PROPOSED

APPENDIX B
TO
FACILITY OPERATING LICENSE
DPR-26

FOR
CONSOLIDATED EDISON COMPANY
OF NEW YORK, INC.

INDIAN POINT NUCLEAR GENERATING
UNITS NUMBERS 1 AND 2

DOCKET NUMBERS 50-3 AND 50-247

ENVIRONMENTAL TECHNICAL SPECIFICATIONS
REQUIREMENTS

TETS

NOTE: This document has been marked by Con Edison to indicate suggested changes to the Technical Specifications proposed by the AEC Regulatory Staff. Suggested deletions are indicated by hyphens and suggested insertions are indicated by italics.

~~June 30, 1973~~

July 16, 1973

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1.0 Definitions

The following terms are defined for uniform interpretation of the Environmental Technical Specifications for Indian Point Unit Nos. 1 and 2.

1.1 Hudson River estuary - the tidal portion of the Hudson River from the Battery up to Troy Dam resulting from the influence of the Atlantic Ocean.

1.2 Abnormal Environmental Occurrence

An abnormal environmental occurrence of any plant condition that:

1.2.1 Results in noncompliance with, and is in violation of, an environmental technical specification and causes an abnormal degradation of the environment, and

1.2.2 Exceeds a Limiting Condition for Operation as established in the Environmental Technical Specifications, or

1.2.3 Causes any uncontrolled or unplanned releases of chemical, ~~radioactive, and~~ thermal or other discharges from the site in excess of applicable State and local regulations.

1.3 Emergency Conditions

1.3.1 Reactor Emergency - shall mean an unanticipated equipment malfunction necessitating prompt remedial action to avoid endangering the public health and welfare.

1.4 Temperature Considerations

1.4.1 Circulating water system includes the intake openings and structure for all units, the condenser cooling water system, the discharge canal, discharge port and structure.

1.4.2 Intake Water Temperature - refers to water temperature measured in the intake structure forebay in the inlet to the circulating water system.

1.4.3 Discharge Canal Water Temperature - refers to water temperature measured in the discharge canal, at *or near* the confluence of the discharge canal with the Hudson River.

1.4.4 ΔT Across Condensers - refers to the temperature difference between the intake water temperature and the discharge canal *water* temperature.

1.4.5 Ambient River Water Temperature - refers to Hudson River water temperature resulting from only the addition of heat from natural sources but not including heat of artificial origin.

1.4.6 Site ~~Background~~ River Water Temperature - refers to a Hudson River Water temperature at the ~~Indian Point site without the addition of thermal discharges from the Indian Point site~~ *edge of the dock, about 65 feet in front of the Unit No. 1 Intake structure. (See Figure 2-1.)*

1.4.7 Thermal Discharge ~~is one which results or would result in a temperature rise at the receiving water above the permissible temperature rises listed in Section 2.1~~ *is the addition of heat from other than natural sources to a receiving body of water.*

1.4.8 Mixing Zone - the volume of water heated up by thermal discharges from the Indian Point Station mixed with the ambient river water volume to reduce temperatures to the limits established in Section 2.1.

1.4.9 Deicing - refers to melting of surface and frazil ice done by recirculating a portion of the condenser discharge water back to the intake structure through the deicing ~~duct and spray header~~ *loop*.

1.5 Velocity

1.5.1 Intake Velocity - water velocity expressed in feet per second (fps) of cooling water withdrawn through the intake opening structure which includes the outer fixed (meshed) screens located at the forebay openings, trash racks, traveling screens, and stop log guides. The intake velocity through the screens is not measured directly but its maximum *average* value over the surface area of the screens is calculated by knowing the volumetric flow rate, i.e.,

$$V_{i_m} \qquad V_{i_a} \qquad = \frac{Q_c}{A_s \times R_f} \qquad (1\text{-}1)$$

~~V_{i_m} = calculated maximum intake velocity, fps~~

V_{i_a} = *calculated average intake velocity at outer fixed screens, fps*

Q_c = ~~maximum~~ volumetric flow rate (cfs) obtained by the capacity of the circulating water pumps

A_s = projected area of the opening of the frame of outer fixed screens through which the cooling water flows, ft^2

R_f = fraction of projected area available for volumetric flow taking into account the size of the mesh screen and diameter of the screen wire, e.g., 0.080 in. diameter wire in 3/8 in. square mesh screen

$$\frac{(0.375 - 0.080)^2}{(0.375)^2} = 0.62 \text{ fraction of area available for volumetric flow}$$

The intake velocity is constant with constant volumetric capacity of the circulating pumps and constant projected area through which the water flows.

1.5.2 Approach Velocity - water velocity at a distance of approximately twenty-four inches away from the outer fixed screens (which are located at the bay openings). The area average value of the approach velocity is estimated by knowing the volumetric flow rate, i.e:

$$V_a = \frac{Q_c}{A_f} \qquad (1\text{-}2)$$

where:

V_a = area average approach velocity (fps)

Q_c = volumetric flow rate (cfs)

A_f = average area of cross section 24 in. from intake forebay opening to river (ft^2)

1.5.3 Discharge Velocity - the average velocity at the vena contracta of the water jets issuing from the discharge ports. The discharge velocity is not measured directly, but is calculated by measuring the difference in water level across the discharge structure.

That is:

$$V_{vc} = C\sqrt{2g\ h} \qquad (1\text{-}3)$$

where:

V_{vc} = velocity at vena contracta (fps)

g = acceleration of gravity (ft/sec^2)

h = height of water in discharge canal above river level (ft)

C = proportionality constant (about 0.95) (Ref. 1-1)

1.6 Chlorine

1.6.1 Free Available Chlorine (Free Chlorine) - that part of the chlorine injected into the water that remains as molecular chlorine, hypochlorous acid (HOCl), and hypochlorite ion or a combination thereof. (Ref. 1-2, 1-3.)

1.6.2 Combined Available Chlorine (Or Combined Chlorine) - that part of the chlorine injected into the water that remains combined with ammonia or other nitrogeneous compounds (Ref. 1-2, 1-3).

