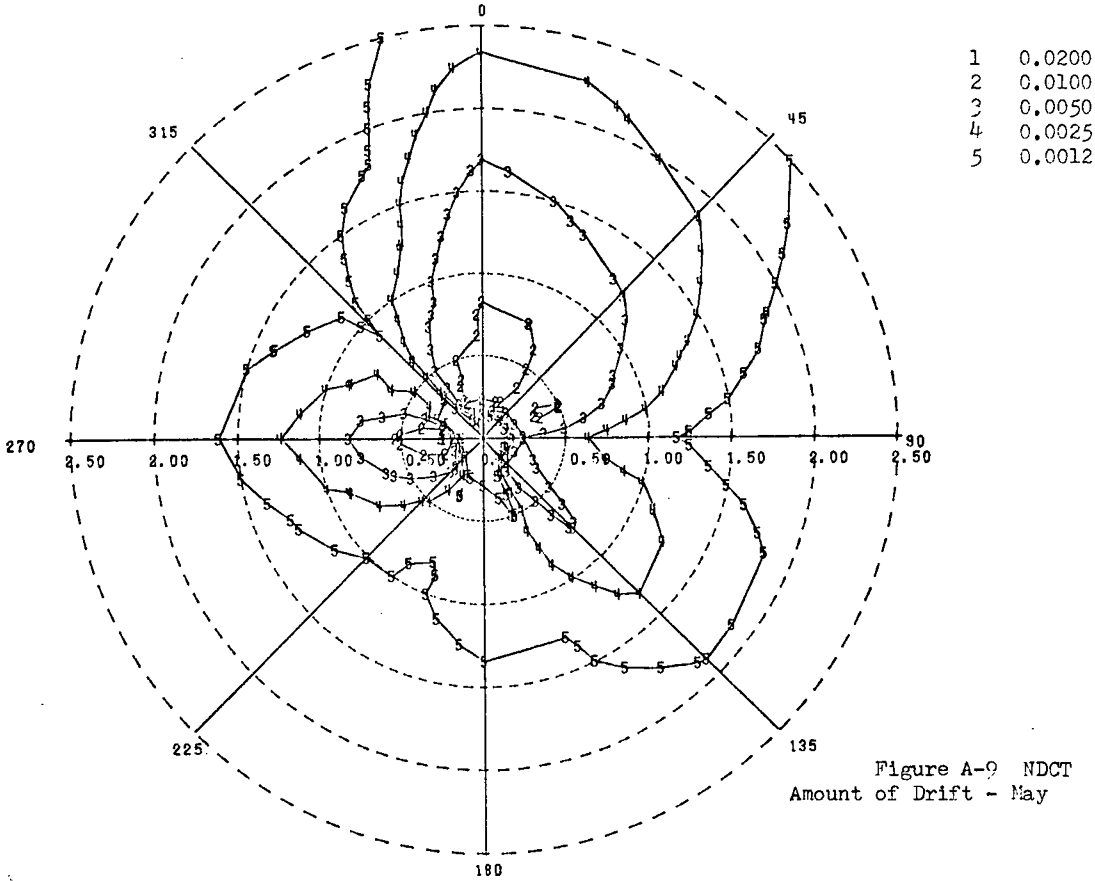


Figure A-9 NDCT
Amount of Drift - May

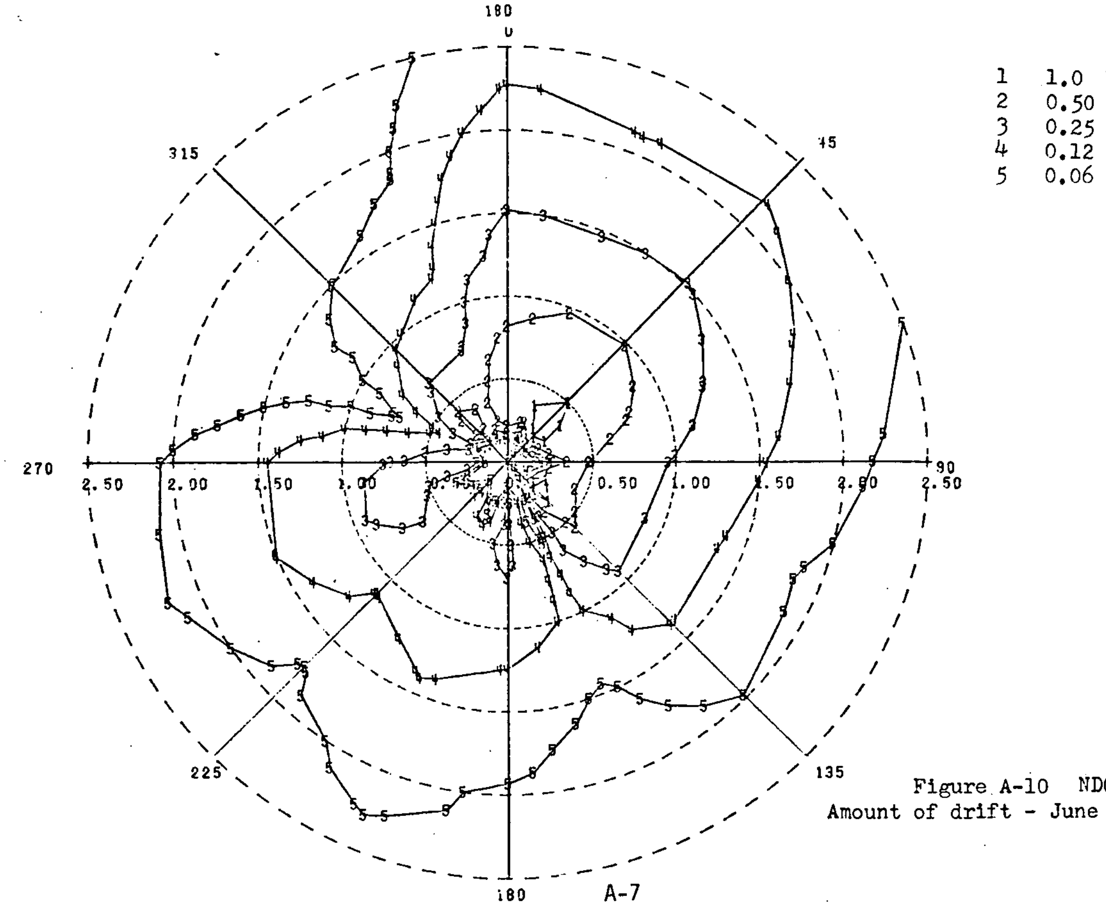
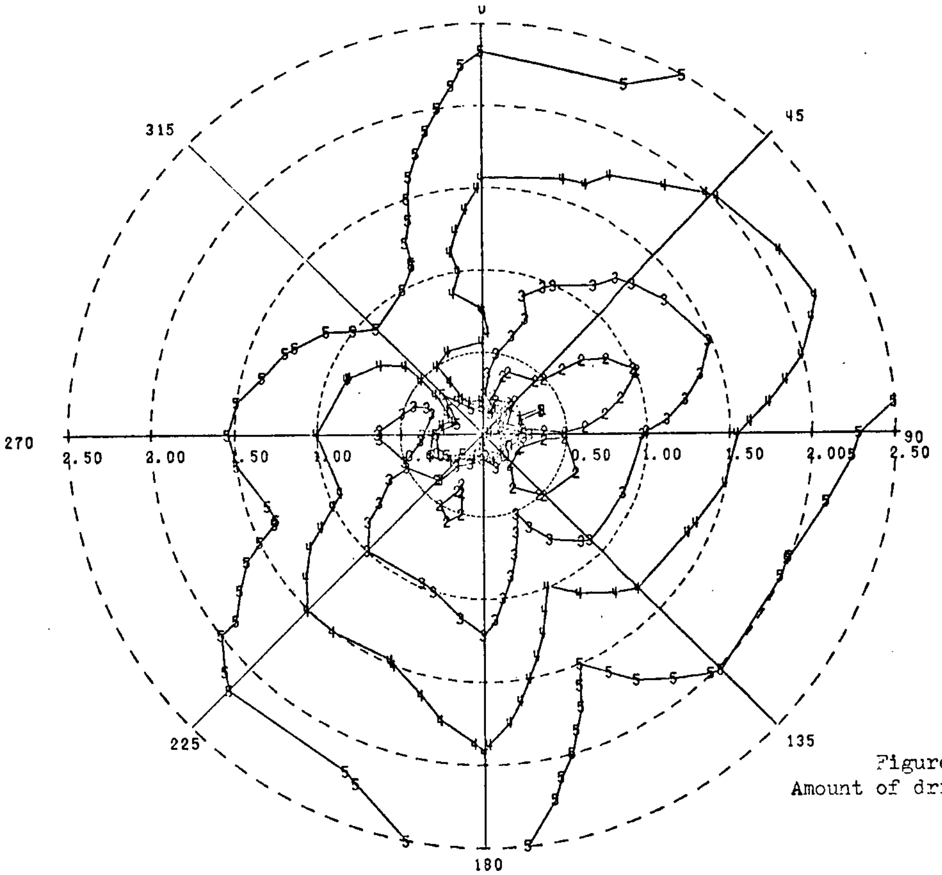
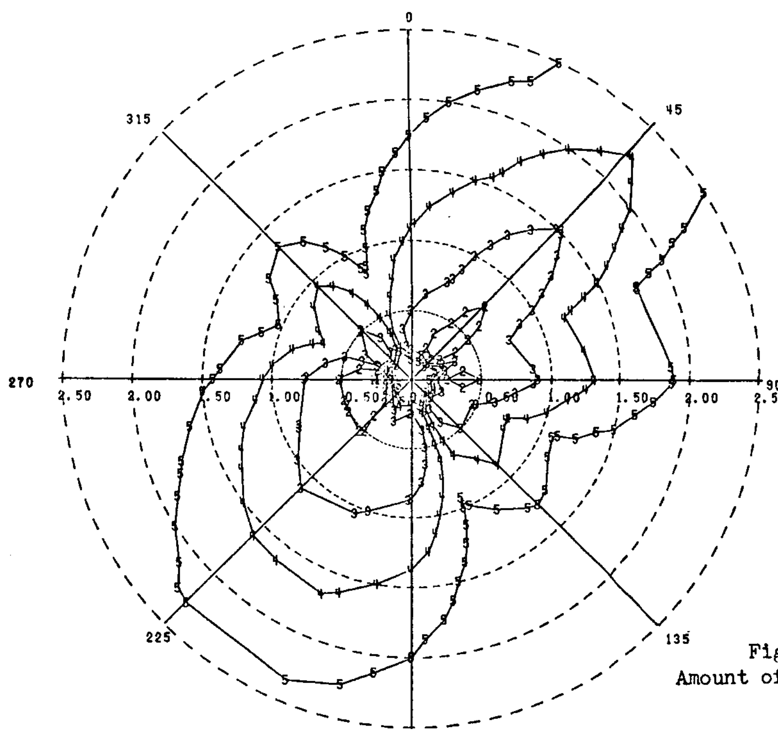


Figure A-10 NDCT
Amount of drift - June



1	3.00
2	1.50
3	0.75
4	0.37
5	0.19

Figure A-11 NDCT
Amount of drift - July



1	9.00
2	4.50
3	2.25
4	1.12
5	0.56

Figure A-12 NDCT
Amount of drift - August

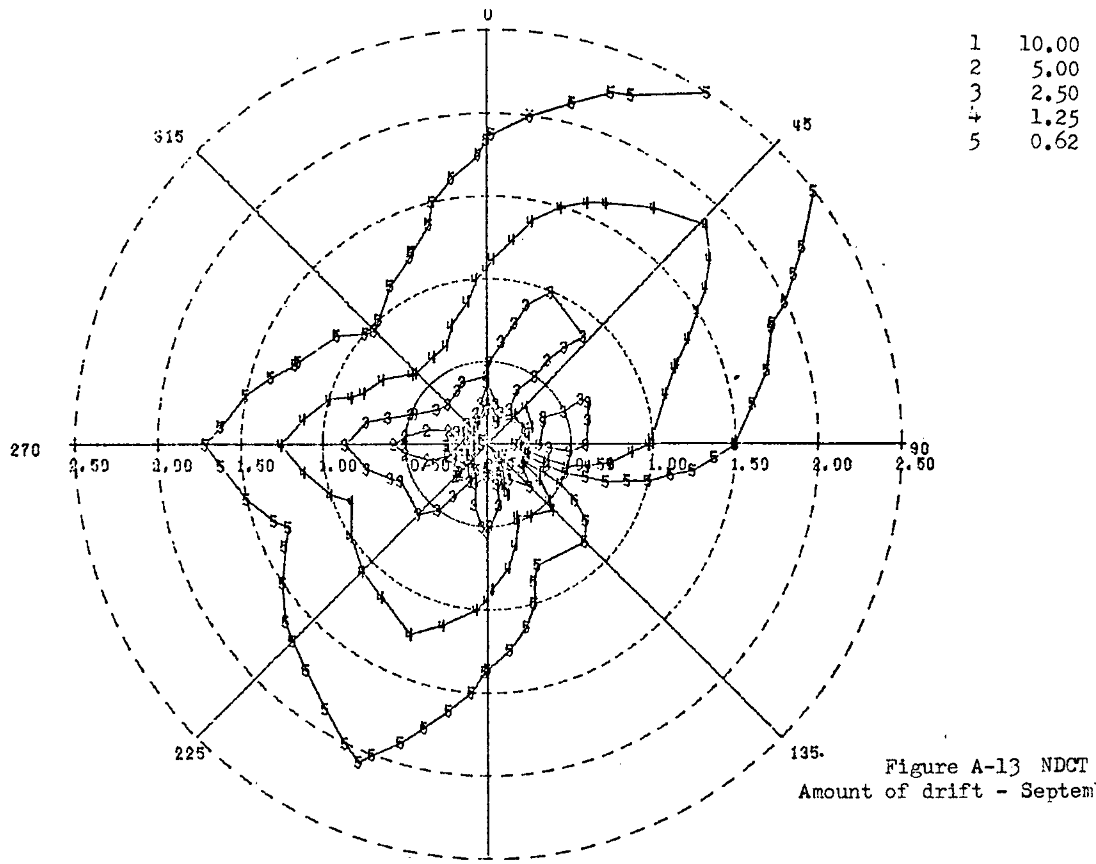


Figure A-13 NDCT
Amount of drift - September

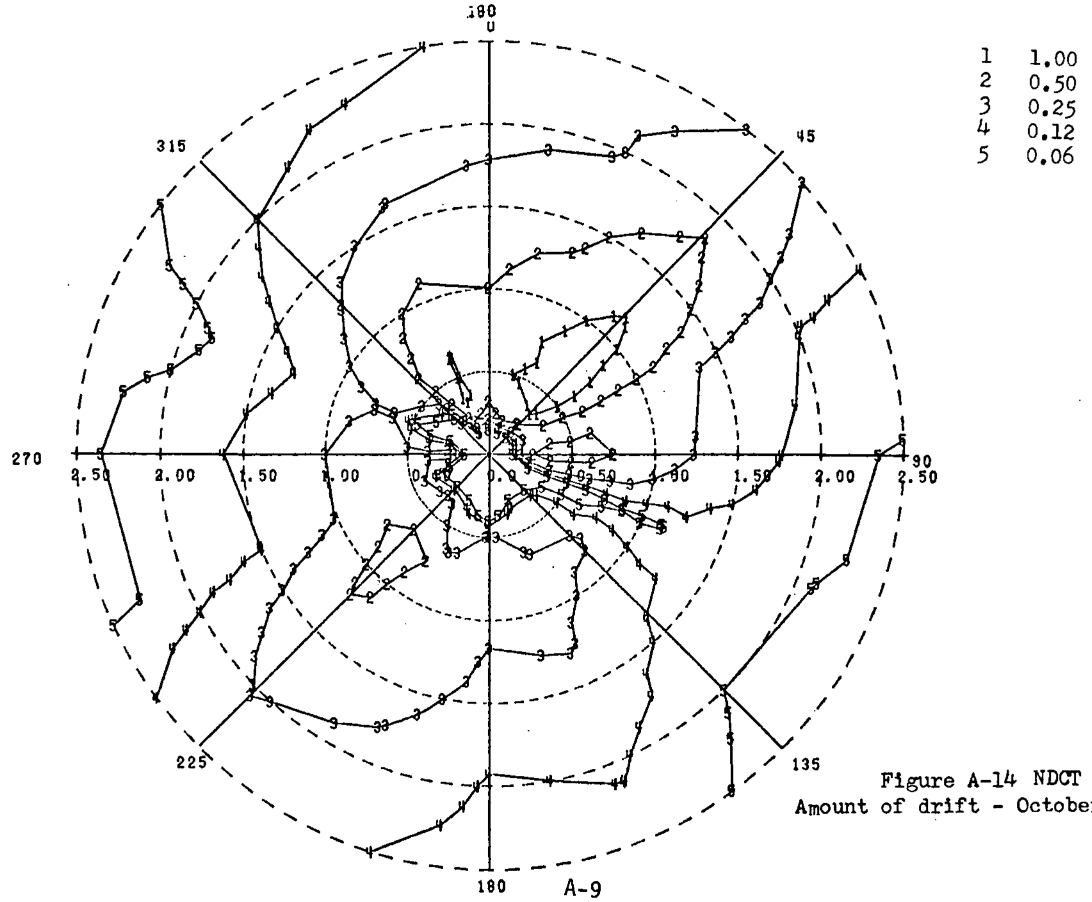


Figure A-14 NDCT
Amount of drift - October

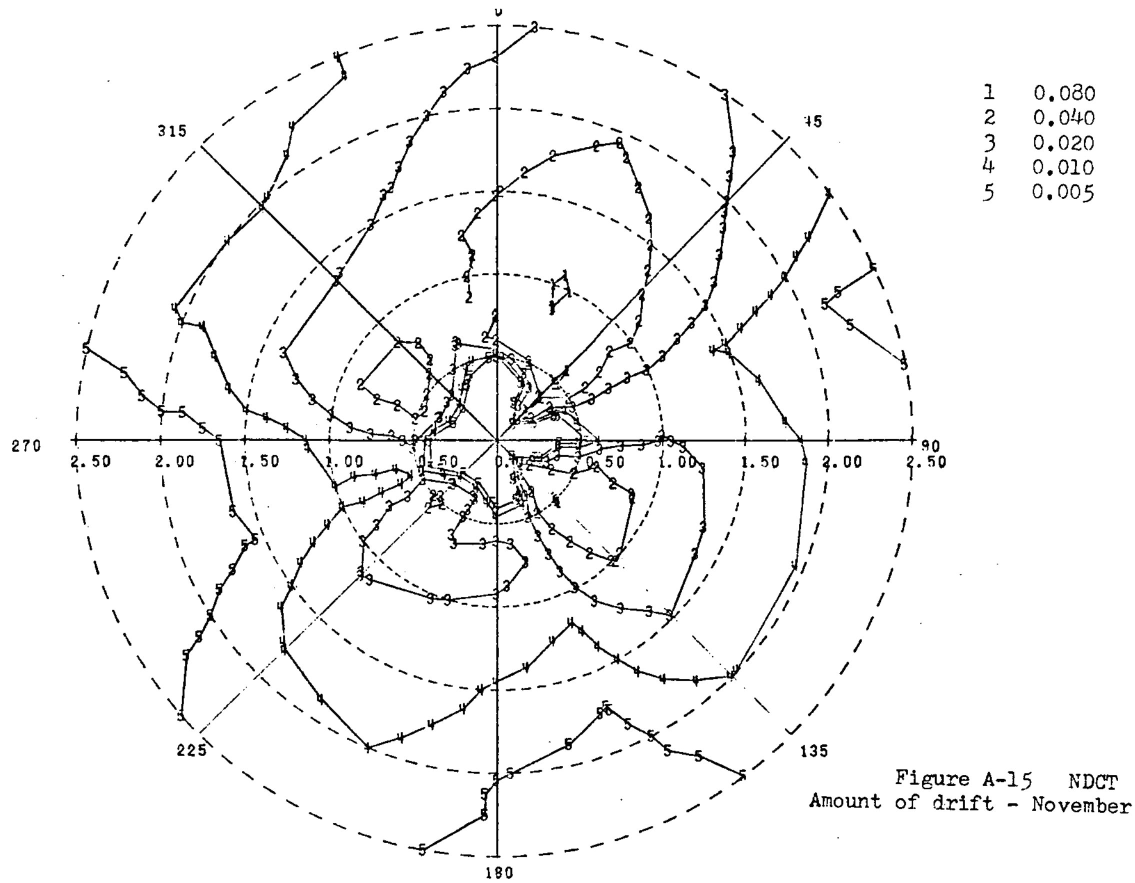


Figure A-15 NDCT
Amount of drift - November

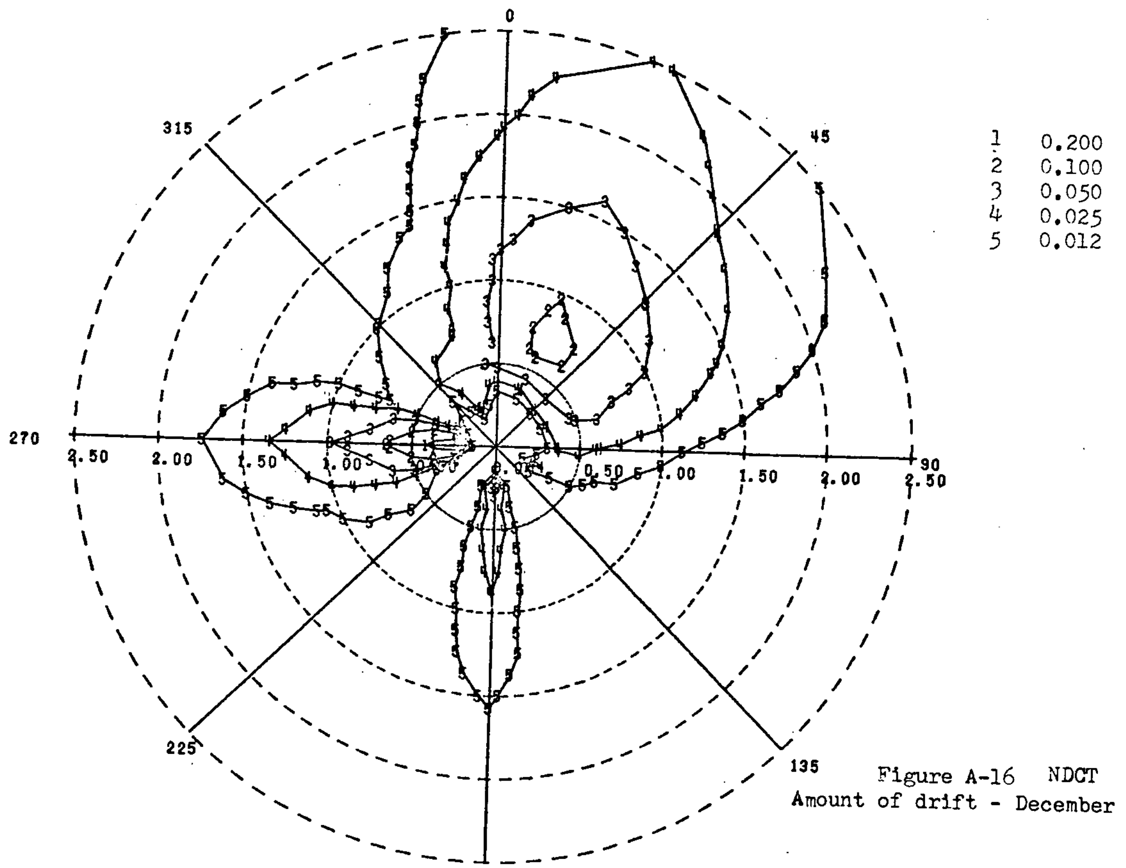


Figure A-16 NDCT
Amount of drift - December

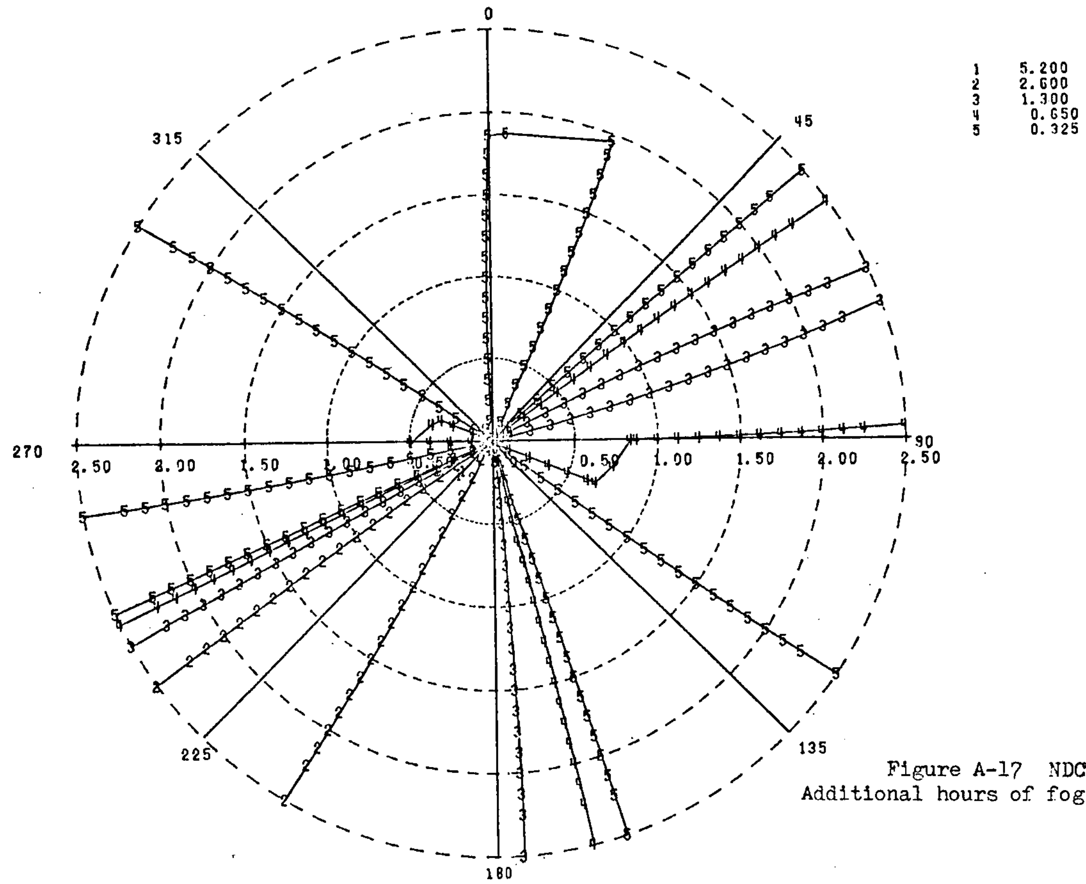


Figure A-17 NDCT
Additional hours of fog - Jan.

No additional hours of fog predicted for February

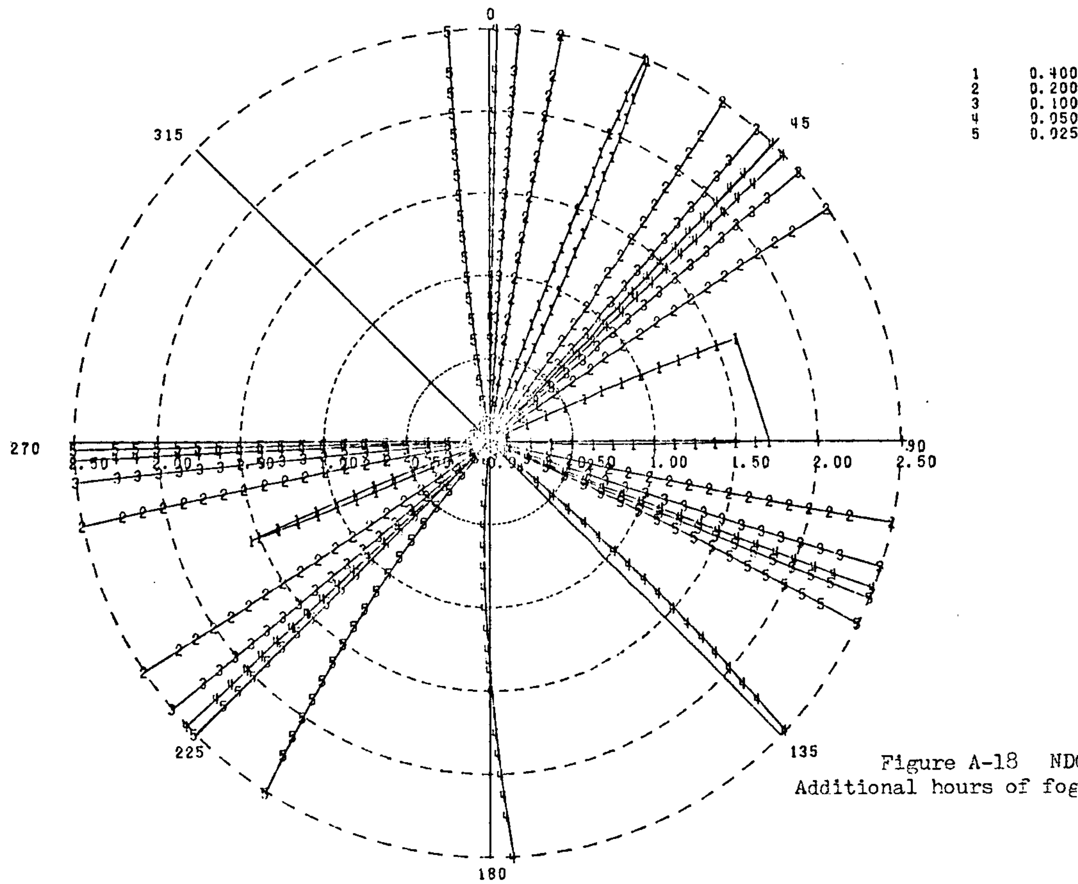


Figure A-18 NDCT
Additional hours of fog - March

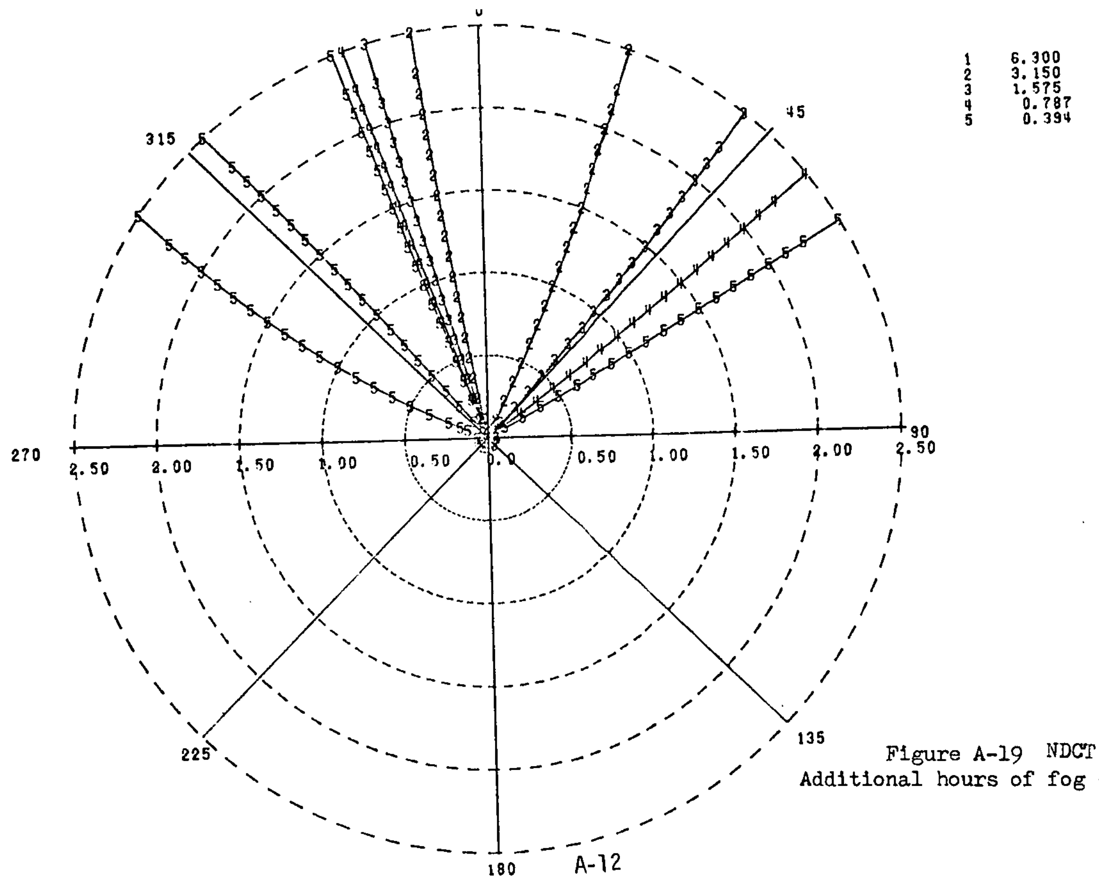


Figure A-19 NDCT
Additional hours of fog - April

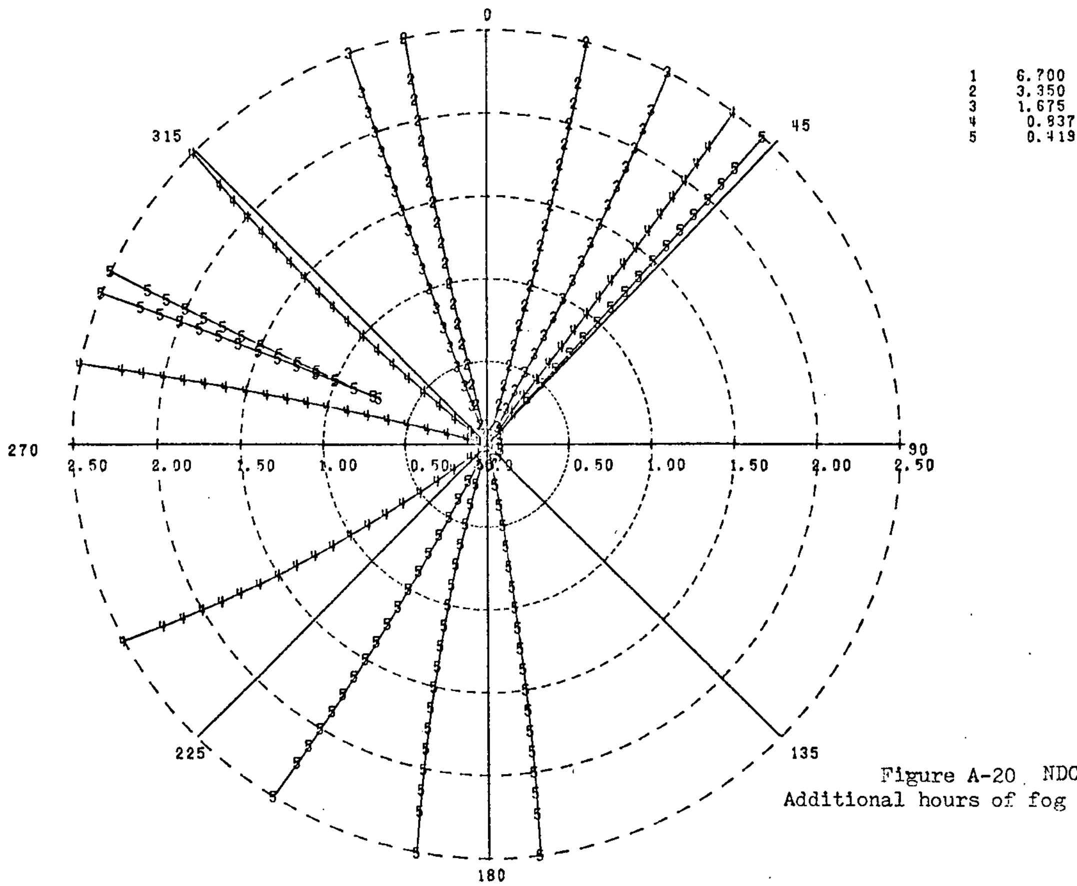


Figure A-20 NDCT
Additional hours of fog - May

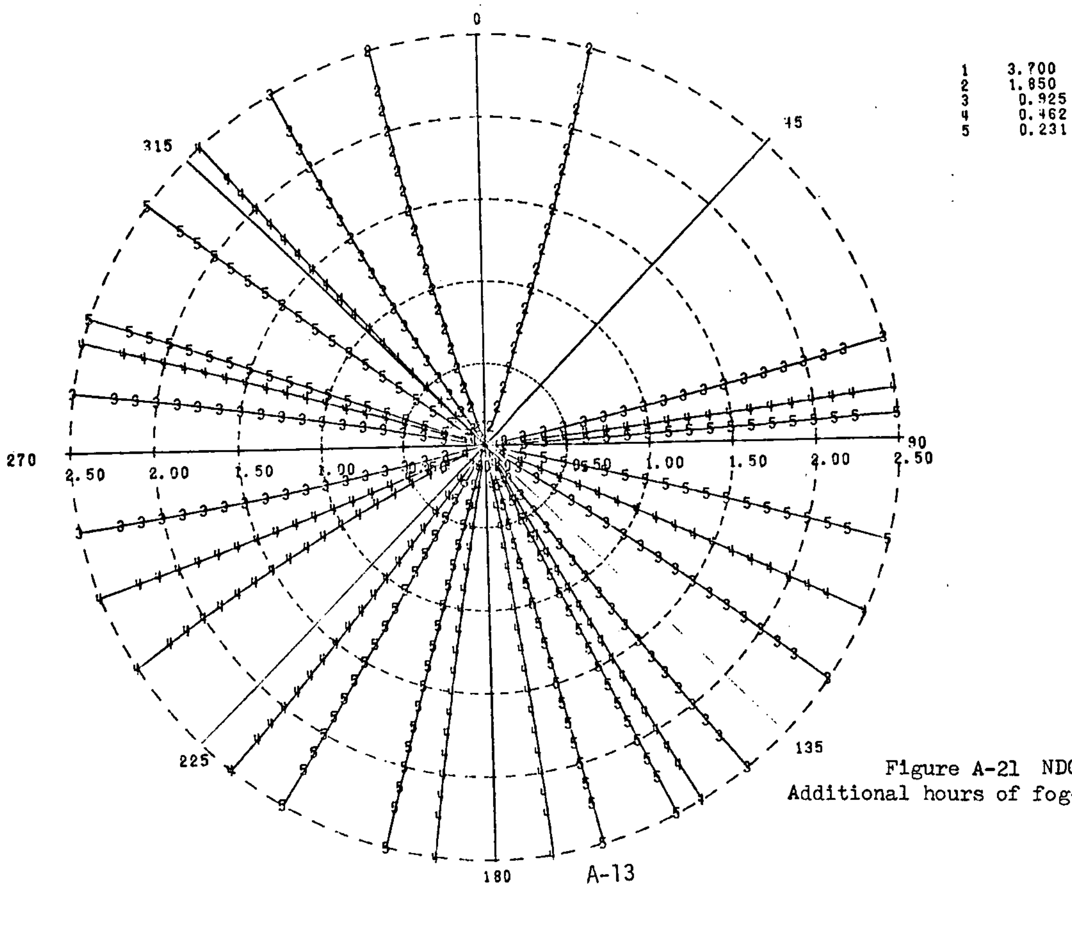


Figure A-21 NDCT
Additional hours of fog- June

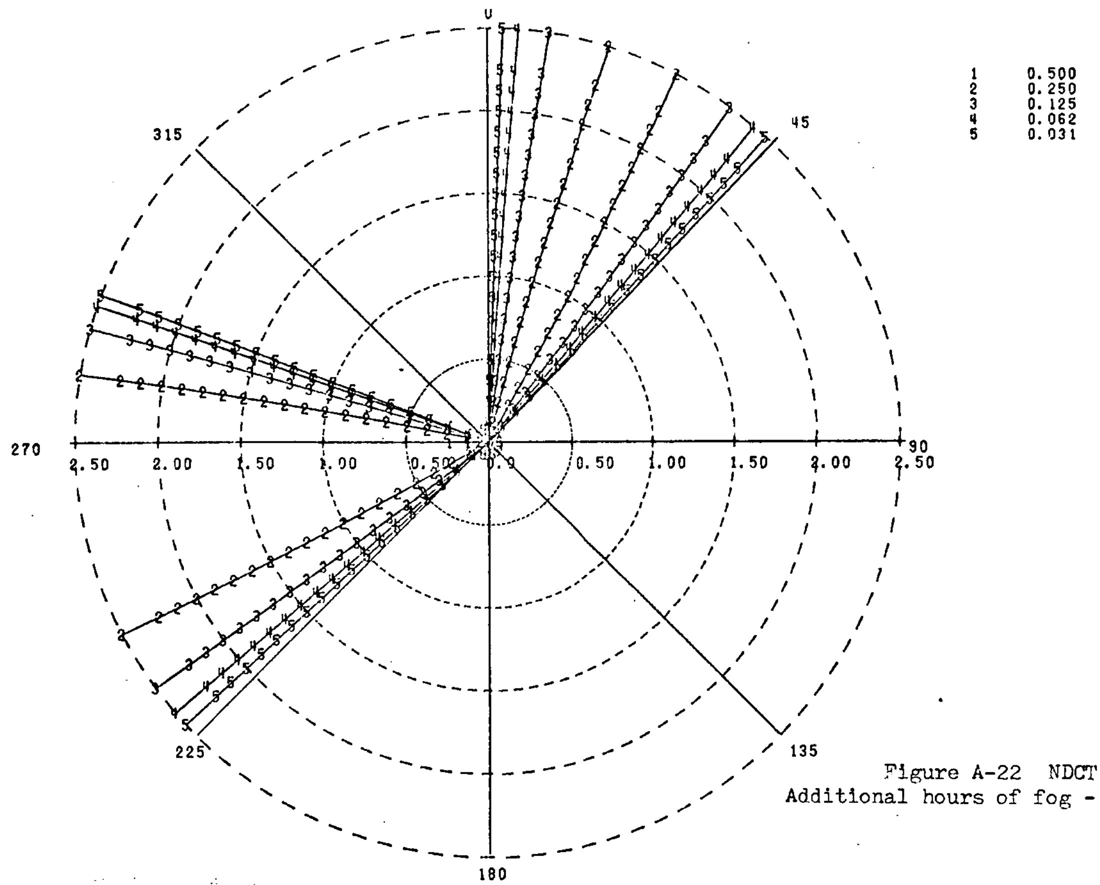


Figure A-22 NDCT
Additional hours of fog - July

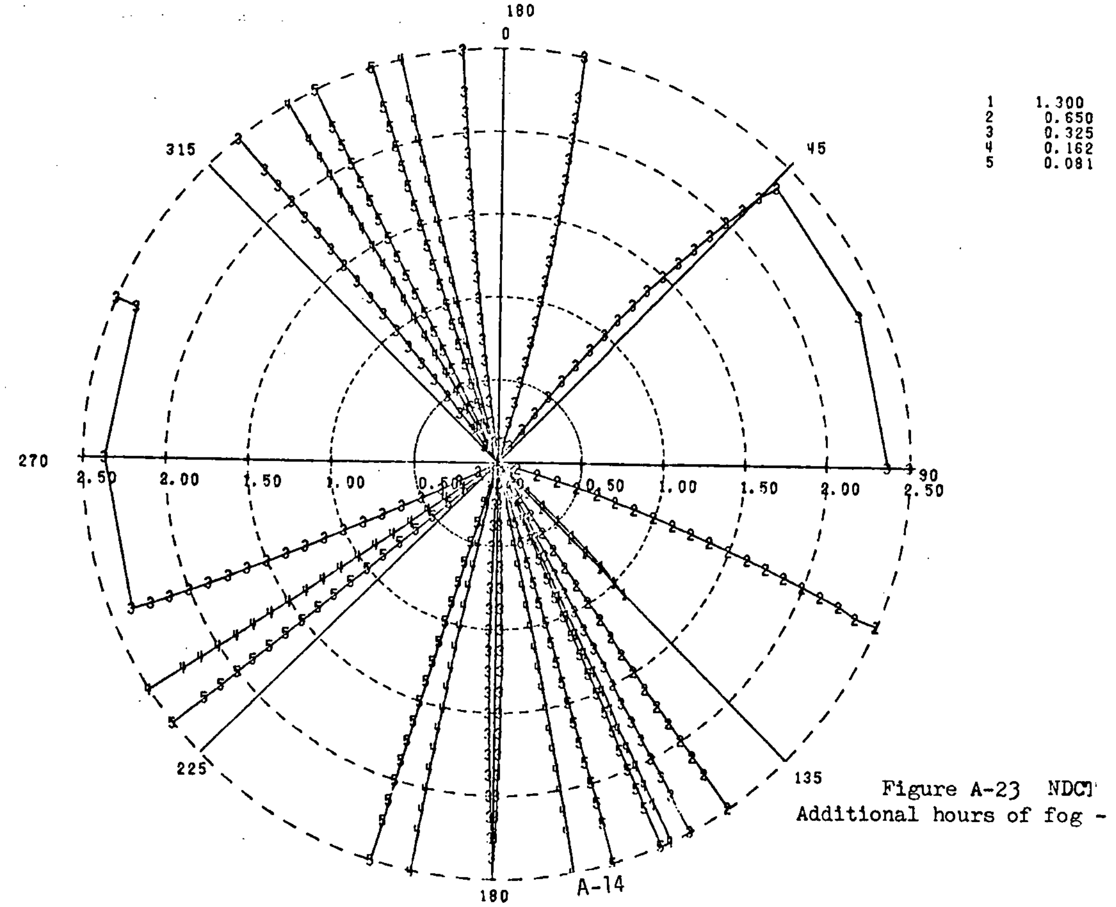


Figure A-23 NDCT
Additional hours of fog - August

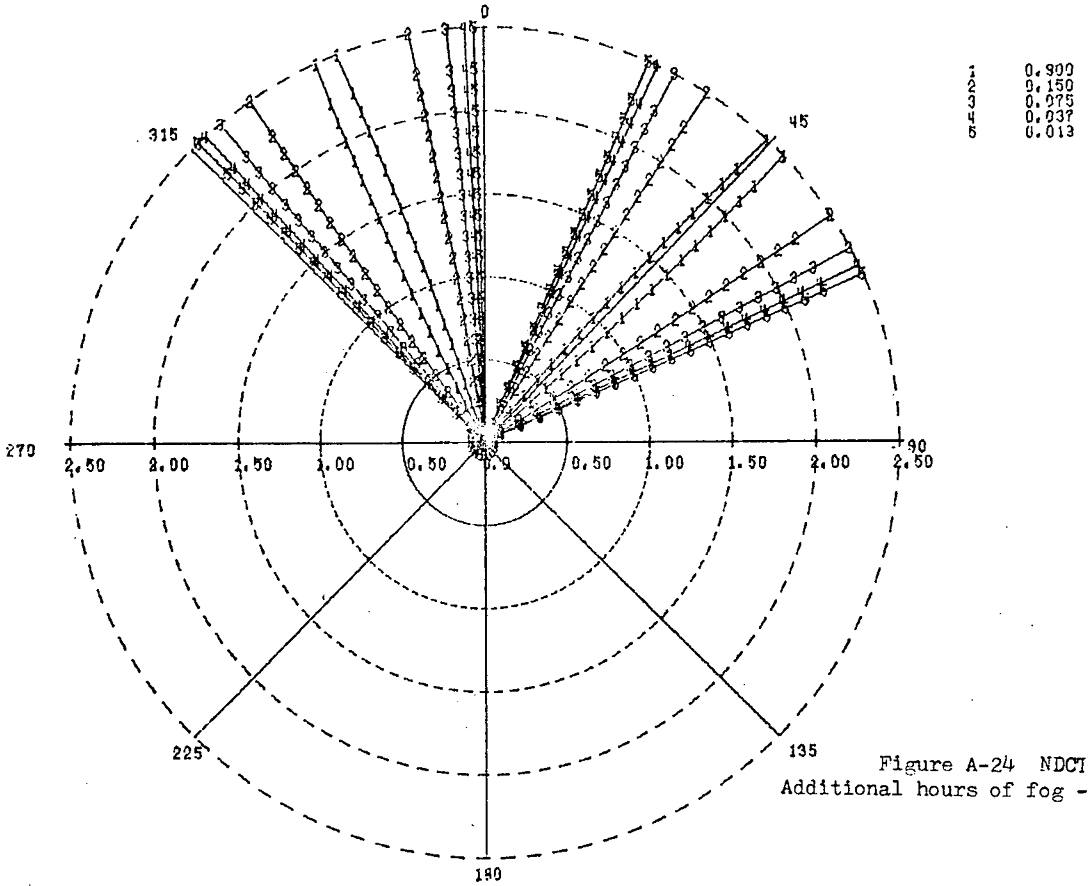


Figure A-24 NDCT
Additional hours of fog - Sept.