1.6.3 Residual Chlorine (or Chlorine Residual) the amount of available chlorine present at any specified time subsequent to the addition of chlorine (Ref. 1-2, 1-3).

1.6.4 Total Residual Chlorine (or Total Chlorine Residual or Active Chlorine) consists of the total amount of chlorine residual (the total free available and/or combined available chlorine) that remains, without regard to type (Ref. 1-2, 1-3).

1.6.5 Chlorine Demand means by implication the exact amount of chlorine required to oxidize completely all compounds that reduce free chlorine in the water. These compounds include both organic and inorganic substances. In practice, the term is used when referring to the difference between the dose and the chlorine left (chlorine residual) after a particular period of contact, for one particular dose rate (Ref. 1-3).

1.7 Fishing - Fishing shall include the propagation of fish and other aquatic life.

1.8 Entrainment - the forced association with and exposure of nonscreenable organisms to cooling water.

1.8.1 Pumped entrainment - passage of organisms with the cooling water through the cooling system.

1.8.2 Plume Entrainment - mixing of organisms present in the ~~cooling water discharge in the receiving water during dispersion of the heated cooling water in the receiving water~~ - *receiving water with the heated water from the discharge canal during dispersion of the heated water into the receiving water.*

~~1.9 Entrapment - the capture and holding of organisms on or within the intake, screening and discharge structures of the cooling system.~~

1.9.1 Impingement - the contact and/or retention of organisms in the screening structures of the cooling water system (screening structure to include all types of mesh screens, trash racks and structural configurations which can impinge organisms).

1.10.1 Cold Shock - exposure of organisms to rapid decrease in temperature.

1.11.1 Zones of Passage - in river and estuary systems, is the continuous water routes of the volume, area and quality necessary to allow passage of free swimming and drifting organisms with no significant effects produced on their populations.

References

1-1 "Indian Point Model No. 2 Cooling Water Studies," Alden Research Laboratories, May 1969. Appendix O, Supplement No. 1 to Environmental Report for Indian Point Unit No. 2, September 9, 1971.

1-2 "Annual Book of ASTM Standards, Part 23, Water: Atmospheric Analysis, D 1253-68," American Society for Testing and Materials.

1-3 Final Environmental Statement, September 1972, p. A-V-22.

2.0 LIMITING CONDITIONS FOR OPERATION

Applicability

Applies to the controlled release of thermal discharges, residual chlorine and other chemical discharges, ~~radioactive liquids,~~ gaseous and solid wastes from the Indian Point Station.

Objective

To define the conditions for release of non-radioactive ~~and radioactive~~ liquids and solids to the Hudson River and gases to the atmosphere in order to assure compliance with applicable Federal, State and local regulations.

2.1 Thermal

Applicability

Applies to the discharge of the heated coolant water from the discharge structure.

Objective

To define the conditions for discharge of the effluent cooling water to assure compliance with applicable State, and local regulations and to limit thermal stress to the aquatic ecosystem in order to minimize adverse thermal effects of the Indian Point Station on biota.

3.0 MONITORING REQUIREMENTS

Applicability

Applies to routine sampling and analysis of the station effluents and to an analytical evaluation of the data collected from the environmental monitoring survey carried out.

Objective

To establish a sampling and analysis schedule which will assure that all effluents are kept within applicable Federal, State, and local regulations.

3.1 Thermal

Applicability

Applies to temperature measurements made in the front of intake and discharge canal.

Objective

A. To establish that thermal releases will conform with applicable State and local regulations.

B. To assure that thermal protection conditions, including temperature difference across the condensers, discharge temperature, rate of temperature change, and temperature within a prescribed mixing zone, are maintained within the Technical Specifications.

2.0 LIMITING CONDITIONS FOR OPERATION

2.1.1 Maximum ΔT Across Condensers

Objective

Limit the maximum temperature rise across the condensers during normal operation.

Specification

A. The maximum temperature rise across the condensers shall not exceed ~~15 F° during normal operation whenever the intake water temperature is greater than 40°F and 25°F whenever the intake water temperature is equal to or less than 40°F.~~

(1) 25°F whenever the intake water temperature is less than 40°F,

(2) 15°F whenever the plant is not operating at reduced flow.

B. The maximum temperature rise across the condensers shall not exceed 28°F during times when one or more circulating water pumps are down for maintenance. ~~All maintenance work on the pumps, if done during June through August, shall be limited to one pump at a time.~~

C. The maximum temperature rise across the condensers shall not exceed 28°F whenever ~~a portion of the condenser discharge is recirculated to the inlet for ice control during deicing operations.~~ *ten percent of*

3.0 MONITORING REQUIREMENTS

3.1.1 Maximum ΔT Across the Condensers

Objective

To monitor the intake and discharge temperatures to assure that the allowable ΔT across the condensers is not exceeded.

Specification

The site river water temperature ~~in front of the intake structure~~ shall be measured continuously by means of at least one temperature element located at a depth of about 13 feet below mean low water ~~at the intake structure; and the intake water temperature shall be recorded at 30 min. intervals. The discharge canal before its confluence with the river shall be monitored continuously using a temperature probe at a depth of 5.5 feet below mean low water. The accuracy of the system and sensitivity of the temperature sensors are 1 3% and 0.1°F, respectively.~~ *The intake water temperature along with the discharge canal water temperature shall both be monitored continuously. The latter shall be obtained by means of a probe located in the discharge canal before the confluence with the river, at depth of 5.5 feet below mean low water (see Figure 2-1 for location of probes).* The continuous temperature recorder shall not be inoperative for a period exceeding 14 days. As an alternate during the system downtime for calibration or repairs, the temperature readings in the front of the intake structure and in the discharge canal shall be obtained locally four (4) times a day.

2.0 LIMITING CONDITIONS FOR OPERATION	3.0 MONITORING REQUIREMENTS
Specification (Cont'd)	Specification (Cont'd)
the normal condenser discharge is recirculated to the inlet for ice control during deicing operations, or 34°F whenever 20% of the normal condenser discharge is recirculated to the inlet for ice control during deicing operations.	The flow rate through the plant shall be logged each day and any changes recorded at the time of changes.
	~~Data from the two sensors are recorded individually every 30 minutes on a strip chart recorder.~~
D. Whenever the temperature increment (ΔT) is above the specified limits for more than one ~~hour~~ *day*, action shall be taken to determine the reason for temperature increase and its expected duration, and corrective action shall be taken to reduce the ΔT to within the specified limits. These occurrences shall be recorded and reported in accordance with the Plant Reporting Requirements.	Continuous temperature monitoring ~~using the automatic system~~ is required following changes in power level or during deicing operations until the ΔT across the condensers are stable.
	~~The tide and temperature of the river immediately surrounding the site shall be taken continuously by means of a tide stage height instrument located beneath the pier in front of Unit No. 1.~~
Bases	Bases
The rise of intake water temperature across the condenser is a fixed value based upon initial condenser design, circulating water pump operation, and the plant's power level.	Temperature monitoring sensors in front of the intake and the discharge canal at the confluence of the Hudson River will be monitored by means of the recorder ~~in the control room~~ which will provide a reliable method for determination of the temperature differential across the condenser.
During normal operation ~~with the six circulating water pumps at full capacity, a total flow of 840,000 gallons per minute (gpm) is expected from Service Unit No. 2 and 280,000 gpm from Unit No. 1. The six pumps for service water circulation results in a total flow of 30,000 gpm from Unit No. 1. Each circulating water pump has a capacity~~	Knowledge of the temperature rise across the condensers and the service water system and the volumetric flow rate of cooling water through the condensers and service water system determines the rate at which the plant

Bases (Cont'd)

~~of 140,000 gpm and each service water pump in Unit No. 2, 5000 gpm~~, *a total condenser water flow of 840,000 gpm is obtained on Unit No. 2 from its six circulating water pumps, and a total condenser water flow of 280,000 gpm is obtained on Unit No. 1 from its two circulating water pumps. Each circulating water pump has a capacity of 140,000 gpm. In addition to the above, Unit 1 has six service water pumps (two with capacities of 16,000 gpm each, and four with capacities of 1500 gpm each) with a total flow of 38,000 gpm. Unit No. 2 has six service water pumps, each with a capacity of 5,000 gpm, for a total flow of 30,000 gpm.* The increase in temperature of the circulating water through each of the three condensers for Unit No. 2, and one condenser for Unit No. 1 will be dependent on the pumping capacity of each of the pumps. ~~At all times a minimum service water flow of up to 68,000 gpm for both Units Nos. 1 and 2 will be required to remove residual heat in the reactor system for the two units.~~ When the intake water temperature is less than 40°F, the flow will be reduced from 100% flow to 60% flow, thereby resulting in an increase in the temperature differential across the condenser. This flow reduction was required by the New York State Department of Environmental Conservation in an agreement made with Consolidated Edison on April 28, 1972, to rescind an order by the State on February 29, 1972, to shut down the circulating water pumps after ~~an extensive~~ fish kill occurred at the

Bases (Cont'd)

rejects heat to the river. Temperature measurements and rate of changes in temperature are necessary to determine the range and relative fluctuations in temperature experienced by aquatic life in the intake and discharge areas. The heat rejection rate as discussed in Section 2.1.3 along with the discharge canal temperature (see Section 3.1.2) at the confluence of the canal with the river, is an important factor affecting the response of the river to the thermal discharge; that is, the maximum river surface temperature and the extent and intensity of the thermal plume. See Sections 3.1.5 and 4.1.1 for further details regarding the monitoring of the thermal plume.

~~The Automatic Environmental System (AES) continuously monitors temperature, dissolved oxygen, and pH in water pumped directly in front of the intake canal. In addition, temperature dissolved oxygen, pH, salinity and euprie ion are monitored in water pumped directly from the effluent canal. Data from the eight probes are recorded every 30 minutes on a strip chart recorder.~~

Bases (Cont'd)

intake structure during testing of the pumps for Unit No. 2. The purpose for flow reduction is to reduce the volume of river water used and the intake velocity through the outer fixed screens to reduce fish impingement during wintertime. *Flow may alos be reduced when the temperatures are greater than 40°F for fish protection.*

Since the temperature differential increases with reduced flow, during the summertime when the ambient water temperature can reach 79°F, maintenance of pumps requiring shutdown should be avoided in order to avoid excessive thermal stresses on aquatic biota.

During the winter, warmed water from the discharge canal can be recirculated to the intake forebay *of Unit No. 2* for deicing purposes to melt surface and frazil ice by means of two 80,000 gpm pumps located adjacent to the discharge canal. *Deicing on Unit No. 1 is attained by means of direct recirculation of a portion of the heated water from the outlet water box of the Unit 1 condenser.* ~~The purpose to limit the incremental temperature of the heated discharge water recirculated to the intake forebay is to reduce the attraction of fish or other biota to heated water and the intake so as to minimize the impingement effects on organisms.~~ Primary use of the deicing operation occurs in December and January with intermittent operation from November through April.

2.0 LIMITING CONDITIONS FOR OPERATION

2.1.2 Maximum Discharge Temperature

Objective

To limit the maximum temperature of the condensers cooling water discharge through the discharge structure at the confluence with the river during normal operation.

Specification

During July through September, the discharge canal water shall not exceed 96°F during normal plant operation of the two units with all circulating pumps and service water pumps in full capacity flow.

During operation of Units Nos. 1 and 2, the thermal discharges from the discharge structure into the estuary shall be limited so that the water temperature at the surface of the Hudson estuary shall not be raised to more than 90°F at any point. Further, the temperature of at least 1/3 of the surface as measured from water edge to water edge at any stage of tide shall not be raised to a maximum of 83°F during October-June and 86°F during July-September. If the limiting condition of 90°F for a non-passageway is exceeded, then appropriate action shall be taken to ensure that this temperature shall not be exceeded for more than two consecutive hours. If the water temperature exceeds this condition, station power shall be reduced to the extent necessary to maintain the discharge cooling water at 90°F below, unless there is an emergency need for power.