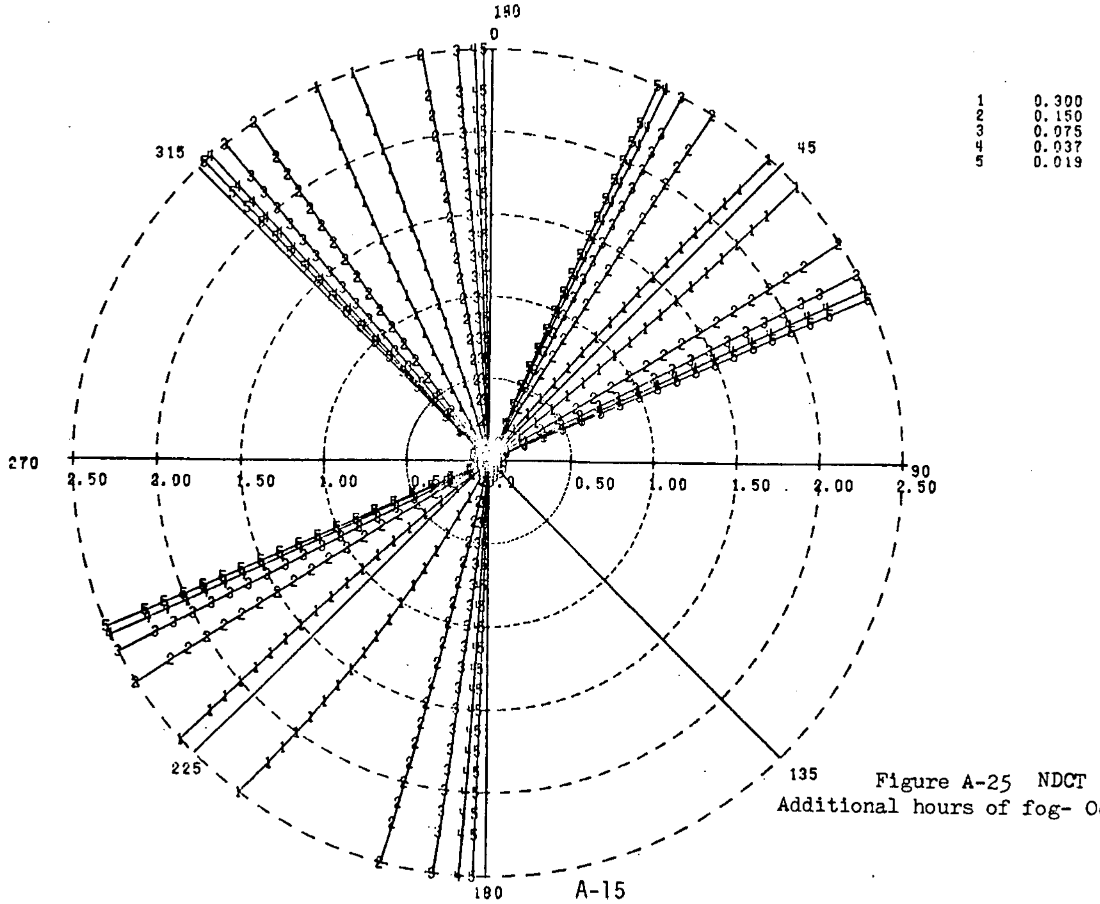


Figure A-25 NDCT
Additional hours of fog- October

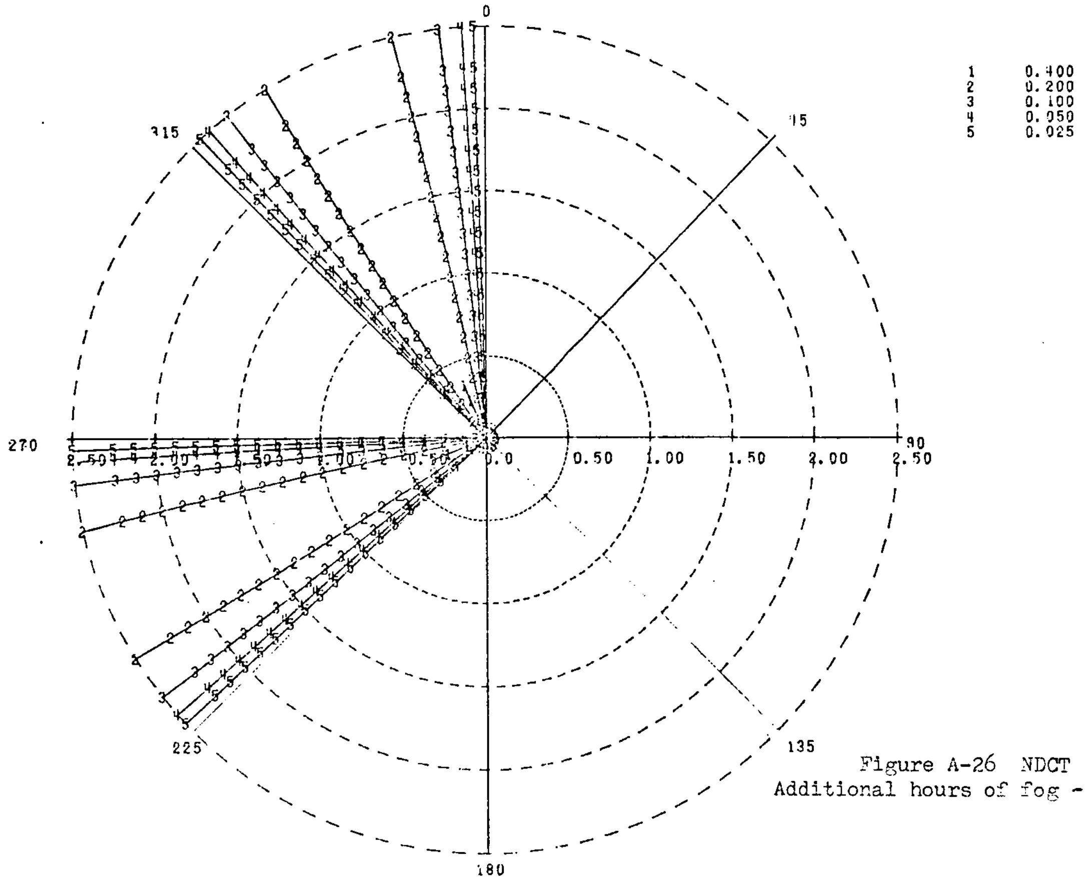


Figure A-26 NDCT
Additional hours of fog - Nov.

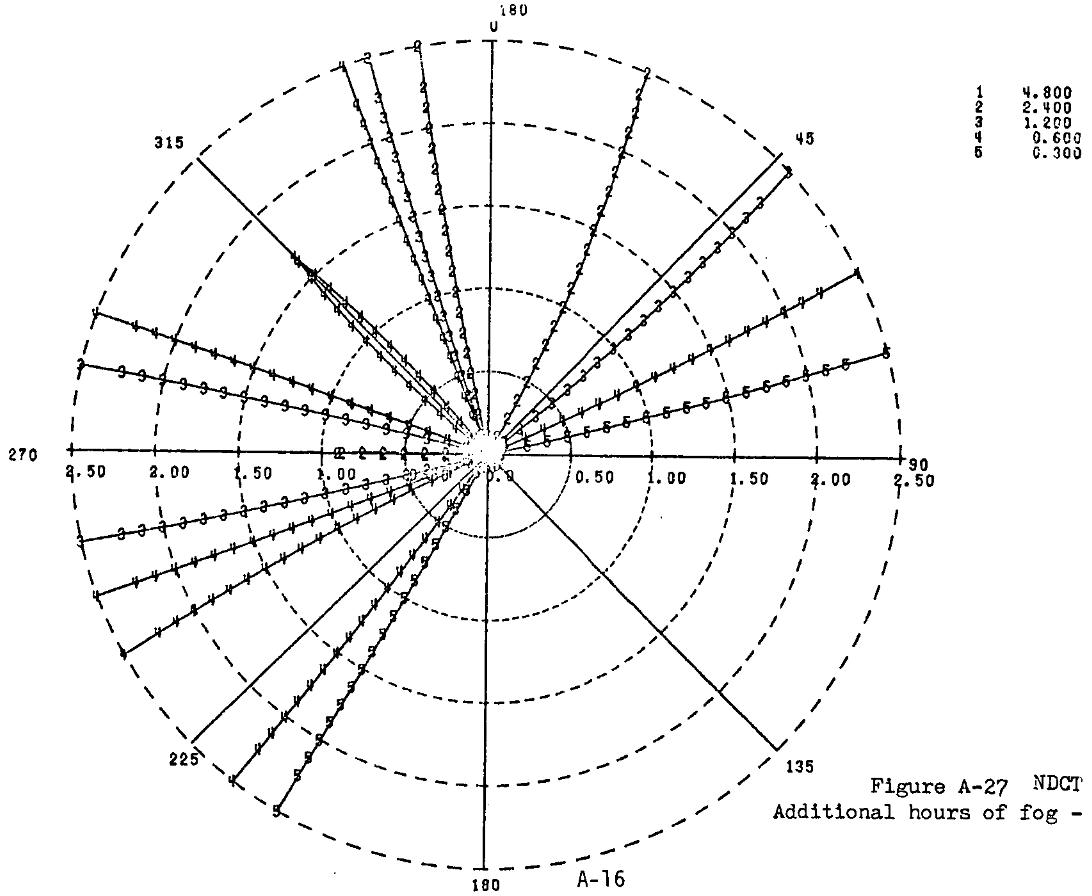


Figure A-27 NDCT
Additional hours of fog - Dec.

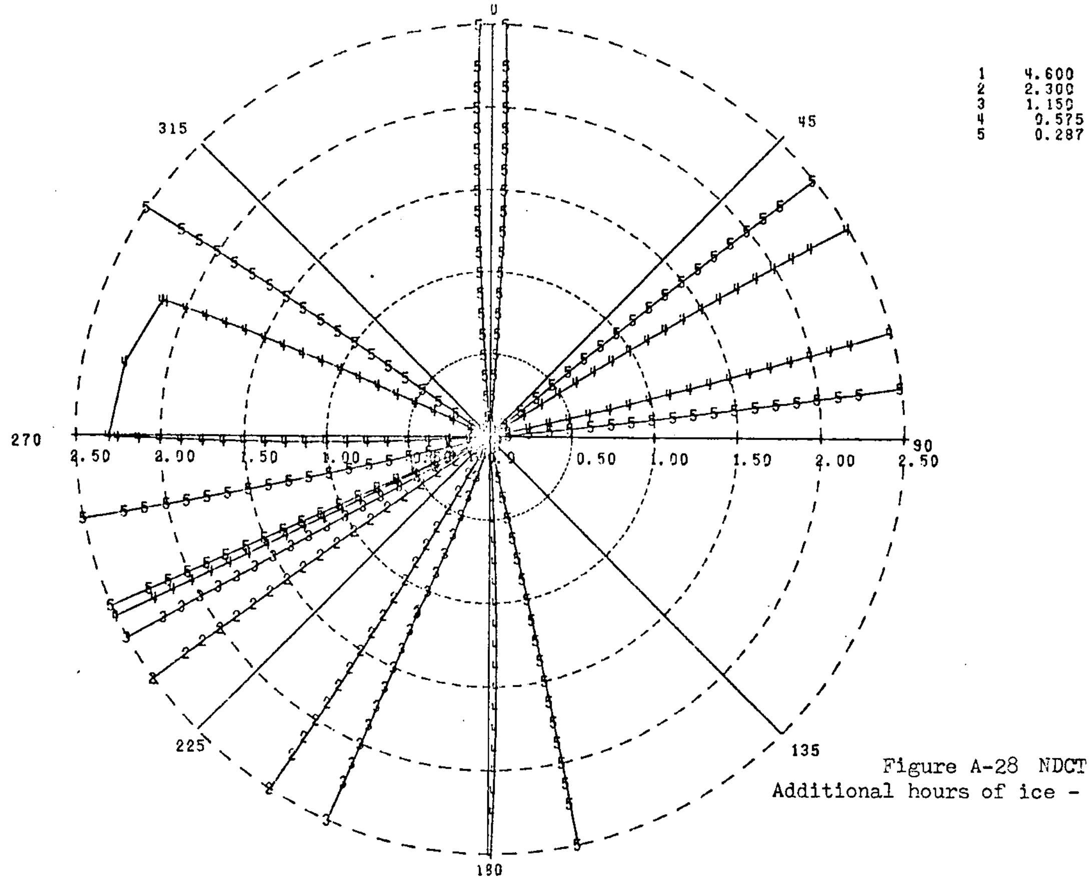


Figure A-28 NDCT
Additional hours of ice - Jan.

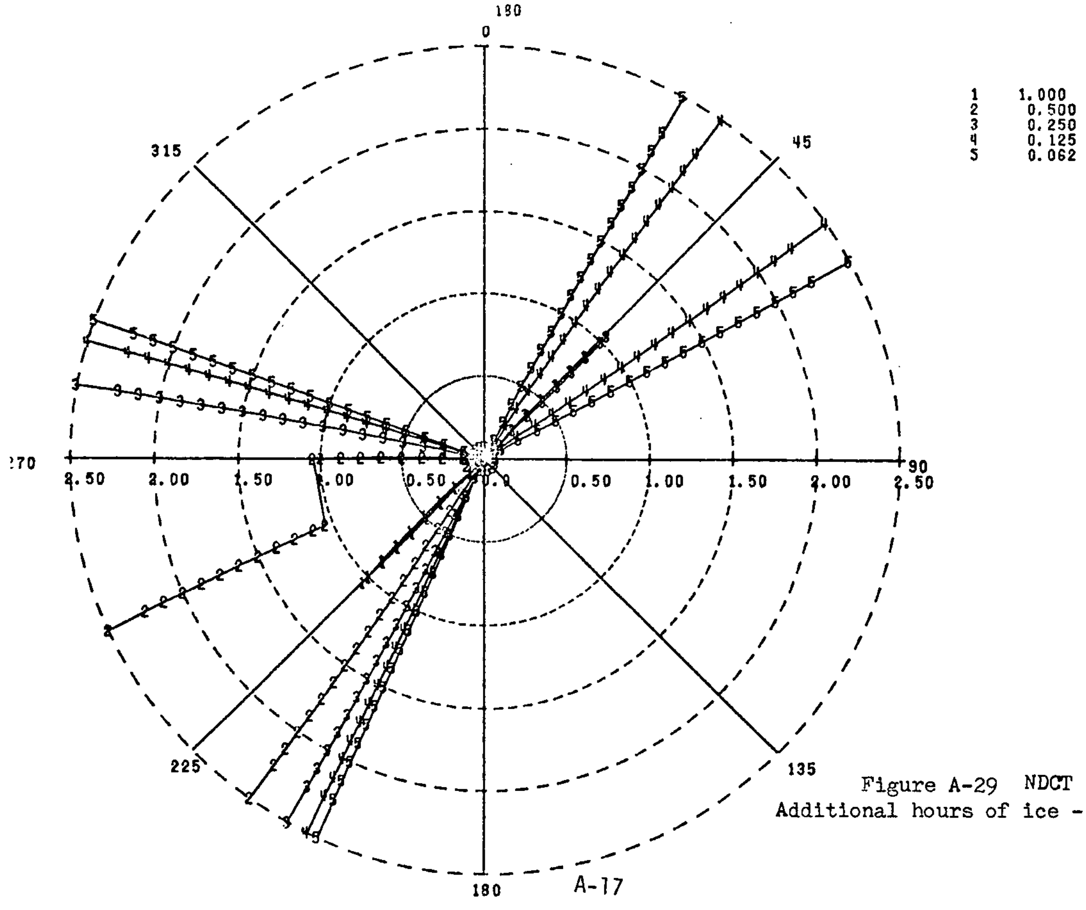


Figure A-29 NDCT
Additional hours of ice - Dec.

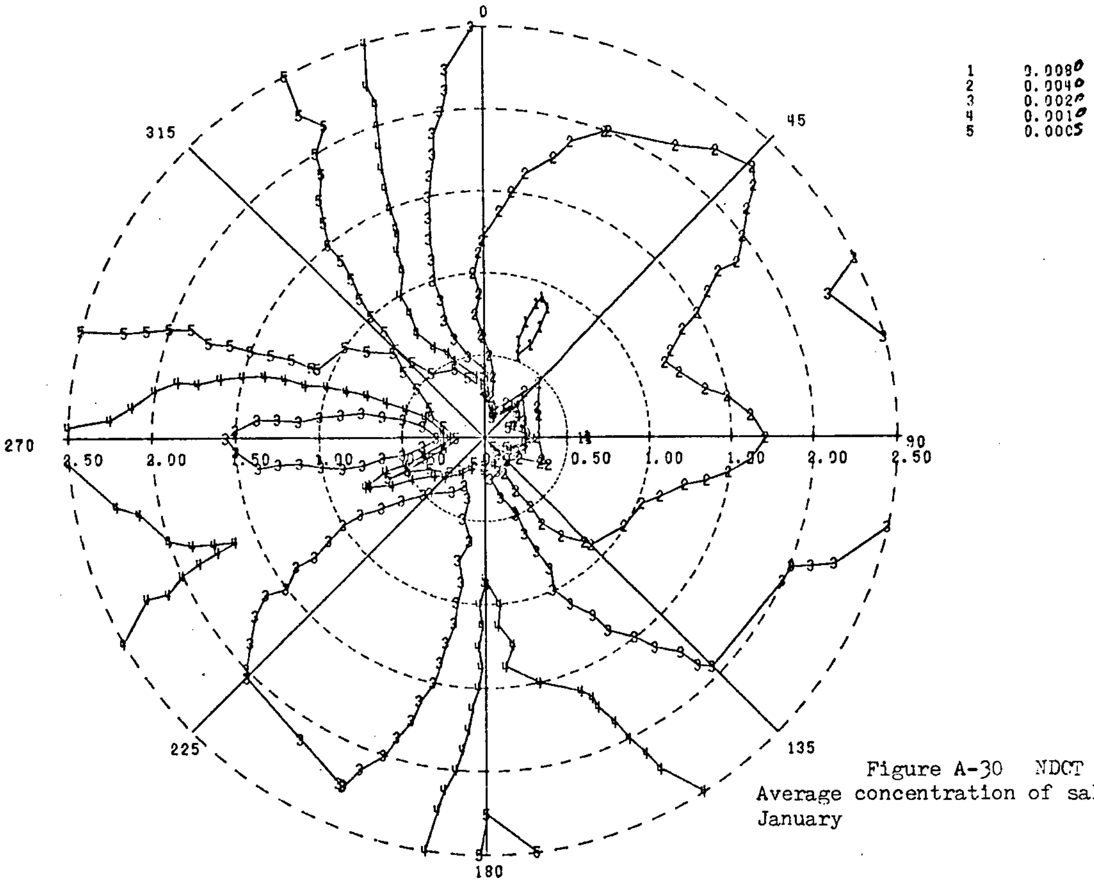


Figure A-30 NDCT
Average concentration of salt in air
January

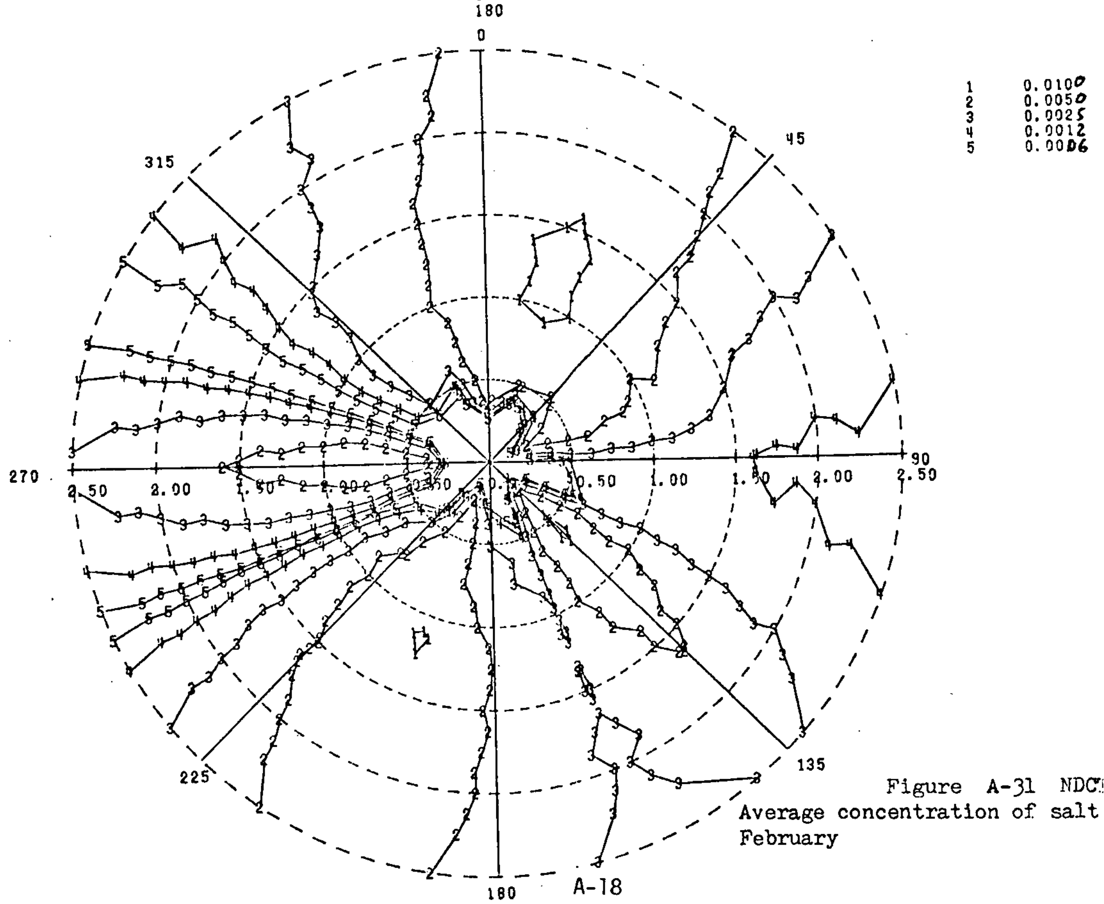


Figure A-31 NDCT
Average concentration of salt in air
February

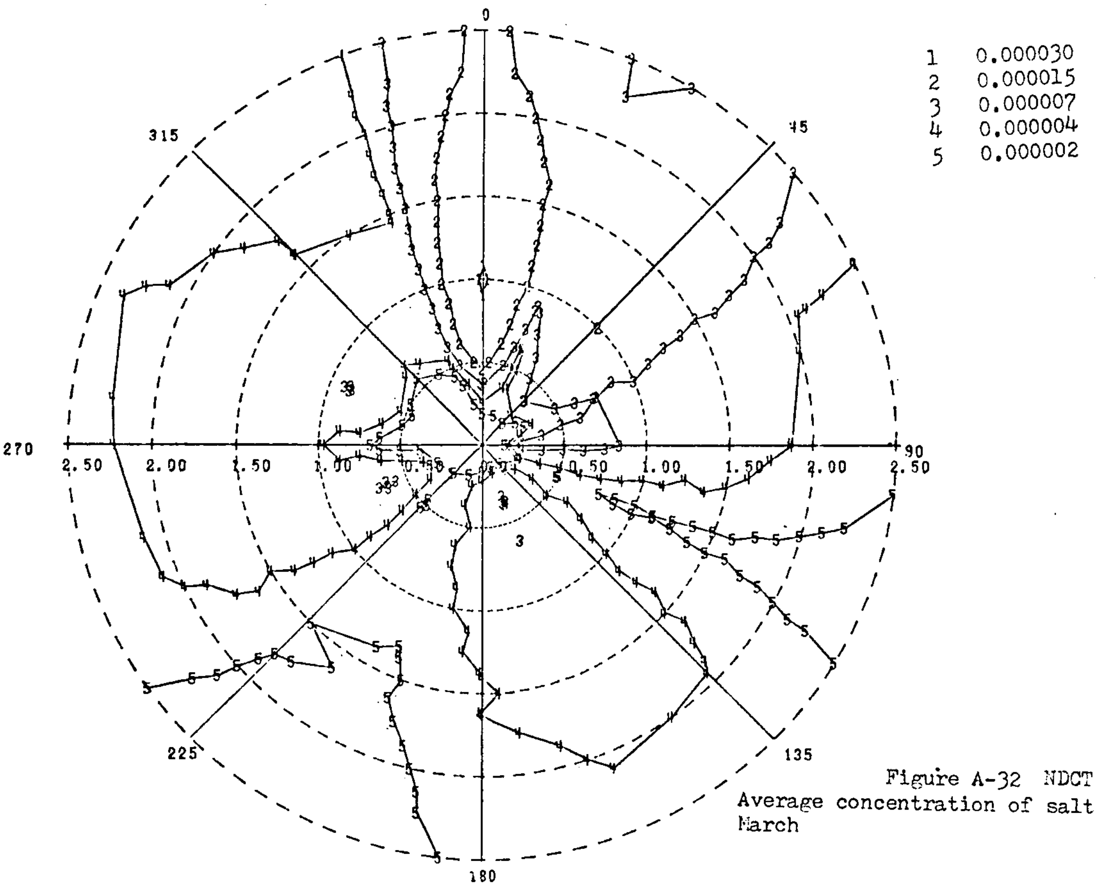


Figure A-32 NDCT
Average concentration of salt in air
March

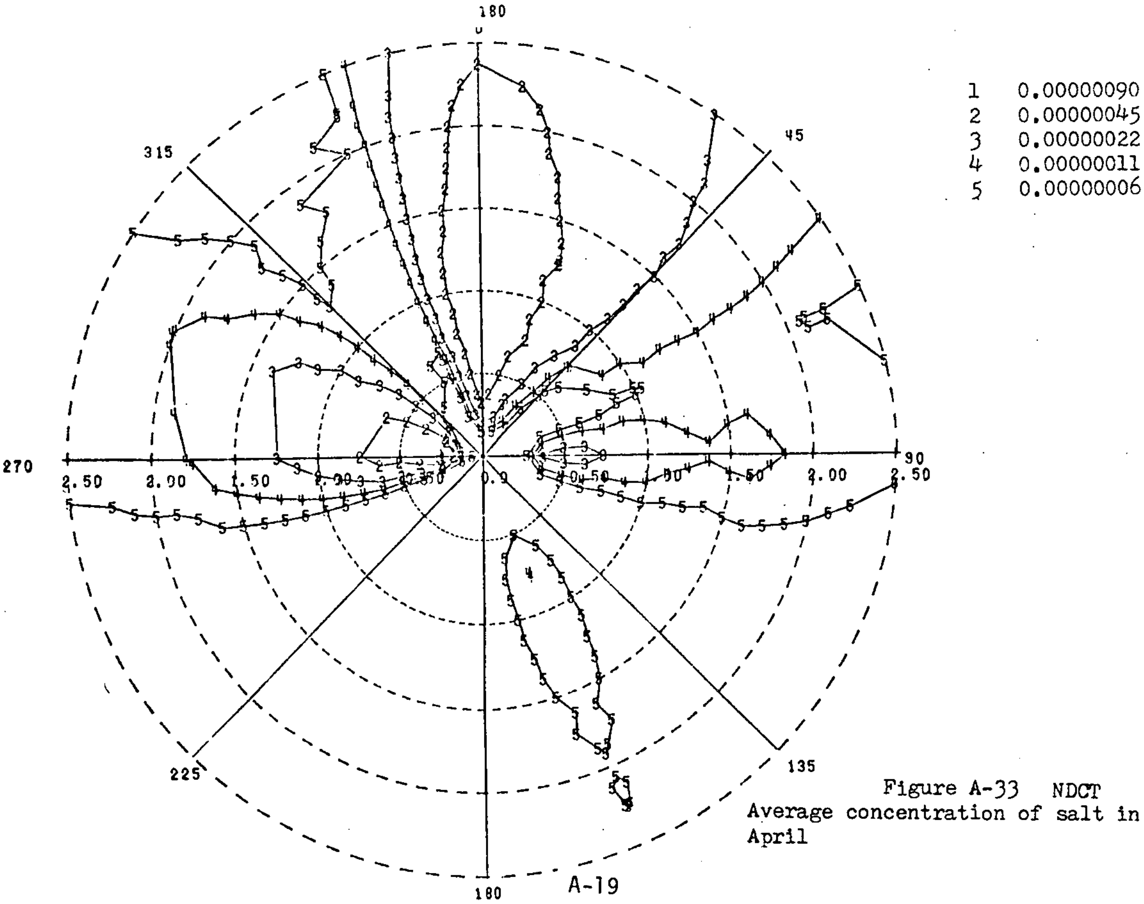
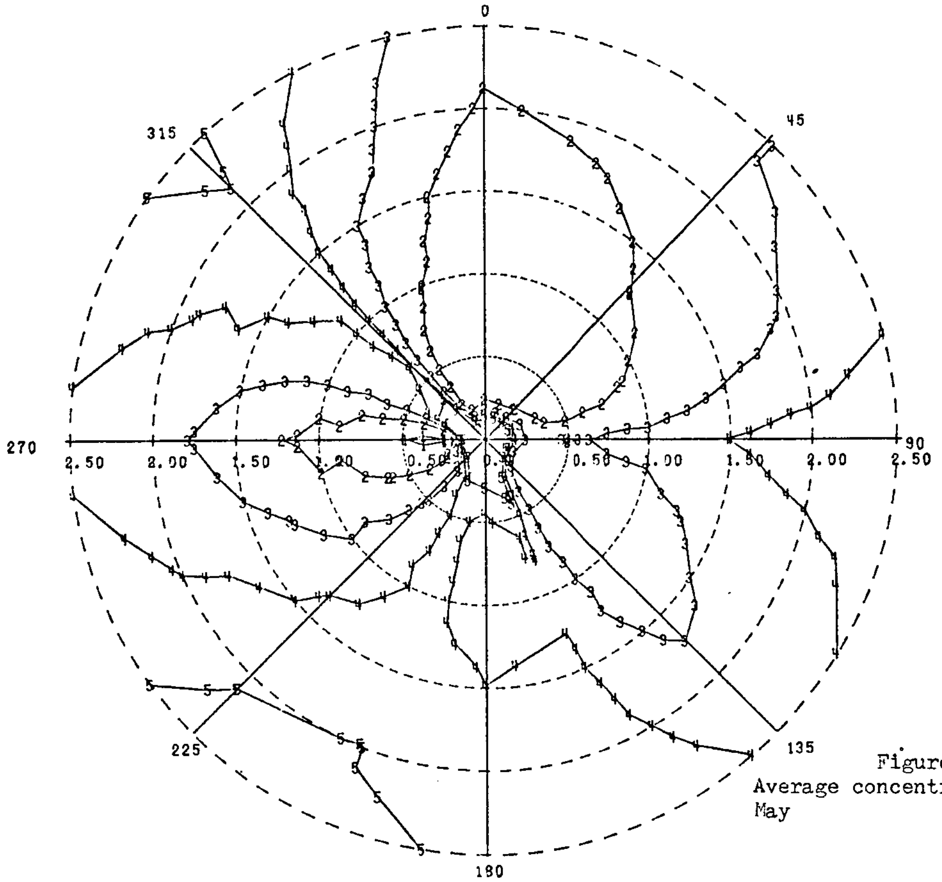
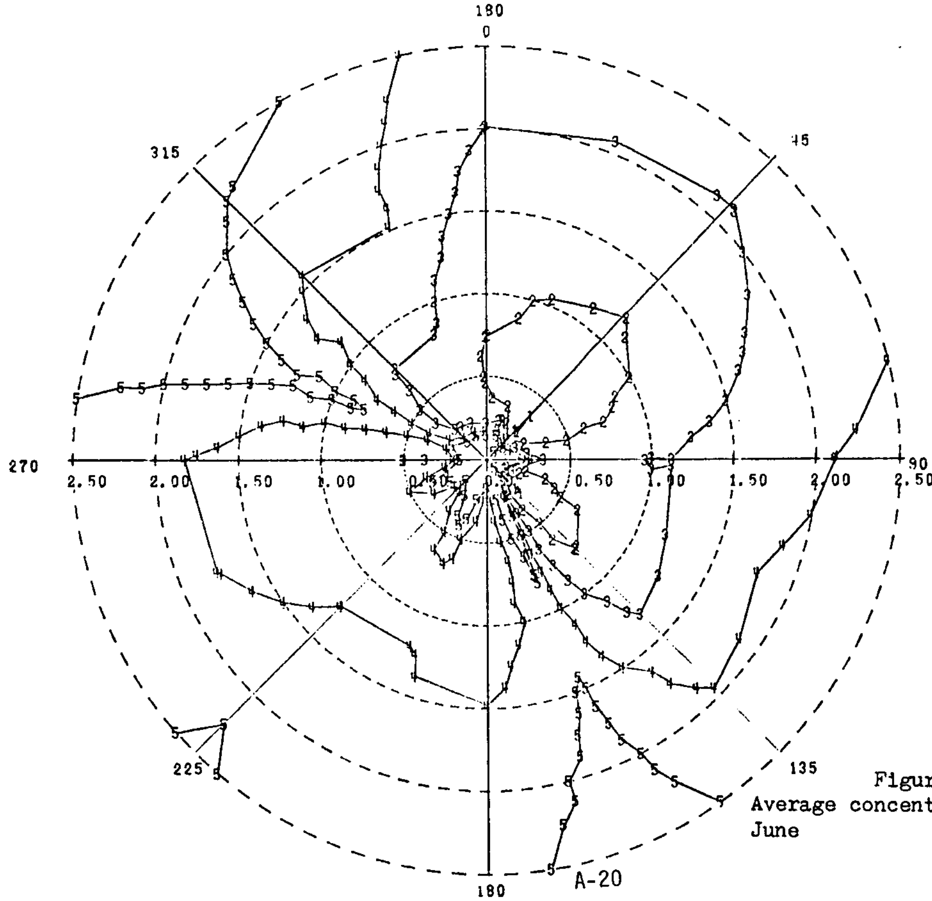