3.0 MONITORING REQUIREMENTS

3.1.2 Maximum Discharge Temperature

Objective

To monitor the circulating water discharge temperature to assure that the allowable discharge temperature is not exceeded.

Specification

A mid-depth continuous temperature recorder will be used in the discharge canal. Temperatures at the discharge canal will be transmitted to the control room~~, over one hour and stored by computer~~. The temperature ~~averaged over one hour~~ will be visually displayed for monitoring purposes. ~~The accuracy of the system and sensitivity of the temperature sensors are 1.3% and 0.1°F, respectively.~~ When the system is not operative, an alternative backup system as presented in Section 3.1.1 will be used.

~~A Thermal Buoy System consisting of four buoys located at various distances upstream and downstream of the site shall record temperature continuously at the top, near top, near bottom, and the bottom of the river by means of thermistors. The probes are located at about 1450 ft downstream, 1000 ft middle, 450 ft upstream and 700 ft as shown in Figure 2-1.~~

Specification (Cont'd)

Deviation from the specifications shall be documented in accordance with the Plant Recording requirements.

Bases

The analyses made by the licensee is based on the assumption that the maximum ambient temperature is 79°F and the maximum effect of recirculation, from the tidal influence of the estuary, on the intake temperature is 1.2F° temperature differential. Therefore, the maximum discharge canal water temperature should not exceed 95.2°F. An upper limit of 96°F of the discharge water at the discharge port is thereby being set.

The thermal discharges shall also be maintained at all times to adequately protect aquatic biota against exposure to excess temperature. The 90° temperature is established because most species in this region cannot tolerate prolonged exposure to temperatures above 90°F. Based on literature review and laboratory studies of several species, 90°F appears to be a maximum temperature that can be biologically tolerated. Since discharge temperatures approaching 90°F will occur a few weeks out of the year, no detrimental changes in population structure, food chain relationships or productivity are anticipated. However, changes of this nature are expected in the immediate discharge area but such changes in a relatively small portion of the receiving waters are not expected to adversely affect the overall aquatic ecosystem.

Bases

The placement of the temperature monitoring instrument in the discharge canal will give the temperature of the discharge water immediately before mixing with the receiving water. The placement of this temperature sensor at 5.5 *feet* in the discharge canal will provide for temperature measurement representative of the discharge water before mixing with the receiving water.

The temperature sensors along the shoreline in front of the discharge structure upstream and downstream of this structure will monitor the water after mixing has occurred with the receiving water.

2.0 LIMITING CONDITIONS FOR OPERATION

2.1.3 Maximum Heat Rejection Rate (Btu/hr)

Objective

Limit the maximum heat discharged with the heated coolant water into the Hudson River.

Specification

The maximum heat rejected into the river with the discharged heated coolant water shall not exceed as follows:

Unit No. 1	2.0×10^9 Btu/hr
Unit No. 2	6.5×10^9 Btu/hr
Unit Nos. 1 and 2	8.5×10^9 Btu/hr

The heat rejection rates shall be calculated on the equation

$$H = Q_c \, C_p \, \Delta T_c \, \rho \qquad (2\text{-}1)$$

where:

H = heat ~~rejected~~ *rejection rate* in BTU/hr

Q_c = condensers cooling water flow in cu. ft/hr. *as* described in Section 2.1.1.

ΔT_c = ~~(condenser)~~ temperature differential ~~(°F)~~ across the condensers as discussed in Section 2.1.1.

ρ = water density, lbs/cu. ft

C_p = specific heat of the water

3.0 MONITORING REQUIREMENTS

3.1.3 Maximum Heat Rejection Rate (Btu/hr)

Objective

Calculate the maximum heat rejection rate.

Specification

Monitoring requirements include those specified in Section 3.1.1 for the monitoring of the ΔT_c across the condensers and the circulating water flow through each condenser in Section 3.1.3. The heat output will be reported in the semi-annual operating report.

Bases

The maximum heat rejected is a fixed value based on the reactor core design, the primary and secondary coolant heat transfer system, and the spent steam temperature and volume as the steam reaches the condenser tubes.

2.1.4 Rate of Temperature Change of Condensers Cooling Water, ΔT

Objective

To limit the rate of temperature change during normal operation within the primary operating cycle, thereby limiting the temperature change of the condenser cooling discharge water.

Specification

The rate of temperature change across the condensers during normal plant operation shall not exceed 15°F per hour, during normal power increase, and ~~(5°F per hour)~~ *7°F per half hour* during normal power reductions. If these rates are exceeded, appropriate corrective action shall be taken to avoid thermal or cold shock to aquatic life. This limitation may be exceeded for brief periods as necessary to maintain protection of critical plant equipment and systems and for certain safeguard operations which cannot be limited or regulated by plant operation. These safeguard operations include automatic plant trips and manual plant trips initiated by licensed personnel in emergencies or other situations requiring such actions.

3.1.4 Rate of Temperature Change of Condensers Cooling Water, ΔT

Objective

To regulate the rate of load change thereby limiting the temperature change of the condenser cooling discharge water to assure that the allowable rates of change are not exceeded for protection of biota.

Specification

~~(Condenser intake and discharge water)~~ *Intake and discharge canal water temperatures* shall be monitored under 3.1.1, continuously. The time of the day and dates when the temperature changes *greater than one-half the limits specified in 2.1.4* occur shall be recorded. ~~The rate of temperature shall be recorded. Any fish~~ *Fish* undergoing thermal stresses shall be observed and documented.

2.0 LIMITING CONDITIONS FOR OPERATION	3.0 MONITORING REQUIREMENTS

Specification (Cont'd)

Deviation from this specification shall be documented ~~in accordance with the Plant Reporting Requirements~~.

Bases

The limiting condition is established to minimize shock to aquatic species of this region. An increase of 15°F per hour of the discharge canal should not cause detrimental effects to fish species since they are motile and capable of leaving the area. A decrease of 5°F per hour should not cause detrimental effects to fish as the discharge velocity will provide rapid mixing with the surrounding river water. The discharge velocity (10 fps) is large enough to discourage most fish from spending time in the region of maximum temperature.