Figure A-33 NDCT
Average concentration of salt in air
April



1	0.00060
2	0.00030
3	0.00015
4	0.00007
5	0.00004

Figure A-34 NDCT
Average concentration of salt in air
May



1	0.070
2	0.035
3	0.017
4	0.009
5	0.004

Figure A-35 NDCT
Average concentration of salt in air
June

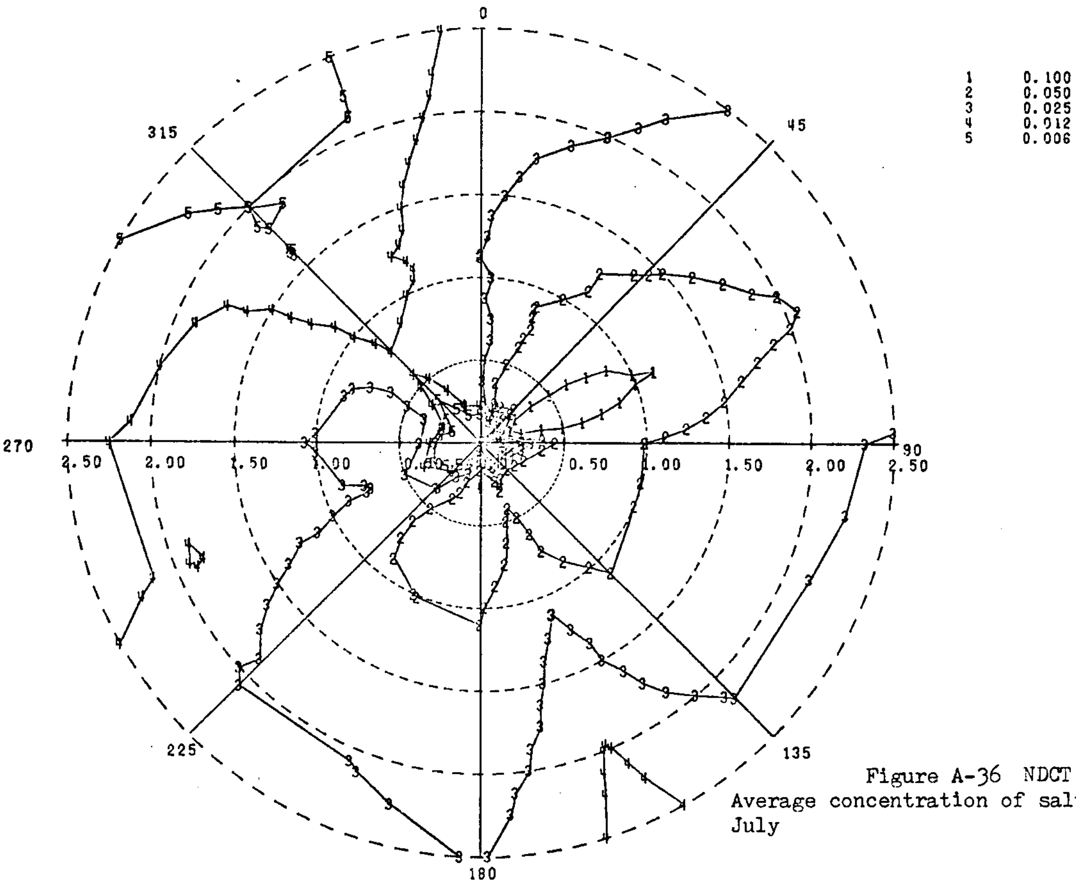


Figure A-36 NDCT
Average concentration of salt in air
July

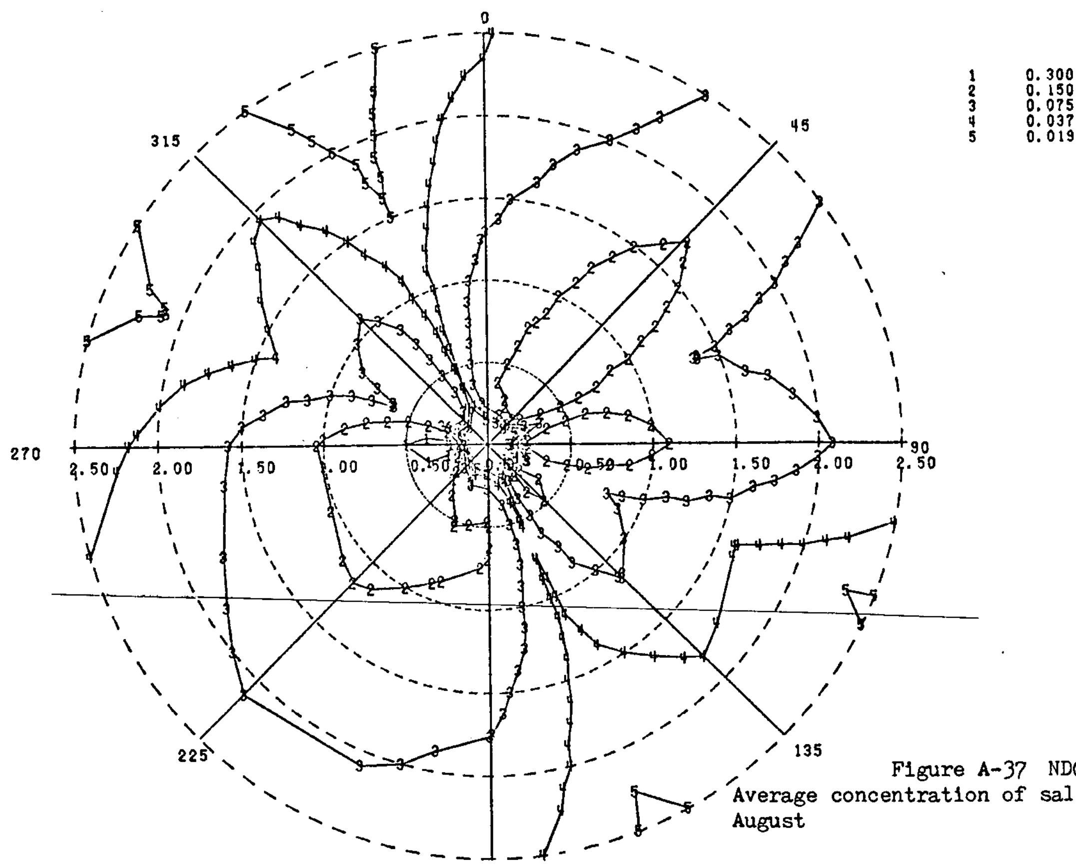


Figure A-37 NDCT
Average concentration of salt in air
August

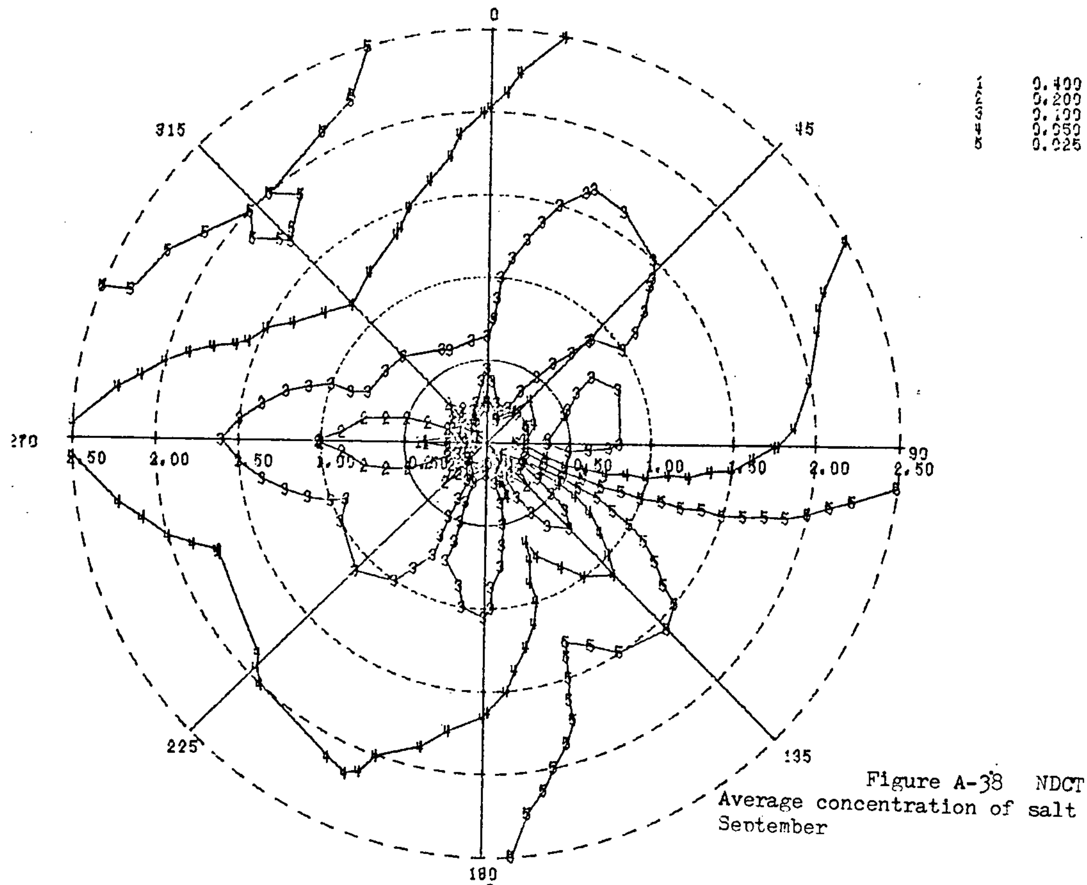


Figure A-38 NDCT
Average concentration of salt in air
September

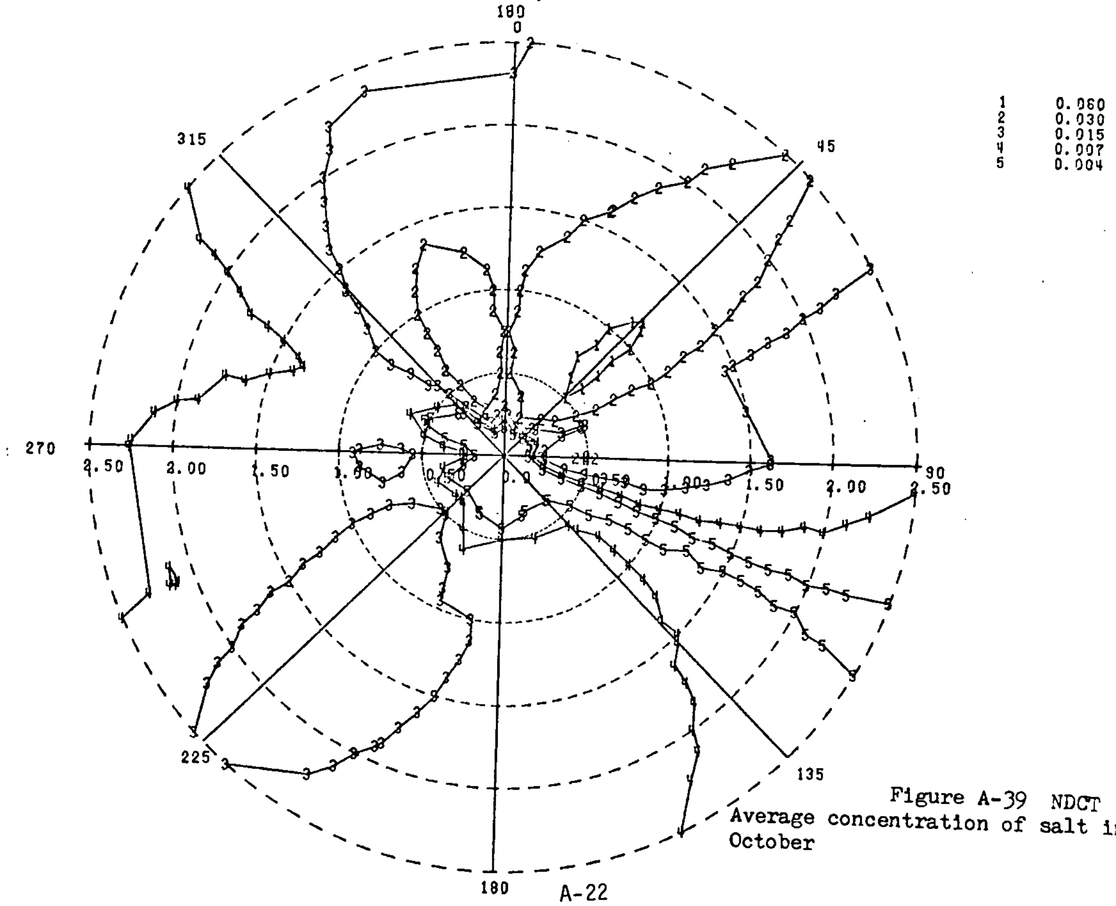


Figure A-39 NDCT
Average concentration of salt in air
October

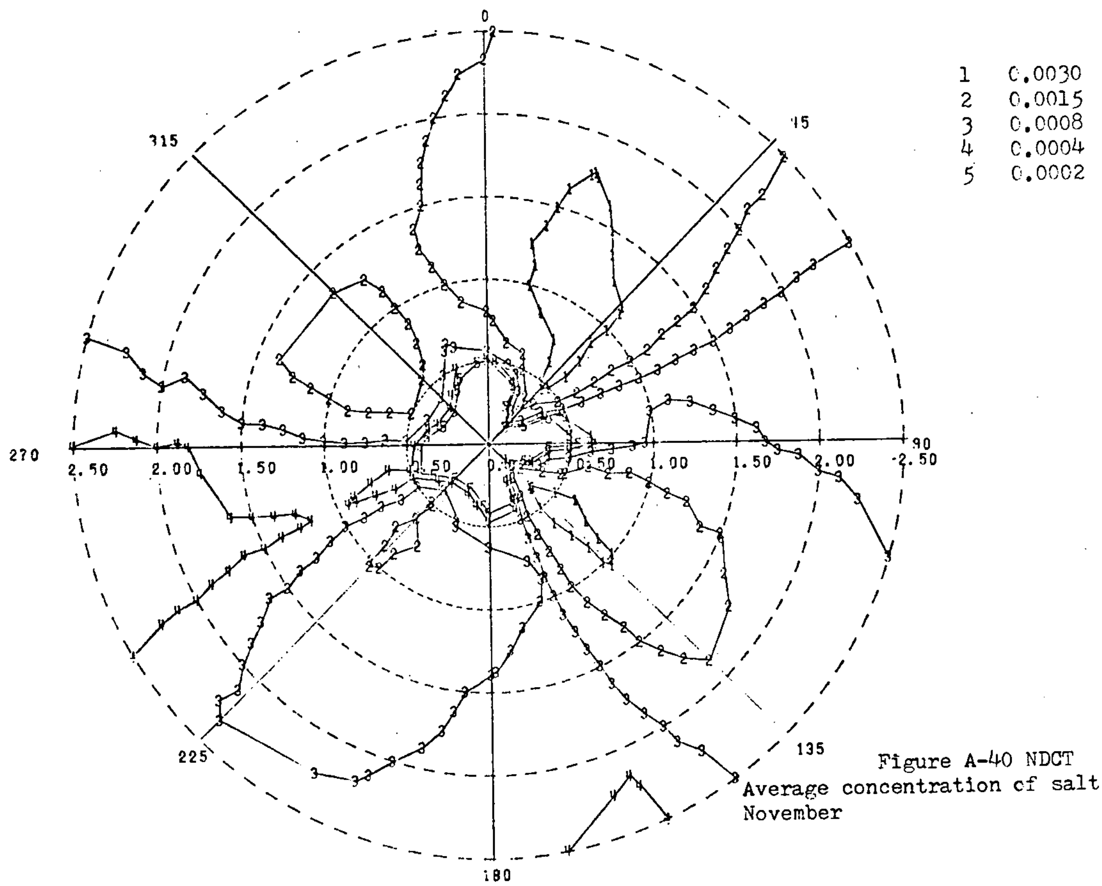


Figure A-40 NDCT
Average concentration of salt in air
November

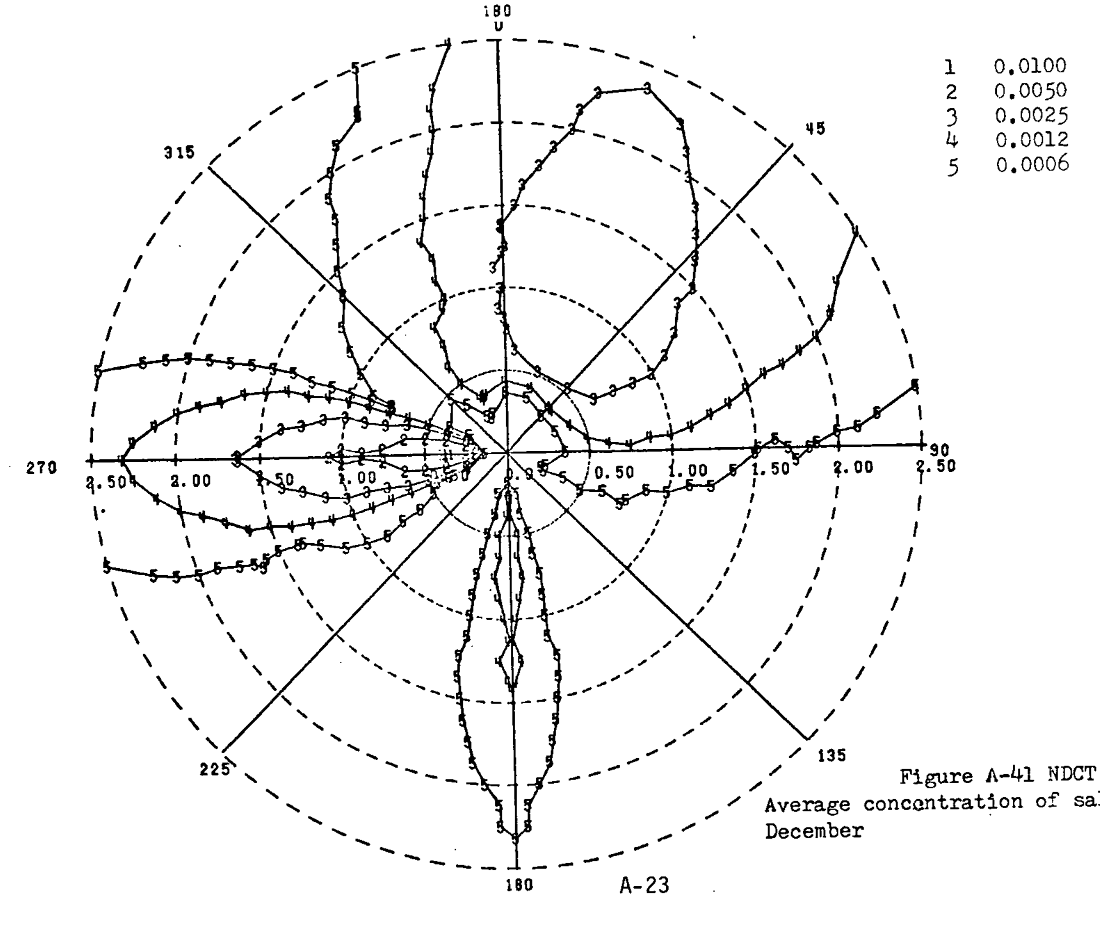


Figure A-41 NDCT
Average concentration of salt in air
December

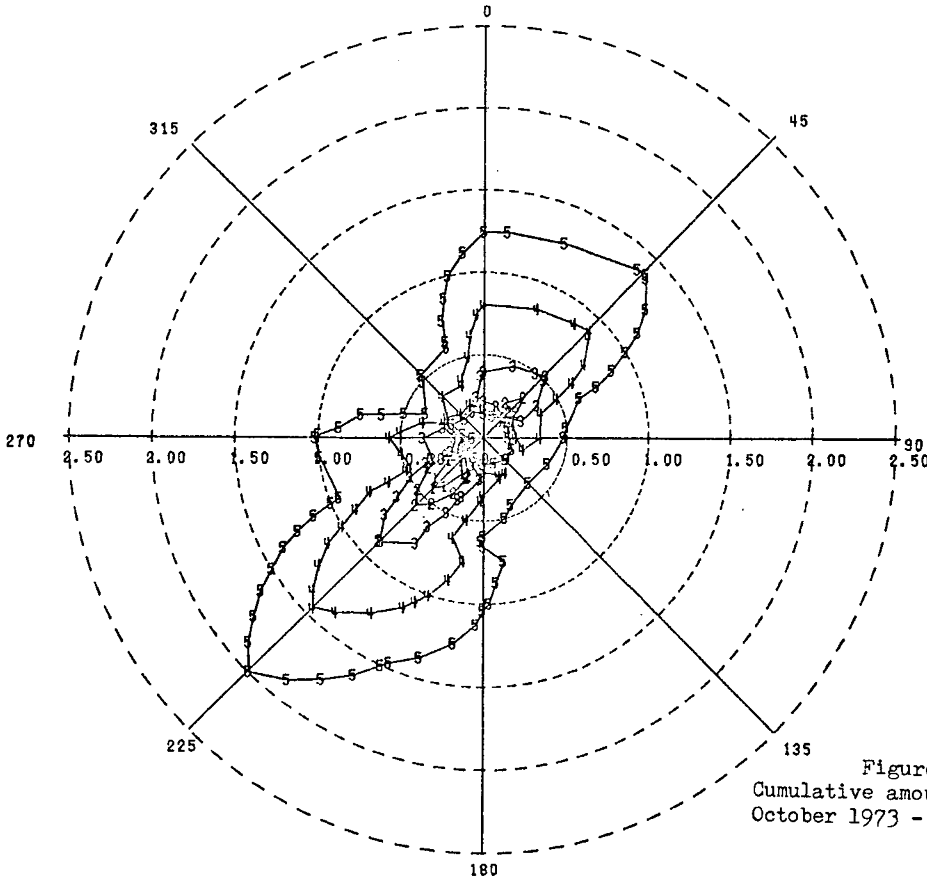


Figure A-42 CMDT
Cumulative amount of drift
October 1973 - September 1974

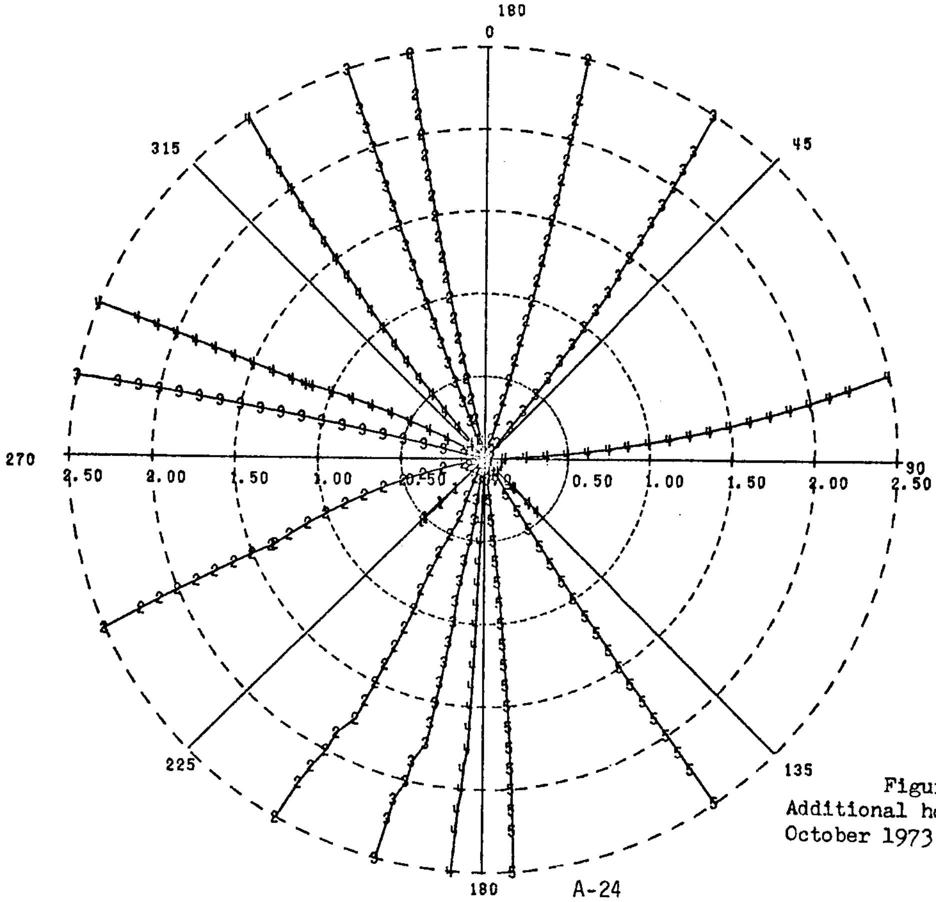


Figure A-43 CMDT
Additional hours of fog
October 1973 - September 1974

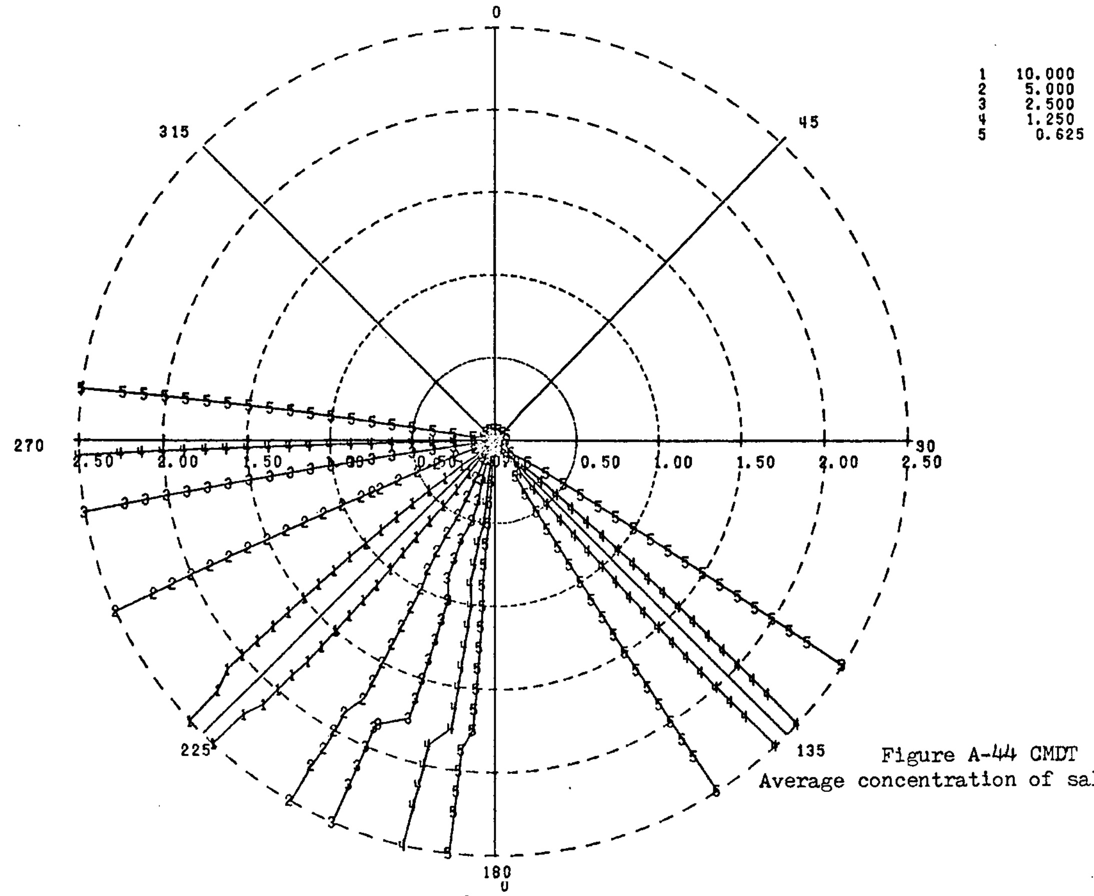


Figure A-44 CMDT
Average concentration of salt in air

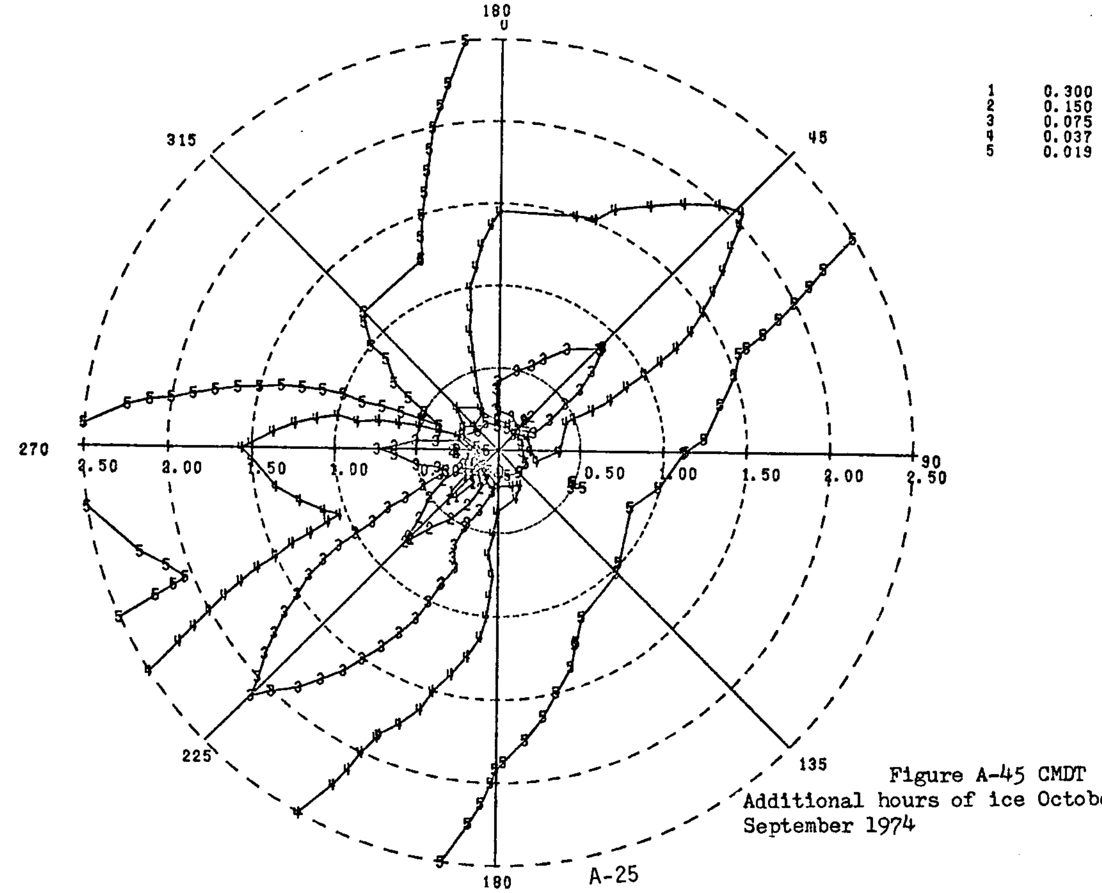


Figure A-45 CMDT
Additional hours of ice October 1973-
September 1974

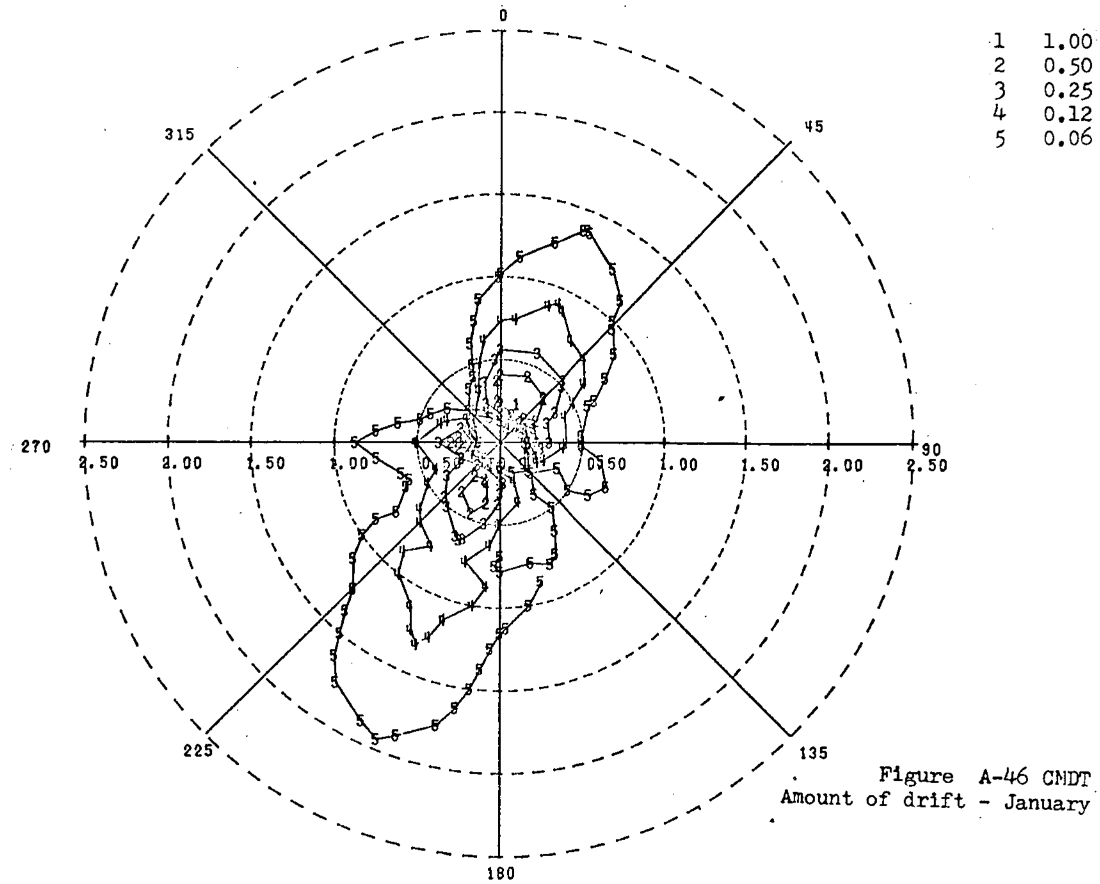


Figure A-46 CMDT
Amount of drift - January

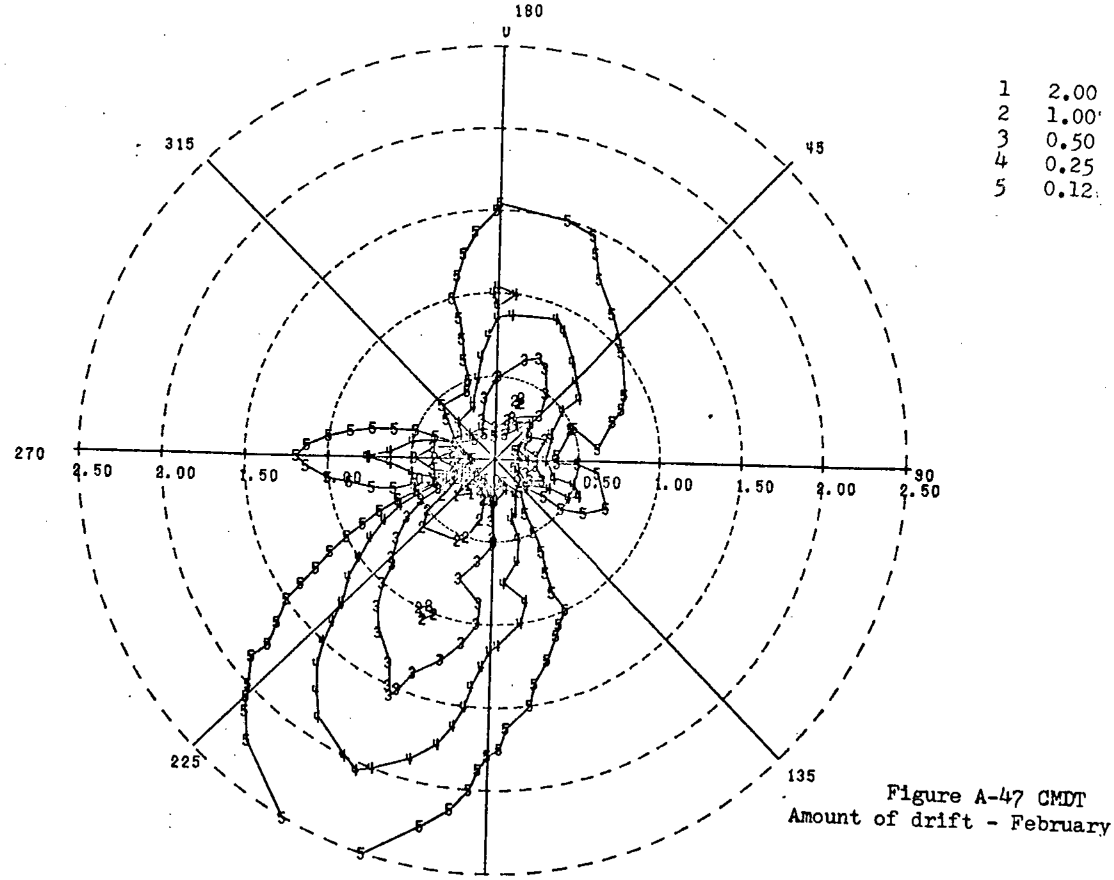
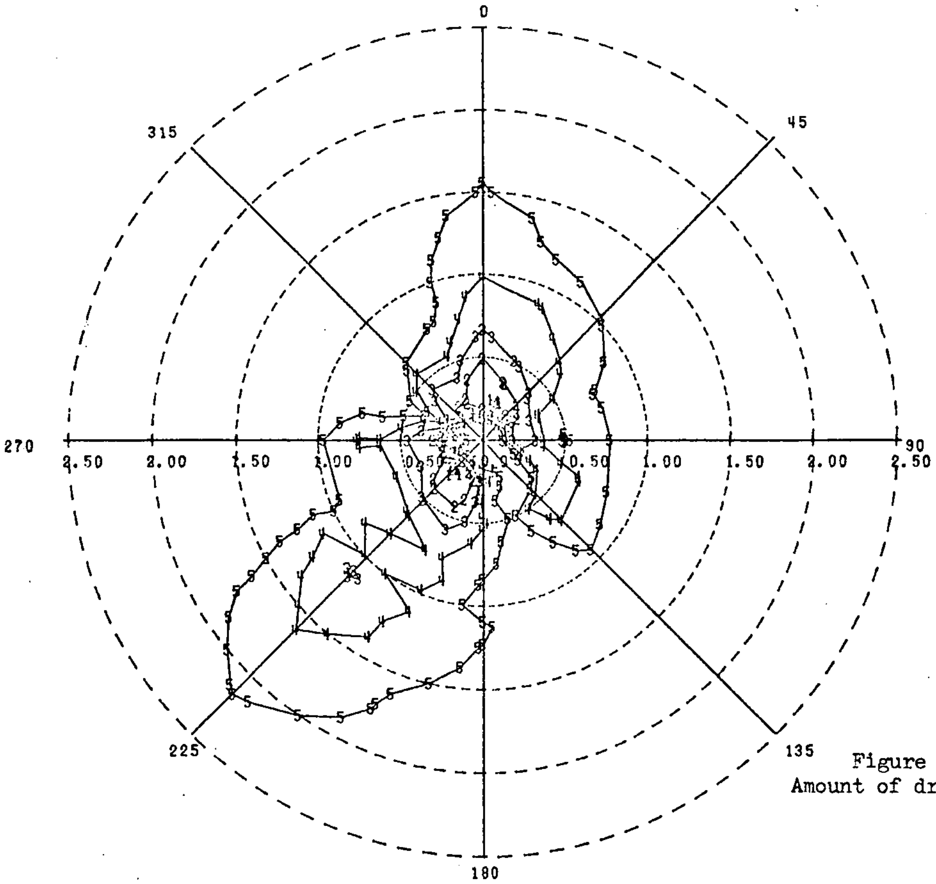
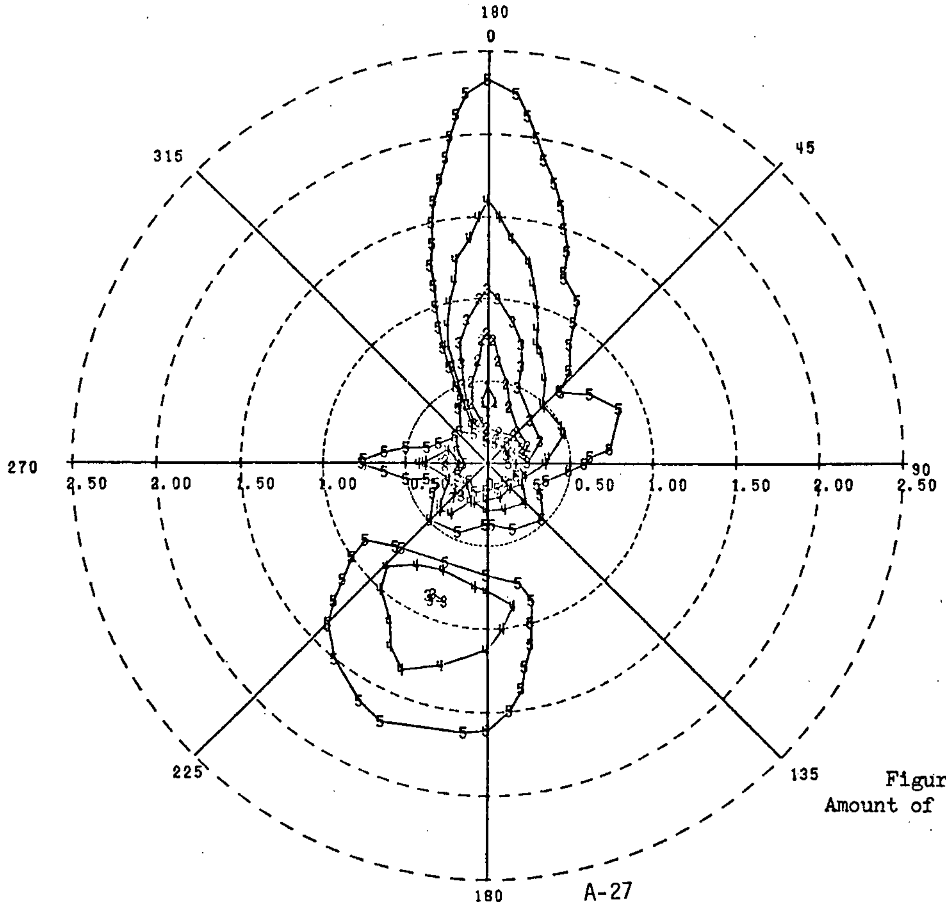


Figure A-47 CMDT
Amount of drift - February



1	0.0030
2	0.0015
3	0.00075
4	0.00038
5	0.00019

Figure A-48 CMDT
Amount of drift - March



1	0.000100
2	0.000050
3	0.000025
4	0.000012
5	0.000006

Figure A49 CMDT
Amount of drift - April

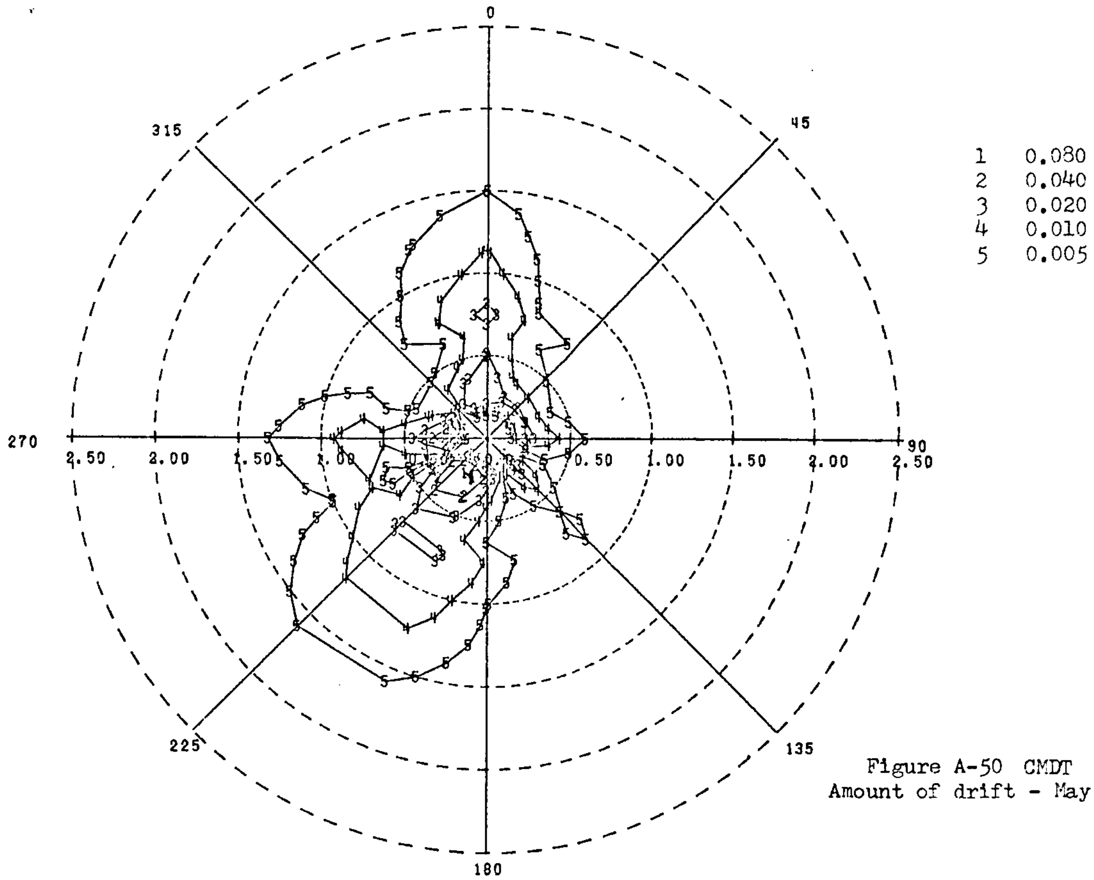


Figure A-50 CMDT
Amount of drift - May

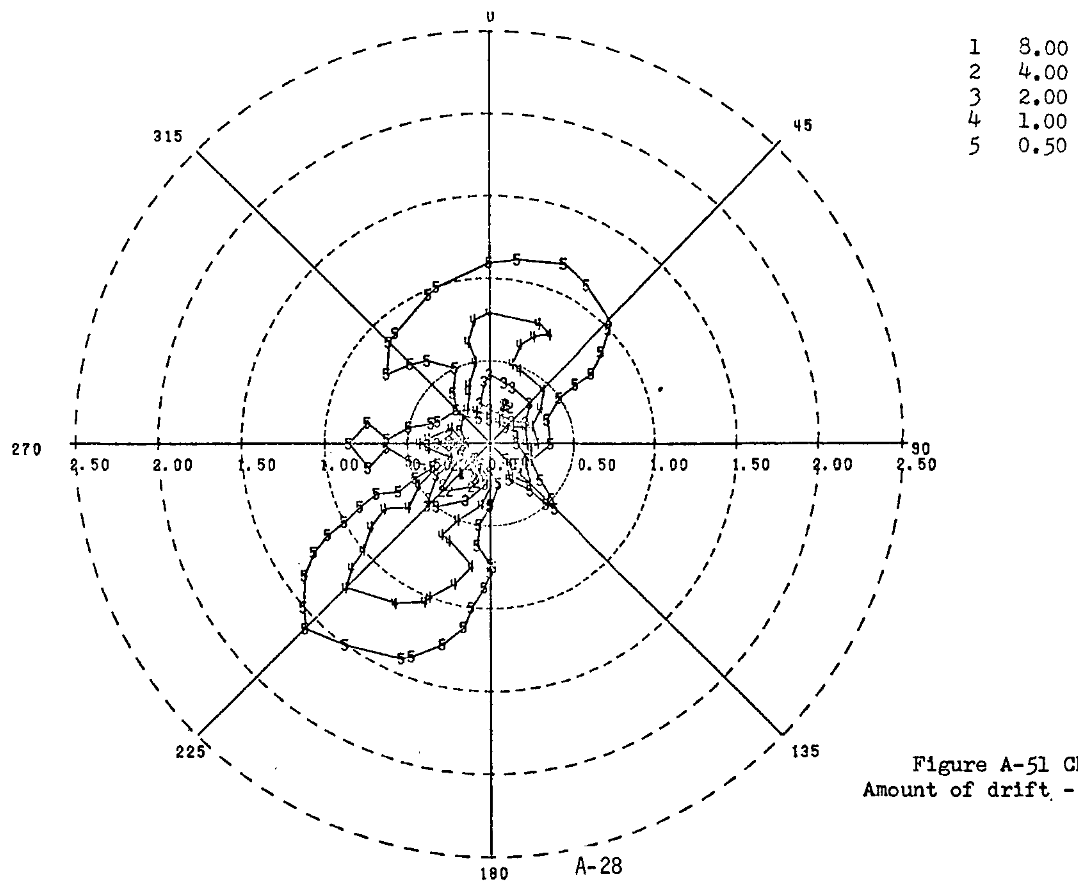
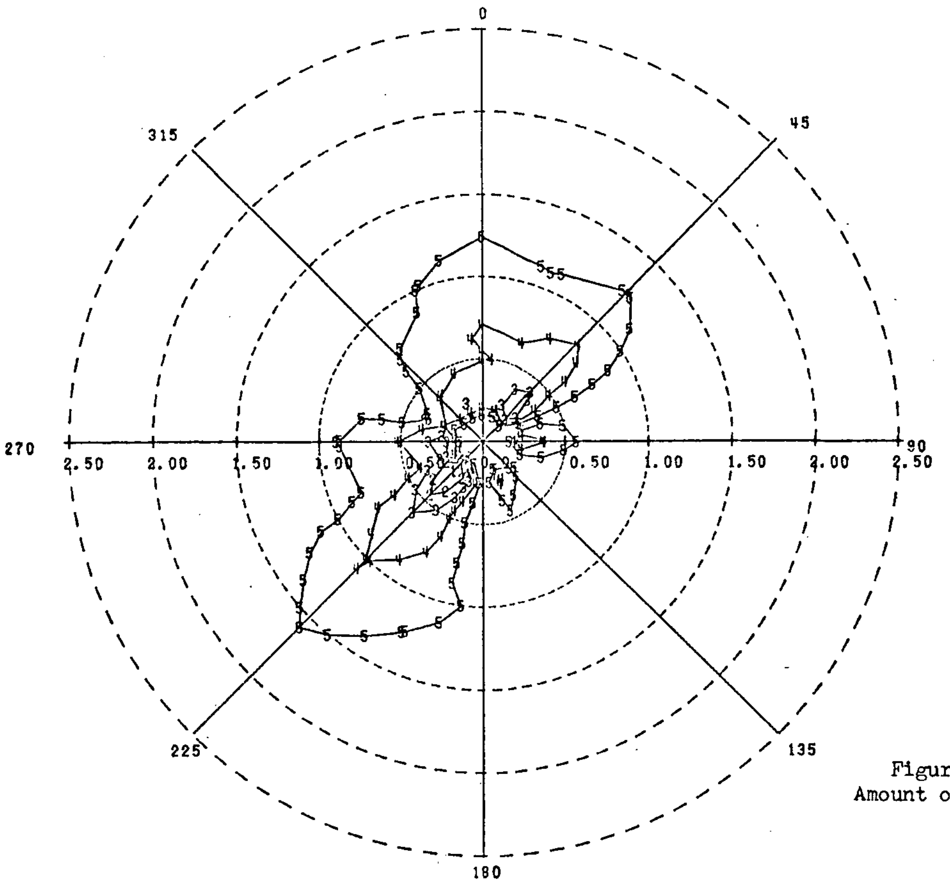
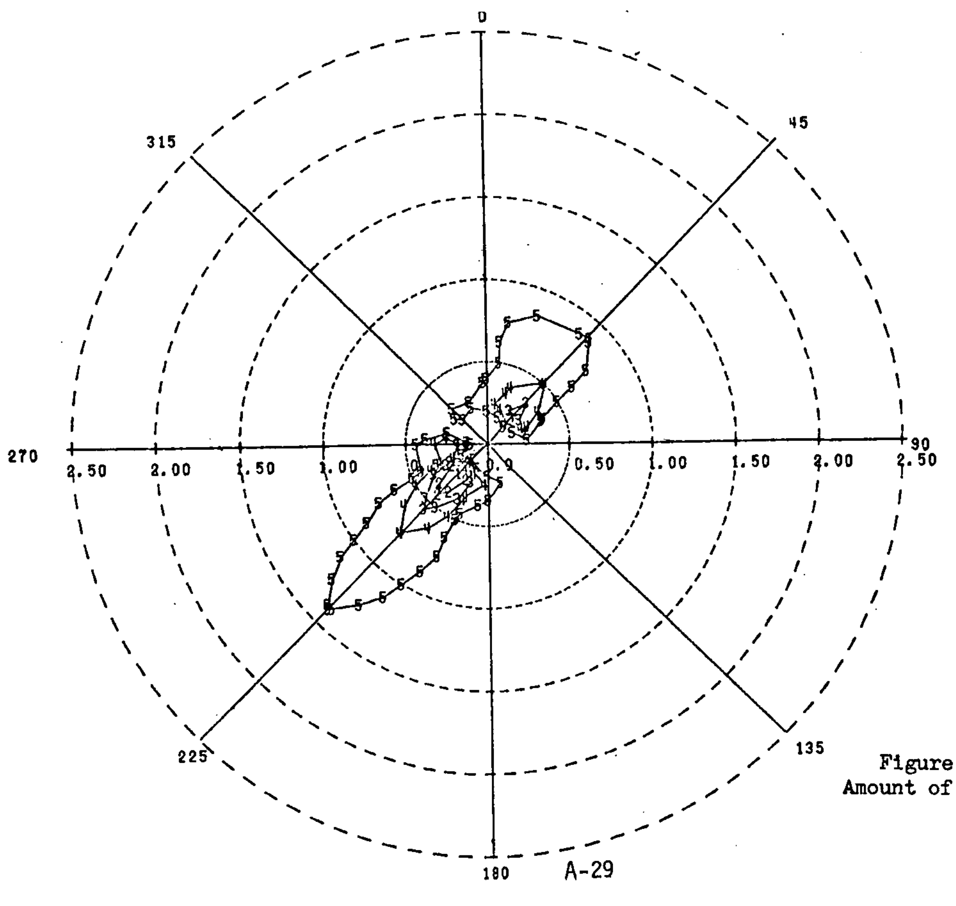


Figure A-51 CMDT
Amount of drift - June



1	23.00
2	11.50
3	5.75
4	2.87
5	1.44

Figure A-52 CMDT
Amount of drift - July



1	81.00
2	40.50
3	20.25
4	10.12
5	5.06

Figure A-53 CMDT
Amount of drift - August

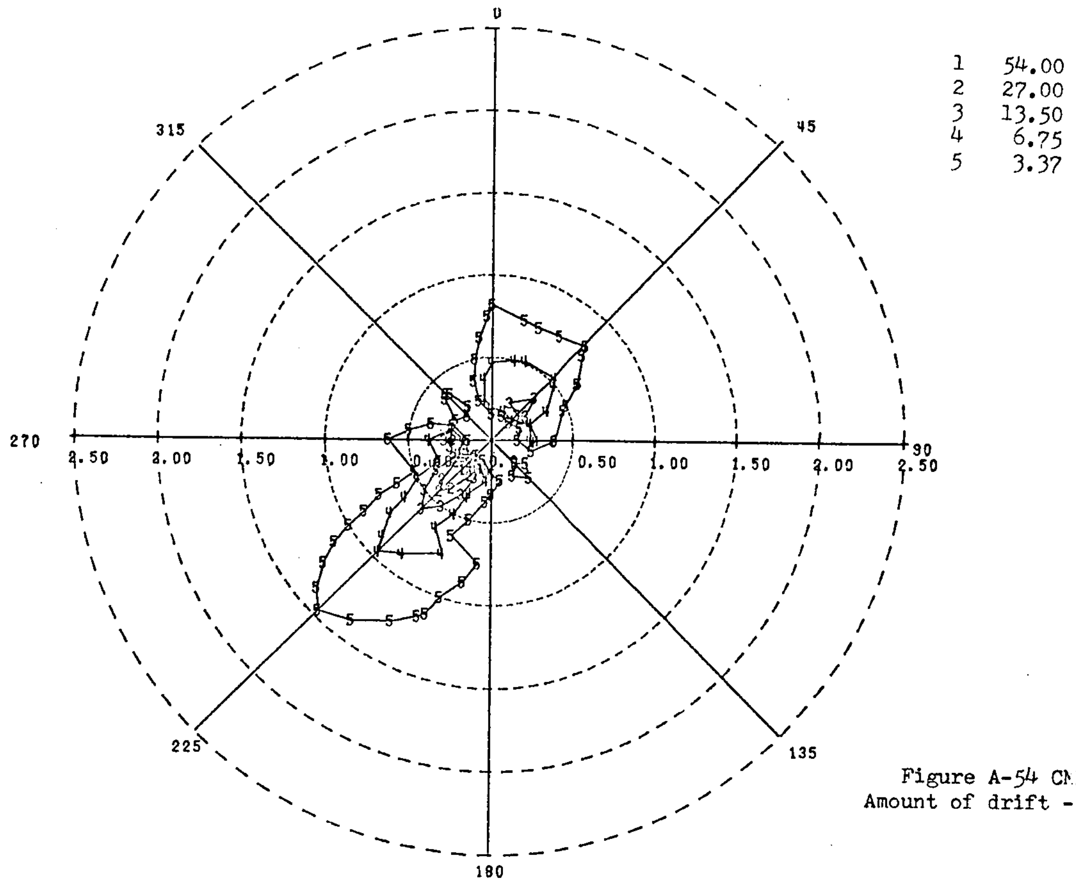


Figure A-54 CMDT
Amount of drift - Sept

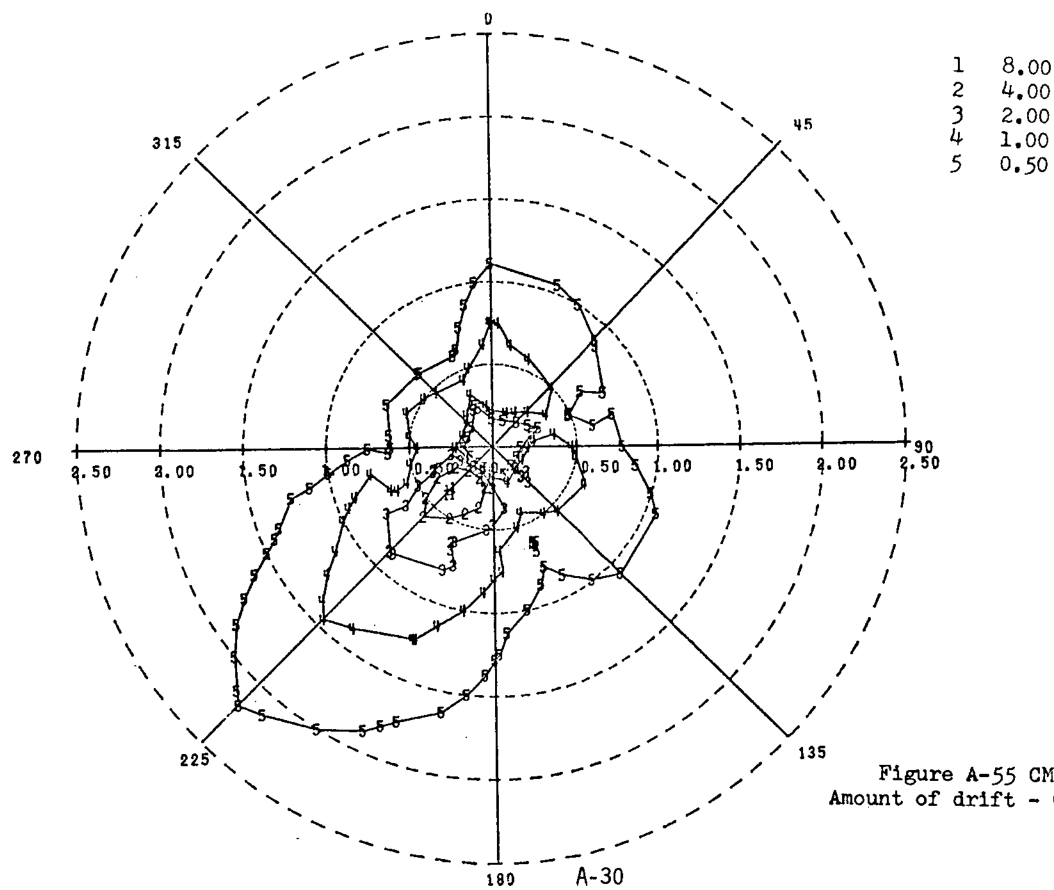


Figure A-55 CMDT
Amount of drift - October

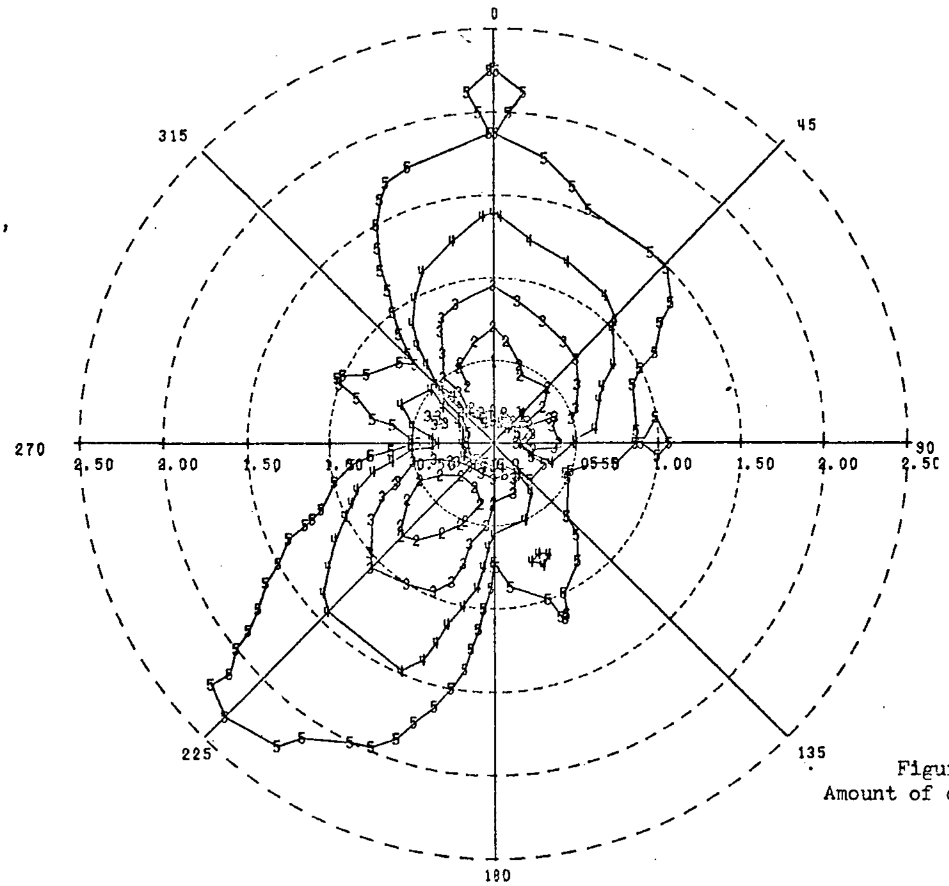


Figure A-56 CMDT
Amount of drift - November

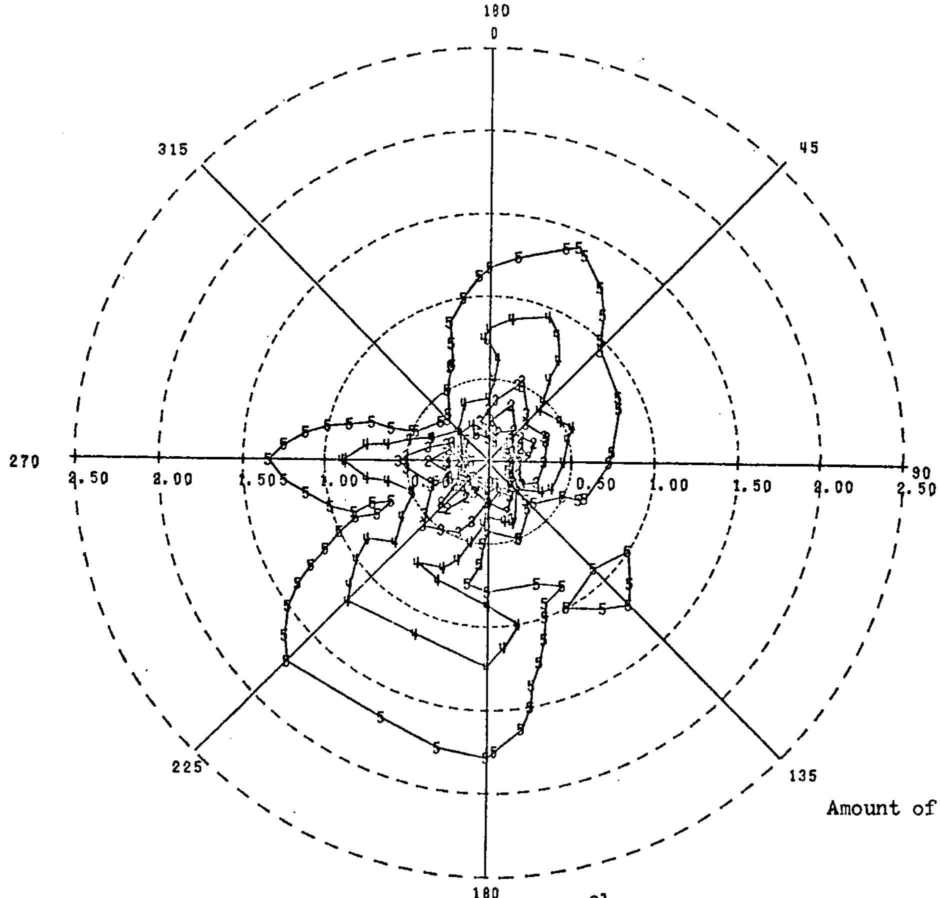


Figure A-57
Amount of drift - December

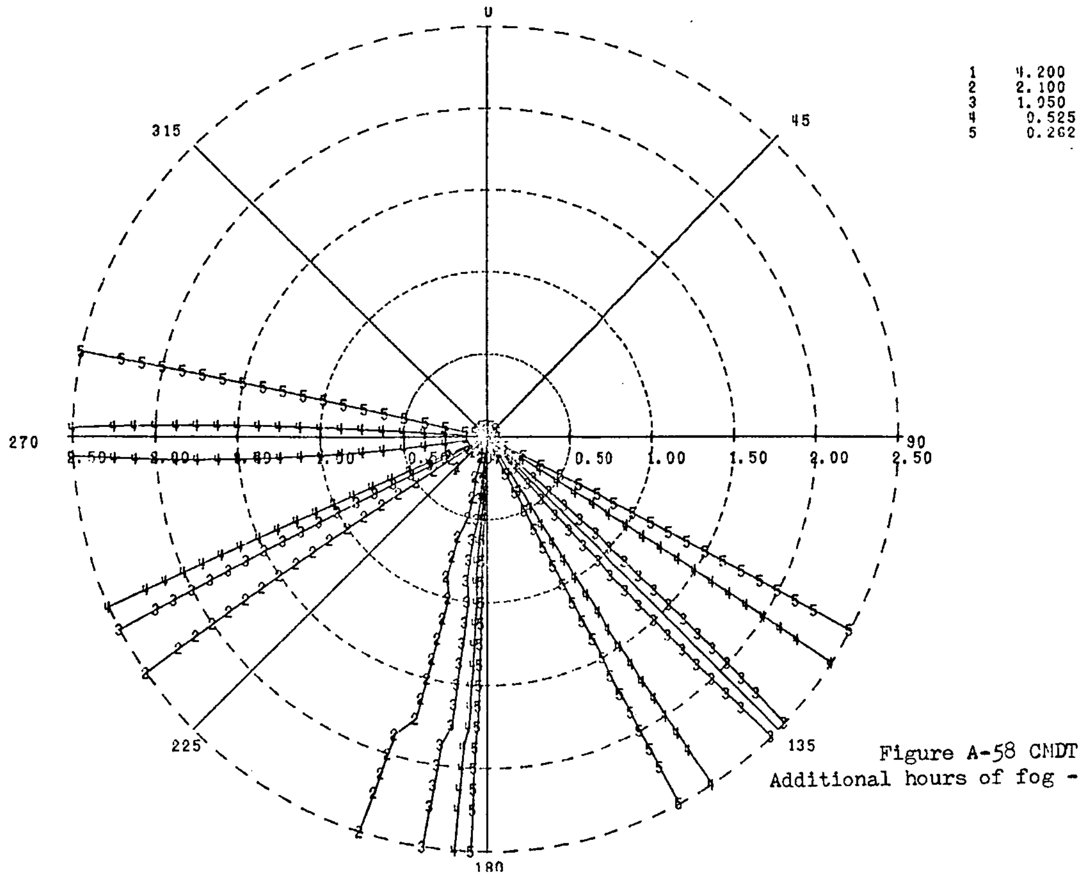


Figure A-58 CMDT
Additional hours of fog - January

No additional fog predicted for February

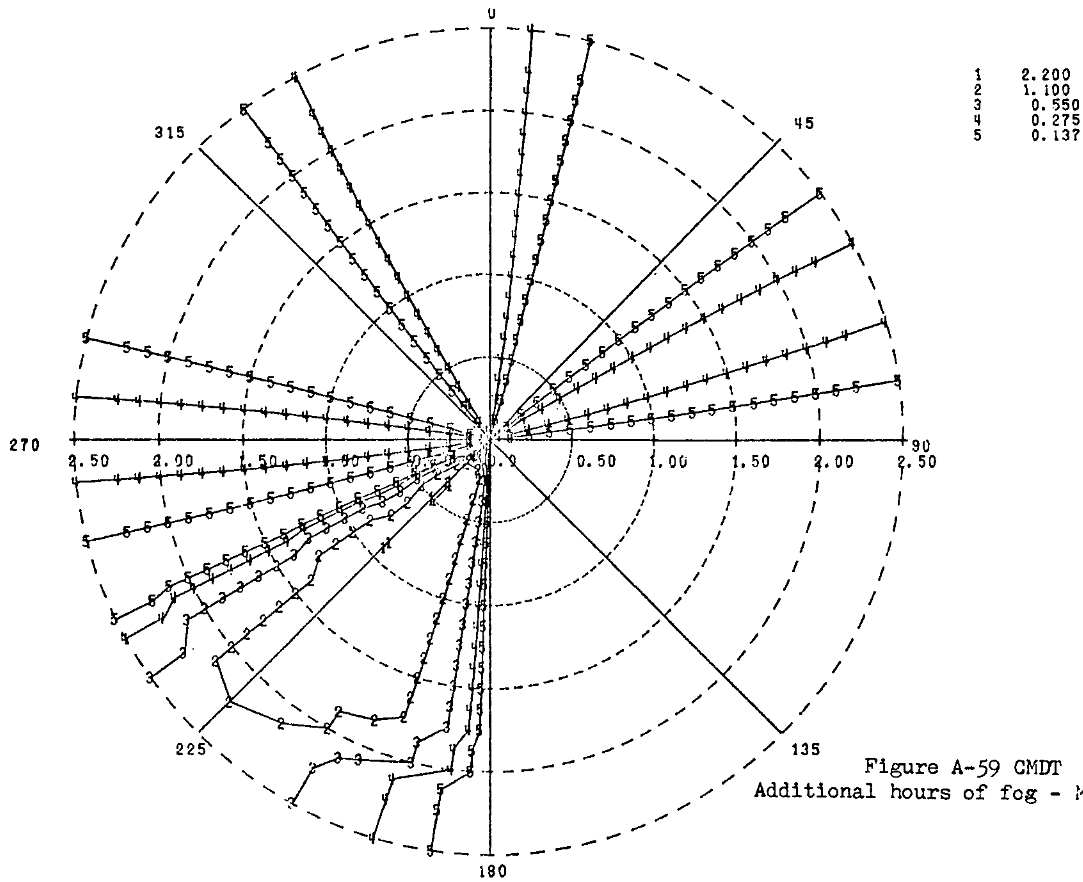


Figure A-59 CMDT
Additional hours of fog - March

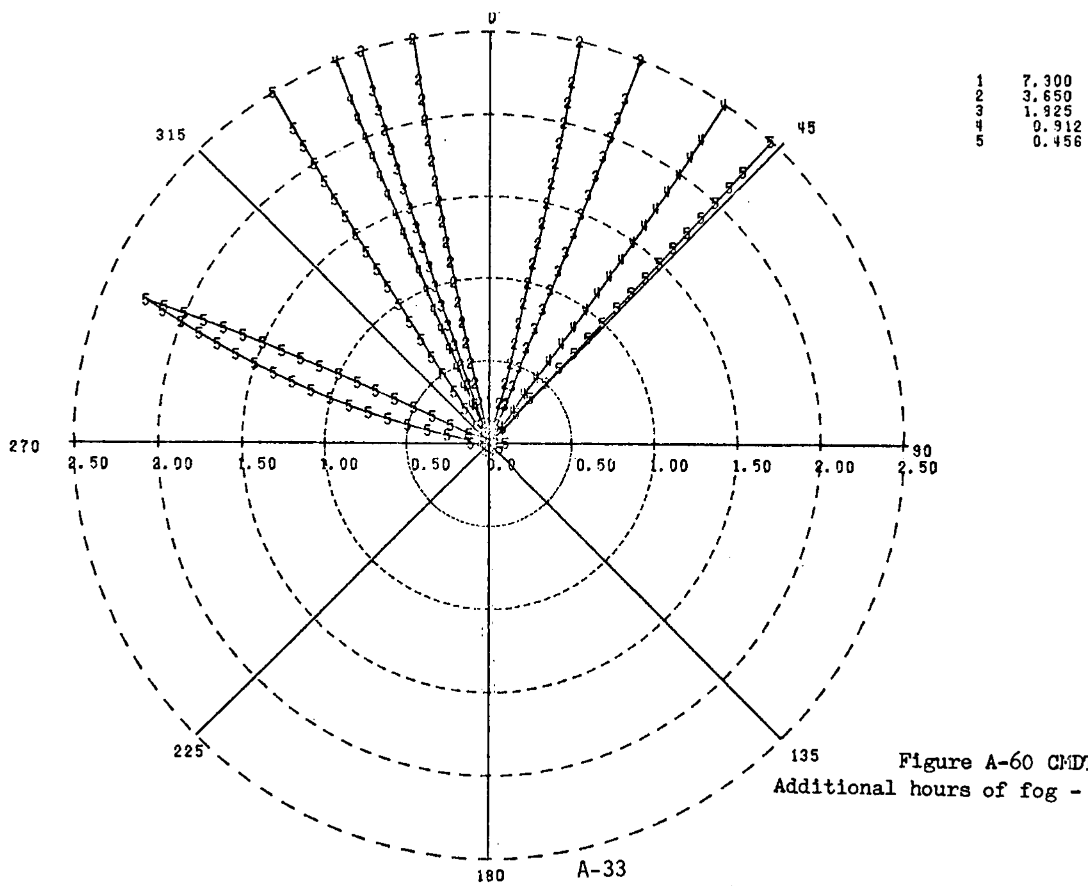


Figure A-60 CMDT
Additional hours of fog - April

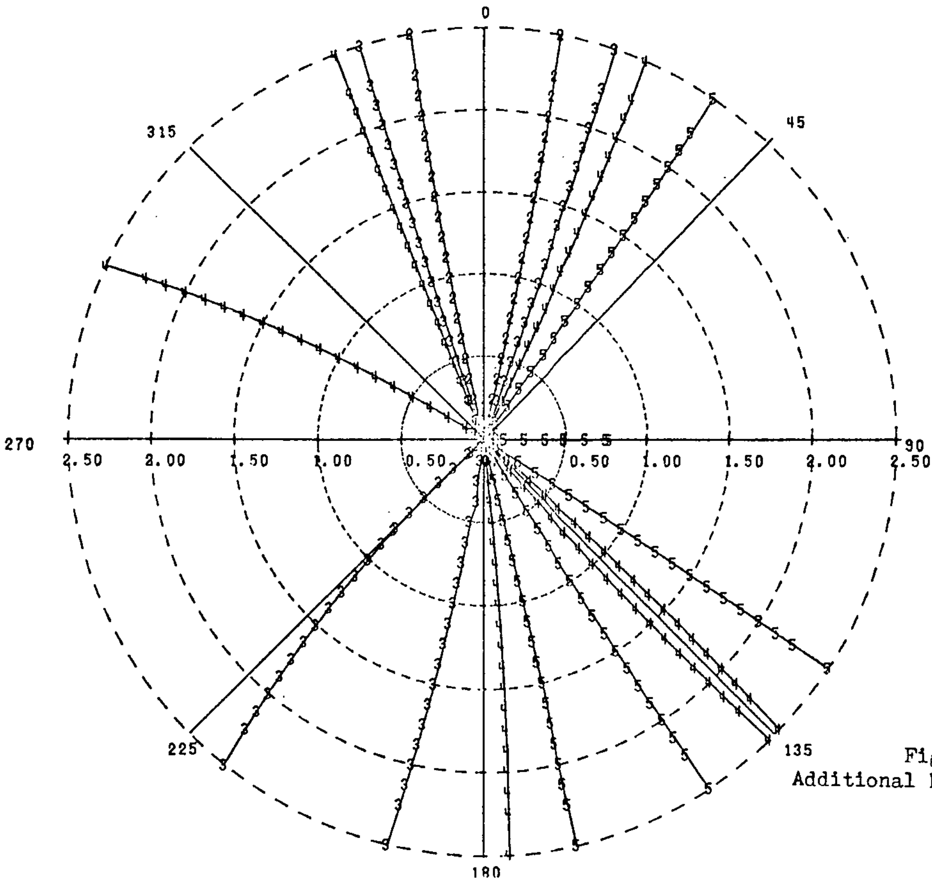


Figure A-61 CMDT
Additional hours of fog - May

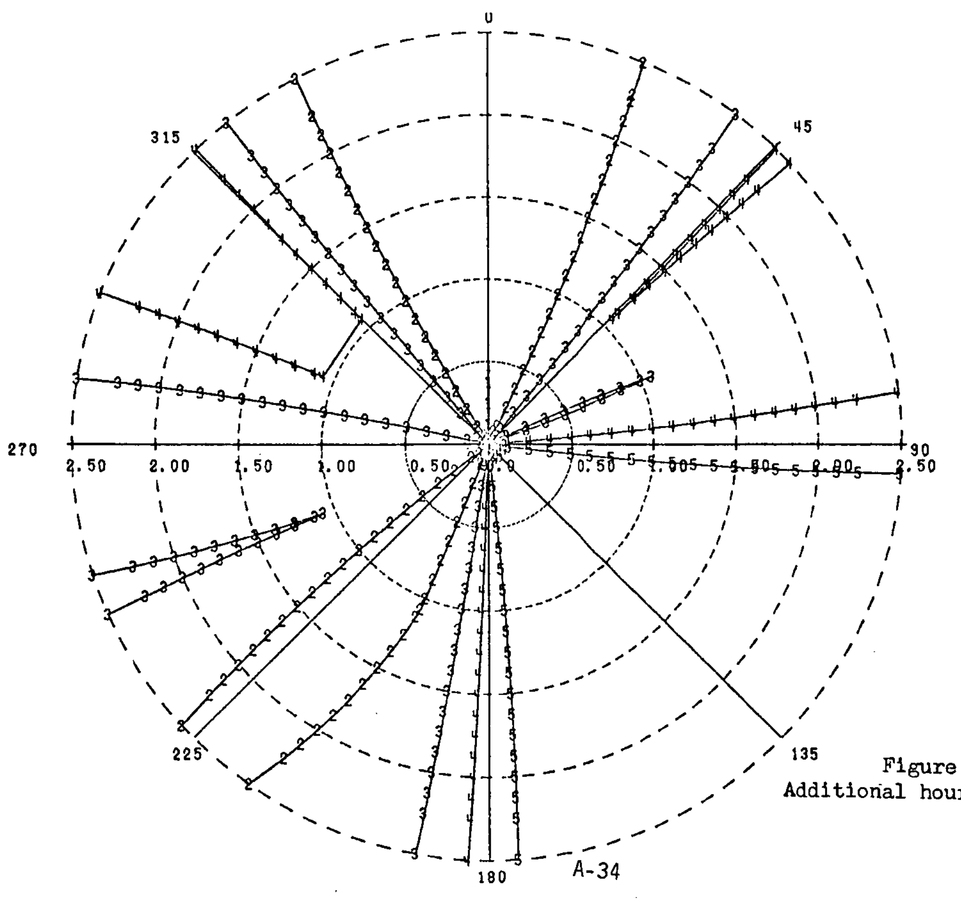


Figure A-62 CMDT
Additional hours of fog - June

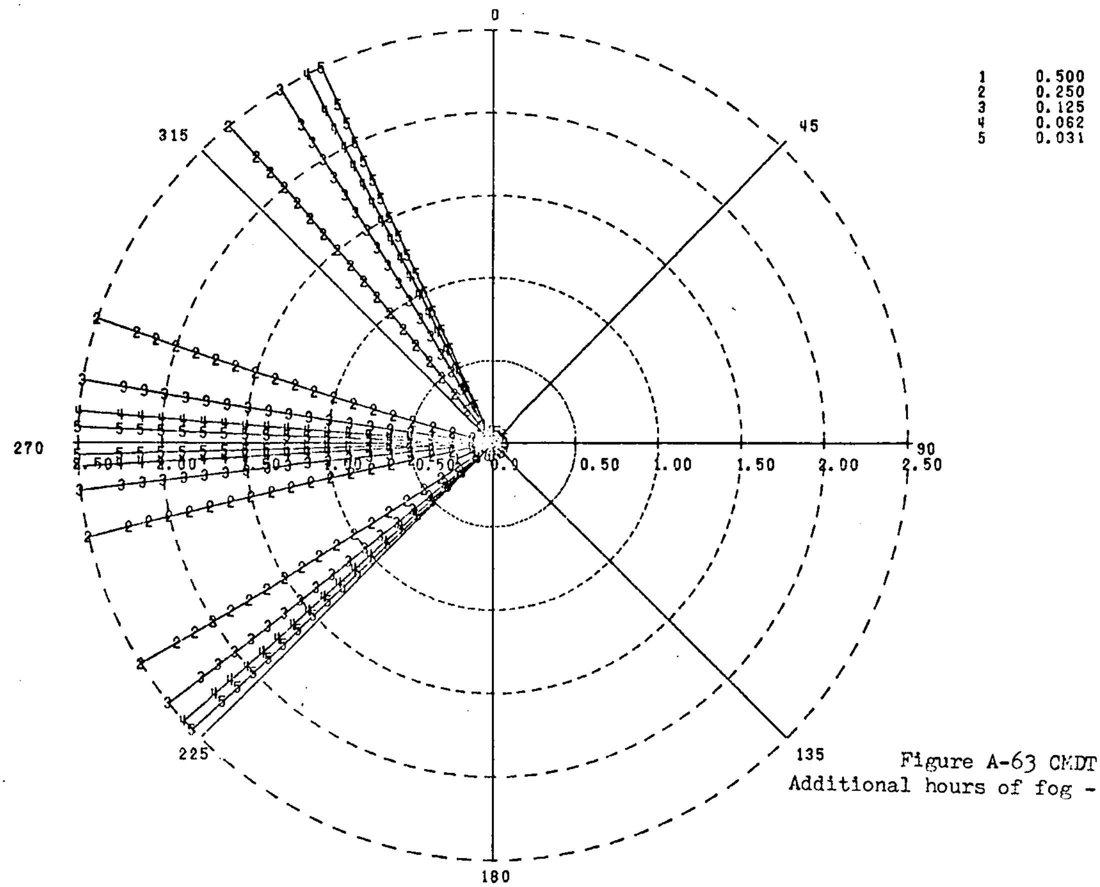


Figure A-63 CMDT
Additional hours of fog - July

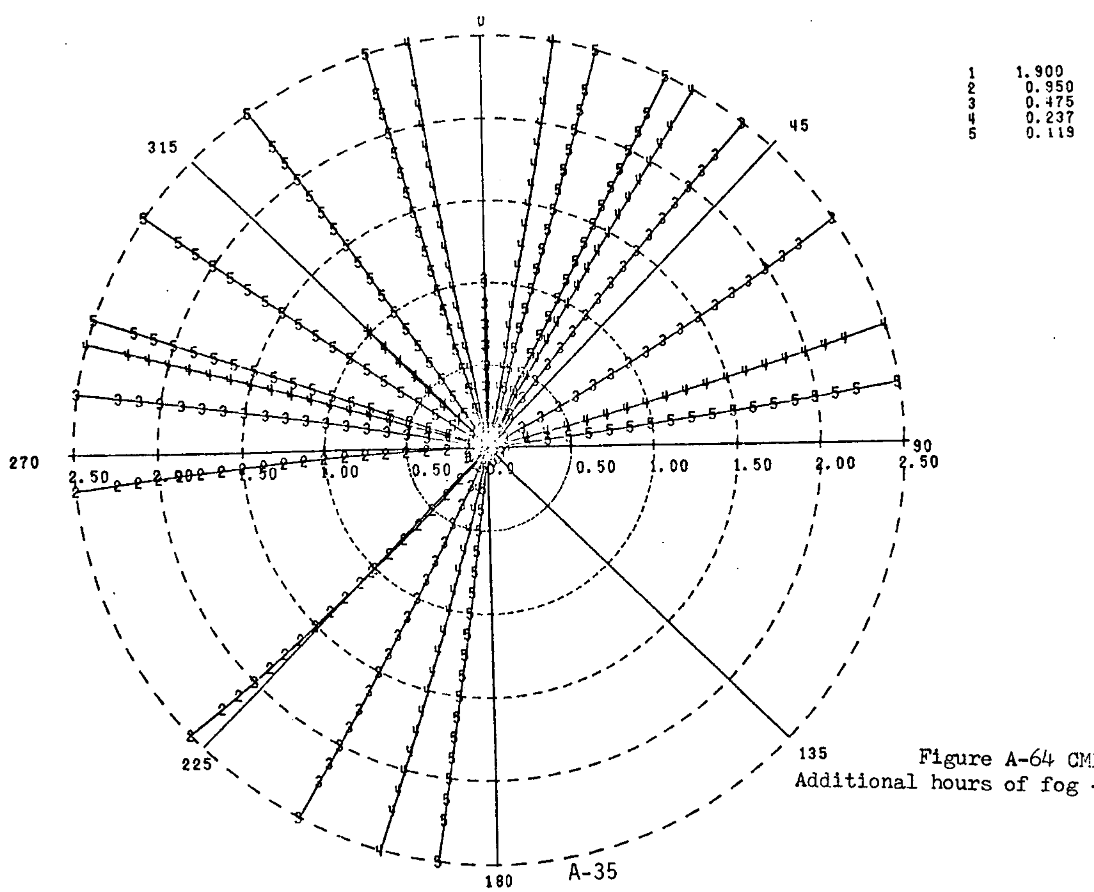


Figure A-64 CMDT
Additional hours of fog - August

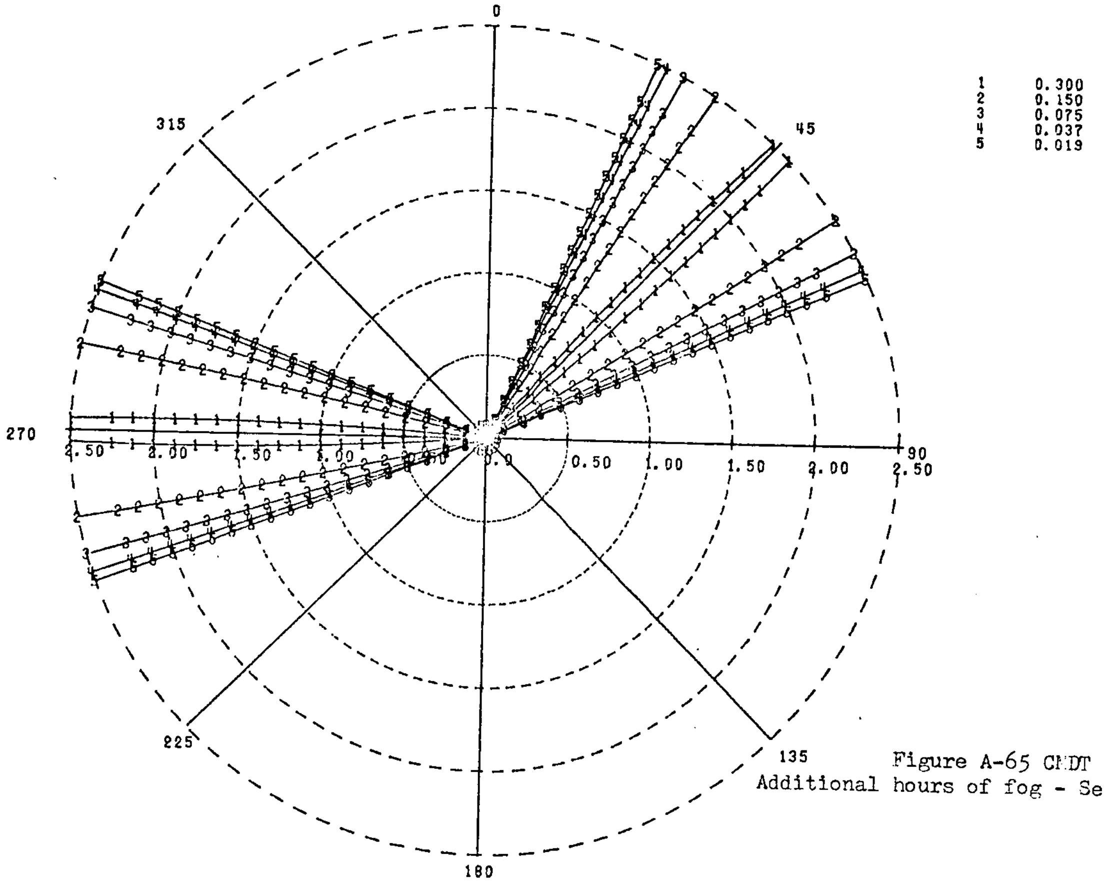


Figure A-65 CMDT
Additional hours of fog - Sept.