Bases

Monitoring of the temperature change across the condensers will ensure representative temperature measurements before dilution of the circulating water with ambient river water. A linear correlation of the rate of temperature change in the discharge canal and the mixing zone boundary is assumed. Any lethal ~~and sublethal effects on biota~~ *effects on* fish from sudden temperature changes shall be observed and reported in the semiannual report.

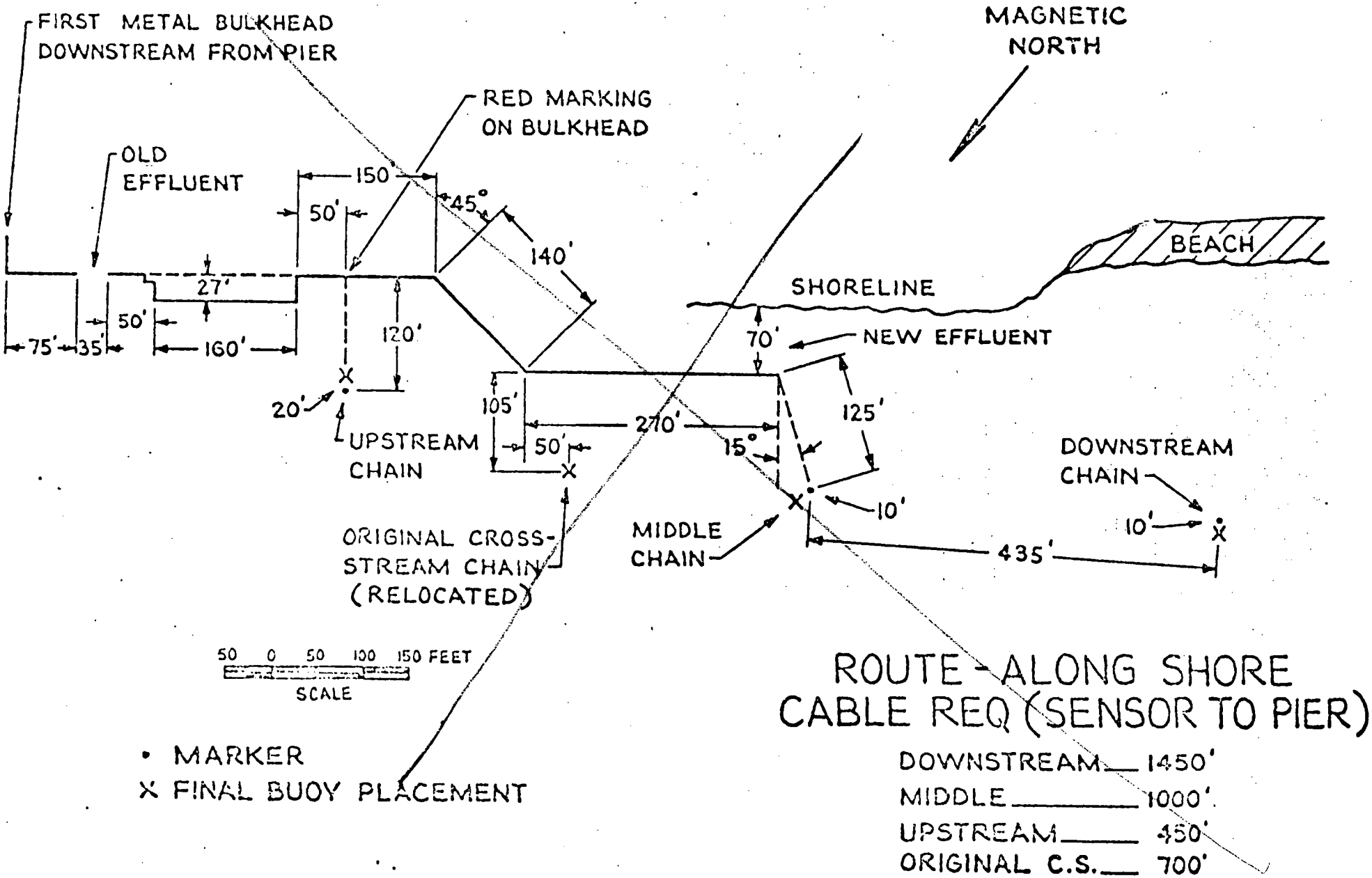
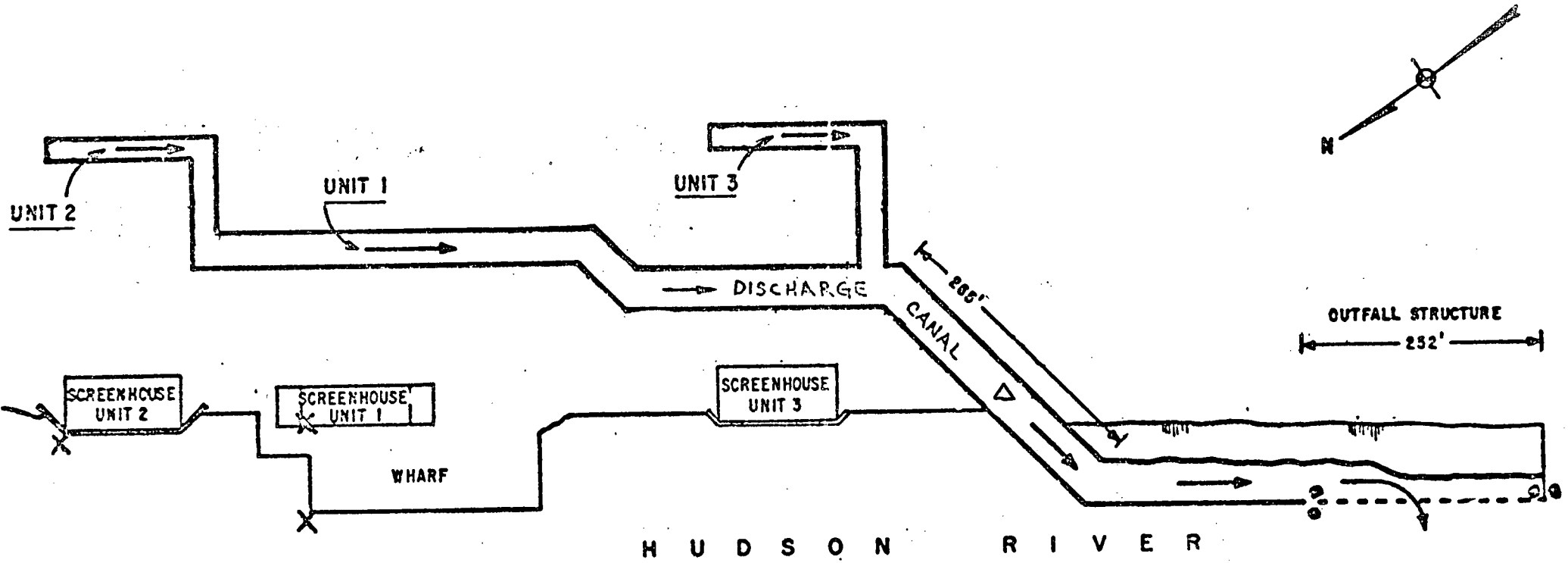