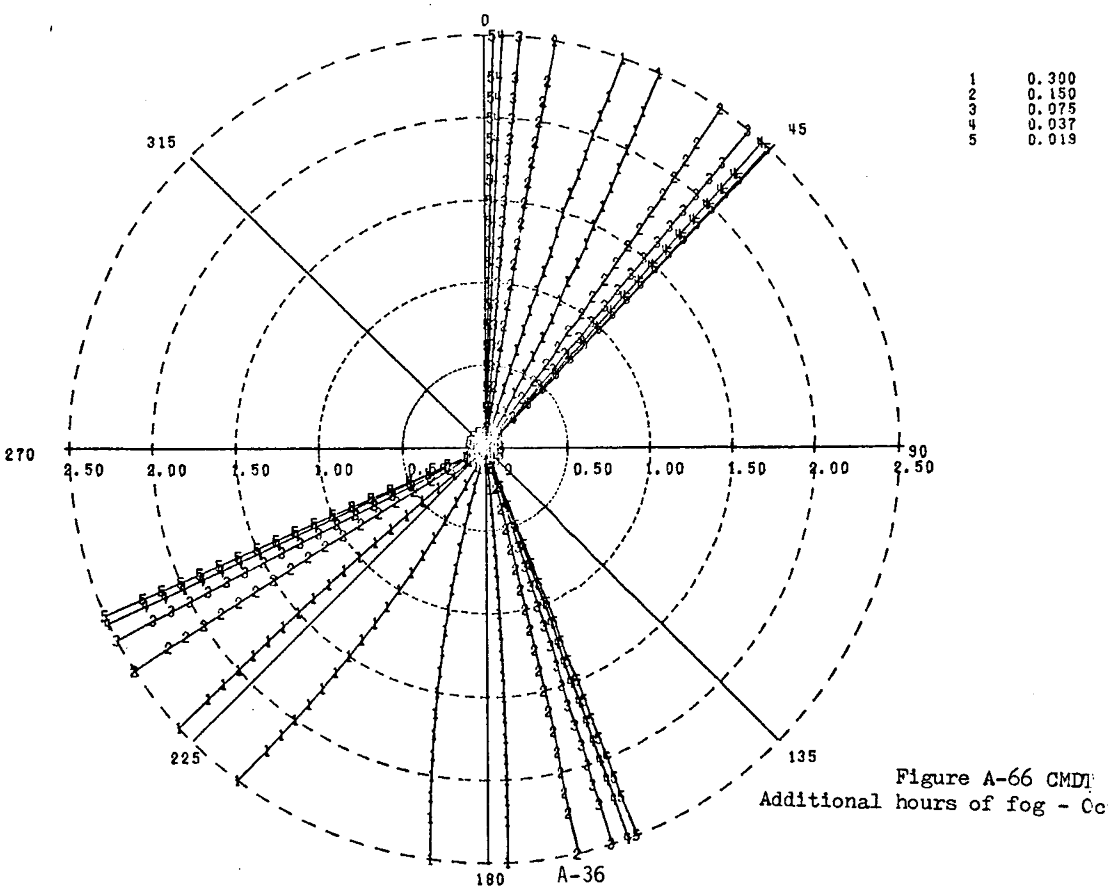


Figure A-66 CMDT
Additional hours of fog - October

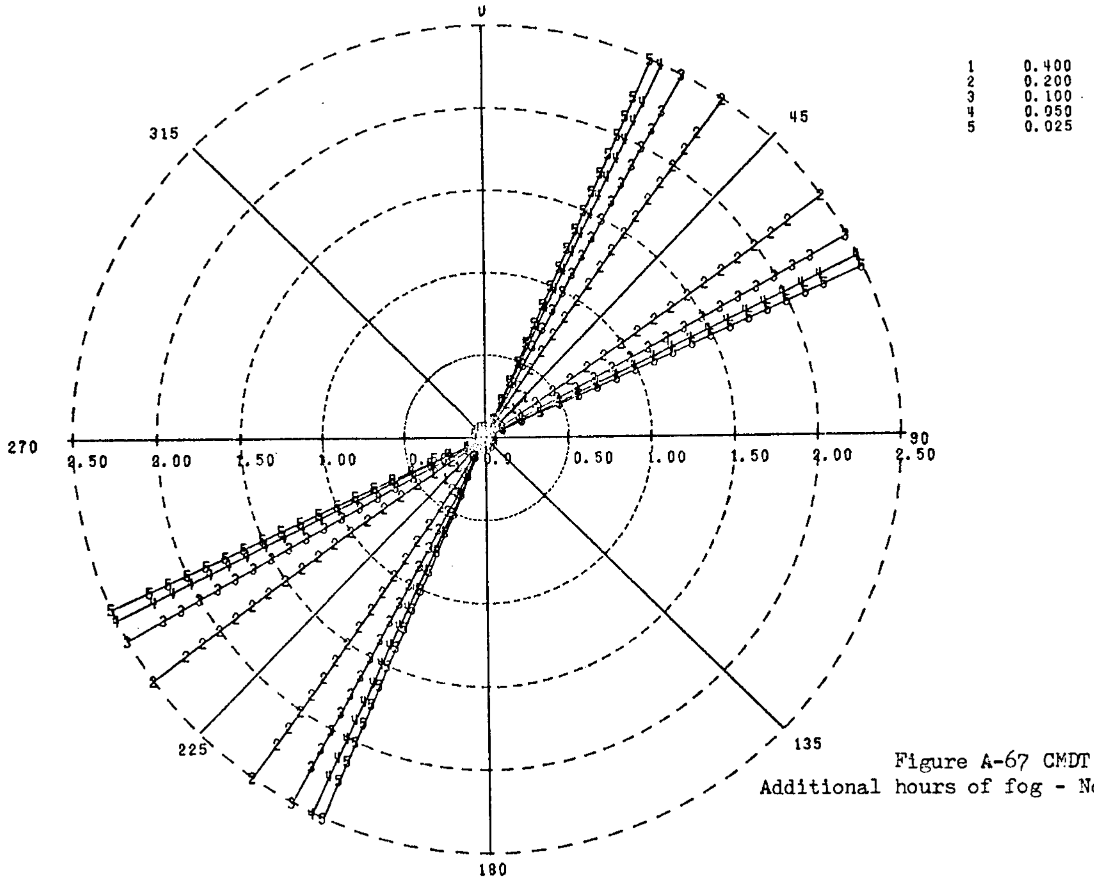


Figure A-67 CMDT
Additional hours of fog - November

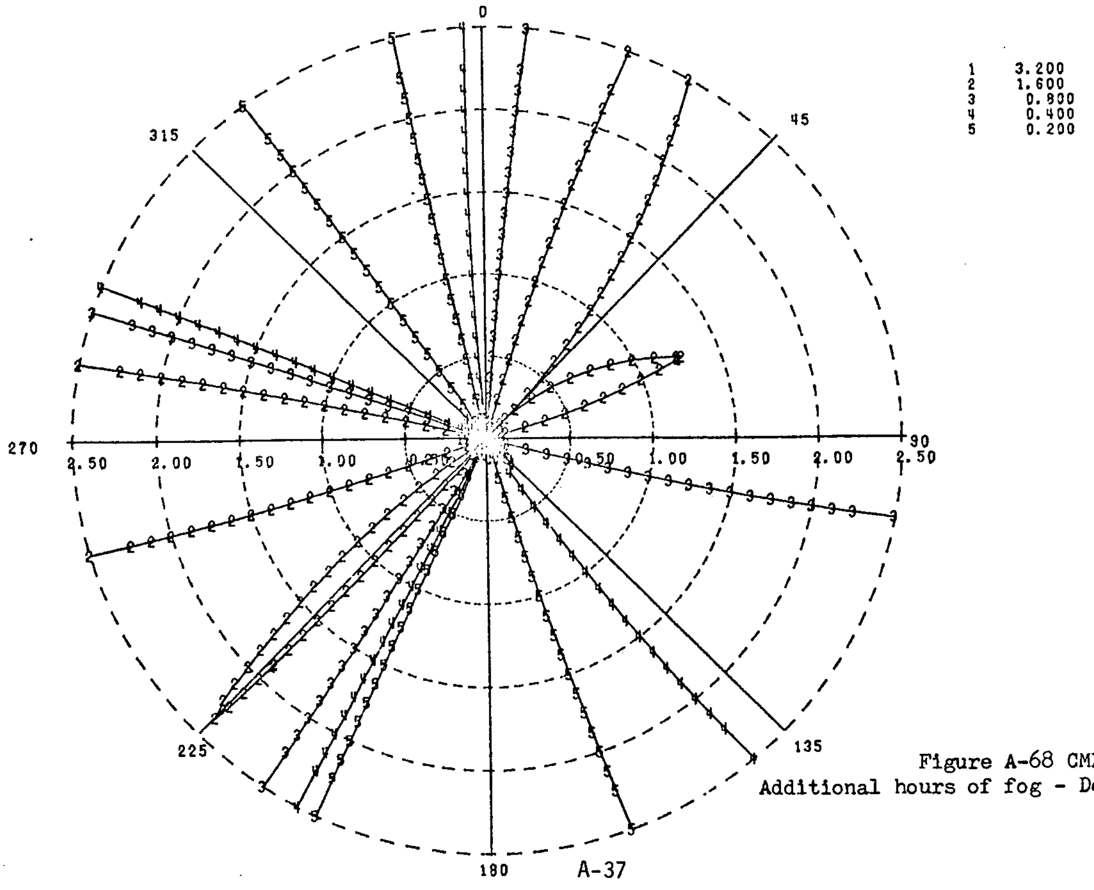


Figure A-68 CMDT
Additional hours of fog - December

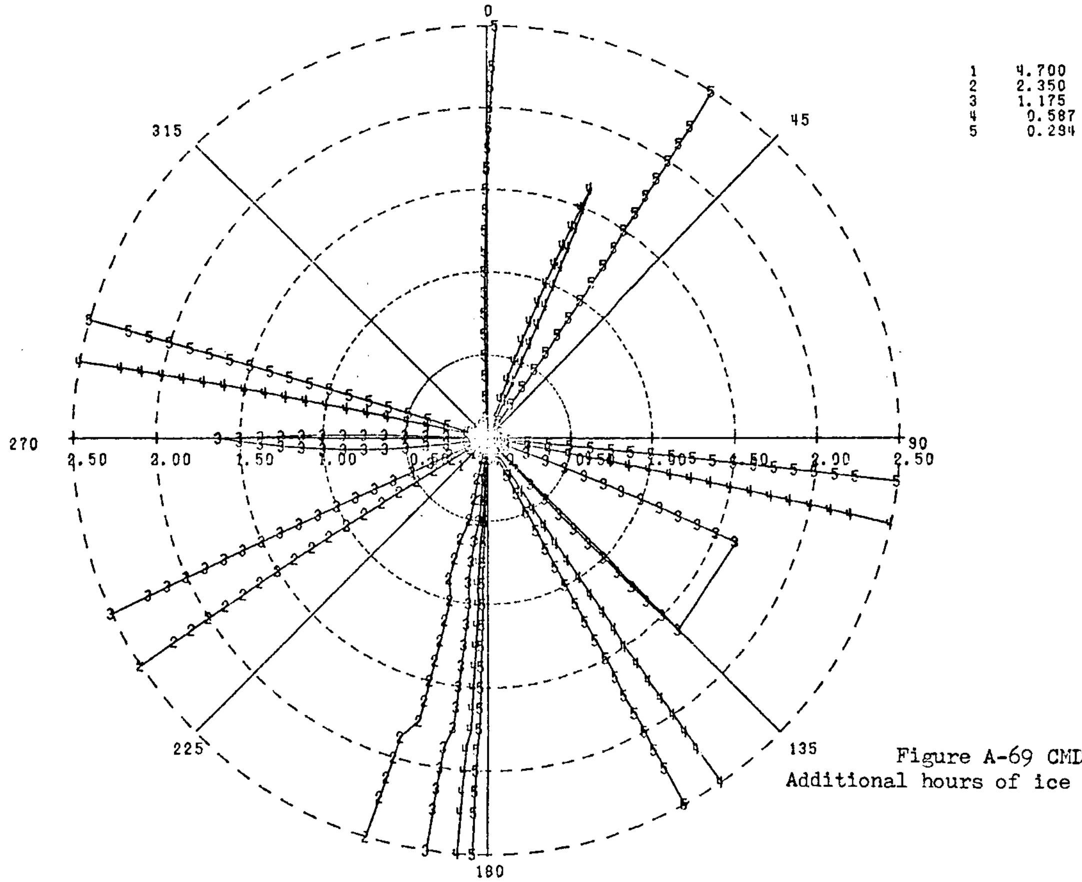


Figure A-69 CMDT
Additional hours of ice - Jan.

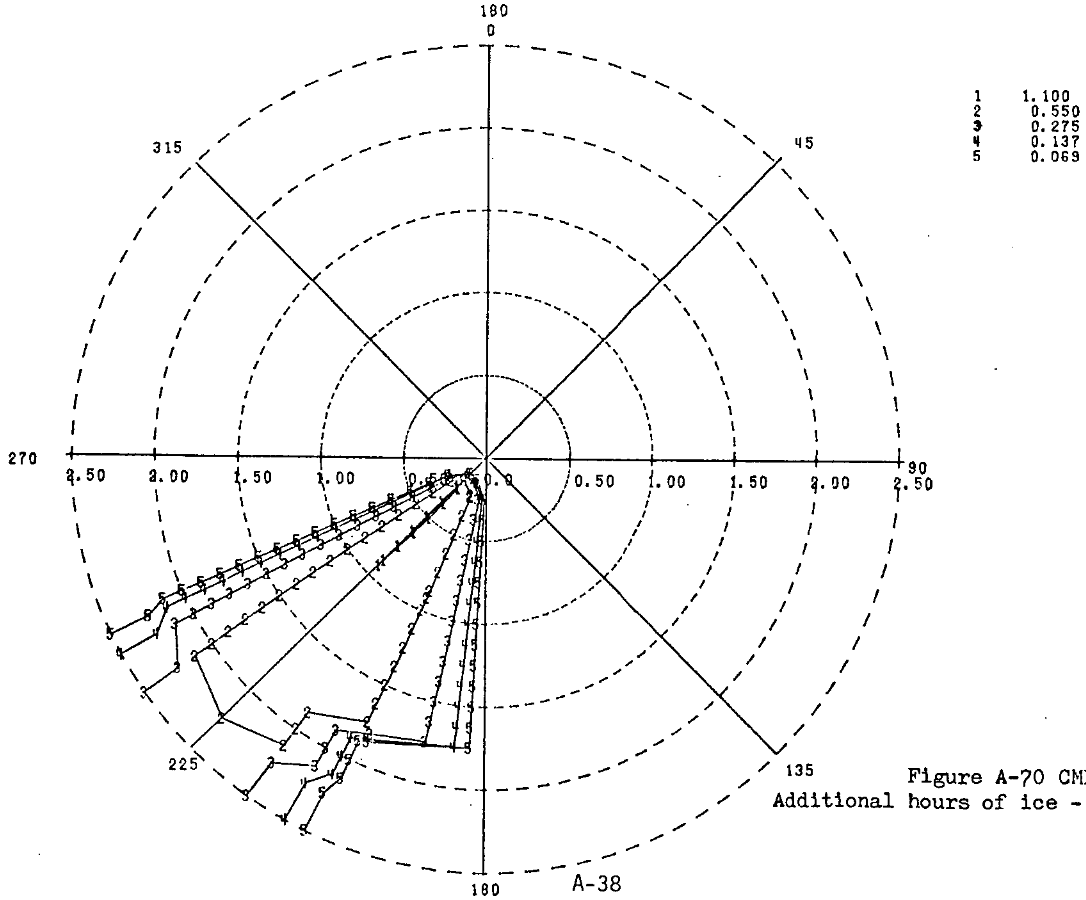


Figure A-70 CMDT
Additional hours of ice - March

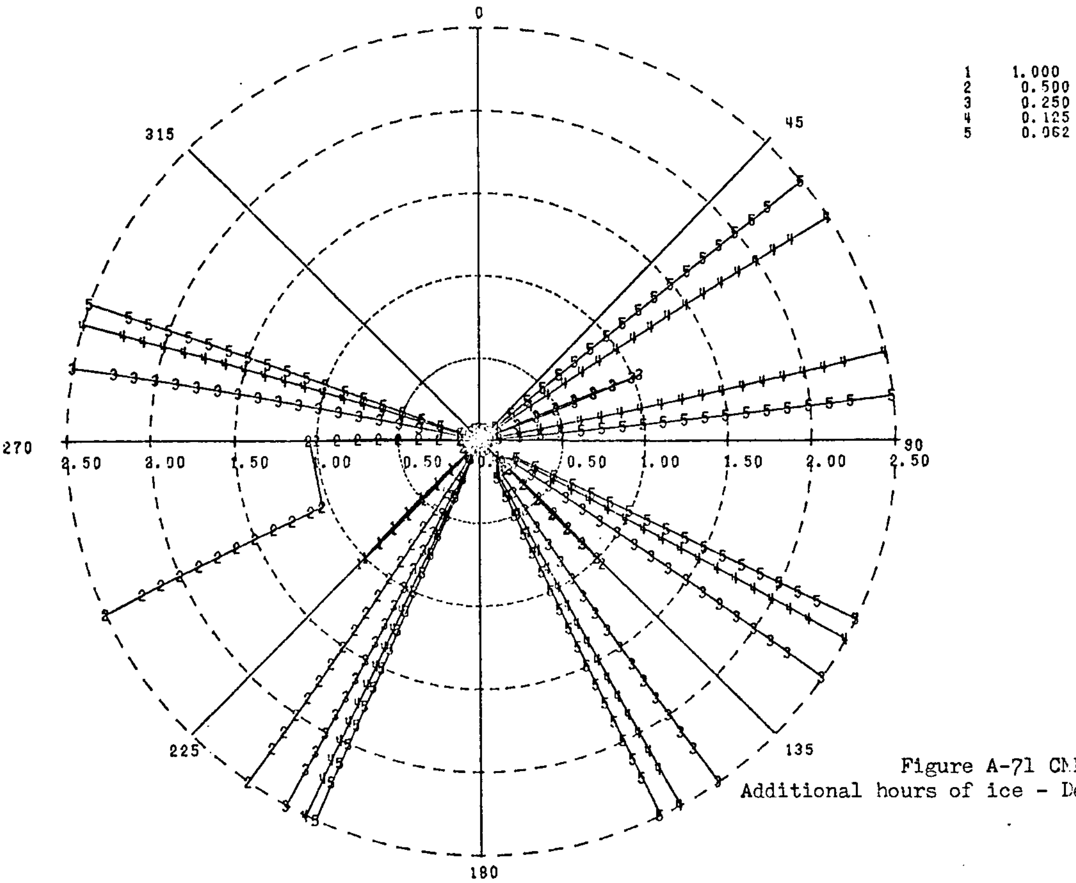


Figure A-71 CMDT
Additional hours of ice - December

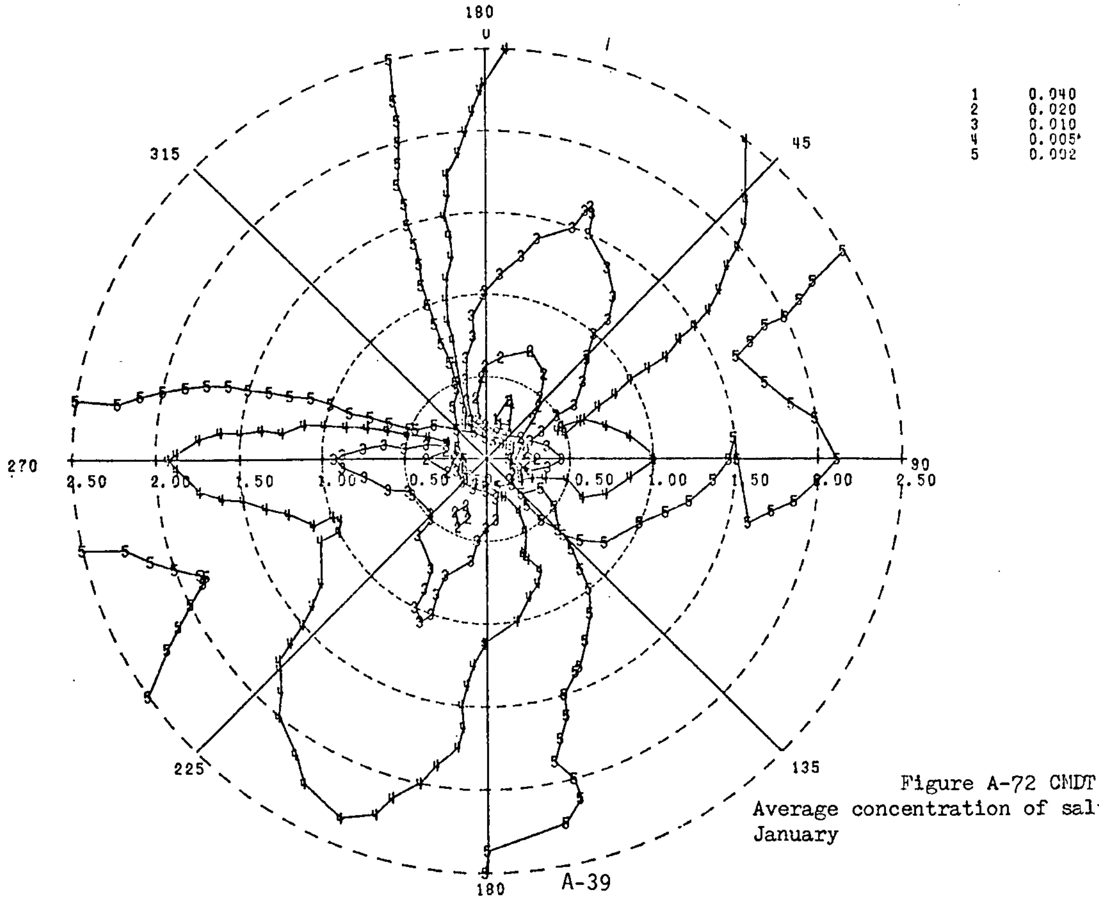


Figure A-72 CMDT
Average concentration of salt in air
January

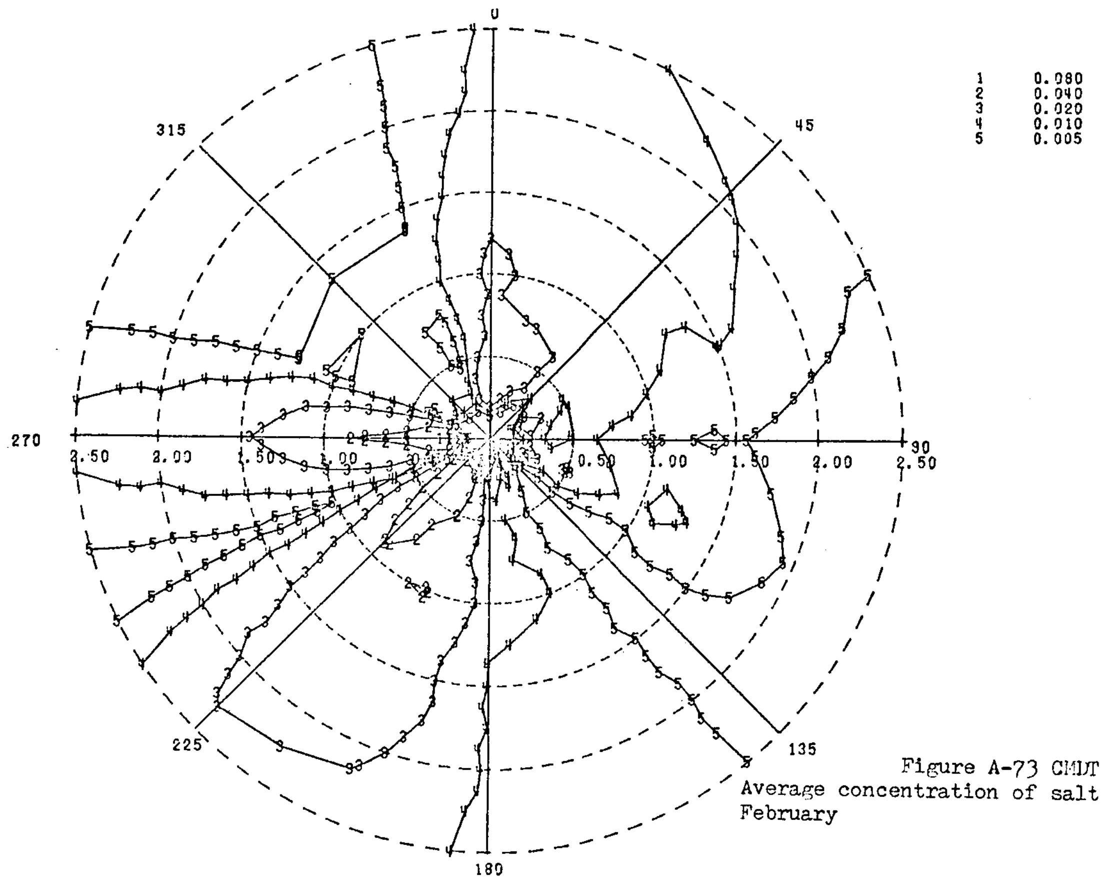


Figure A-73 CMDT
Average concentration of salt in air
February

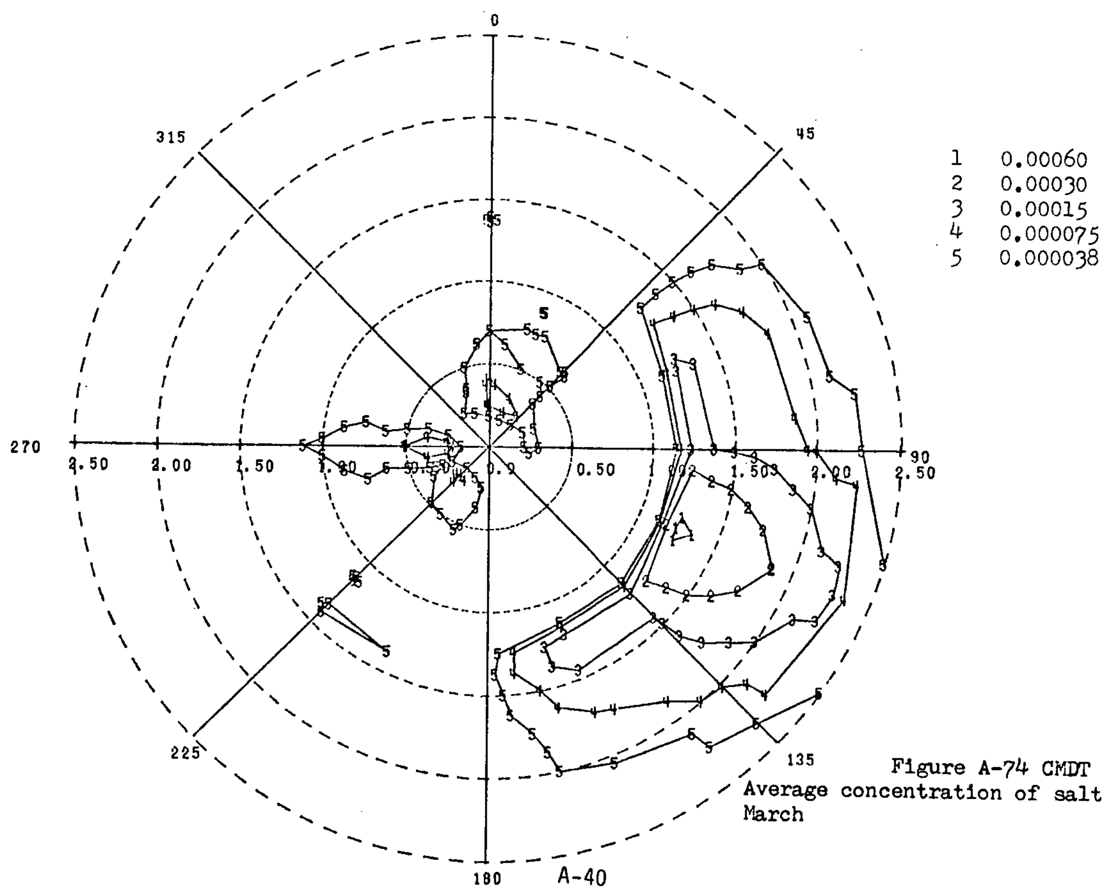
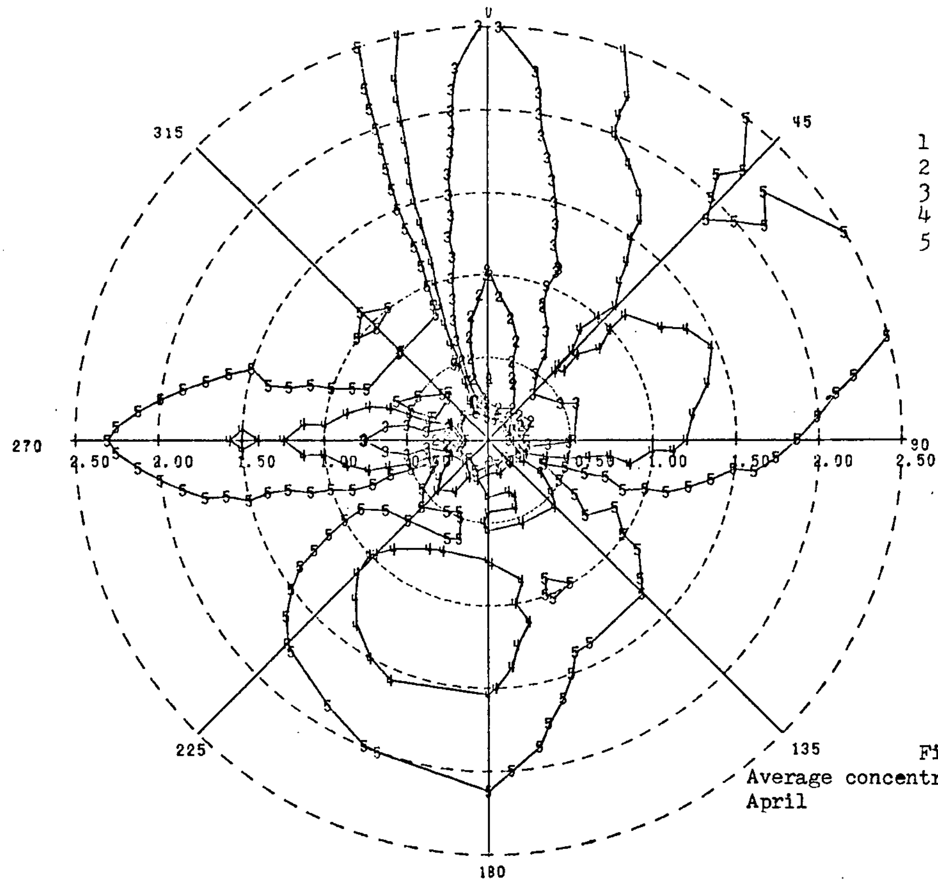
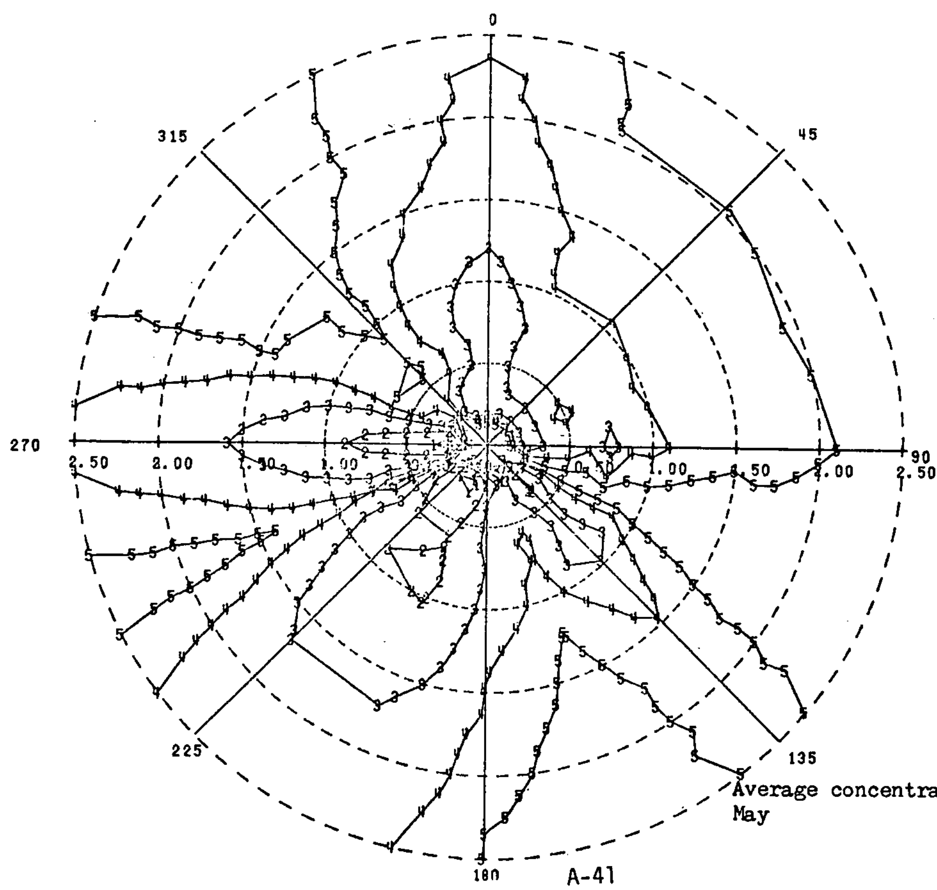


Figure A-74 CMDT
Average concentration of salt in air
March



1	0.00000300
2	0.00000150
3	0.00000075
4	0.00000038
5	0.00000019

Figure A-75 CMDT
Average concentration of salt in air
April



1	0.00200
2	0.00100
3	0.00050
4	0.00025
5	0.00012

Figure A-76 CMDT
Average concentration of salt in air
May

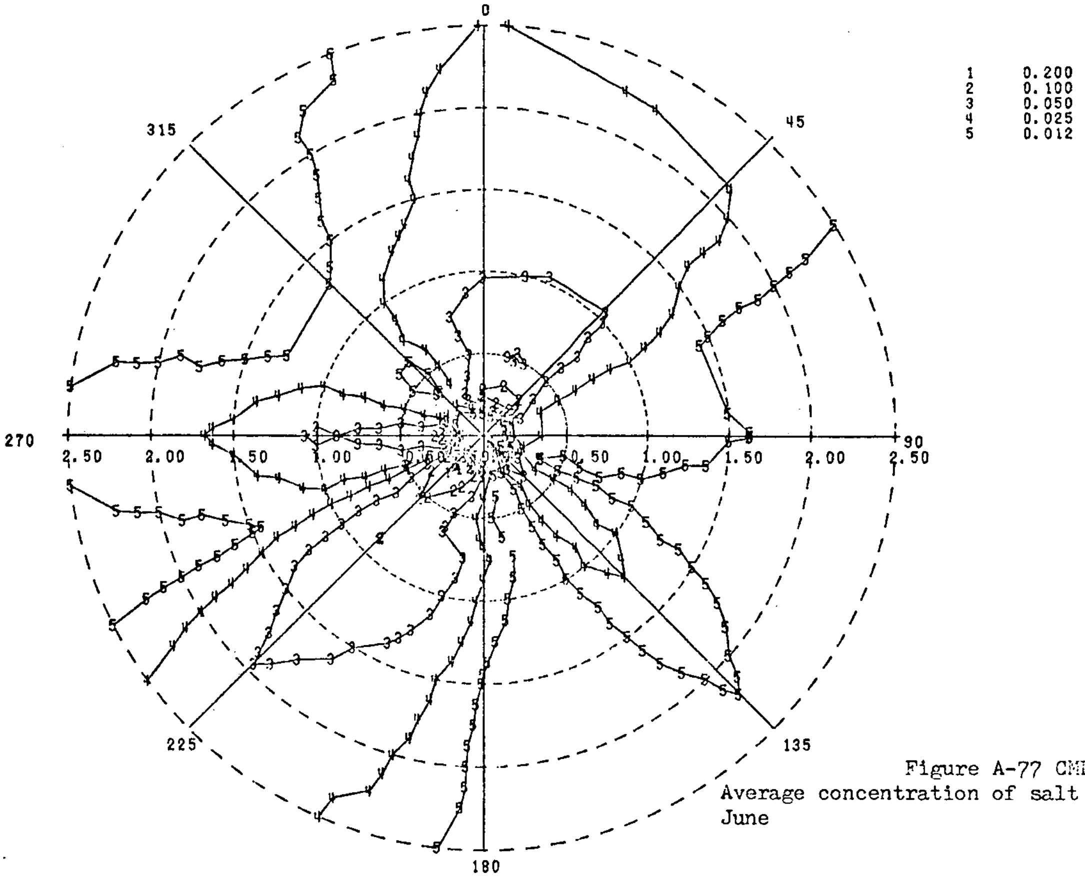


Figure A-77 CMDT
Average concentration of salt in air
June

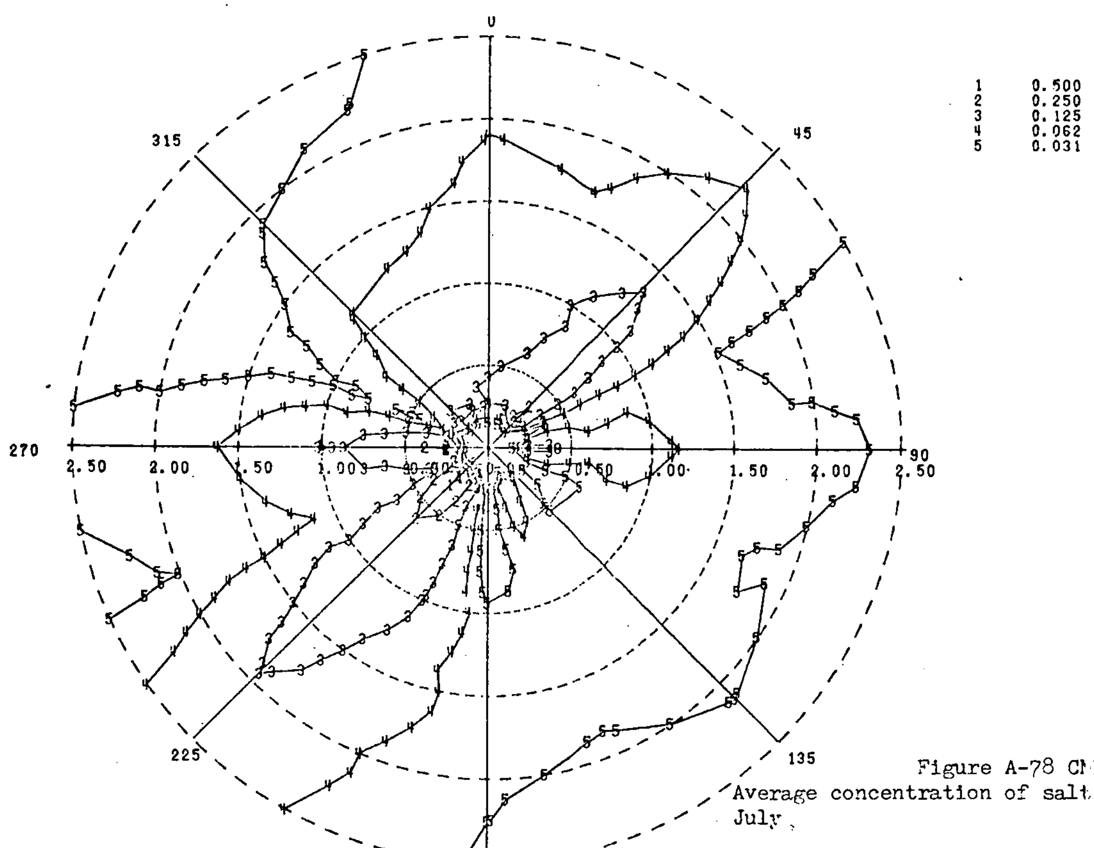


Figure A-78 CMDT
Average concentration of salt in air
July

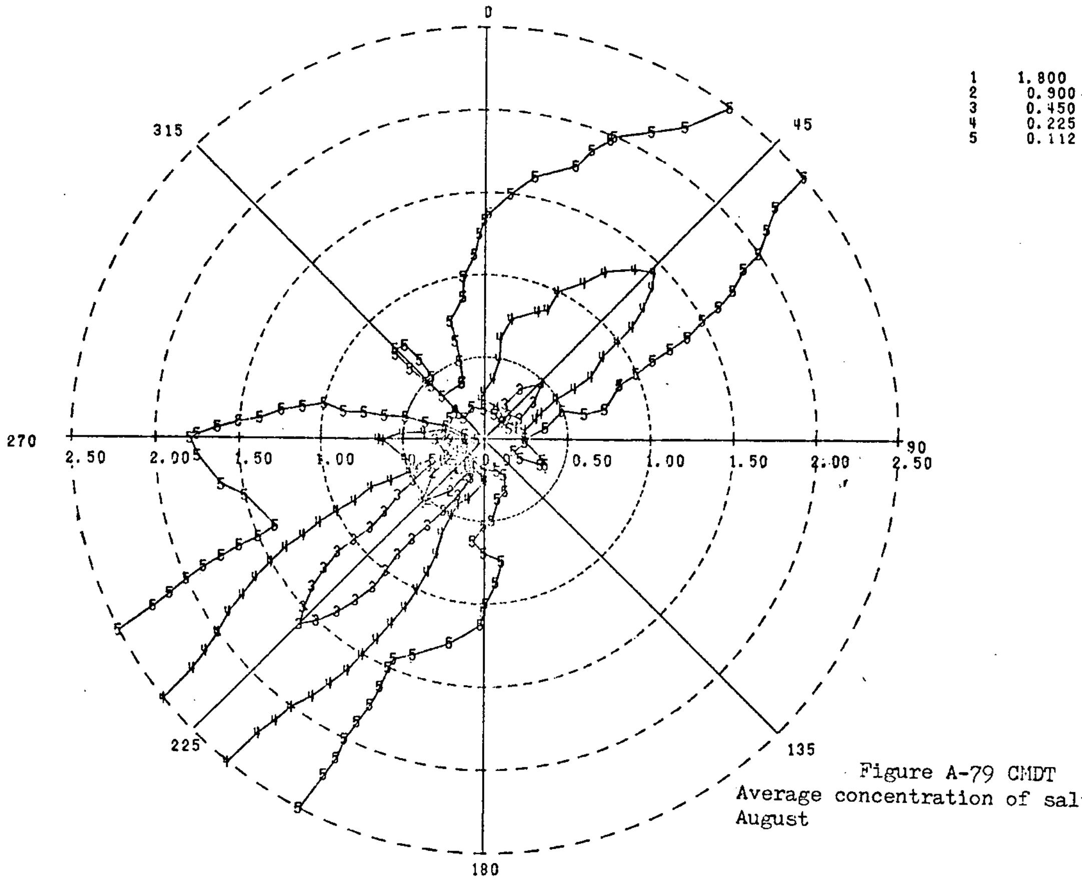


Figure A-79 CMDT
Average concentration of salt in air
August

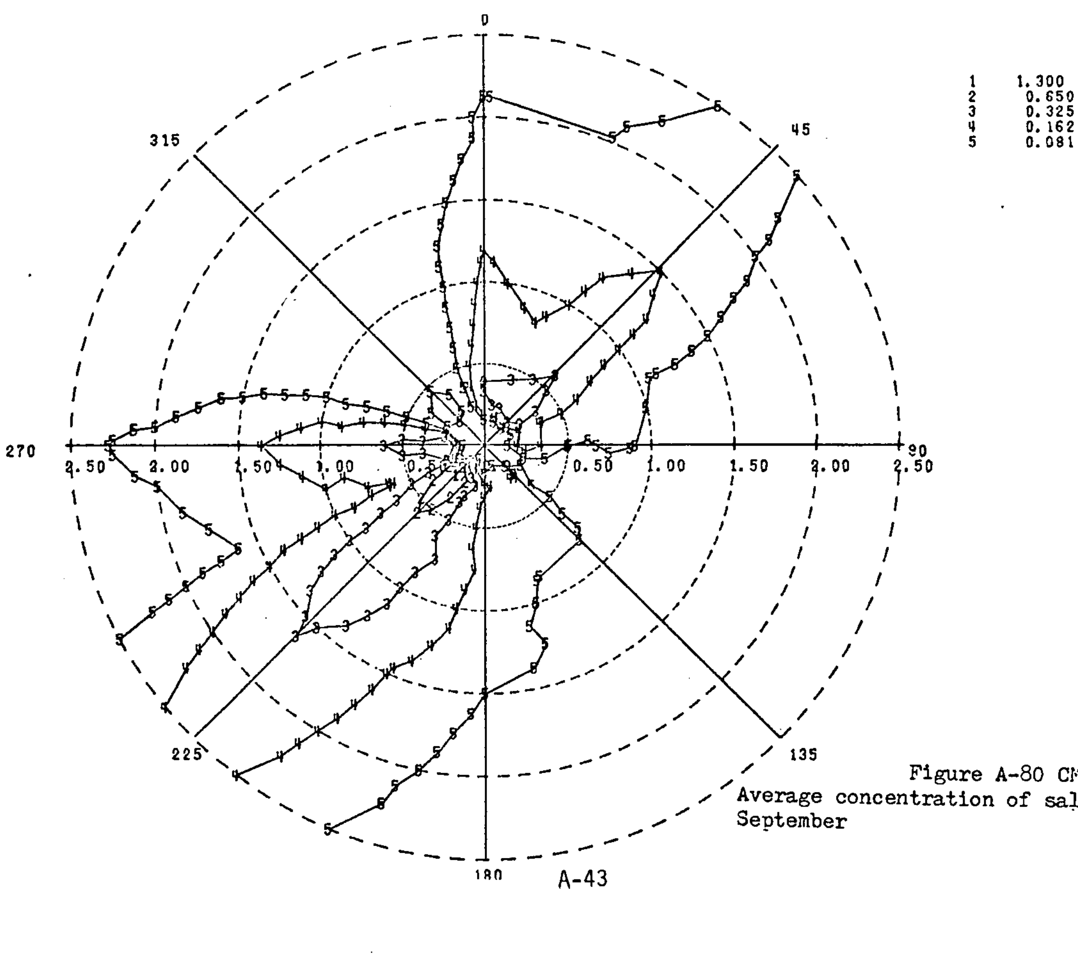


Figure A-80 CMDT
Average concentration of salt in air
September

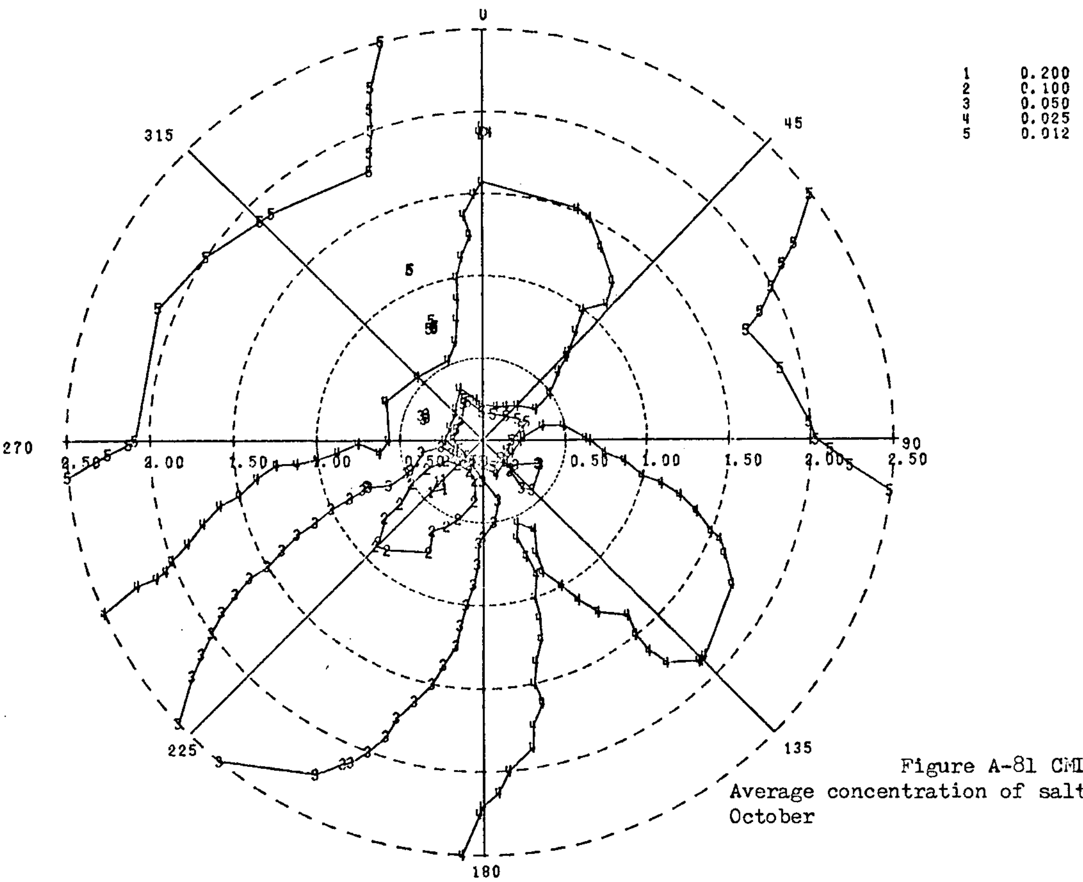


Figure A-81 CMDT
Average concentration of salt in air
October

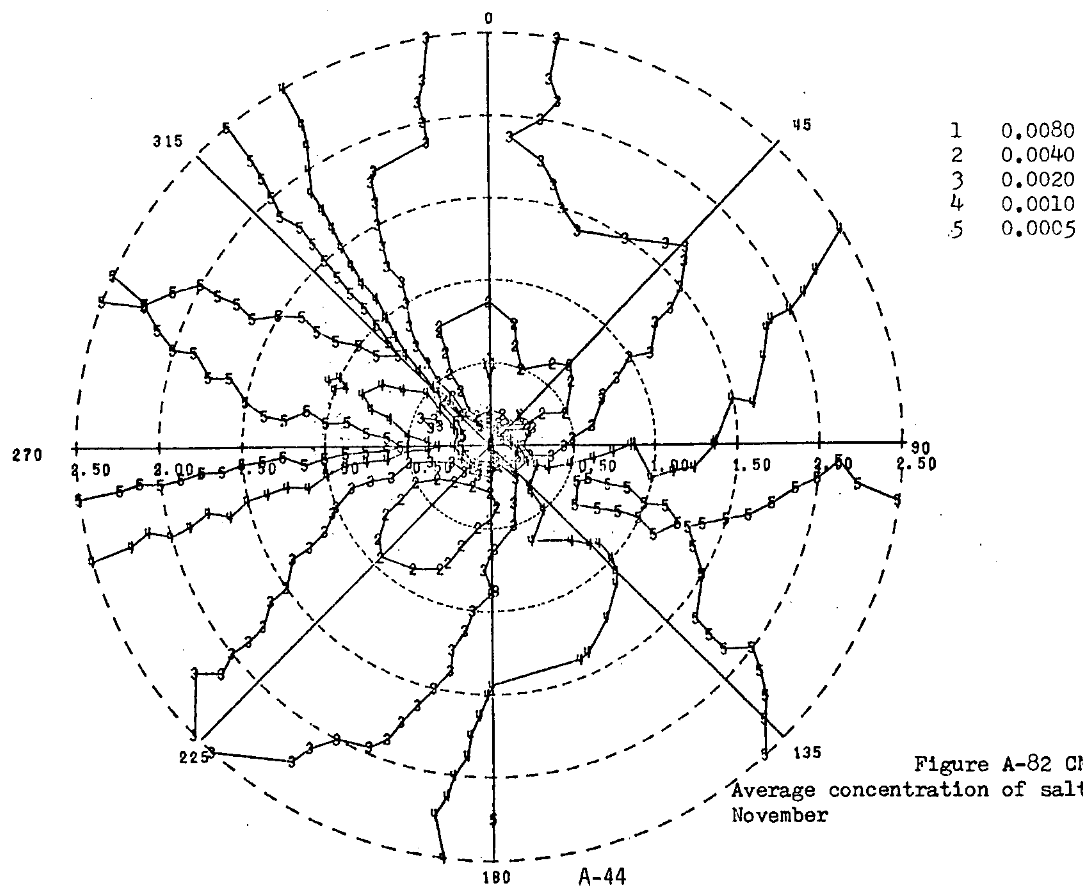
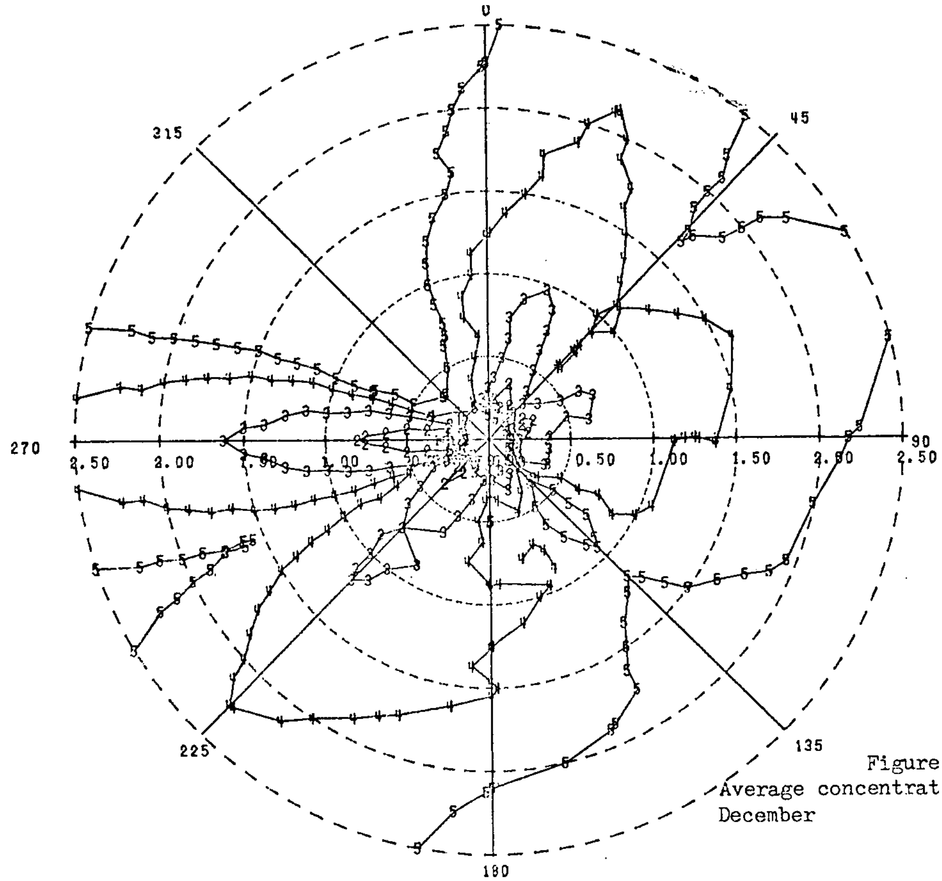


Figure A-82 CMDT
Average concentration of salt in air
November



1 0.200
2 0.100
3 0.050
4 0.025
5 0.012

Figure A-83 CMDT

Figure A-83 CMDT
Average concentration of salt in air
December

APPENDIX B

COMMENTS ON THE DRAFT ENVIRONMENTAL STATEMENT

AGRICULTURAL RESEARCH SERVICE OFFICE OF ADMINISTRATOR

OF UNITED STATES DEPARTMENT OF AGRICULTURE

WASHINGTON, D.C. 20250

September 21, 1977

Mr. George W. Knighton
Division of Site Safety
and Environmental Analysis
Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Knighton:

In response to your letter of August 8 to Mr. Carlson, we have reviewed the Draft Environmental Statement related to the Indian Point Nuclear Generating Station, Unit No. 3, Docket No. 50-286. We have no comments to add to your staff's evaluation and conclusions.

We appreciate having an opportunity to review this statement.

Sincerely,

H. L. Barrows

H. L. Barrows
Deputy Assistant Administrator

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
U. S. Courthouse & Federal Bldg., 100 S. Clinton St., Syracuse, NY 13202

50-286

September 19, 1977

Mr. George W. Knighton, Chief
Environmental Projects Branch No. 1
Division of Site Safety and
Environmental Analysis
United States Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Knighton:

We have reviewed the Draft Environmental Statement to amend Facility Operating License No. DPR-64 "for selection of the preferred closed cycle cooling system at Indian Point Unit No. 3" prepared by the U. S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation published August 1977.

This office has no comments to make regarding this statement.

Sincerely yours,

Paul A. Dodd /for

Robert L. Hilliard
State Conservationist

cc: Council on Environmental Quality
722 Jackson Place, N. W.
Washington, D. C. 20006
Attention: General Counsel

R. M. Davis, Administrator
Soil Conservation Service
Washington, D. C.

Dr. Fowden G. Maxwell
Coordinator, Office of Environmental
Quality Activities
Office of the Secretary
United States Department of Agriculture
Washington, D. C. 20250

Department of Energy
Washington, D.C. 20545

OCT 20 1977

Mr. George W. Knighton, Chief
Environmental Projects Branch No. 1
Division of Site Safety and
Environmental Analysis
Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Knighton:

This is in response to your transmittal dated August 8, 1977, in which you invited the Energy Research and Development Administration (ERDA) to review and comment on the Nuclear Regulatory Commission's draft environmental impact statement concerning the selection of the preferred closed cycle cooling system at Indian Point Unit No. 3 (Docket No. 50-286). Since that time, ERDA was abolished under the Department of Energy (DOE) Reorganization Act of 1977 and on October 1, 1977, those functions previously assigned ERDA were assumed by DOE.

ERDA staff review of the statement has indicated that the proposed action would not conflict with current or known future ERDA programs. Staff comments are enclosed which you may wish to consider in the preparation of the final statement.

Thank you for the opportunity to review and comment on the draft statement. Future NRC statements should be directed to DOE as noted below.

Sincerely,

W. H. Pennington, Director
Office of NEPA Coordination

Enclosure:
ERDA Staff Comments

cc w/enclosure:
Council on Environmental
Quality (5)

ERDA STAFF COMMENTS
ON THE
NRC DRAFT ENVIRONMENTAL STATEMENT
FOR SELECTION OF THE PREFERRED
CLOSED CYCLE COOLING SYSTEM AT
INDIAN POINT UNIT NO. 3
NUREG-0296

1. Front page (i) indicates Unit No. 2; this should be Unit No. 3. There is no discussion of constituents in the drift water other than salt. What about organics such as PCBs? The Hudson River is reported to be the worst in the Nation for PCB contamination. Would this be a problem?

2. The comments on page iv., 7a, are not consistent with the basic report (see page 1-14). Natural draft towers are very clearly the preferred, if not the only acceptable solution, considering the very close proximity of the villages involved and the noise and potential for fog and icing of the lower mechanical draft towers. Earlier environmental statements for Indian Point No. 2 had indicated that the noise level in nearby schools would be above recommended levels--even for mechanically assisted natural draft towers which would have relatively low noise. This subject is not discussed anywhere in this report.

3. Item 7.C. should more positively reinforce the applicant's selection of natural draft towers. This indecisiveness in the conclusions stems from failure to properly differentiate between the alternates elsewhere in the report such as on page 5-91 (See also discussion on pages 100, 101). The staff finding of page 5-100, last paragraph, is not reflected in the Summary Conclusions on page iv.

4. On page 5-1, third paragraph, Section 5.1.1.1, it is indicated that precipitation has not been observed from plumes. An article in Science, September 1976, indicated that precipitation has occurred, although, we would not attach great significance to this. Were it not for the close proximity of Buchanan, we would support the wet/dry solution as preferred for this site.

5. For completeness, this report should have dealt with the alternates such as improved inlet screens and beneficial use of the waste heat--at least in summary fashion. It is realized that extensive earlier treatment was given to this in the Indian Point No. 2 deliberation. However, it would be our view that these various dockets should stand alone.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION II
26 FEDERAL PLAZA
NEW YORK NEW YORK 10007

0 3 OCT 1977

50-286

Mr. George W. Knighton, Chief
Environmental Projects Branch No. 1
Division of Site Safety and
Environmental Analysis
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Knighton:

We have reviewed the draft environmental impact statement (EIS) for the selection of the preferred closed-cycle cooling system at Indian Point Unit No. 3, and we have determined that additional information will be needed in the final EIS on the economics and the potential radiological effects of closed-cycle cooling. Our views on the project's potential effects on water quality and aquatic biota are already a matter of record and do not require further comment. As you know, these issues will be the subject of an upcoming adjudicatory hearing on EPA-Region II's permit requirement (under the National Pollutant Discharge Elimination System) for closed-cycle cooling at Indian Point Unit No. 3 and other Hudson River power plants.

In general, we agree that the natural draft, fan-assisted natural draft, and circular mechanical draft cooling tower alternatives are environmentally and economically preferable to the other systems considered. Our review indicates that the air quality and noise impacts of the proposed project will be minor. However, our review also indicates the need for more detailed information concerning the discharge of radiological wastes.

As a result of the change-over to closed-cycle cooling, the amount of water available for dilution of radioactive waste effluents will be reduced from 870,000 gpm to 45,000 gpm, a reduction factor of 19. According to Table 6-9 of Con Edison's Economic and Environmental Impacts of Alternate Closed-Cycle Cooling Systems for Indian Point Unit No. 3 (January 1976), the largest percentage of the 10 CFR 20 limits would be I-131 (9.38 percent as opposed to 0.35 percent with once-through cooling). While 9.38 percent is well within the permissable range, we believe that two points in the EIS require clarification.

First, the EIS should indicate whether or not any changes to the radwaste system are planned as a result of the change-over to closed-cycle cooling. Second, the final EIS should identify precisely the point at which the radwaste effluent will be released into the Hudson River. With a once-through cooling system, the radioactive liquid waste can be released into the circulating waters before final release into an estuary. The draft EIS indicates only that the radwaste will be diluted in the blowdown from the closed-cycle cooling system. We suggest that the final EIS include a flow chart that clearly illustrates the relationship between the radwaste system and the closed-cycle cooling system. Also, the dose estimates from the radwaste effluents should be compared to the limits expressed in 40 CFR 190 and 10 CFR 50 instead of just to those in 10 CFR 20.

On the subject of economics, we believe that some clarification is required. The economic analyses presented in the draft EIS are based primarily on information supplied by Con Edison in its January 1976 report. As a result, the draft EIS does not reflect the fact the Power Authority of the State of New York (PASNY), the present owner, and not Con Edison would incur the cost of installing and operating a closed-cycle cooling system at Indian Point Unit No. 3. We suggest that cost estimates in the final EIS be based on PASNY ownership in order to reflect the actual situation.

We have rated the draft statement LO-2, indicating a lack of objections (LO) to the project provided that the additional information (2) needed to finalize that conclusion is included in the final EIS. If you have any questions about our comments or if we can be of further assistance, please call us at 8-264-8556.

Sincerely yours,

Daniel Sullivan

for Barbara M. Metzger
Chief
Environmental Impacts Branch

FEDERAL POWER COMMISSION
WASHINGTON, D.C. 20426

IN REPLY REFER TO:

7, SEP 1 1977

Mr. George W. Knighton, Chief
Environmental Projects Branch No. 1
Division of Site Safety and Environmental Analysis
Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Knighton:

This is in response to your letter of August 8, 1977, requesting comments on the NRC Draft Environmental Statement (DES) related to the proposed construction of a closed cycle cooling system for Indian Point No. 3 Nuclear Unit (Docket No. 50-286), owned by the Power Authority of the State of New York (PASNY) and operated by Consolidated Edison Company of New York (Con Ed). The unit is located at Indian Point, Village of Buchanan, Westchester County, New York State. The new cooling system is to embody a natural draft cooling tower, to replace the existing once-through cooling system.

These comments by the Federal Power Commission's Bureau of Power Staff are made in compliance with the National Environmental Policy Act of 1969 and are directed to the effect on the New York Power Pool (NYPP) system (of which Con Ed and PASNY are members) of the derating, and temporary loss of total capacity, at Indian Point No. 3 due to the installation of the closed cycle cooling system. The NYPP is involved because it dispatches generation for all of its member systems.

In preparing these comments, the Bureau of Power Staff has considered the NRC Draft Environmental Statement, and the Northeast Power Coordinating Council's (NPCC) April 1, 1977, "Report on Reliability and Adequacy of Electric Power" (submitted pursuant to FPC Order 383-4, Docket R-362).

Indian Point No. 3, with a net dependable capability of 1,033 MW, would be shutdown for seven months (from September 15, 1981, to April 15, 1982) while it is being connected to the new closed cycle cooling system. After installation of the new cooling system Indian Point No. 3 will be derated 78 MW to a net dependable capability of 955 MW.

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

Mr. George W. Knighton -2-

The attached table shows NYPP's load and supply situation for the winter peak period during initial shutdown and for the summer peak period after tie-in. NYPP is a predominantly summer peaking system and the shutdown period would occur during the winter while the derating would have the greatest effect during the summer peak period. After the derating the NYPP reserve margin would be above the 18 percent NYPP criteria for the shutdown period and through 1986.

The Bureau of Power Staff concludes that there will be no loss of reliability to NYPP due to the installation of the closed cycle cooling system at Indian Point No. 3. The possible reduced reliability of the more complex cooling system will be eliminated due to the fact that Indian Point No. 3 can also use the existing once-through cooling system.

Very truly yours,

Jack L. Weiss

Jack L. Weiss
Acting Chief, Bureau of Power

LOAD - SUPPLY SITUATION

WITH INDIAN POINT SHUTDOWN AND DERATING

NEW YORK POWER POOL	WINTER 1981-82	SUMMER 1982	1983	1984	1985	1986
Total Peak Capability - Megawatts	32,171	31,894	31,855	34,545	35,072	35,962
Peak Load - Megawatts	22,990	25,850	26,850	27,950	28,910	29,930
Reserve Margin - Megawatts	9,181	6,044	5,005	6,595	6,162	6,032
Reserve Margin - Percent of Peak Load	39.9	23.4	18.6	23.6	21.3	20.2
Desired Reserve Margin (Based on 18 Percent of Peak Load) - Megawatts	4,138	4,653	4,833	5,031	5,204	5,387
Reserve Deficiency - Megawatts	None	None	None	None	None	None

FEDERAL POWER COMMISSION
WASHINGTON, D.C. 20426

SEP 30 1977

RECEIVED
OCT 6, 1977
U.S. NUCLEAR REGULATORY COMMISSION
Mail Section

Mr. George W. Knighton
Chief, Environmental Projects Branch No. 1
Division of Site Safety and Environmental Analysis
Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Knighton:

This is in response to your letter of August 8, 1977, addressed to the Commission's Advisor on Environmental Quality, requesting comments on the draft environmental statement related to the selection of the preferred closed cycle cooling system at Indian Point Unit No. 3. The plant is located in the Village of Buchanan on the Hudson River estuary, 24 miles north of the New York City boundary line.

The Facility Operating License No. DPR-64 requires the termination of the existing once-through cooling procedure at Unit No. 3 by September 15, 1980. The applicant has selected a natural draft wet cooling tower to replace the once-through system. The 965-megawatt unit is owned by the Power Authority of the State of New York and operated by the Consolidated Edison Company of New York, Inc.

These comments of the Federal Power Commission's Bureau of Power are made in accordance with the National Environmental Policy Act of 1969. Our principal concern with proposals affecting land and water resources is the possible effect of such proposals on bulk electric power facilities including potential hydroelectric developments, and on natural gas pipeline and related facilities.

Relocation of Gas Pipeline

It is indicated on Pages 3-13 and 4-2 that a natural gas pipeline owned by Algonquin Gas Transmission Company will have to be relocated because of its proximity to the proposed cooling tower and that a Federal Power Commission permit would be required.

If impacts on safety, socioeconomics including maintenance of service, and other aspects associated with the relocation of this pipeline are of

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

such a magnitude that they would constitute a "major federal action having a significant effect on the quality of the human environment," the preparation of an environmental impact statement would be required before the Federal Power Commission could issue the permit. In order to avoid the likelihood of this requirement, we suggest that the Nuclear Regulatory Commission's final environmental statement contain a description of actions required and impacts of relocating the pipeline. We suggest that this description include a map showing the existing and proposed locations of the pipeline and the relationship to other features including the power plant and cooling towers.

Availability of Once-through Cooling

According to Page 3-15 of the environmental statement the applicant will have the capability of operating the plant with once-through cooling or with the closed cycle cooling system. We would like to point out the significant potential value of maintaining the operating condition of the once-through system.

1. In periods of severe cold weather it may be determined to be in the interest of aquatic resources to discharge part or all of the waste heat into the river.

2. Cooling tower operational experience may show that effects of the cooling tower plume are greater than anticipated during abnormal atmospheric conditions. Since these abnormal conditions usually occur during the winter season, use of the once-through system to convey all or part of the waste heat from the plant could serve to alleviate these conditions.

3. According to the statement, the average capability of the plant will be reduced by about 4% (33.5 MW) as a result of shifting from the once-through system to cooling towers. An oil-fired plant such as Bowline Point would require over 300,000 barrels of oil per year to make up this lost capability. Therefore, if a critical oil or gas shortage reoccurred comparable to that of 1973 with the oil embargo or the winter of 1976-77, the plant could be shifted to once-through cooling and the savings in fuel could be realized.

4. Future conditions may result in a different set of tradeoffs among fuel consumption, atmospheric discharges of waste heat, esthetics, fish and wildlife requirements, and other factors in power plant operation. By having the flexibility of using once-through cooling, cost and adverse environmental effects could be minimized.

We hope our comments will be helpful to you in the preparation of the final environmental impact statement.

Very truly yours,

William W. Lindsay
Acting Chief, Bureau of Power

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
AREA OFFICE
666 FIFTH AVENUE
NEW YORK, NEW YORK 10019

REGION II
26 Federal Plaza
New York, New York 10007

NOV 8 1977

IN REPLY REFER TO:
2.1SS

NOV 11 1977
U.S. NUCLEAR REGULATORY COMMISSION
Mail Section

George W. Knighton, Chief
Environmental Projects Branch No. 1
Division of Site Safety and
Environmental Analysis
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Knighton:

Subject: Draft EIS
Proposed Action: US NRC Closed Cycle Cooling System
Indian Point Nuclear Generating Unit No. 3, Village of
Buchanan, Westchester Co., N. Y.

We have reviewed subject statement and we have the following comments on the environmental aspects of the proposed action. These comments are essentially the same as those we made on reviewing the DEIS of the Closed Cycle Cooling System for Unit No. 2 of the Indian Point nuclear generating installation.

A critical issue is the massiveness of the power complex at Indian Point. The number of reactors has increased over the years to three and their waste heat will now be disposed of almost entirely on the land and atmosphere. The impacts of Indian Point on its surrounding communities will therefore be felt directly as a daily experience and will cut across the major constituents and qualities of this part of the Hudson River valley.

For example, the City of Peekskill, which has spent much time, money and effort on its planning and development, must now contend with unexpected and adverse influences, many of which the City has detailed in its response to the DEIS for the closed cycle cooling system planned for Indian Point Unit No. 2. In addition, the classical river community of Verplanck is in the path of much of the worst air-borne effects of the proposed towers, and the cooling towers almost reach the height of Dunderberg Mountain across the river, overwhelming all other man-made features in the area.

The final statement should, therefore, address the following issues:

Since at least two on-site cooling systems and possibly three will be required, the cumulative impact of the systems should be assessed.

Any particular requirements critical to the siting of three cooling systems should be identified and considered.

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The shadow effect cast by the sun, particularly the cumulative impact of a possible set of three towers including their plumes, should be determined and assessed.

Reclamation of waste heat for some useful local purpose should be considered as a possible feature, now or in the future, of a CCC system.

A cooling system that more equitably shares the impact of disposing of waste heat on both the river and the land-atmosphere might be considered.

Thank you for the opportunity to review the statement.

Sincerely,

Acting Director
New York Area Office

cc: Council on Environmental
Quality (5)

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

ER 77/752

SEP 23 1977

Mr. George W. Knighton, Chief
Environmental Projects Branch No. 1
Division of Site Safety and
Environmental Analysis
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Knighton:

Thank you for your letter of August 8, 1977, transmitting copies of the Nuclear Regulatory Commission's draft environmental statement for selection of the preferred closed-cycle cooling system at Indian Point Unit No. 3, [50-286], Westchester County, New York.

We have reviewed the draft statement and reiterate below several of our concerns from our comments on the draft statement for selection of preferred closed-cycle cooling system at Indian Point Unit No. 2 (Attachment 1), and in our comments on the draft statement for extension of operation with once-through cooling for Indian Point Unit No. 2 (Attachment 2). These issues, summarized below, remain of concern to us on the selection of a cooling system for Unit 3.

Additional comments are presented according to the format of the statement or by subject.

General

1. We are concerned that the ultimate decision on the selection of closed-cycle cooling systems at Indian Point Unit No. 3 will only be prolonged by the differences in the evaluations made by the NRC staff and the applicant.

We believe that the once-through cooling systems presently in operation at Indian Point have the potential for causing unacceptable long-term impacts on the fisheries of the Hudson River. Any licensing delays will only lengthen the exposure of fish populations of the Hudson River and Middle Atlantic coastal States to adverse impacts which previously have been determined to be unacceptable. Positive steps should be taken as quickly as possible to reach an agreement on the use of closed-cycle cooling systems at Indian Point.

2. Impacts on Groundwater

The final statement should show the location of surrounding wells on a map that includes contours on the water table and should give the typical range of depths to water. This information is needed in the evaluation of the effects from the potential infiltration of salts from cooling tower drift. The draft statement considers the potential for buildup of saline soils to be negligible because of the frequency of rainfall; however, we do not find any indication that infiltration to groundwater has been considered--except by implication in the assertion that groundwater flow will be to the river rather than to surrounding wells. The final statement should assess this issue.

3. Cultural Resources

We recommend that a qualified archeologist be consulted and that the final statement provide a more detailed discussion concerning the presence of archeological values, the probability of the project's impact on them, and the disposal of excavated material from construction. Even though the area has recently been disturbed by plant construction, the potential for impact upon cultural resources at the construction site was inadequately considered in the draft statement; it appears that only a literature survey has been made.

4. Historic sites have been given initial consideration to the extent of locus identification and a brief evaluation of probable impacts in the draft statement. Among the sites listed, many of which are indicated on the National Register

of Historic Places, there are some (not so indicated) that are also National Historic Landmarks. Of these National Historic Landmarks, we believe the following bear closer evaluation in the final statement: (1) Stony Point Battlefield, (2) Palisades Interstate Park, and (3) Van Cortlandt Manor. A more detailed discussion of these sites should be presented in the final statement.

While the staff conclusion of negative impact on page 6-28 of the draft statement may hold true, we believe it should be substantiated by the display and discussion of a favorable commentary in the final statement from the State Historic Preservation Officer and from the qualified archeologist as mentioned above.

5. Page 5-96 - The amount of the Hudson River's tidal flow appears to be a misprint; probably it should be 180,000 cfs and corrected in the final statement.

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

Sincerely,

Larry E. Meierotto
Deputy Assistant SECRETARY

Attachments (2)

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

PEP ER-76/177

APR 26 1976

Dear Mr. Knighton:

Thank you for your letter of February 23, 1976, requesting our comments on the draft environmental statement on the Selection of the Preferred Closed Cycle Cooling System at Indian Point Unit No. 2, Westchester County, New York.

Our comments are submitted according to the format of the statement or by subject.

Selection of Cooling Tower Design
An excellent review has been made of the relative merits of different cooling tower designs by the NRC staff which leads to the general conclusion that any of the systems could achieve the cooling function satisfactorily but with different costs, design requirements, and aesthetic impacts. Although the NRC staff has concurred in the applicant's selection of the NDCT as the preferred cooling tower design, the draft statement appears to lack a clear cut summary of reasons why the NDCT is the design of preference for the NRC staff as well as the applicant. The section on Evaluation of Program Activities, page 7-1, could appropriately be expanded in the final statement to summarize the reasons why the NDCT is preferred.

On page 3-14, the NRC staff notes that smaller sizes of natural draft towers could be possible for the site. This possibility is not evaluated further in the statement but would seem to merit further consideration if the visual impacts could be lessened through this means.

The NRC has made a commendable effort to project the future viewscape with the cooling towers in operation, through photographic exhibits. Although the draft statement indicates that local viewpoints have been solicited, we believe the review process will be enhanced if all local parties having a prime concern in the aesthetic

CONSERVE AMERICA'S ENERGY

ATTACHMENT 1

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impact of the cooling towers have had the benefit of these projected viewscapes. It would seem appropriate for the final statement to indicate to what extent these viewscapes have been made available for local comment.

Cooling Tower Impacts on Parks, Recreation Areas, and Historic Sites

Since various recreation facilities, parks, and historic sites are located within fifteen miles of the cooling towers, the impacts could best be discussed by proceeding radially outward from the cooling towers and identifying each park, recreation area, or historic site with an evaluation of visual impacts in each case. This would provide a better appraisal of the aesthetic impact of the cooling towers on recreational areas and historic sites than is now evident from the draft statement.

Parks at Plant Site

Page 5-39 mentions plans for a natural park area at the plant site and notes that the cooling towers will impact on the 80 acres designated for this purpose. If these plans had been discussed in another environmental statement, this should be referenced. Otherwise, the proposed park should be discussed in more depth, describing the facilities to be offered (parking, restrooms, picnicking), who could use it, and when it would be opened.

Cultural Resources

No mention is made in the draft statement to indicate that cultural resources at the construction site have been considered. The final statement on Indian Point Unit No. 3 indicated that contact had been established with the State Historic Preservation Officer and the National Advisory Council on Historic Preservation. The final statement for the closed cycle cooling system on Unit No. 2 should indicate what measures were taken as a result of these contacts and whether the previous arrangements adequately cover cultural resources in the cooling tower area for Unit No. 2.

To assure that the archeological potential in the area to be excavated is properly appraised, we recommend contact with the State Archeologist, Dr. Robert Funk, New York State Museum and Science Service, Albany, New York 12224.

Disposal of Excavated Materials

Construction of the proposed cooling system would require excavation of approximately 700,00 cubic yards of rock and unconsolidated material (page 3-4, paragraph 3.3). The only information on disposal of the excavated material is the statement that "the beach of Lent's Cove could also be used for delivery and disposal of material" (page 3-9, paragraph 1). However, no information is provided on the ultimate disposal site proposed for the excavated material, or on related environmental impacts. The present use of the beach at Lent's Cove is not discussed. The final statement should adequately address these matters.

Ground Water

Locations of the wells (page 5-68) should be shown on one of the maps; and typical magnitudes of rates of infiltration in areas of ground-water use should be provided. An indication of relations between the rate of water-table change and precipitation or other evidence of infiltration potential is needed for full impact evaluation.

Fish and Wildlife

Although we generally support the conclusions and recommendations contained in the environmental documentation, we are concerned that the differences in evaluation made by the NRC staff and the applicant could cause delays in the licensing process and interfere with the established schedule which requires termination of once-through cooling by 1979. The welfare of the fishery resources of the Hudson River should not be jeopardized by any delays which could be avoided. The final statement should give assurance that this schedule will be maintained.

Specific comments according to section and page are as follows:

Section 3.4.3, page 3-10: Asbestos fibers have been found to be carcinogenic to fish and humans. In view of recent adjudicatory hearings which have highlighted the potential hazards of Hudson River polychlorinated biphenyls (PCB's) to human health, we recommend that NRC require the use of wooden or plastic components (rather than asbestos-cement) in cooling towers at Indian Point.

Section 3.5.1, page 3-13: We support the staff's recommendation that the applicant use amertap balls, rather than chlorine, to clean the tubes in the condenser. This would greatly reduce the adverse effects of residual chlorine discharges on Hudson River biota, especially egg, larval, and juvenile fishes.

Section 5.1.3.3, pages 5-8 to 5-27: We commend the staff on its application of the ORFAD drift model to the Indian Point Unit No. 2 situation. The staff's modified ORFAD model represents a substantial improvement over the applicant's model. However, the credibility of staff conclusions is limited by the availability of only one year of on-site meteorological data. The staff should make additional model runs using more recent data, as they become available. These should include observations of on-site fog and cloud cover. Additional runs will enable the staff to better define the variability of local meteorological conditions and refine its predictions concerning salt deposition and botanical damage.

Figures 5-4 and 5-19 should be improved in the final statement for the following reasons:

1. It is unclear what scale (units) was used to denote radial distances from the cooling towers.

2. It is very difficult to read and properly interpret the estimated rates (salt deposition, fog, ice) in the immediate vicinity of the cooling towers.

3. The use of the index from one to five to indicate decreasing rates (salt deposition, fog, ice) is potentially confusing. Index values should increase as the estimated rates increase.

Section 5.5.2, pages 5-28 to 5-38: The staff has pointed out that the applicant's experimentally determined threshold for salt deposition (on hemlock, dogwood, and ash) may be in serious error (i.e., too low) for at least two reasons:

1. The possibility that trees in experimental chambers may have been affected by two pathways--gravitational deposition on leaf surfaces and entry of salt particles into stomata.

2. The importance of dose rates as opposed to total dose has not been conclusively demonstrated to be the critical factor causing damage.

In view of these potential errors and the importance of establishing accurate values for damage thresholds, and the dependency of overall environmental impact assessment on these thresholds, we recommend that NRC require the applicant to conduct more extensive and technically sound experiments designed to resolve the potential errors mentioned above. Unless these problems are resolved, there will continue to be a difference of opinion as to whether the botanical impacts are of primary concern or whether the aesthetic impacts are more important.

We hope these comments are helpful to you.

Sincerely yours,

Stanley D. Doremus

Deputy Assistant Secretary of the Interior

Mr. George W. Knighton, Chief
Environmental Projects Branch No. 1
Division of Site Safety and
Environmental Analysis
Nuclear Regulatory Commission
Washington, D. C. 20555

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

PEP ER-76/664

AUG 26 1976

Dear Mr. Knighton:

Thank you for your letter of July 8, 1976, transmitting the Nuclear Regulatory Commission's draft environmental statement for extension of operation with once-through cooling for Indian Point Unit No. 2, Westchester County, New York.

We have reviewed the subject project and have the following comment.

The draft statement does not provide sufficient reason for alteration of our previous comments on the draft environmental statement on the Selection of the Preferred Closed Cycle Cooling System at Indian Point Unit No. 2 of April 25, 1976 regarding fish and wildlife resources. A copy of this letter is enclosed.

We are concerned that the welfare of the fishery resources of the Hudson River may be jeopardized by this further delay in the termination of once-through cooling.

We hope these comments will be helpful to you.

Sincerely yours,

(Sgd) Ronald G. Coleman

Assistant Secretary of the Interior

Mr. George W. Knighton, Chief
Environmental Projects Branch No. 1
Division of Site Safety and Environmental Analysis
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Enclosure

ATTACHMENT 2

New York State Department of Environmental Conservation
50 Wolf Road, Albany, New York 12233

Peter A. A. Berle,
Commissioner

October 12, 1977

RECEIVED OCT 17 1977 U.S. NUCLEAR REGULATORY COMMISSION

Mr. George Knighton, Chief
Environmental Projects Branch #1
Division of Site Safety and
Environmental Analysis
Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Knighton:

Enclosed are the State of New York's comments on the U. S. Nuclear Regulatory Commission (NRC) "Draft Environmental Statement for Selection of the Preferred Closed Cycle Cooling System at Indian Point No. 3", published August, 1977. We have incorporated the relevant views of interested State Agencies in these comments.

The NRC staff's conclusion that natural draft cooling towers would be the most environmentally compatibile alternative is the appropriate conclusion from most areas of environmental conservation. However, the significant exception was in the area of aesthetics, where the circular mechanical draft cooling towers are clearly preferable.

In evaluation of environmental compatibility of cooling towers, we must analyze the combined impact of all the proposed cooling towers on the environment of the Hudson River watershed and the Hudson Valley airshed, since cooling towers will transfer a significant quantity of water and dissolved solids from the river to the atmosphere. Although individual towers may not be detrimental to the environment, the combined effect could be significant and therefore should also be addressed in this impact statement.

We hope that our comments will be of assistance to your staff in the preparation of the final environmental statement. We appreciate the opportunity to comment on this DES and request that you give our comments your utmost consideration.

Sincerely yours,

Langdon Marsh
Acting First Deputy Commissioner

Enclosure

STATE OF NEW YORK COMMENTS ON THE
U.S. NUCLEAR REGULATORY COMMISSION'S
DRAFT ENVIRONMENTAL STATEMENT
FOR SELECTION OF THE PREFERRED
CLOSED CYCLE COOLING SYSTEM AT

INDIAN POINT UNIT #3
(Docket #50-286)
(Published August, 1977)

September 29, 1977

General Comments

1. The IP-3 cooling tower was correctly assessed for a plant generating capacity of 1033 MWe (neglecting derating). However, the FES for the IP-2 cooling tower (published August, 1976, Docket #50-247) assumed an IP-2 generating capacity of 873 MWe. Our cover letter introducing New York State's comments for the IP-2 DES pointed out that Con Edison plans to use the total IP-2 generating capacity of 1033 MWe by May, 1980 (two years after scheduled cooling tower installation). The analysis should have been based on closed cycle cooling systems capable of dissipating this greater heat output. This was not corrected in the FES, so it is assumed that the same IP-2 parameters were incorrectly used for this DES (see comment 9 of p. 7 of the present reviews).

2. The FES for IP-2 cooling towers (in response to our comment #19) discounted aquaculture as a beneficial use of waste heat because of nearby shipping channels. However, Lents Cove is only about 400 m to the northeast of the proposed cooling tower location. Since this bay is removed from the shipping channel and its dimensions are about 500 m by 300 m, it would appear to be a feasible location for a controlled impoundment section to be used in addition to cooling towers. This should be considered for IP-3 as well as IP-2.

Chapter 2 Description of Alternate Closed Cycle Cooling System

1. P. 2-3 (section 2.3): Mention is made (third paragraph from the bottom) of the use of chemicals in the water circulated through the cooling towers to prevent freezing which would also be discharged in the blowdown. We are not aware of the use of such additions in evaporative cooling towers and would object to the introduction of sufficient chemicals to have a significant effect upon the freezing point of the circulating water as being unnecessary and a possible hazard to aquatic life in the receiving waters. Protection of cooling tower systems from freezing depends upon the waste heat being dissipated, reduction of air flow through the tower, and dewatering of pipes not conveying heated water.

Chapter 3 Design, Construction, and Operating

Characteristics of Alternate Systems

1. P. 3-11 (section 3.4.1): While dual mode operation is not generally economically feasible, the addition of cooling towers to an existing once-through system makes the incremental cost of retaining the once-through capability economically attractive and will also conserve some energy provided the Power Authority is authorized to use the once-through system when its use will have minimal effect upon the Hudson River aquatic resources. We therefore feel that it is very desirable that this dual capability be retained. It would appear, however, that a basis for the utilization of the once-through system should be established so that the operating and energy savings which may be obtainable could be determined. If it is not possible to set dates between which the once-through system could be used, then an aquatic life monitoring program upon which such operations could be based should be set forth.

Use of once-through cooling whenever it would not have a serious adverse effect upon aquatic life would reduce the effect of salt drift still further and keep that terrestrial impact of the plant as low as possible.

2. P. 3-4 (section 3.3):

(a) This section states that extensive excavation will be required. The effects of excavation section (5.2.1) omits the effect of spoil disposal. Spoil disposal is not discussed in the site preparation section either (3.3). The volumes to be removed range from three to thirteen acre-feet. Depending on how and to where this material is transferred, major or minor impacts could accrue.

Therefore, this aspect of excavation and site preparation deserves considered mention in the EIS.

(b) Consideration of the effects caused by excavation de-watering during construction should be documented.

Chapter 5.1 Atmospheric Effects

1. p. 5-17 to 5-51 - Figures 5-6 to 5-35 B: None of the diagrams of drift deposition isopleths give the units of the distance intervals. Although we assume that the intervels are miles (2.5 miles maximum) this should be stated on the diagram.

2. p. 5-7 (table 5-1): This gives the maximum monthly and annual comulative drift deposition rate at one mile and at 2.5 miles for a natural draft cooling tower. Of course, these points are not necessarily points of maximum deposition associated with the cooling tower. Realistic maximum monthly and annual deposition rates must be presented, including the expected distance and degrees azimuth from the cooling tower. This should be for the highest expected average monthly and annual relative humidity-not an unrealistic assumption of 90% relative humidity.

3. p. 1-7 (section 1.6): The third paragraph of this section states"(2) wind speeds within the valley tend to be lower than in the open terrain." The assumption is doubtful-especially in the direction of the river channel. For this "prevailing" North-South wind direction, the wind speed will likely be greater in a valley than in flat topography, due to the concentration of the air mass.

4. General Comment: From an air quality viewpoint we concur with the staff that their preferred choice of natural draft cooling towers will not cause violations of the suspended particulate standard nor exceed the allowable increment for settleable particulates. However, the salt fallout will cause vegetation damage. In addition, impacts on visibility, aesthetics, noise and air quality all are adverse to some extent.

(Chap. 5.1 cont)

5. General Comments: If all the cooling towers which are scheduled for existing and proposed power plants are built, more than 200 CFS of fresh water will be evaporated from the Hudson River. This constitutes approximately 10% of the MA7CD10 (minimum average 7 consecutive day flow occurring every 10 years) river flow (see table below). This will result in additional salt concentrations at the City of Poughkeepsie's water supply intake and in higher salinity in the circulating water of the cooling towers which in turn will lead to increased concentrations of settleable particulates.