Figure - 29 Temperature sensor buoy system locations.

Figure 2-1

INDIAN POINT FACILITY



INTAKE WATER TEMPERATURE MONITORING - X

DISCHARGE WATER TEMPERATURE MONITORING - △

DISCHARGE CANAL DIFFERENTIAL LEVEL MONITORING - ⁘

2.0 LIMITING CONDITIONS FOR OPERATION

2.2 Hydraulics of Circulating Water System

Applicability

Applies to the mode of operation of the circulating water system.

Objective

To define the limiting conditions of operation of the circulating water system.

2.2.1 Approach and Intake Velocities

Objective

To limit the approach and intake velocity of the condenser cooling water so as to limit the impingement of organisms on the screens and racks of the intake structure.

Specification

The withdrawal of cooling water from the Hudson River shall be maintained so that the maximum value of area average approach velocity taken 24 inches in front of the intake structure shall not exceed one foot per second (1 fps) and the maximum value of intake velocity through the outer fixed screens of Unit No. 2 or Unit No. 1 shall not exceed 2.25 fps. When the daily (24-hour) average site river water temperature is less than 40°F the area average approach and the intake velocity shall be reduced to approximately 60% of the maximum full flow conditions of 870,000 gpm through

3.0 MONITORING REQUIREMENTS

3.2 Hydraulics of Circulating Water System

Applicability

Applies to the recording and measurement of the operating characteristics of the intake and discharge system.

Objective

To monitor and record the limiting condition of operation of the circulating water system.

3.2.1 Approach and Intake Velocities

Objective

To monitor and record the approach and intake velocities through the intake system.

Specification

The approach and the intake velocities shall be calculated for the intake system according to equations 1-1 and 1-2 in Section 1. Any changes in the flow rate of each circulating water pump shall be recorded including the date and time of day. When changes in the flow rate are made, *the* site *river* water temperature~~(s)~~ in front of the intake structure shall also be measured and recorded. Adjustments in the flow rate shall be described and reported in the semiannual operating report including the above mentioned information.

Specification (Cont'd)

the Unit No. 2 intake system and 318,000 gpm through the Unit No. 1 intake system. The adjustment in the two types of velocities will be made within one week after the 24-hour average site river water temperature reaches below 40°F. The flow rate will be restricted to 534,000 gpm through Unit No. 2 without the deicing loop operating and 374,000 gpm with the deicing loop operating during the winter time. All changes in flow rate shall be logged and reported in the semiannual operating report.

Bases

The withdrawal of cooling water from the Hudson River through the outer protective screens may cause damage to aquatic biota by impingement on these screens. Fish collections have been experienced at the Indian Point Unit No. 1 intake screens and at Unit No. 2 during testing of the circulating water pumps. Information indicates that by maintaining the approach velocity at one (1) foot per second (fps) and the intake velocity to 2.25 fps or less, this problem should be significantly reduced.

By design, the velocity approaching the outer screens of the intake structure is less than 1 fps. When the daily average site river temperatures are less than 40°F, Unit No. 2 will be operated with the cooling water flow reduced to approximately 60% of full flow. Flow reduction will be accomplished with recirculation loops installed on the discharge side of the

Bases

At present the approach and intake velocities through the outer fixed screens are being calculated and recorded depending on the flow rate through each intake system. The Licensee shall devise a procedure to measure the velocity or current, or pressure head through the forebay of the intake system so as to verify the actual velocity (linear or volumetric) through the traveling screens. When the outer fixed screens are pulled up one or more times a day for washing off impinged fish or debris, the traveling screens collect what is transported past the trash racks to the screens by the water flow of the circulating water pumps. Occurrences of the screen washings and the number of fish collected are recorded and the fish count, type and size, are reported on a monthly basis to the Director of Regulatory.

Bases (Cont'd)

pump. A week is required to convert the outlet of the condensers so to result in 60% recirculation of the cooling water. These loops permit approximately 40% of the pump flow to be returned back to the intake bay. Thus, the approach velocity of the river water transversing the outer fixed screens will be reduced to approximately 0.5 fps.

The intake velocity through the outer screens will not only be dependent on the pumping flow capacity of the circulating pumps and the area of the opening through which the circulating water flows but also the openings within the screened mesh. The R_f value, the resistance factor, corrects for the actual area of the openings in the screen through which the water passes. The intake velocity is calculated by taking into account the pumping flow, the area of opening and the resistance factor. The finer mesh of the outer screens serves to keep the smaller fish from penetrating to the trash racks and traveling screens but also causes a higher resistance to water flow, thereby causing an increase in the intake velocity. The licensee will observe through its impingement surveillance program described in Section 4.1.2a(4), the effects of velocity on the extent of impingement. The licensee shall provide proposed modifications to the flow through intake system to the Director of Regulation in the event of excessive fish impingements as measured by the impingement surveillance program. Results of all the flow restrictions and

Bases (Cont'd)

By monitoring and reporting the velocities through the intake system, a correlation with any fish impingement can be attempted. A better understanding of the problems of fish impingement will be obtained by calculating and measuring the dynamic characteristics of the intake system.