EVAPORATIVE LOSSES

COOLING TOWERS - HUDSON RIVER

Proposed Facility	Fuel	Generating Capacity (MW)	H_2O Makeup (CFS)
Indian Point #2	Nuclear	864	22.8
Indiam Point #3	Nuclear	873	22.9
Bowline	Oil	1200	22.4
Roseton	Oil	1200	22.4
Cementon**	Nuclear	1200	31.6
Quarry/Athens*	Coal	700	13
Stuyvesant**	Coal/Nuclear	2400	63.2***
Mid-Hudson**	Coal/Nuclear	1300	34.4***
			232.7

* Proposed backup site for proposed PASNY Arthur Kill Facility.

** Proposed

*** Estimated from Cementon.

(Chap. 5.1 cont.)

6. Section 5.2.26., page 5-63

NRC staff should be informed that any salts (or other material remaining after evaporation of water) which are contained in settleable droplets constitute settleable particulates. Thus maximum impacts should be evaluated together with background data and compared with State settleable particulate standards. The Department will permit an increment of up to 0.1 mg/cm^2/mo annual average where standards may presently be exceeded. If the standards will not be exceeded the allowable impact may be greater than this increment.

7. Section 5.1.3.1, p. 5-5

It is stated that the highest NDCT off-site salt deposition rate was found by the applicant to be 350 kg/km^2/month (about 3 lb/acre/month). However, Figure 5.1 (Ref: ER - cc - 3 , Fig. 6-5) shows the maximum isopleth to be 200 kg/km^2/month. There should have been at least a 300 isopleth in this figure.

8. General Comment

To further reduce salt drift concentrations, consideration should be given to the addition of fans to a natural draft cooling tower (450-550 ft. tall) to increase the plume height and thereby increase dispersion. These fans could be operated only in the most environmentally critical months (July to October). This alternative should be discussed in the environmental statement.

9. P. 5-15 (Table 5-2)

It is not clear whether this table of cooling tower parameters pertains to both IP-2 and IP-3 or to IP-3 alone. Since the staff performed an analysis for both towers combined, this should be clariifed. These parameters should be in terms of the projected full load for both plants (see comment #1 (page 1)of the present review).

Chapter 5.2 Terrestrial Impacts and Land Effects

1. P. 5-52 (Section 5.2.1): The Statement does not address the presence of rare or endangered plants or animals on site. The staff (and the applicant) should consult with Curators of botany, zoology, etc. at New York State Museum to see if there are established stations for such species and include these in this section. Any construction should avoid disturbance if established stations of flora and fauna in the State are present on the site.

2. P. 5-59 (Section 5.2.2.4): The staff estimated the replacement cost of ornamental plants damaged by salt drift. However, no-where does the staff estimate the cost of reforesting public land or replacing non-ornamental plants which occur on private or public property. Later in the summary the staff stated that "the total number of trees at risk is relatively small and replanting of trees after a severe damaging episode would be both technically and financially possible" (p. 5-63), (§ 5.2.2.7), #(6):

(a) It should be indicated that this reforestration must occur on public land as well as private land. In fact the DES concentrated on the impact on privately owned trees and ignored the impact on public land, such as the Bear Mountain State Park and areas east and north of Peeksville.

(b) There was no mention of post-operative monitoring of tree damage. This should be done after drought periods or other times of stress to establish the need for reforestation.

(c) Consideration should be given to prevention of drift damage, possibly by watering of affected or sensitive plants during drift episodes to remove salt deposits from the foliage.

(Chapt. 5.2 cont.)

3. P. 5-65 (Section 5.2.3.2): The staff does not present additional hours due to icing clearly for each alternative. Figures are somewhat confusing. Thirty hours of additional icing during the month of February seems like quite a load (equivalent to one hour per day). Staff addresses biological stress cursorily, and makes no comments as to who will be responsible for clearing dead branches etc. The staff should also address the problem associated with additional icing of roads.

Icing and wetting of roads can cause problems in parts of the country frequented by aquatic birds such as loons and grebes. These birds are attracted to wet land surfaces which they may believe to be bodies of water. They are then permanently grounded, since they require open water as a runway for take-off. The staff does not address this problem.

4. P. 5-59 (section 5.2.2.4 b): It is stated that there is a 40% chance (0.4 probability) of occurrence of a 14 day rainless period in any one year. This means that such drought conditions could feasibly occur twice in the same year or (even more likely)in two or three consecutive years. Although the next paragraph states that "Recovery of most trees would be observed the following spring" a recurrence of a drought the following summer (with the associated increase of salt deposition on leaves) could injure the trees beyond recovery. These longer term effects were not adequately considered.

In addition, even in cases where trees are not totally destroyed by the salt, their susceptibility to insect or disease damage would be increased.

Chapter 5.4 Hydrological and Aquatic Effects

1. P. 5-96 (section 5.4.1): Depletion of ground-water resources is not a likely impact of tower operations but the narrative presented does not convey that sense. The second paragraph of this section appears to be the result of editing from a larger, more detailed narrative and, as presented, leads the reader to no understandable conclusion. A more cogent paragraph should be prepared to describe the effects (or lack of effects).

Chapter 6 Socio - Economic Analysis

1. P. 6-6 (section 6.2.2.2 d): While the down time required for the tie-in of an onshore cooling system should be considered for backfitting of any existing plant, the time required for the Indian Point facility appears to be much greater because of safety aspects of a nuclear plant and the rocky nature of the Indian Point site. We agree that the outage period should be five rather than seven months since the two month refueling period for the plant can be concurrent with construction of the cooling tower.

Consideration should also be given to the possibility of planning various phases of tower construction (such as excavation and blasting) to occur over two years during periods of refueling. This would decrease the extra down time even further (to three months).

The impact report appraisal of the availability of reserves at the time of installation of the cooling tower and assignment of expected capital and operating costs of these facilities as an assesment against the cost of installation appears reasonable.

Chapter 6.3.3.3 Impact on the Human Environment

1. General Comment: In response to DEC comment 6a, Pg. 8-21 of the Final Environment Impact Statement for Indian Point No. 2 staff acknowledges the deficiencies in the Jones and Jones Study and its limited application as an assessment tool. It is further stated that, "Although the staff used portions of the study which it felt relevant, an independent assessment was conducted by staff and used as the basis for the conclusions presented in the DES and FES.

The NRC should be informed that the Department is extremely concerned to find that, despite staff's admitted lack of confidence in the Jones and Jones methodology and its apparent lack of value, for this purpose, it has again been included in the DEIS for Indian Point No. 3 to assess a visual change that staff consider to be "the most socially and economically consequential of the various possible environmental impacts."

2. General Comment: DEC is aware that it is not staff's policy to include referenced documents in their entirety in an EIS. However, the Commission should also be aware that staff's interpretations of the Jones and Jones Study cannot be properly evaluated by the State unless those portions determined to be relevant to the facility are included.

3. P. 6-46 (section 6.3.3.3 a): Staff briefly mentions the Three Mile Island, Arkansas, Zimmer, Schmehausen, and Biblis Studies which consider impact upon real estate and aesthetic perception of cooling towers by local residents. There are few Eastern U. S. rivers, if any, comparable in scenic quality to the Hudson. If these studies were used as a basis for staff's conclusions they should be presented in greater detail so that the State may determine their relevance to the Indian Point No. 3 situation.

(Chapt. 6.3.3.3 cont.)

4. P. 6-48 (section 6.3.3.3 e): Staff's summary states that, if an NDCT is installed at Indian Point Unit 2, that an NDCT for Indian Point 3 is aesthetically preferred. It is further proposed that, if an NDCT is installed at Unit 2 that an NDCT at Unit 3 would be more in proportion with the landscape and other structures than any other alternative considered. This is a direct contradiction to staff's statement, as follows, in the last paragraph on Pg. 6-46: "A natural draft tower combination at IP-2 and IP-3 would be a considerable visual intrusion to the site. A fan assisted natural draft tower combination would be less of an intrusion, but still out of proportion with other elements in the view scape. The structure of the circular mechanical draft towers would likely be in proper proportion to both the structures at the Indian Point Facility and other elements of the view scape, as would linear mechanical draft towers, but the circular mechanical draft towers have a more attractive design than do the linear mechanical draft towers."

Under the circumstances, staff should justify their conclusions that an NDCT that is admittedly out of proportion with all other elements in the landscape, including the existing IP-2 & 3 power blocks is aesthetically preferred for the IP area in general. Staff should also provide further comment concerning the fact that their final conclusion is based upon the assumption that IP-2 will have an NDCT and not upon the data they provided in the DEIS.

5. P. 6-34 (Fig. 6-1): To provide an opportunity for comparative analysis a map similar to Fig. 6-1 - which shows the affected viewshed should be included for all of the alternatives mentioned in the DEIS. A similar map showing the impacted viewshed as described in the Pickard, Lowe and Associates study would also be helpful for this purpose.

Chapter 7 Evaluation of Proposed Action

1. pg. 7-1 (sections 7.2 and 7.3): These sections primarily appear to relate to the decision as to the application of cooling towers rather than to the selection of the type of cooling. Most of these sections, therefore, appear to be inappropriate to this DES.

2. P. 7-3,4 (Table 7-1): The DEC is aware of staff's position that decommissioning of the cooling system structures is dependent upon the level of decommissioning selected for the Power Block. However, in view of the significance of the visual impact on the environment, the staff in its comparative analysis of the impacts associated with the various alternative cooling systems, should consider the costs to completely dismantle, recycle, and/or remove the structures from the site irregardless of the level of decommissioning selected for the power block.

CITY OF PEEKSKILL
CITY HALL
PEEKSKILL, N. Y. 10566

Office of
CITY CLERK

Telephone
(914) 737-3400

October 26, 1977

RECEIVED NOV 2, 1977 U.S. NUCLEAR REGULATORY COMMISSION Mail Section

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

Dear Sir:

Enclosed please find a certified copy of a resolution adopted by the Peekskill Common Council at a meeting held on October 24, 1977 and a copy of a letter to you from the Peekskill Planning Commission dated September 13, 1977. The Common Council of the City of Peekskill endorses the recommendations of the Peekskill Planning Commission and strongly urges that they be taken into consideration.

Very truly yours,

Agnes M. Pryzgoda
Agnes M. Pryzgoda
Deputy City Clerk

AMP/ms
enclosures

WHEREAS, this council is in receipt of a letter dated September 30, 1977 to the U. S. Nuclear Regulatory Commission from the Peekskill Planning Commission wherein said Planning Commission takes strong exception to the proposed closed cycle cooling system at Indian Point Unit No. 3 located in the Village of Buchanan, and

WHEREAS, this council has reviewed the letter of the Planning Commission in detail and concurs in all of the objections raised therein to these great looming proposed aesthetic monstrositi each fifty five stories high and as large as a football field, and

WHEREAS, this council is particularly mindful and concerned as to the impact of these proposed structures upon the Peekskill Riverfront Green (Con Edison's neighbor to the North) in which this City as well as the State and Federal Governments have made so much of a contribution in order to preserve the natural beauty and recreational potential of this magnificient and historic area;

NOW, THEREFORE, BE IT

RESOLVED, that the Common Council of the City of Peekskill does hereby endorse the recommendations of the Peekskill Planning Commission made to the U. S. Nuclear Regulatory Commission by letter dated September 13, 1977 and does further strongly urge the Nuclear Regulatory Commission to take into account the recommendations of the Peekskill Planning Commission, and be it further

RESOLVED, that the City Clerk forward certified copies of this resolution together with the annexed letter from the Planning Commission to the U. S. Nuclear Regulatory Commission and to the City's elected representatives in the U. S. Senate and House of Representatives.

STATE OF NEW YORK
COUNTY OF WESTCHESTER ss:
CITY OF PEEKSKILL

I, Agnes M. Pryzgoda, duly appointed qualified Deputy City Clerk of the City of Peekskill, NY, do hereby certify that the above is a copy of a resolution adopted by the Common Council of the City of Peekskill at a meeting held on October 24 , 1977, and is a true, correct and compared copy of the whole of said original resolution as adopted at said meeting, the same being on file in this office.

Witness my hand and the seal of the City of Peekskill this 25th day of October , 1977.

Agnes M. Pryzgoda
Deputy City Clerk

"RTIFIED-
RETURN RECEIPT REQUESTEI

Sent to Mayor & Council

Att: John Walsh

ING COMMISSION
OF PEEKSKILL
CITY HALL
KSKILL, N. Y. 10566

CITY OF PEEKSKILL
CITY MANAGER
RECEIVED
SEP 30 1977

Dir. P.W.	Water D.	Clerk	Police	Person
A. Dir PW	Park D.	Cur Co.	Fire	
Bldg. D	Court	Asses.	Comp.	File

*ember 30, 1977.

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

Attention: Director, Division of Site Safety and Environmental Analysis

Re: Draft Environmental Statement for Selection of the Preferred Closed Cycle Cooling System at Indian Point Unit No. 3 - Docket No. 50-286

Gentlemen:

The Planning Commission of the City of Peekskill hereby expresses its opposition to the construction at Indian Point of any of the closed cycle cooling systems necessitating the construction and use of cooling towers because of the aesthetic and economic impact of these towers on the City of Peekskill and its neighboring communities.

In the Draft Environmental Statement (pages 6-33 to 6-48) the Nuclear Regulatory Commission staff notes the adverse visual impact the cooling towers and their plumes will have on the Village of Buchanan, the City of Peekskill and the surrounding area. It makes particular note of their impact on the Peekskill waterfront. On page 6-46 of the document it is stated,

> "The most significant potential impact involves the southern part of the Peekskill waterfront redevelopment area, what is now Standard Brands property."

and

> "A natural draft tower combination at IP-2 and IP-3 would be a considerable visual intrusion to the site. A fan-assisted natural draft tower combination would be less of an intrusion, but still out of proportion with other elements of the viewscape."

In the Summary Comparison--Impacts of Alternative Systems--the NRC staff states,

> "Visual aesthetics were found to be the most consequential category of impacts when both tower installations are considered. However, from an incremental standpoint, the staff judges that an additional natural draft cooling tower at IP-3 would be a marginally small visual intrusion to the landscape."

This is precisely the point that the Planning Commission made in our letter of April 14, 1976, relative to the closed cycle cooling system proposed for Indian Point No. 2, in which we expressed our opposition to the construction of these "preferred" natural draft type cooling towers. In its summary, the NRC staff indicates that the aesthetic impact of one such tower would be so great that the construction of a second could only produce a small additional visual intrusion on the viewscape. The thought of one or more of these monstrous structures, each wider than the length of a football field, towering more than fifty-five stories above the ground and spewing forth a saline cloud that could not only obscure the sun's rays but also shower salt droplets on the surrounding communities, was then and is now, both inconceivable and unacceptable to the Commission.

The recent power black-out and the brown-outs that have occurred over the past few years have provided ample evidence of the metropolitan area's need for the electricity generated at Indian Point and the Commission is not suggesting that the safe generation of power be in any way disrupted or discontinued. The Commission suggests that the power plant be permitted to continue to operate with the existing once-through cooling system. If a screening perimeter long enough to mitigate the intake velocity and a screen with a mesh suitable to reduce the impingement and entrapment of fish and fish eggs to acceptable levels can not be devised, the Commission is of the opinion that the establishment of hatcheries could insure the maintenance of the aquatic population at a much lower cost and certainly with less aesthetic and economic impact on the City of Peekskill and, in particular, on our waterfront redevelopment area.

As in our previous correspondence, the Planning Commission requests of the Office of Nuclear Reactor Regulation that the City of Peekskill and its inhabitants be given consideration commensurate with that being afforded to the inhabitants of the Hudson River.

Very truly yours,

Edwin I. Ziegler, Chairman

cc: Mayor and Common Council
mm

CERTIFIED-
RETURN RECEIPT REQUESTED

PLANNING COMMISSION
CITY OF PEEKSKILL
CITY HALL
PEEKSKILL, N. Y. 10566

September 30, 1977

RECEIVED OCT 4, 1977 U.S. NUCLEAR REGULATORY COMMISSION Mail Section

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

Attention: Director, Division of Site Safety and Environmental Analysis

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The Planning Commission of the City of Peekskill hereby expresses its opposition to the construction at Indian Point of any of the closed cycle cooling systems necessitating the construction and use of cooling towers because of the aesthetic and economic impact of these towers on the City of Peekskill and its neighboring communities.

In the Draft Environmental Statement (pages 6-33 to 6-48) the Nuclear Regulatory Commission staff notes the adverse visual impact the cooling towers and their plumes will have on the Village of Buchanan, the City of Peekskill and the surrounding area. It makes particular note of their impact on the Peekskill waterfront. On page 6-46 of the document it is stated,

> "The most significant potential impact involves the southern part of the Peekskill waterfront redevelopment area, what is now Standard Brands property."

and

> "A natural draft tower combination at IP-2 and IP-3 would be a considerable visual intrusion to the site. A fan-assisted natural draft tower combination would be less of an intrusion, but still out of proportion with other elements of the viewscape."

In the Summary Comparison--Impacts of Alternative Systems--the NRC staff states,

> "Visual aesthetics were found to be the most consequential category of impacts when both tower installations are considered. However, from an incremental standpoint, the staff judges that an additional natural draft cooling tower at IP-3 would be a marginally small visual intrusion to the landscape."

This is precisely the point that the Planning Commission made in our letter of April 14, 1976, relative to the closed cycle cooling system proposed for Indian Point No. 2, in which we expressed our opposition to the construction of these "preferred" natural draft type cooling towers. In its summary, the NRC staff indicates that the aesthetic impact of one such tower would be so great that the construction of a second could only produce a small additional visual intrusion on the viewscape. The thought of one or more of these monstrous structures, each wider than the length of a football field, towering more than fifty-five stories above the ground and spewing forth a saline cloud that could not only obscure the sun's rays but also shower salt droplets on the surrounding communities, was then and is now, both inconceivable and unacceptable to the Commission.

The recent power black-out and the brown-outs that have occurred over the past few years have provided ample evidence of the metropolitan area's need for the electricity generated at Indian Point and the Commission is not suggesting that the safe generation of power be in any way disrupted or discontinued. The Commission suggests that the power plant be permitted to continue to operate with the existing once-through cooling system. If a screening perimeter long enough to mitigate the intake velocity and a screen with a mesh suitable to reduce the impingement and entrapment of fish and fish eggs to acceptable levels can not be devised, the Commission is of the opinion that the establishment of hatcheries could insure the maintenance of the aquatic population at a much lower cost and certainly with less aesthetic and economic impact on the City of Peekskill and, in particular, on our waterfront redevelopment area.

As in our previous correspondence, the Planning Commission requests of the Office of Nuclear Reactor Regulation that the City of Peekskill and its inhabitants be given consideration commensurate with that being afforded to the inhabitants of the Hudson River.

Very truly yours,

Edwin I. Ziegler

Edwin I. Ziegler, Chairman

cc: Mayor and Common Council

mm

COMMENTS OF THE

HUDSON RIVER FISHERMEN'S ASSOCIATION

AND

SAVE OUR STRIPERS

ON THE

DRAFT ENVIRONMENTAL STATEMENT

FOR SELECTION OF THE

PREFERRED CLOSED-CYCLE COOLING SYSTEM

AT

INDIAN POINT UNIT NO. 3

Prepared by

Sarah Chasis
(Natural Resources Defense Council, Inc.)
122 East 42nd Street
New York, New York 10017

With the assistance of

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Marshall, Bratter, Greene, Allison
& Tucker
430 Park Avenue
New York, New York 10022

These comments are being submitted on behalf of the Hudson River Fishermen's Association (HRFA) and Save Our Stripers (SOS). HRFA and SOS are non-profit membership organizations dedicated to protection of the natural resources of the Hudson River and the conservation of the striped bass fishery in the waters of the State of New York. Both HRFA and SOS were parties to the licensing proceeding for Indian Point Unit No. 3. By order of October 12, 1976 both organizations were also admitted as parties to the Nuclear Regulatory Commission (NRC) proceeding to designate the preferred alternative closed-cycle cooling system for Indian Point Unit No. 3.

The significant harm posed to the Hudson River fishery by operation of the Indian Point 3 plant with its present once-through cooling system was thoroughly documented in the Final Environmental Statement related to operation of Indian Point Nuclear Generating Plant Unit No. 3 (February, 1975). No evidence presented to date and exposed to the tests of independent expert analysis and cross-examination in a hearing indicates to HRFA and SOS that the harm to the fishery is anything but extremely serious. For this reason, HRFA and SOS support the installation of a closed-cycle cooling system at Indian Point 3 which will most effectively reduce the harm to the Hudson River ecosystem from plant operation and which will pose the least threat of environmental harm in other respects, as well.

The Draft Environmental Statement (DES) on alternative closed-cycle cooling systems for Indian Point 3 makes clear that there are several alternative systems which are feasible and which may be constructed and operated in an environmentally acceptable manner. The statement also makes clear that in several important respects the alternative proposed by the Applicant, the wet natural draft cooling tower, is the most desirable alternative from both an environmental and economic point of view. With certain important exceptions, detailed below, the DES lays a firm foundation for choosing the wet natural draft cooling tower as the preferred alternative through its detailed review of the data relating to the potential adverse impacts of the different systems.

The Staff's analysis in the DES of potential problems from saline drift, fogging, icing, and noise indicates that for the wet natural draft cooling tower a maximum of 20 hours/year of additional fogging can be expected, as compared with an estimated 110 hours/year of naturally occurring fog (pp. 5-14 and 5-15); that additional icing in the general vicinity due to the tower is likely to be on the order of 11 hours/year (pp. 5-16, 5-65 and Figure 5-12); that the aerosol salt concentrations generated by the tower are significantly lower than any recorded values that are known to have caused damage to plants (p. 5-16); that the maximum cumulative drift deposition of the tower would be 5.3 lbs./acre/year at a distance of one mile from the tower, of 2.2 lbs./acre/year at a distance of 2.5 miles from the tower

(Table 5-1 at p. 5-7); that the predicted operational acoustical effects will not significantly exceed the ambient acoustical environment (p. 5-80). The predicted increase in fogging, icing and saline drift are not predicted to cause any permanent damage to vegetation (pp. 5-64 and 5-65). In addition, with respect to the potential impacts from drift and noise, the wet natural draft cooling tower is the least environmentally damaging, compared with the other cooling tower types examined, and after the wet/dry mechanical draft tower, has the least potential for weather modification (pp. 5-100 and 5-101).

In contrast to the great detail with which certain alternatives and their impacts are treated, there are certain alternatives which we believe the DES has dealt with inadequately. We would like to see these more fully amplified in the FES.

We believe that the spray pond alternative, because it could if feasible eliminate the visual problem associated with a cooling tower, should be afforded more complete treatment than is provided in Section 2.3. The unavailability of land near the site should be documented. In addition, it should be explained why if land near the site is unavailable, land farther from the site could not be used. The total cost of the spray pond alternatives should be included.

At one point in the DES, it is stated that the size of the cooling towers proposed by the Applicant appears to be reasonable except for the natural draft cooling tower and that

smaller sizes for the natural draft cooling towers could be possible for the site. (p. 3-14). We failed to find in the DES any further examination of the important alternative of a smaller natural draft cooling tower. The NRC Staff has the responsibility under NEPA not simply to react passively to the alternatives proposed by the Applicant, but to undertake an independent analysis of alternatives, and to pursue affirmatively the soundest environmental alternative. We would like to see further discussion of the alternative of a smaller size natural draft cooling tower for Indian Point 3.

A calculation should be made of the replacement cost for vegetation lost in the vicinity because of salt drift from the cooling towers. It should be noted in this regard that there apparently exists a disease affecting hemlocks, one of the trees found most sensitive to salt drift, in the vicinity of Indian Point. This may affect the calculation of replacement costs.

The schedule set out in Section 4 needs to address how the relocation of the Algonquin gas pipeline will be coordinated with excavation and construction work at both Units 2 and 3. This poses a potential problem because of the blasting which has to occur in connection with the latter activities. There appears to be an error in setting the date for commencement of construction activities at Indian Point 2 for June 1, 1981. Shouldn't it be June 1, 1980 in view of the fact that excavation

which is due to commence on June 1, 1979 should last only one year, not two?

We recommend that consultation with the U.S. Fish and Wildlife Service pursuant to the Fish and Wildlife Coordination Act be included under permits and regulatory approvals required. We also understand from Con Edison that an FPC permit is <u>not</u> needed from the FPC to relocate the gas pipeline. Finally, with respect to the Village of Buchanan approval, we believe it should be stated that to date, the courts and the NRC have all ruled that the Village may not block construction of the cooling tower.

The FES should set forth not only which approvals may be needed for construction and operation of the natural draft cooling tower, but the schedule which must be met if the May 1, 1982 date is to be met and the Applicant's progress to date in meeting this schedule.

Finally, we believe that the DES should make clear that the installation of the natural draft cooling tower will have the benefit of saving an extremely valuable fishery. To this end, we suggest that in the socio-economic section, the overall importance and value of saving the natural resource should be explained whether by cross-reference to the FES on operation of Indian Point 3 or other means.

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October 3, 1977

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U.S. NUCLEAR REGULATORY COMMISSION

Mail Section

Dr. Robert P. Geckler
Division of Site Safety and
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Office of Nuclear Reactor
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U.S. Nuclear Regulatory
Commission
Washington, D.C. 20555

Re: Indian Point Station, Unit No. 3
Dkt. No. 50-286, OL No. DPR-64

Dear Dr. Geckler:

By notice published in the Federal Register on August 15, 1977, 42 Fed. Reg. 41195 (1977), the Nuclear Regulatory Commission solicited comments on the Draft Environmental Statement issued by the Regulatory Staff in connection with selection of a preferred closed-cycle cooling system for installation at Indian Point Station, Unit No. 3 (NUREG-0296). Power Authority of the State of New York, as owner of this facility and co-holder of Facility Operating License No. DPR-64, has reviewed the Staff's draft statement, and as their attorneys we respectfully submit the attached detailed comments.

As discussed with Stephen H. Lewis, Esq. of the Office of the Executive Legal Director's on September 26, 1977, a detailed review of the economics portion of this draft statement to the staff is being performed and will be submitted to the staff no later than October 24, 1977. Preliminary comments with respect to the economics portion of NUREG-0296 are, however, provided herewith, and for convenience we have attached to our comments

a further copy of pertinent information on the economics of cooling tower, construction and operation that was submitted earlier this year by the Power Authority to the Environmental Protection Agency and provided to the Regulatory Staff.

We would appreciate receiving copies of any comments that may be received from other sources concerning NUREG-0296 as soon as possible, in order that we may review and comment on these as well.

Thank you for your cooperation.

Very truly yours,

Eugene R. Fidell

Eugene R. Fidell

Enclosures (10 copies)

cc (w/encl.): Samuel W. Jensch, Esq.
Mr. R. B. Briggs
Dr. Franklin C. Daiber
Richard C. Browne, Esq.
Sarah Chasis, Esq.
Richard C. King, Esq.
Carl R. D'Alvia, Esq.
Paul S. Shemin, Esq.
Secretary, USNRC (2)

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of	)	
	)	
CONSOLIDATED EDISON COMPANY	)	Docket No. 50-286
OF NEW YORK, INC. and	)	(Selection of Preferred
POWER AUTHORITY OF THE	)	Alternative Closed-Cycle
STATE OF NEW YORK	)	Cooling System)
(Indian Point Station,	)	
Unit No. 3)	)	

COMMENTS OF POWER AUTHORITY OF THE STATE OF NEW YORK WITH RESPECT TO DRAFT ENVIRONMENTAL STATEMENT

Power Authority of the State of New York ("the Power Authority"), as owner of the Indian Point Station, Unit No. 3 ("Indian Point 3") facility and co-holder of Facility Operating License No. DPR-64 ("the License"), submits the following detailed comments on the Draft Environmental Statement ("the DES") prepared by the Regulatory Staff ("the Staff") of the Nuclear Regulatory Commission ("the Commission") in the above-captioned proceeding.

In summary, the Power Authority concurs in the Staff's assessment that the natural draft, wet cooling tower is the preferred closed-cycle cooling system, should such a system ultimately be installed at Indian Point 3. Nevertheless, there are some aspects of the Staff's analysis that require comment and/or qualification, as appears more fully below.

Summary and Conclusions

Paragraph 2, ¶ 2. Due to the failure of Indian Point 3 to operate at the levels required under ¶ 2.E(1)(e) of the License, the termination date for the period of interim operation with the installed once-through cooling system has been moved back to September 15, 1982. The Environmental Report in this proceeding (Consolidated Edison Co. of New York, Inc., Economic and Environmental Impacts of Alternative Closed-Cycle Cooling Systems for Indian Point Unit No. 3 (1976)) was filed on January 30, 1976.

Paragraph 3.e. The cost data summarized in this paragraph are under examination, and a detailed assessment with up-to-date Power Authority information will be provided by October 24, 1977.

Paragraph 3.g. Pursuant to State law, the Power Authority is not subject to taxation. Hence, there will be no increase in the tax base upon construction of a cooling tower system at Indian Point 3.

Paragraph 5. The Power Authority should have been listed as an interested entity.

Paragraph 8. This paragraph should refer to Part 51 of the Commission's regulations, rather than the former Appendix D to Part 50 of the regulations. The penultimate paragraph refers to a monitoring program for drift and salt deposition and the detection of botanical injury from cooling tower operation. See also § 5.2.2.5 (last paragraph). Any such

proposed program should be presented in advance of adjudicatory proceedings (if any are held) in this docket, in order that the Power Authority can know at an appropriate time the obligations the Staff seeks to impose upon it. In light of the Staff's conclusion that no permanent damage will occur with operation of a natural draft cooling tower, however, this monitoring program is unnecessary, and the Power Authority would object to any program that was essentially a matter of pure research that should be funded by the Federal Government. Once a cooling tower is built, the utility of such a program to the Power Authority would be nil, and hence, the Power Authority should not be compelled to pay for it. In any event, if there is to be a monitoring program, the details should not form part of the License, in order to afford a measure of flexibility.

It is understood that this paragraph lists the sole area in which the Staff intends to seek formal license or technical specification provisions conditioning the approval of a particular type of closed-cycle cooling system.

Chapter 1 Introduction

§ 1.2, ¶ 1. At present, Indian Point 3 operation is limited to 873 MWe, rather than 878 MWe. On April 20, 1977, an application was filed with the Commission to remove the limitation on Indian Point 3 operation to 91% of full power. That application would authorize operation at 3,025 MWt.

The Power Authority has also applied for a transfer of operating authority from the present operator, Consolidated Edison Company of New York, Inc. ("Con Edison"), to itself.

§ 1.3. The discussion of the status of the Indian Point 2 proceeding is not current. The Power Authority recommends that the Final Environmental Statement ("FES") reflect conditions in effect at the time that document is prepared. With respect to the penultimate paragraph of this section, it should be noted that the stipulation among the parties to the Indian Point 3 case has been incorporated into the License.

§ 1.5. The Power Authority recommends that the Staff provide a current report on the status of the Chalk Point study program as of the publication of the FES in this case.

§ 1.6, ¶4. The reference to "meteorological rockets" is incorrect and should be deleted.

Chapter 3 Design, Construction and Operating Characteristics of Alternative Closed-Cycle Cooling Systems

§ 3.4.3, ¶3. The drift rate used in the Environmental Report analysis of the natural draft cooling tower was 0.002% rather than 0.0025%.

§ 3.4.5, ¶2. As shown in Figure 3-1, the proposed natural draft cooling tower is located relatively close to the plant because of the proximity to the south property line which restricts the physical arrangement. Thus, the tower would be less than a tower height away from the Indian Point 3 containment,

the control room the primary auxiliary building and the emergency diesel generator. Nevertheless, we believe that the tower would be sufficiently removed from the safety-related structures and equipment and would not affect plant safety because collapse of the tower shell, based on past incidents, would be inward. In addition, we concur with the Staff that the Indian Point 2 and 3 structures are capable of withstanding tornado-generated missiles and, therefore that any missiles generated by a tower failure would not constitute an additional safety problem. See 1 Environmental Report at 3-15.

§ 3.6. In paragraph 2 of this section, the Staff states, without discussion, that "[s]maller sizes for the natural draft towers could be possible for the site." The basis for this assessment should be provided.

In the following paragraph, it is understood that formal license conditions will not be issued with the proposed license amendment requiring the use of particular construction materials or methods. The Power Authority intends, however, to install drift eliminators to meet the performance criterion referred to in line 2 of page 3-15.

Chapter 4 Schedule and Permits

§ 4.1. We understand from discussions with representatives of the Regulatory Staff that the schedules presented in this chapter are being revised. In view of this, we cannot offer detailed comments at this time. We do, however, agree

that the September 15, 1983 outage date shown as Item 12 on page 4-2 is proper as a reflection of the need to avoid simultaneous excavation or outage of Indian Point 2 and 3 as reflected in the License pursuant to the stipulation of the parties to the Indian Point 3 operating license proceeding in the event that it is necessary to construct these cooling towers. The establishment of a new date to reflect this requirement and licensing developments in the Indian Point 2 docket is a proper subject for the present proceeding, just as was the case with the proceeding to designate a preferred alternative closed-cycle cooling system for Indian Point 2.

The following is a corrected list of milestones, to which Figure 4-1 should conform:

Major Milestones	Event or Action Item
(1) January 30, 1976	Submittal of the economic and environmental evaluation report to the NRC;
(2) February 1, 1980	Receipt of regulatory reviews and approvals required for construction of the closed cycle cooling system;
(3) May 1, 1980	Commencement of gas line relocation;
(4) August 1, 1980	Commencement of excavation;
(5) August 1, 1980	Commencement of construction;
(6) September 15, 1983	Commencement of cutover to closed cycle cooling system;
(7) April 15, 1984	Completion of construction of closed cycle cooling system and commencement of operation.

These milestones represent the latest dates that must be met to complete the construction of the closed cycle cooling system to meet a shutdown date of September 15, 1983.

§ 4.2. With respect to the necessary permits and approvals listed in this section, the approval of the Federal Power Commission is not required for relocation of the Algonquin Gas Transmission Company pipeline (Item 8). Also, under New York law the Power Authority is not required to obtain a building permit or zoning variance from the Village of Buchanan (Item 9).

Chapter 5 Environmental Impacts of Feasible Alternative Closed-Cycle Cooling Systems

§ 5.1.3.2 (last ¶). The salt drift deposits for each type of cooling tower assessed at Indian Point 3 are the accumulated deposits resulting from hourly calculations including hourly variations in humidity. The Staff has incorrectly assumed that the accumulated deposits obtained were based on the highest humidity observed during the month.

§ 5.1.3.3.b.1 (¶2). The natural draft cooling tower drift analysis for Indian Point 2 is not materially altered if reduced salinity of the makeup water is not considered as has been done for Indian Point 3. The circulating water in each such tower is approximately 600,000 gpm. The salinity is about the same as the basin salinity. The 5% dilution effect of the addition of 30,000 gpm of makeup water with half the salinity of basin water is negligible.

§ 5.2.2.2. The Staff has incorrectly stated that the Boyce Thompson Institute ("BTI") estimated "threshold" rates of saline deposit, and in subsequent sections (5.2.2.3, 5.2.2.4, 5.2.2.5) it develops conclusions based on the threshold concept. The goal of the BTI study was not to determine the threshold for injury but to estimate the distribution of thresholds for a population of receptors

under certain environmental conditions. Thus the Environmental Report's analysis considers the risk of injury greater than or equal to a certain amount instead of a threshold for injury. In the case of hemlock, that analysis is based on a level of salt deposition which affected 100% of the plants, not on the threshold.

¶1. The Staff's comment is misleading with respect to the location of the parafilm-covered deposition plates. It would be more accurate to describe the position of the plates as at a height close to the tops of the trees rather than "near the bottom of the chambers". Furthermore, the deposition rate was expressed as $ug.min^{-1}.cm^{-2}$ and total dose as $ug.cm^{-2}$. It was not assumed that leaves intercepted the same deposit as the collectors but that leaves were exposed to the same flux across a horizontal plane as the collectors.

¶¶3, 5 and 6. The DES states that the background concentration of chloride in suspended particles during the exposures of plants to simulated drift was 1500 $ug\ m^{-3}$ of salt. This is erroneous. At dose rates of about 0.20 and 0.05 $ugCl\ cm^{-2}\ min^{-1}$, the concentrations of suspended particles were 10.1 and 4.8 $ugCl\ m^{-3}$, respectively, and no detectable Cl was found in the control chamber. Thus, the background was actually zero.

The levels upon which the predictive models were based all resulted from later experiments in which larger particles

ranging from 50-1500 ug generated by a different method were used. No direct measure of the atmospheric concentration of salt in the chamber could be made because of the mass and settling velocities of the particles and the BTI reports make no mention of aerosol concentrations in the tests in which dose-responses were determined. Therefore the Staff's statements regarding salt concentration in the chambers must be regarded as conjectural.

The incorrect assumption by the Staff of a high background aerosol concentration in the chamber (see paragraph 3) should not be used to cast doubt on the estimated deposition levels causing injury to the most susceptible species tested. The tests were conducted at BTI at the doses stated and injury occurred at the doses used, not at the dose plus some background amount.

¶7. Care must be exercised in extrapolating Cassidy's results with ambient xerosols to those anticipated with aerosols of cooling tower origin. In the case of ambient aerosols which Cassidy studied, the particle size was between 0.1 and 10 um and the submicron particles might diffuse into stomates by Brownian motion. In the case of cooling towers, the range of particle sizes is much larger. In the BTI study, nearly 95% of the particles ranged between 50-150 um (see BTI Report, Table 7, p. 40 (Sprayco pneumatic at 13 psi)), which is too large for Brownian diffusion. Leaves of

most of the vegetation tested by BTI have few no stomates on the upper surface of the leaf, and because of the downward flow of air in the chambers it would be unlikely that aerosols of 50-150 um would deposit into stomates on the lower leaf surface. Therefore the stomatal pathway which the Staff posits appears highly unlikely in the chambers. In the actual environment, where upward moving wind currents may carry salt particles upward, the stomatal pathway might be significant, but this has not been tested.

§ 5.2.2.3(a). The Staff has assumed that "salt effects may be at least a factor of two less than the maximum", and then based its own analysis on this assumption. Because Staff has not presented data to justify this assumption, it appears to be little more than conjecture.

§ 5.2.2.3(b). The probability of 14 rainless days has been documented as 0.42 each year. See Consolidated Edison Co. of New York, Inc., Economic and Environmental Impacts of Alternative Closed-Cycle Cooling Systems for Indian Point Unit No. 2, Supplement No. 2 (1975). Subsequent reviews of rainfall in the Dobbs Ferry area for 1973 and 1974 substantiate the assumption. It is not the "low probability" described by the Staff.

§ 5.3.1.a. The Environmental Report's ananlysis of cooling tower plumes was besed upon one year of data, from October 1, 1973 thorugh September 30, 1974.

§ 5.4.4. There are no fixed screens at Indian

Point 3. The Power Authority disagrees with the implication in the last sentence of this section that present entrainment and impingement levels are unacceptable, and objects to the entire sentence on the ground that it is irrelevant to the present proceeding. In the first paragraph of this section, the reference should be to Indian Point 3 rather than Indian Point 2.

§ 5.5.1. The discussion of anticipated liquid releases and their anticipated radiological impact from the Indian Point reactors is based on outdated models and calculational techniques. This section of the DES should be updated and revised to reflect the most recent models utilized. A detailed discussion of these models and the calculated results can be found in "An Evaluation to Demonstrate the Compliance of the Indian Point Reactors with the Design Objectives of 10 CFR Part 50, Appendix I", which was filed with the Commission on March 14, 1977.

Chapter 6 Socio-Economic Analysis of Closed-Cycle Cooling Systems

As indicated in our covering letter, the Power Authority will be submitting a detailed economic analysis reflecting cooling tower system cost data directly applicable to the Power Authority, since the Power Authority expects to succeed to the responsibility for operation of Indian Point 3 in the near future. We have, however,

attached to the present comments a copy of the cooling tower system cost data that were previously submitted to the Environmental Protection Agency in connection with that body's proceedings under the Federal Water Pollution Control Act. The report from which this material was drawn has already been provided to the Regulatory Staff. See Consolidated Edison Co. of New York, Inc. and Power Authority of the State of New York, Indian Point Unit Nos. 2 & 3 Engineering, Environmental (Nonbiological), and Economic Aspects of a Closed-Cycle Cooling System (July 1977).

As a preliminary matter, we shall note several of the areas in this chapter of the DES which the Staff may wish to be reconsidering pending receipt of our detailed comments.

§ 6.1(¶1). In the last sentence, the reference should be, we assume, to the FES for selection of a preferred alternative closed-cycle cooling system at Indian Point 2, rather than Indian Point 1.

§ 6.2.1 (last ¶). The Power Authority has previously noted the Staff's policy of using a conventional discount rate of 10% in environmental impact statements for investor-owned utilities. As the Power Authority is a political subdivision of the State of New York, the use of such a convention is inappropriate.

§ 6.2.2.2.a. Taxes should not be included in calculating Power Authority costs of cooling tower system construction, as the Authority is exempt from Federal, State and local taxation.

§ 6.2.2.2.d. This section's use of a five month "penalty" for the transitional outage assumes that that outage will overlap outages for some other purpose. We believe this to be an unduly optimistic assumption that may well not be borne out by events. In addition, this reduction to five months assumes that the cutover work could be performed simultaneously with other outage activities. Safety and other considerations may render simultaneous activities impracticable.

§ 6.3.1.8. (pp.6-28). We do not understand why it was not feasible for the Staff to consider plume visibility in assessing the impact of cooling tower designs on historic points of interest in the site area. Viewshed techniques such as those applied elsewhere in the DES to an assessment of towers themselves should be available for an assessment, under simulated conditions, of plume observability at these sites as well. With respect to the final paragraph of this section, we are concerned that the statement that the Indian Point site housed an amusement park for some years may be misconstrued. In fact, while there is development in the area, including industrial

activity, any suggestion that it is entirely given over to such would be misleading, for the site itself is, to a considerable degree, tree-covered and quite handsome. Cf. NUREG-0296, § 6.3.2.3.e.

§ 6.3.1.9 (pp. 6-29). The reference in the penultimate paragraph to "701" funding for the City of Peekskill is unclear; presumably this is some sort of shorthand reference to a law or regulation. The Staff should give a more precise reference if it considers it necessary to retain this sentence in the FES.

§ 6.3.2.3.c. This paragraph would be pertinent only to Con Edison. As indicated above, the Power Authority is not subject to taxation. See also § 6.3.3.3.d.

Chapter 7 Evaluation of Proposed Action

§ 7.1. With regard to the final paragraph in this section, the Power Authority considers it insufficient for the Staff to suggest, without more, that no additional land will be required for a cooling tower system at Indian Point 3. As stated in the Environmental Report submitted on January 30, 1976, "[a]ddition of the Unit No. 3 natural draft cooling tower system would expand the total area now utilized for the three-unit generating station (including auxiliary facilities and the Unit No. 2 cooling tower) from 51 to 67 acres -- or to about 28% of the total 239 acre

Indian Point site." See 1 Environmental Report § 6.5.4, at 6-67. The DES, then, tends to obscure and understate even the site-impact of the proposed action. The Power Authority also questions the basis for the Staff's conclusion concerning the impact on terrestrial biota.

§ 7.2. We have serious misgivings concerning this section of the DES. The "proposed action" in issue in the present proceeding is not the question of whether a closed-cycle system should be installed, but rather, which type of such system should be selected. The Staff's "Evaluation" tends to obscure this. Its conclusion that "the benefits to be derived from the closed-cycle cooling system outweigh the potential impacts on the environment" is therefore neither germane nor supported by the body of the DES.