Bases (Cont'd)

site river water temperature measurements will be reported in the semiannual operating report.

2.2.2 Air Bubbler System

Objective

To define the conditions for the specific mode of operation of the air bubbler systems and to provide the most effective mode for fish protection from impingement or other damage.

Specification

Except when out of service for ~~unscheduled~~ maintenance, the air bubbler system will be operated in front of the outer intake screens in accordance with New York State requirements, ~~as stated in the Order of April 28, 1972 from the New York State Department of Environmental Conservation to the Licensee~~. The specific mode of operation (i.e., continuous, bursts, sporadic, random, specific pressures, etc.) will be determined through testing to provide the most effective fish protection mode.

The procedures and results of all tests will be reported upon in the semiannual operating report. From the tests, the optimum mode of operation shall be established ~~within the first continuous year of operation of Unit No. 2~~.

3.2.2 Air Bubbler System

Objective

To monitor the operating tests of the air bubbler system at each intake.

Specification

Monitoring and recording of the results of tests to determine the optimum operating characteristics of the air bubbler system shall be carried out. All data on the tests shall be recorded and reported in the semiannual operating report.

Bases

The installation of double air bubbler screens for the intake of Units Nos. 1 and 2 were ordered by the New York State Department of Environmental Conservation on April 28, 1972. The air bubbler system will be tested in various modes of operation and in conjunction with other devices designed to keep fish away from the intake area. The final operational scheme of this system will depend on the results of these tests. Any unscheduled maintenance work shall be reported in the semiannual operating report as well as the results of the tests of this system.

2.2.3 Discharge Velocity

Objective

To limit the minimum discharge velocity of the cooling water through the discharge structure so that effective dilution with the receiving water of the Hudson River will be achieved.

Specification

The discharge velocity as defined in Section 1.5.3, shall ~~not be less than 10 fps.~~ *be determined from the head differential across the discharge structure. Under normal steady state conditions, the minimum head differential across the outfall structure shall be maintained at 1.5' ± 0.25'. This will assure a minimum discharge velocity, as defined in section 1.5.3, of approximately 10 fps.* The

Bases

To understand how the air bubbler system will help to reduce impingement of organisms, a series of tests to determine the optimum operating characteristics shall be carried out in accordance with the Order of April 28, 1972 by the New York State Department of Environmental Conservation. The operating experience of the air bubbler system shall be documented and evaluated to determine the effectiveness of such a device for the purpose of fish protection.

3.2.3 Discharge Velocity

Objective

To monitor and measure that a minimum discharge velocity of 10 fps shall be maintained.

Specification

Measuring the water level differential of the water in the discharge canal as against that in the Hudson River will provide information useful in calculating the actual discharge velocity. The Licensee shall provide a method of measurement of the discharge velocity and report the results of such measurement in the semiannual operating reports. All adjustments to the gates of each of the

2.0 LIMITING CONDITIONS FOR OPERATION	3.0 MONITORING REQUIREMENTS
Specification (Cont'd)	Specification (Cont'd)
adjustable ports in the outfall structure shall be adjusted such that the discharge velocity, during initial operation, is maintained at a minimum of 10 fps in accordance with the analysis of thermal discharge models (mathematical and hydraulic) except during testing of the structure and the circulating water system, and exploration of the effect of discharge velocity on the thermal plume temperature distribution. The adjustment in the ports shall be made within 24 hours of any change in the steady-state flow in the discharge canal.	ports of the discharge structure shall also be recorded.
At power levels below one-third the rating of Units 1 and 2, a nominal discharge velocity through the discharge ports will suffice to safisfy the New York State Thermal Criteria. At low thermal loads, the thermal plume is minimal.	
Bases	Bases
The capability of a jet discharge to mix with the ambient receiving water is a strong function of the jet discharge velocity. The analysis of the thermal hydrological models has been performed based on the commitment that a minimum discharge velocity of 10 fps shall be maintained. Compliance of the dispersion of the thermal plume with the New York State Thermal Criteria requires maintaining this velocity.	In order to assure the proper mixing of the heated coolant water with the receiving water of the Hudson River, the proper discharge velocity has to be maintained. By actual measuring and recording the flows and water level differential, the Licensee can be certain that proper dispersion of the thermal plume will occur in accordance with the mathematical and hydraulic models developed for Units Nos. 1 and 2. ~~A level control weir in the discharge canal is designed to automatically maintain a predetermined head~~
The modified multiport discharge structure uses adjustable gates that will provide a discharge	

Bases (Cont'd)

velocity of at least 10 fps under varying flow rates. Such operation will be conducted to give assurance that, at full power levels, the applicable New York State Thermal Criteria will be met. The discharge velocity is obtained through the use of equation 1-3, in Section 1.5.3. For a discharge velocity at the vena contracta of about 10 fps, the difference in height across the discharge structure will be maintained at about 1.5 feet.

The relationship between power level, plant flow rate, discharge velocity, and characteristics of the thermal discharge (i.e., dilution of the discharge jet with the ambient river) shall be investigated to determine the optimum relationship, and the final operating modes of the circulating water system through the intake-discharge structure. The results of all adjustments to the gates on the ports and measurements of the discharge velocity through the ports of the submerged structure shall be recorded and reported upon in the semiannual operating report.