The Power Authority recognizes that it is somewhat difficult to address the proposed action in this case using the standard matrix the Staff has developed for environmental impact statements under the National Environmental Policy Act. Despite this, we submit that this portion of the DES should at least attempt to assess the relationship between short-term uses and long-term productivity in terms of the options being addressed in this proceeding. If, based on this analysis, the choice seems to favor a particular

closed-cycle system, then that should be so indicated.

§ 7.3. This subsection should be both corrected, and expanded and refined, for, as written, it fails to address the subject its heading seems to advertise. First, it is false to state that the labor and money required for a cooling tower system are a "small fraction" of the present sunk costs of the facility. In fact, such a system would significantly increase the total capital cost of the facility as well as the cost of operation. Further, the "more of the same" phrase in the initial paragraph gives the sense that the Indian Point site is essentially a lost cause having no further environmental value. This is plainly not true, as the Staff's own viewshed materials attest. Moreover, merely because the types of materials are of the same general character as those that have previously been used on the site does not properly disclose the arrangement and use to be made of those materials and their effects on the surrounding environs. Simply because there are already tall structures on the site does not relieve the Staff of the obligation to state clearly and distinctly that the towers yet to be built would loom much larger on the horizon.

We have already addressed the assertion that no additional land needs to be taken. See Comment to § 7.1 supra. The fact that certain acreage is within a site boundary does not relieve the Commission of the obligation, when preparing an impact statement, to disclose that

additional portions of a site are to be dedicated to new and different uses.

Finally, with respect to the closing observation that the "irreversible and irretrievable commitments are appropriate for the benefits to be gained," the Staff should provide a comparative assessment of the choice among alternative closed-cycle cooling systems. The DES in no way supports such a conclusion, nor should it, since it misconceives the issue in the proceeding.

§ 7.4, ¶2. Based on noise evaluations, the ranking of the three alternatives considered viable by the Staff appears to be inconsistent with the relative noise evaluation found in paragraph 2 of § 5.2.5.3. This should be clarified or corrected.

The Power Authority appreciates the opportunity to submit the foregoing comments, and will provide its further economic analysis no later than October 24, 1977.

Respectfully submitted,

LeBOEUF, LAMB, LEIBY & MacRAE

By [signature]
Eugene R. Fidell
Partner

1757 N Street, N.W.
Washington, D.C. 20036

Attorneys for Power Authority
of the State of New York

October 3, 1977

INDIAN POINT UNIT NOS. 2 and 3

ENGINEERING, ENVIRONMENTAL (NONBIOLOGICAL), AND ECCNOMIC ASPECTS OF A CLOSED-CYCLE CCOLING SYSTEM

CONSOLIDATED EDISCN COMPANY OF NEW YORK, INC.

and

THE POWER AUTHORITY OF THE STATE OF NEW YORK

JULY 1977

3.2 METHODOLOGY FOR QUANTIFYING COST OF CONSTRUCTION AND OPERATION OF THE COOLING SYSTEM AT INDIAN POINT UNIT NO. 3

3.2.1 CAPITAL COSTS

The total capital cost of the natural draft cooling tower consists of the direct capital cost, indirect capital costs, escalation from the time of the estimate of the costs (March, 1975) to the completion date of tower construction, and contingency.

3.2.1.1 DIRECT CAPITAL COST

Direct capital cost for the natural draft wet cooling tower system for Indian Point Unit No. 3 and other major cost components are set forth in Table 3-6 (March 1975 costs). The direct capital costs are based on construction cost estimates prepared by Con Edison for submission to the Nuclear Regulatory Commission.

TABLE 3-6

CAPITAL ESTIMATE SUMMARY

Indian Point Unit No. 3
Natural Draft Cooling Tower
Installed June, 1984

Total Direct Cost		$ 40,575,000
Design & Engineering Expense	(15%)	6,086,300
Construction Management	(8.5%)	3,448,900
Authority Administrative Cost	(3%)	1,503,300
Interest During Construction	(14.82%)	7,649,100
Total Project Cost (1975 Dollars)		$ 52,262,600
Escalation	(57.12%)	33,850,800
Contingency	(20%)	18,622,700
Total Estimated Cost		111,736,100
Finance Charge	(2%)	2,455,700
Bond Reserve	(7%)	8,595,100
TOTAL CAPITAL COST		$122,786,900
Say		123,000,000

3.2.1.2 INDIRECT CAPITAL COST

The estimated total project cost is made up of direct costs and those indirect or overhead costs which in keeping with standard utility practice, are capitalized as part of the project capital cost. The indirect or overhead cost is composed of the following components:

A. Design and engineering expense (15% of total direct costs).

B. Construction management (8.5% of total direct costs).

C. Power Authority administrative costs (3% of the sum of total direct costs plus the costs in A and B above.)

D. Interest during construction (7% per year or 14.82% of the sum of total direct cost plus the costs in A, B, and C above.)

Design and Engineering Expense

In order to construct a cooling tower system, the Authority would employ the services of an engineering consulting firm to prepare preliminary engineering designs and bidding

documents. These engineering costs are estimated to be 15% of total direct construction costs.

Construction Management

The Authority would also employ the services of an engineering consulting firm to perform project supervision and management. The cost of such services is estimated to be 8.5% of total direct construction costs.

Authority Administrative Costs

Proper accounting practice requires the allocation to capital project costs a portion of the general administrative expenses of the Authority. This recognizes the fact that general administrative costs are in part attributable to capital projects.

The Power Authority uses a factor of 3% of the sum of direct project cost and engineering consultant expenses as an estimate of the allocatable portion of these expenses.

Interest During Construction

The cost allowance for interest during construction of 14.82% was calculated using a 7% rate of interest compounded annually, assuming an even cash flow for the four-year construction period.

Escalation

The Authority has adopted Con Edison's escalation rates for construction projects for this analysis. Con Edison has developed a New York City Construction Price Index which forms the basis fo the Company's projected escalation rates.

The average annual rate of escalation indicated by this index was (1) 1964-1971 at 6.3%, (2) 1964-1974 at 6.4%, and (3) 1973 at 7%. The period from 1974 to 1976 was estimated at a 9% average annual rate of change and for years after 1976 at 7.5%.

Contingency

The contingency allowance is based on experience and reflects the extent and certainty of the knowledge of project details. A contingency factor of 20% is appropriate

for this project in view of the fact that the detailed design of the project has not been completed.

3.2.2 INCREMENTAL GENERATING COSTS

The following section describes the method of computing the cost impact of installing a closed-cycle cooling system at Indian Point Unit No. 3. This cost impact is presented in the form of the cost of the tower for an economic analysis.

The economic life of the cooling tower used in this analysis is measured from the time it becomes operational to the end of the total economic life of the nuclear plant, taken herein to be forty years from initial commercial operation. Indian Point Unit No. 3 began commercial operation August 30, 1976, thus incremental generating costs are considered only for the economic life of the cooling tower from the beginning of June 1984 to the beginning of September 2016.

Indian Point Unit No. 3 is presently licensed to operate at 873 MWe (net electrical output). (See Section 2.3 above.) It is expected that the license will be amended to allow operation at 1033 MWe (net electrical output). For purposes of this analysis, the Authority has assumed that the unit

will be licensed to operate 1033 MWe in 1980 with the existing once-through cooling system.

The incremental generating costs, presented in Table 3-7, are the sum of the additional annual costs due to the cooling tower present-worthed to January 1, 1977 using a discount rate of 6.5%. The present worth of a revenue requirement in any year is the amount of money which if invested at the specific rate of return in 1977 would meet this revenue requirement in the later year.

Aside from the expected values of these incremental generating costs, Table 3-7 shows values for each line item corresponding to the Authority's best judgment of: 1) the low estimate such that the probability that the actual cost will be lower than this value is .05 and 2) the high estimate such that the probability that the actual will be higher than this value is .05.

3.2.2.1 MAINTENANCE AND OTHER OPERATING EXPENSES

Cooling tower operating and maintenance expenses were estimated based on industry experience. The estimate is

TABLE 3-7

INCREMENTAL GENERATING COSTS ABOVE BASE PLANT
FOR CLOSED-CYCLE COOLING AT INDIAN POINT UNIT NO. 3

	Description of Expenses	Present Worth of Revenue Requirements[1] $ Low Estimate	Best Estimate	High Estimate
a)	Maintenance and other operating expenses	3,500,000	3,880,000	4,300,000
b)	Carrying cost of capital for cooling tower	88,400,000	98,250,000	117,900,000
c)	Cost of replacing deficient energy (annual derating)	78,900,000	92,770,000	120,600,000
d)	Carrying cost of capital for replacement capacity (peak derating)	36,600,000	40,720,000	48,900,000
e)	Replacement energy for plant downtime to cut in cooling tower	34,300,000	48,920,000	68,500,000
f)	Firm purchase for replacement capacity for downtime to cut-in tower	11,100,000	15,790,000	22,100,000
	TOTAL:	-	300,330,000	

[1] Base year 1977.

escalated by 5.5% per year compounded to reflect anticipated increases in the cost of labor and materials.

3.2.2.2 CARRYING CHARGES ON ADDITIONAL CAPITAL FOR THE COOLING TOWER SYSTEMS

The Authority's annual carrying charge is computed as the sum of the level debt payments on the bonds issued to finance the cooling tower plus insurance.

The level debt charge is calculated using the Authority's assumed cost of 7% for bonds having a 35 year maturity. This level debt charge of approximately 7.72% is increased by 20% as provided for under the terms of the Authority's Bond Resolutions to yield a total level debt charge of 9.27% per year.

An allowance for increased property insurance premium payments was also included in the annual charge rate. An amount equal to 0.25% has been included for this purpose.

3.2.2.3 COST OF REPLACING DEFICIENT ENERGY

The computation of the incremental revenue requirements includes the cost of replacing energy required because of the average annual derating (33.5 MWe) imposed on Indian Point Unit No. 3 by the installation of a cooling tower. The derating results from the additional energy required to operate circulating water pumps and other auxiliary equipment and high turbine back pressures associated with heat transfer characteristics of the cooling tower as compared to once-through cooling.

The cost of this derating is the cost to New York State of replacing the lost energy with alternative generation. In this analysis the alternate generating source has been assumed to be combined generation resources of the member companies of the New York Power Pool. It has been assumed that the lost Indian Point Unit No. 3 generation would be replaced by oil-fired generation for the period 1984 through 1994, by a mix of 25% coal-fired generation and 75% oil-fired generation for the period 1995 through 2004, and by a mix of 50% coal-fired generation and 50% oil-fired

generation from 2005 through the end of the analysis (2016). The cost of the oil-fired generation for the period 1984 through 1994 is based on a generation cost of $28.10 per megawatt-hour in 1982 and 5.5% escalation per year through 1994. The cost of the 25% coal-fired mix and the 75% oil-fired mix for the period 1995 through 2004 was calculated using a price of $52.31 per megawatt-hour in 1995 and 5.5% annual escalation through 2004. The cost of the replacement energy for the period 2004 through 2016 was based on a price of $82.42 per megawatt-hour for a mix of 50% coal and 50% oil generation in 2004 and 5.5% escalation per year through the end of the analysis.

3.2.2.4 CHARGES ON ADDITIONAL CAPITAL FOR REPLACEMENT GAS TURBINE CAPACITY

The installation of closed-cycle cooling at Indian Point Unit No. 3 will reduce its peak generating capability which would have been available to meet New York State's peak load by 77.5 MWe. The loss of this peak generating capacity would have to be replaced in order to maintain system reliability.

The economic value of the loss in system reliability is the cost to New York State of replacing Indian Point Unit No. 3's lost peak generating capability. For purposes of this analysis it was assumed that the capacity would be replaced by the cheapest source of such capacity through the installation of gas turbines at an estimated cost of $304 per installed kilowatt of capacity in 1984. This cost represents the most recent estimates used by the New York Power Pool for purposes of generation planning.

The cost of the replacement capacity in Table 3-2 is the carrying charge on the capital cost of the gas turbines, assumed to be 20.6 percent annually. The cost of any operation of the gas turbines is not included within this item because the cost of energy to replace lost Indian Point Unit No. 3 generation is included in the cost of replacing deficient energy.

The annual carrying charge on the capital cost of gas turbine replacement capacity (peak derating) includes a 7% property tax. For the low, best and high estimates of this incremental generating cost item the tax equals $12,400,000, $13,840,000 and $16,600,000 respectively.

3.2.2.5 REPLACING ENERGY FOR PLANT DOWNTIME

Indian Point Unit No. 3 would not operate during the seven month period required for the cut-in of the closed-cycle cooling system. It was assumed that a normal refueling outage of two months duration could be scheduled to coincide with the start of the cut-in period and that the additional cost associated with the replacement of energy during the cut-in period would be for the additional five month outage period.

The Authority, in conjunction with the other utilities participating in this proceeding, has attempted to develop a schedule for the construction and cut-in of cooling towers at the four lower Hudson River generating sites that will minimize the cost of replacement energy. This schedule minimizes the overlap of cut-in periods.

The cost of replacing the five months of Indian Point Unit No. 3 generation lost because of the cut-in of closed-cycle cooling is the cost of running alternative generation in New York State. This cost was calculated using a multi-area production simulation program which can economically dispatch the generating resources of the New York Power Pool observing power transfer limits between load-generation areas within the State. This program was run with the

assistance of the New York Power Pool staff and reflects the Pool's latest long range plan and its estimates of future economic parameters affecting generation costs.

3.2.2.6 RELIABILITY IMPACT OF INDIAN POINT UNIT NO. 3 OUTAGE

The outage for the cooling tower cut-in reduces the reliability of service to New York State consumers. In order to maintain equivalent reliability it would be necessary to purchase an equivalent amount of capacity.

While there is no assurance the neighboring utilities would have excess capacity available to sell on a firm basis, an assumption that gas turbine capacity would be purchased assigns a minimum value to the lost reliability.

The cost of replacement capacity for the outage shown in Table 3-2 represents five months carrying charges on the purchase of 1033 MWe of capacity assuming a cost of $304 per installed kilowatt for gas turbine capacity in 1984 and an annual carrying charge rate of 20.6%.

The annual carrying charge on the capital cost of gas turbine replacement capacity for downtime to cut-in the cooling tower includes a 7% property tax. For the low, best and high estimates of this incremental generating cost item the tax equals $3,800,000, $5,370,000 and $7,500,000 respectively.

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October 24, 1977

RECEIVED
OCT 27 1977
U.S. NUCLEAR REGULATORY COMMISSION
Mail Section

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

Re: Indian Point Station, Unit No. 3
Dkt. No. 50-286, OL No. DPR-64

Dear Dr. Geckler:

As counsel for the Power Authority of the State of New York, we submit the enclosed further comments on the Draft Environmental Statement issued by the Regulatory Staff in connection with selection of a preferred closed-cycle cooling system for installation at Indian Point Station, Unit No. 3 (NUREG-0296). These comments supplement the Power Authority's previous comments, which were transmitted on October 3, 1977.

We are reviewing the comments that have been submitted to the Regulatory Staff by various agencies and groups, and will be providing responses as appropriate in the near future.

Very truly yours,

LeBoeuf, Lamb, Leiby & MacRae

Enclosures (25 copies)

cc: See page 2.

cc (w/encl.):
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Mr. Paul J. Merges
Director, Technical Development Programs
State of New York Energy Office
Secretary, USNRC (2)

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of CONSOLIDATED EDISON COMPANY OF NEW YORK, INC. and POWER AUTHORITY OF THE STATE OF NEW YORK (Indian Point Station, Unit No. 3)	Docket No. 50-286 (Selection of Preferred Alternative Closed-Cycle Cooling System)

ADDITIONAL COMMENTS OF POWER AUTHORITY OF THE STATE OF NEW YORK WITH RESPECT TO DRAFT ENVIRONMENTAL STATEMENT

On October 3, 1977 Power Authority of the State of New York ("the Power Authority") filed its Comments with Respect to the Draft Environmental Statement ("DES") concerning designation of a preferred alternative closed-cycle cooling system at Indian Point Station, Unit No. 3 ("Indian Point 3"). As indicated on page 12 of those comments, certain economic information contained in the DES was more directed to circumstances that would have obtained were Indian Point 3 still owned by Consolidated Edison Company of New York, Inc. ("Con Edison"). In these additional comments, the Power Authority will present economic data concerning the preferred alternative cooling system premised on the fact that the Power Authority now owns Indian Point 3 and will be the owner at such time as a change is made--should one be required to be made--in the installed cooling system.

At the outset, several observations should be made which serve to distinguish Power Authority and Con Edison econimic analyses. These differences flow from the distinct legal character of these two entities. First, as noted in the October 3 comments, the Power Authority is not subject to federal, state or local taxations. As a consequence, the overall annual carrying charges that were developed as a percent of capital cost would be lower than shown in the DES, the data in which were predicated on Con Edison's taxable status. This difference serves to reduce by approximately 12% the annual carrying charges as a percent of capital cost for a natural draft wet cooling tower. Annual carrying charges for other alternative systems would be similarly reduced.

Second, the Con Edison cost data were based upon that company's experienced discount rate of 15 3/8%. The Staff, however, at page 6-2 of the DES has rejected this in keeping with its own convention of a 10% discount rate for investor-owned utilities. As pointed out on page 13 of the October 3 comments, use of such a convention is inappropriate since the Power Authority is

not an investor-owned utility. The Power Authority's data are based upon a 6.5% social discount rate that reflects an assessment of the opportunity costs associated with this type of investment. Use of this 6.5% discount rate serves to increase the sum present worth of the project costs. This phenomenon is equally present with respect to each of the alternative closed-cycle systems.

With respect to the alternative closed-cycle systems deemed to be feasible, the Power Authority concurs in general with Con Edison's presentation of the direct construction costs. It should be borne in mind, however, that those costs were estimated as of a date in 1975, and accordingly should be understood as having experienced uniform escalation since that time. In addition those data uniformly take into account certain real estate taxes that are not pertinent to Power Authority economic analysis. Hence, from the standpoint of direct construction costs, no change in the ordering of alternatives is occasioned by substitution of the Power Authority

Con Edison as owner. The Power Authority also concurs with the Con Edison Aanlysis of derating impacts of the various alternative systems; here again, no material change in the overall selection process is necessitated by Power Authority ownership of the facility.

In addition, the Power Authority notes that the Staff's analysis apparently fails, despite the implications of the first paragraph of § 6.1 and of § 6.2.1(4), to present in a quantified fashion the costs associated with provision of replacement capacity during down-time for cooling system tie-in. Our analysis indicates that over $16,000,000 (1978 dollars) of additional cost over the life of the project would be attributable to this feature of system installation, assuming a seven-month cutover outage. If, as shown in Table 6-17B of the DES, down-time costs for cooling system tie-in--replacement energy are the same for all alternatives, then this discrepancy between the analyses of the Staff and the Power Authority is immaterial from the standpoint of comparing alternative systems.

The cost of replacing the loss of peak generating capacity due to plant derating was based, in § 6.2.2.2(c) on a derating of 77.5 MWe for a natural draft wet cooling tower.

The derating experienced--and hence the size of this cost--varies from alternative to alternative. The Power Authority's analysis of this cost is $304/KW installed in 1984 as opposed to the Staff's estimate of $330/KW installed in 1981. Moreover, with regard to the replacement of peak capacity, while the Power Authority concurs in the assessment that gas turbines would have to be the source for such capacity, it is believed that, in the event this capacity is required, it would be purchased from an investor-owned utility in the State of New York. The Power Authority estimates the total fixed charges associated with the capital investment in the required gas turbine capacity as 20.6%, rather than the 22.8% shown in Table 6-3 of the DES.

On page 6-6 the Staff has noted its position that installation of additional gas turbine capacity is an inappropriate means of evaluating the peak derating associated with installation of a cooling tower. Whatever the merits of the Staff's analysis given Con Edison's planned capacity, load and reserve margins, it is clear that those factors cannot be applied to the Power Authority.. Hence, it would be incorrect to disregard this cost on the theory

that present or projected Power Authority capacity conditions would cover the reduced availability of peak capacity attributable to the derating.

On page 6-2 of the DES, the Staff has stated its methodology for determining the total project cost for each alternative. Its formula, however, implies continuous compounding, whereas the Authority's analysis assumes that compounding would take place on an annual basis.

Attached hereto is a chart comparing the Staff and Power Authority estimates of expenses associated with installation of a natural draft wet cooling tower at Indian Point 3, expressed in 1978 dollars.

With respect to direct comparison of the alternatives, there are divergent aspects of the Staff's and the Power Authority's analyses which would be consistently applicable within each analysis, and which, as a consequence, would not skew the rank order of the alternative systems. Thus, the Staff's analysis refers to the sum present worth of capital costs, DES § 6.2.2.2, over the period 1978-2005. This implies a 23-year useful life, which is not in keeping with the average life of facilities of this character. The Power Authority, in contrast, would develop this cost over the projected life of the cooling system from 1984

through 2016, a 32-year average life. This would raise the sum present worth of annual capital expenses. In each case, however, the calculation would apply uniformly to any cooling system that might be selected. Selection of the useful life has implications for other areas of the economic analysis wherever a sum present worth is developed.

A final area of disagreement is the selection of an annual escalation rate. In § 6.2.2.2(b), the Staff has posited a 5% rate, whereas the Power Authority's judgment, based on current experience, is that a rate of 5.5% is required. This Staff position has the effect of understating the revenue requirements for a cooling system, but again, the error would be constant and hence would not alter the selection of a particular system.

Respectfully submitted,

LeBOEUF, LAMB, LEIBY & MacRAE

By ______________________
Eugene R. Fidell
Partner

1757 N Street, N.W.
Washington, D.C. 20036

Attorneys for Power Authority
of the State of New York

COMPARISON OF EXPENSES ASSOCIATED WITH
INSTALLING A NATURAL DRAFT WET COOLING TOWER
AT INDIAN POINT 3

Expense	Power Authority Estimate	NRC Staff Estimate
Maintenance and other operating expenses	$ 4,127,000	$ 1,404,000
Carrying cost of capital for cooling tower	104,635,000	103,737,000
Cost of replacing deficient energy (annual derating)	98,796,000	58,924,000
Carrying cost of capital for replacement capacity	43,368,000	- 0 -
Replacement energy for plant downtime to cut in cooling tower	52,101,000	54,984,000
Firm purchase for replacement capacity for downtime to cut in cooling tower	16,827,000	- 0 -
Total (1978 dollars):	$319,854,000	$219,049,000

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CARL R. D'ALVIA
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OF COUNSEL:
ROBERT C. D'ALVIA

December 7, 1977

United States
Nuclear Regulatory Commission
ATTN: George W. Knighton, Chief
Environmental Projects Branch 1
Division of Site Safety and
Environmental Analysis
Washington, D. C. 20555

Re: Docket No.: 50-286
(Selection of Preferred
Alternative Closed-Cycle
Cooling System)

Gentlemen:

I am pleased to enclose original and twenty-five copies of the comments of the Village of Buchanan with respect to the question of the Preferred Alternative Closed-Cycle Cooling System.

Very truly yours,

CARL R. D'ALVIA

CRD:ps
Encs.
cc: See next page

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of	)	
	)	
CONSOLIDATED EDISON COMPANY OF NEW YORK, INC. and POWER AUTHORITY OF THE STATE OF NEW YORK (Indian Point Station, Unit No. 3)	)	Docket No. 50-286 (Selection of Preferred Alternative Closed-Cycle Cooling System)

THE VILLAGE OF BUCHANAN IS THE MUNICIPALITY IN WHICH THE INDIAN POINT STATION, UNIT NO. 3, IS PRESENTLY LOCATED AND THE VILLAGE SUBMITS THE FOLLOWING STATEMENT WITH RESPECT TO THE QUESTION OF A PREFERRED ALTERNATE CLOSED-CYCLE COOLING SYSTEM AT INDIAN POINT NO. 3

The Village of Buchanan, New York, is strenuously opposed to the construction of cooling towers as the preferred alternate closed-cycle cooling system for Indian Point No. 3 for the reason that we already are under order of the Nuclear Regulatory Commission to construct cooling towers for Indian Point No. 2 and the further construction of cooling towers for Unit No. 3, which will add to the other two towers that have been ordered to be constructed with respect to Indian Point No. 2, would accumulate additional problems with respect to the atmosphere in and around the Village of Buchanan and the surrounding areas.

The Village of Buchanan has heretofore expressed its opposition to the construction of the preferred natural draft type cooling towers for reasons which will be repeated herein, namely, that the construction of these towers would produce a blow-off of vaporized water in the form of white vapor plumes or clouds of tremendous sizes and stability and because of the salinity of the Hudson River water at Indian Point No. 3, the vapor will contain salt droplets which will drift and fall to the ground which would result in damage to vegetation and other property in the Village of Buchanan.

Our further understanding is that these plumes would soar at times and at other times would remain fairly stable in the areas over the Village of Buchanan and the City of Peekskill and, of course, by the construction of additional towers at Indian Point No. 3, there would be a consequent increase of plumes and more noise than the inhabitans and residents of the Village of Buchanan are enduring under the present system and under any other cooling systems which are to be constructed by virtue of the order of the Nuclear Regulatory Commission with respect to Indian Point No. 2.

The Village of Buchanan is further concerned from an aesthetic point of view that they would pose an unsightly appearance in these very predominantly residential areas of the Villages of Buchanan, Croton-on-Hudson, Montrose, and the City of Peekskill.

The Mayor and Board of Trustees of the Village of Buchanan, New York, are, as always, concerned with the well-being, property and health of the residents of the Village of Buchanan, and to construct additional towers in this area would, from an environmental point of view, have a detrimental effect in the community and would create problems in the areas of air pollution, noise and aesthetic value which are, of course, of vital concern to the Mayor and Board of Trustees on behalf of the residents of the Village of Buchanan, New York.

The one other factor that the Mayor and the Board of Trustees are raising with respect to the construction of these towers is the effect that it would have with respect to the large amounts of money that would be paid for the construction of these towers and their upkeep and the eventuality that the cost of these towers and their upkeep would have to be borne by the public at large and they are already burdened by many taxes and also high utility costs at the present time.

The Village feels that the harm that will come to the fish life and damage to the fish life in the waters of the Hudson River surrounding the Village of Buchanan under the present once-through cooling system would be minimal compared to the cost for the construction of these towers and

their upkeep, which costs would be superimposed upon the residents in the immediate area and also throughout the County of Westchester.

WHEREFORE, the Village of Buchanan, New York, is unalterably opposed to the construction of any further cooling towers for Indian Point No. 3 in the Village of Buchanan, New York, for the reasons hereinabove set forth.

Respectfully submitted,

VILLAGE OF BUCHANAN, NEW YORK

By: [signature]

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NEW YORK STATE PARKS & RECREATION Agency Building 1 Empire State Plaza, Albany, New York 12238 Information 518 474-0456
Orin Lehman, Commissioner

January 11, 1978

Dr. Robert P. Geckler
NRC Project Manager
Division of State Safety and
Environmental Analysis
Office of Nuclear Reactor
Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Dr. Geckler:

This letter contains comments from our Office regarding the "Draft Environmental Statement for selection of the preferred closed cycle cooling system at Indian Point No.3, docket No. 50-247."

Since the comment period for the DES may have expired, inclusion, within the FES, of staff responses to the following may not be possible. We respectfully request, however, a reply by staff at their convenience.

General Comment - Aesthetics

Our Office confirms previous statements and testimony provided by representatives from the Palisades Interstate Park Commission that the combined visual impact of cooling towers proposed to service IP-2 and 3 power facilities represents an environmental insult of considerable magnitude to the natural beauty of the Hudson River Valley. This applies also to parks, scenic roads and trailways on the eastern side of the Hudson River, particularly the views from Hudson Highland State Park (Taconic State Park Commission). Among the factors contributing to the value of large tracts of open space associated with trails and scenic overlooks is relative freedom from features significantly disruptive to the natural and the scenic setting of a region. The design and specifications of the natural draft cooling towers proposed for use at Indian Point are indicative of such disruptive features.

Section 5.1.2 Ground Level Fogging and Icing

1. The staff states that since the height of the proposed NDCT's is apparently greater than that of the verticle extent of nocturnal inversions, the drift from NDCT's will not contribute significantly to ground fog. Depending on the surrounding topography as well as magnitude of current meterological conditions, the height of nocturnal inversions can vary significantly. A range estimate of nocturnal inversion height would be useful in evaluating the height differential between the NDCT's and the inversion ceiling.

2. In Section 5.1.2.1 Natural Draft Cooling Tower (NDCT). Staff provides several examples of plumes from NDCTs that do not contribute significantly to ground fog. Staff should indicate how many of these towers are situated in a topographical setting similar to that surrounding Indian Point.

3. Staff should discuss how persistent periods of meterological stagnation might affect plume dispersal. The frequency of subsidence inversions as well as stagnation periods resulting from movement of warm frontal air masses over the Indian Point site should be determined.

Section 5.2.2.2 Applicant's Estimates of Damage Threshold

Staff should contrast the pH of the salinity aerosol used to determine the salt tolerance of selected species of plants with the probable pH of saline drift from the NDCTs. Staff should also discuss whether a significant relationship exists between pH and the damage potential of saline mists.

Section 5.2.2.3 Estimate of Botanical Inquiry from a NDCT.

Staff should provide additional discussion of injury during more persistent inversions (e.g., subsidence inversion of 5 days duration).

Section 5.2.2.6a Effects of Drift Aerosols on Human Populations

Staff should also discuss impact relative to persistent stagnation of meterological conditions.

Section 5.2.2.7(4) Summary of Drift Effects of Cooling Towers

Depending on the probability of persistent stagnation, staff should include inversions.

Our thanks for your time and consideration.

Sincerely,

IVAN P. VAMOS
Deputy Commissioner
Planning and Operations

mk

cc: Nash Castro, Palisades Interstate Park Commission
Dr. Peter J. R. Buttner, Environmental Management Bureau, OPR
Terrence Curran, Department of Environmental Conservation

THE UNIVERSITY OF THE STATE OF NEW YORK
THE STATE EDUCATION DEPARTMENT
ALBANY, NEW YORK 12234

NEW YORK STATE MUSEUM AND SCIENCE SERVICE
ANTHROPOLOGICAL SURVEY

January 24, 1978

Mr. Robert P. Geckler
Senior Environmental Project Manager
Environmental Projects Branch 1
Division of Site Safety and Environmental Analysis
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Geckler:

I have reviewed the materials provided on the Indian Point Nuclear Plant proposed improvements. I appreciate the opportunity to comment regarding archeological resources and the potential impact of these plans on such resources.

Although the Draft Environmental Impact Statement indicates only two archeological sites in Westchester County, our statewide archeological site files indicate 13 archeological sites along the Hudson River within three miles of the plant site, 5 sites within two miles and 1 site within one mile of the plant site. It is not unusual to find up to 700% more sites in an area through on-site survey than are reported in the site files, either due to their not being discovered as yet or lack of formal reporting to the State Museum by local collectors. This would be particularly expected in the Hudson Valley, where prehistoric occupation was intense.

The area of Indian Point appears very sensitive, archeologically, from its geographic location and topographic characteristics. Modern construction associated with the amusement park and the nuclear plant may have reduced the probability of finding significant archeological sites in the proposed construction area greatly. However, the general nature of the area, and the known sites reported in proximity to it, tend to support at least a moderate probability that sites may be found in the impact zone for these proposed towers.

I would suggest a brief on-site inspection, with subsurface survey, of the area to determine whether any sites remain and what their significance might be. A similar study conducted for the Cementon Plant did produce several sites, in spite of a great deal of modern industrial disturbance in the area. We have proposed a system to begin in May by which we will conduct such studies. Reimbursement of direct costs would be made via a "charge-back" budget effective April 1.

(continued)

We estimate the time and cost for a study required to locate and evaluate archeological resources in the tower location at less than 7 days of field time and under $1,500 cost, including report preparation. If archeological sites do not exist in the impact area, this fact could be confirmed in 2 days with costs below $500.

Please contact us if you wish us to schedule a site examination. As an alternative a list of private consulting firms or individuals known to be active in the area is enclosed.

Please note that under Section 233 of State Education Law, archeological materials excavated on State lands become part of the collections of the State Museum. In that regard, we would be happy to accept any cultural materials for curation and storage, thus answering the question of artifact disposition raised by the Department of Interior in their letter of September 23, 1977.

If I can assist you in any further way, please feel free to contact me. I am returning the map you provided, showing site locations, as part of this assessment. I hope this information will prove helpful.

Sincerely,

Philip Lord, Jr., Scientist (Archeology)
Office of the State Archeologist

PL:dm
enc.

Albert Dekin
Department of Anthropology
State University of New York at Binghamton
Binghamton, New York 13901

Karen Hartgen
Consultant
31 Terrace Avenue
Albany, New York 12203

Charles Fisher
Department of Anthropology
State University of New York at Albany
Albany, New York 12204

January 12, 1978

NOTE FOR: Mr. Phil Lord
Office of the State Archeologist
State Education Building
Albany, New York 12234

With this note I am sending you a map of the area around Indian Point where Con Edison has a nuclear power station and a copy of the Draft Environmental Statement concerned with the selection of the preferred closed cycle cooling system for Indian Point Unit No. 3. A similar document was prepared for Indian Point Unit No. 2. Both units are operating, but cooling towers may be added in the future. The tower locations are indicated in the figures in Section 3 of the draft statement.

Also enclosed is a copy of the comments relative to cultural resources and historic sites for which your assistance is sought. In the draft statement, the information we had obtained may be found in Section 6.3.1.8 (pages 6-26 to 6-28 incl).

If you have any questions, please call me at (301) 492-8429.

s/Robert P. Geckler/
Robert P. Geckler
Senior Environmental Project Manager
Environmental Projects Branch 1
Division of Site Safety and
Environmental Analysis

Enclosures:
As stated

United States Department of the Interior

HERITAGE CONSERVATION AND RECREATION SERVICE
WASHINGTON, D.C. 20240

IN REPLY REFER TO: H32-NR

JUL 17 1978

50-3/247/286

Mr. Voss Moore
Assistant Director of Environmental Projects
Division of Site Safety and Environmental
Analysis
Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Moore:

Re: Proposed cooling towers at Indian Point Nuclear Plant in Westchester County, New York.

We have received information that historic properties may be located in the area of a proposed project. The purpose of this letter is to offer our assistance in considering such properties as part of your project planning responsibilities. Enclosed for your information are copies of any material or correspondence we have on this subject.

This office is responsible, on behalf of the Secretary of the Interior, for providing assistance in the identification and evaluation of historic properties pursuant to Executive Order 11593 and the National Historic Preservation Act of 1966, as amended. Under section 800.4 (a)(2) of the Advisory Council on Historic Preservation's procedures for implementing the Executive Order and the National Historic Preservation Act, Federal agencies are to identify all historic and cultural properties in the area of an undertaking's potential environmental impact at the earliest stage of planning and to request that the Secretary of the Interior determine their eligibility for inclusion in the National Register.

Requests for determinations of eligibility, along with the necessary supporting documentation, may be submitted to this office following consultation with the appropriate State Historic Preservation Officer. *Enclosed for your convenience are regulations and guidelines explaining the documentation necessary for our review of such requests. We would like to bring to your attention the alternative expedited determination of eligibility process outlined in 36 CFR 63.3 which provides for rapid processing of determinations when the Federal agency and State Historic Preservation Officer agree on the eligibility of a property.

We recommend that you investigate the property or project mentioned above to ascertain whether a request for a determination of eligibility may be appropriate. Thank you for your cooperation on behalf of historic preservation.

7802020292

Sincerely yours,

William J. Murtagh
Keeper of the National Register

C007 ES11

Enclosures

*Enclosure not included in the FES. See Federal Register 42 FR 47660, September 21, 1977.

TELEPHONE REPORT

OFFICE OF ARCHEOLOGY AND HISTORIC PRESERVATION

PROJECT: Proposed cooling towers - Indian Point Plant, Westchester Co., NY

TO/FROM: Lenore Kuwik | DATE: 6/20/78

ADDRESS: NY State historic preservation office | PHONE:

STAFF MEMBER: Carol Dubie | DIVISION: National Register

REPORT: Larry Gobrecht, the preservation surveyor for this area of NY, is concerned about two proposed cooling towers at the Indian Point Plant. He says that they will present substantial visual impact problems, affecting historic resources in the area. He would like for us to write to the Nuclear Regulatory Commission, advising NRC of the need to identify historic properties and request determinations of eligibility where appropriate.

APPENDIX C

ATOMIC SAFETY AND LICENSING BOARD CORRESPONDENCE AND STAFF EVALUATION RELATIVE TO THE USE OF WASTE HEAT FROM INDIAN POINT

The following pages support Section 8.1.3.1.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

November 9, 1976

Leonard M. Trosten, Esq.
Edward J. Sack, Esq.
Carmine J. Clemente, Esq.
Paul S. Shemin, Esq.
Sarah Chasis, Esq.
Stephen H. Lewis, Esq.
Carl R. D'Alvia, Esq.
(Addresses attached)

I
S. Lewis 11-[illegible]
Brauner [illegible]
Reply due Nov. 2[illegible]

Dear Madam
and Sirs:

In re: Consolidated Edison Company of New York, Inc.
(Indian Point Unit 2)
Docket No. 50-247

The Atomic Safety and Licensing Board, by letter of November 1, 1976, made reference to the statement proposed as a limited appearance by the City of Peekskill on October 25, 1976 for inclusion into the transcript of the preferred alternative session of hearings.

The document attached to the City letter, entitled "A Search For Alternatives To The Proposed Cooling Towers at Indian Point", dated February 27, 1976, as supplemented by another statement dated September 27, 1976, proposed canals using power spray modules on land near the Indian Point facility, or power spray ponds moored in the Hudson River as viable closed-cycle alternatives to the cooling towers at Indian Point.

On further review of the attachment to the letter, the Board believes that it is important for the parties to comment on the feasibility of these alternatives. It is requested that the comments be mailed by November 26, 1976. Opportunity will be given at a conference on December 8, 1976 for further comment.

Very truly yours,

Samuel W. Jensch, Chairman
Atomic Safety and Licensing Board

cc: Secretary, USNRC

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

November 24, 1976

Samuel W. Jensch, Esq., Chairman
Atomic Safety and Licensing Board Panel
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dr. Franklin C. Daiber
College of Marine Studies
University of Delaware
Newark, Delaware 19711

Mr. R. Beecher Briggs
110 Evans Lane
Oak Ridge, Tennessee 37830

In the Matter of
Consolidated Edison Company of New York, Inc.
(Indian Point Station, Unit No. 2)
Docket No. 50-247 (Selection of Preferred Alternative Closed-Cycle Cooling System)

Gentlemen:

This is in response to Chairman Jensch's letter of November 9, 1976, requesting the parties' comments on the report entitled "A Search for Alternatives to the Proposed Cooling Towers at Indian Point" and a memorandum dated September 27, 1976, both submitted by the City of Peekskill. We have no objection to the inclusion of these documents in the record of this proceeding as a limited appearance. The Staff's comments on the report are attached hereto. We would request that the Staff's comments be included in the record as well. Consistent with the Board's letter, we would reserve our right to comment further at the December 8, 1976 conference called by the Board, particularly with respect to the September 27, 1976 Memorandum.

Sincerely,

Stephen H. Lewis
Counsel for NRC Staff

Enclosure:
As stated

cc: See page 2

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

November 24, 1976

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.	)	Docket No. 50-247 (Selection of Preferred Alternative Closed-Cycle Cooling System)
(Indian Point Station, Unit No. 2)	)	

COMMENTS OF NRC STAFF ON "A SEARCH FOR ALTERNATIVES TO THE PROPOSED COOLING TOWERS AT INDIAN POINT"

The NRC Staff has reviewed the report entitled "A Search For Alternatives To the Proposed Cooling Towers at Indian Point" submitted by the City of Peekskill and offers the following comments thereon.

The report is devoted mainly to the topic of re-use of waste heat from large power plants, and especially those at Indian Point. The main conclusions are that the use of the waste heat at Indian Point is not feasible and, generally, for such heat to be useable, the plant would have had to encompass this function in the original design phase, (i.e., the plant had to be dual purpose from the beginning). (pp. 3-4).

The report also includes a recommendation that "articulated spray canals" and a "floating spray pond" deserve further study as potential alternatives to a cooling tower. (pp. 6, 49). The authors have not, however, offered

any information to rebut the NRC Staff's conclusion that spray ponds and spray canals are not feasible at the Indian Point site because of a lack of suitable level land on or near the site. (FES, pp. 2-1, 2-3). Nor does the report address any of the questions posed by the Atomic Safety and Licensing Board regarding possible placement of a spray pond in the Hudson River. (See: Tr. 183-84, 217-18, 234-38, and 253-55).

From our review, we have not been able to identify any new information in the report which would enable the Board to find that spray ponds or spray canals are a feasible alternative to the proposed natural draft cooling tower. 1/

1/ We note that much of the data contained in the report is simply drawn from the Licensee's Environmental Report or the Staff's Final Environmental Statement (See, for example p. 27).

NRC FORM 335 (7-77) U.S. NUCLEAR REGULATORY COMMISSION **BIBLIOGRAPHIC DATA SHEET**	1. REPORT NUMBER *(Assigned by DDC)* NUREG-0574
4. TITLE AND SUBTITLE *(Add Volume No., if appropriate)* Final Environmental Statement related to Selection of the Preferred Closed Cycle Cooling System at Indian Point Unit No. 3	2. *(Leave blank)*
	3. RECIPIENT'S ACCESSION NO.
7. AUTHOR(S)	5. DATE REPORT COMPLETED MONTH: December YEAR: 1979
9. PERFORMING ORGANIZATION NAME AND MAILING ADDRESS *(Include Zip Code)* U. S. Nuclear Regulatory Commission Office of Nuclear Reactor Regulation Washington, D. C. 20555	DATE REPORT ISSUED MONTH: December YEAR: 1979
	6. *(Leave blank)*
	8. *(Leave blank)*
12. SPONSORING ORGANIZATION NAME AND MAILING ADDRESS *(Include Zip Code)* See 9 above	10. PROJECT/TASK/WORK UNIT NO.
	11. CONTRACT NO.
13. TYPE OF REPORT Final Environmental Statement	PERIOD COVERED *(Inclusive dates)* Post Operating License Stage
15. SUPPLEMENTARY NOTES This report pertains to Docket No. 50-286	14. *(Leave blank)*

16. ABSTRACT *(200 words or less)*

A Final Environmental Statement related to the Selection of the Preferred Closed Cycle Cooling System at Indian Point Unit No. 3 has been prepared by the Office of Nuclear Reactor Regulation of the U.S. Nuclear Regulatory Commission. Unit No. 3 is located in Westchester County, New York and is owned and operated by the Power Authority of the State of New York. This FES presents an evaluation and analysis of several closed cycle cooling systems from an economic and environmental standpoint. The systems considered were: cooling ponds and lakes; spray ponds and spray canals; dry cooling towers wet-dry mechanical draft cooling towers; and wet cooling towers. Major factors entering into selection of tower type were noise, drift, and aesthetics. On the basis of the evaluation and analysis set forth in the Statement and after weighing the environmental, economic, technical, and other benefits against environmental costs and risks and considering available alternatives, the staff concludes that the action called for under the National Environmental Policy Act of 1969 and 10 CFR 51, is issuance of an amendment to the Facility Operating License No. DPR-64 for Unit No. 3 authorizing construction of a natural draft cooling tower as proposed by the licensee and evaluated by the staff subject to conditions for protection of the environment. These are:a monitoring program relating to drift and salt deposition which will be incorporated into the technical specifications and an

17. KEY WORDS AND DOCUMENT ANALYSIS — 17a. DESCRIPTORS

Abstract (cont'd)

archeological literature and field survey which must be completed before construction activities of the cooling towers begin.

17b. IDENTIFIERS/OPEN-ENDED TERMS

18. AVAILABILITY STATEMENT	19. SECURITY CLASS *(This report)*	21. NO. OF PAGES
Releasable to the public. Available at NTIS	UNCLASSIFIED	
	20. SECURITY CLASS *(This page)* UNCLASSIFIED	22. PRICE S

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