Bases (Cont'd)

~~on the discharge water to provide the required jet velocity and also to reduce the head requirements in the intake pumps.~~

2.0 LIMITING CONDITIONS FOR OPERATION	3.0 MONITORING REQUIREMENTS
2.3 Chemical	3.3 Chemical
Applicability	Applicability
Applies to the limits of release of non-radioactive liquids, gases and solids from the site.	Applies to monitoring the total amount, rate of release and the concentration of non-radioactive chemicals in liquid, gaseous and solid waste discharges.
Objective	Objective
To define the conditions for release of non-radioactive liquids and solids to the river and gases to the atmosphere to assure compliance with applicable State and local regulations and to ensure the releases are controlled and diluted so as not to adversely affect public health or the natural environment and to minimize degradation of the quality of the receiving medium.	To monitor the amount, rate of discharge, frequency of discharge, and concentration of chemicals released from the site.
Specification	Specification
All station chemical discharges shall be diluted by the circulating cooling water effluent during release ~~to assure the natural aquatic ecosystem is protected and the recreational use of the water of the Hudson River may be preserved~~.	To establish a sampling schedule which will assure that liquid and gaseous effluent releases are kept within applicable Federal, State and local regulations and the natural ecosystem and the public health and welfare are protected.
2.3.1 Chlorination of Circulation Water System	3.3.1 Chlorination of the Circulating Water System
Applicability	Applicability
Applies to the release of residual chlorine from Indian Point Units Nos. 1 and 2.	Applies to monitoring of the amount and concentration of the total residual chlorine in the discharge water.

2.0 LIMITING CONDITIONS FOR OPERATION

Objective

To limit the amount and concentration of residual chlorine discharged to the Hudson River from Indian Point Units Nos. 1 and 2.

Specification

Should the circulating water system be chlorinated, the maximum frequency of chlorination for the condensers of each unit shall be limited to three times per week. The duration of chlorination shall not exceed one hour during any 24 hour day and the total time for chlorination treatment for both units shall not exceed six hours per week. Chlorination of the condensers of each unit shall be staggered with the other unit to prevent simultaneous treatment with chlorine. Chlorination shall take place during daylight hours ~~at peak tidal flows~~. Routine chlorination shall be suspended during the winter months (e.g., when the site river water temperatures are less than 45°F). The maximum concentrations of the total residual chlorine in the cooling water discharged at the confluence of the discharge canal and the Hudson River shall not exceed 0.5 ppm. All practicable measures to reduce it to 0.1 ppm or below that level shall be taken. The dates, times and length of chlorination, the amount and concentration measures shall be logged. The need to chlorinate during tests outlined in Section 4.1.2 (1)a for studying the impact on biota shall be reported.

3.0 MONITORING REQUIREMENTS

Objective

To monitor the amount and concentration of total residual chlorine in the discharge water and timing and duration of chlorination treatment.

Specification

During periods of chlorination, ~~duplicate~~ samples of circulating water shall be taken to measure residual chlorine at both the condenser outlet water box and at the confluence at the discharge canal with the Hudson River. The measurements at the condenser water box are sampled 5 minutes before and 5 minutes after the start of chlorination, at approximately 10 minute intervals while chlorination is taking place.

The samples for total residual chlorine shall be analyzed using the amperometric method of analysis. Concentration shall be measured with an accuracy of ± 0.1 ppm of the limit of 0.5 ppm and with a precision of ±0.05 ppm. Samples will be taken at one (1) meter depth and three (3) meter depth at the discharge point of confluence with the Hudson River to assure that representative samples of chlorinated water being discharged into the Hudson River are being collected and analyzed.

Chlorine demand will be taken at the plant intake by collecting ~~duplicate~~ samples within two hours prior to the chlorination of Indian

2.0 LIMITING CONDITIONS FOR OPERATION	3.0 MONITORING REQUIREMENTS
Specification (Cont'd)	Specification (Cont')
The chlorine demand shall be determined at the rate of once per week within two hours prior to the chlorination of Indian Point Unit No. 2.	Point Unit No. 2. During chlorination treatment of the condenser, the discharge shall be visually inspected for evidence of any detrimental effects on aquatic life, such as dead fish or fish in distress. Such evidence shall be noted and a record of such evidence shall be maintained with the records of the amount, time and dates of chlorination. All data shall be reported in the semiannual operating report.
Bases	Bases
Of special concern ecologically is the potential damage to the river organisms from exposure to residual chlorine, including chloramines formed by reaction between chlorine or hypochlorite ions and nitrogeneous compounds, during and after the periodic chlorination of the circulatory water system. Chlorination treatment involves the use of *approximately* a 15% sodium hypochlorite solution (390 lb/day average) at a rate of 5 gpm for dosing at any one time the condenser inlet water boxes. The chlorine dose is fed into one-half of each of the three Unit No. 2 condensers at the same time so as to produce a maximum chlorine concentration at the outlet box of less than 1.0 ppm of total residual chlorine. Dilution with the unchlorinated portion should reduce the maximum total residual chlorine level to less than 0.5 mg/1. The magnitude of the residual chlorine concentration at the point of discharge into the river depends on the rate of decomposition	The samples of residual chlorine (free and combined) are taken during the chlorination treatment so as to obtain representative sampling of the chlorinated discharges. The samples will be analyzed by amperometric method of analysis which will ensure accurate results and will allow for complete documentation of residual chlorine (free and combined) in the circulating water system and receiving waters. The chlorimetric method of analysis will serve as a backup should the amperometric method fail.

Bases (Cont'd)

and on the retention time in the discharge canal. Since the addition of Unit No. 2 will cause a nearly four-fold reduction in the retention time as compared to that of Unit No. 1, the discharge concentration of total residual chlorine can be higher than the licensee's estimates during chlorination of Unit No. 2. Every precaution shall be taken not to exceed 0.5 ppm at the discharge point into the river and all practicable measures taken to reduce the level to 0.1 ppm at the point of discharge into the river. Efforts will be made to minimize the impact of chlorine, by such means ~~(of correlating chlorination periods with peak tidal flows,)~~ *as* timing of chlorination so as not to coincide with rapid shutdowns or release of nitrogeneous materials, and chlorinating during the daytime. The discharge jets (from the discharge ports) containing chlorine rise to the upper layers of the river. Whereas during the day important organisms (such as zooplankton, Gammarus and Neomysis and fish eggs and larvae) are prevalent in the lower layer.

The chlorine demand of the river estimated to be about 1.0 ppm and chlorine breakdown by chemical reaction aids in reducing the concentration released to the Hudson River. The resulting tests carried out by the licensee on existing discharge from Unit No. 1 has shown that the chlorination program and discharge limits have not caused significant damage to the ecosystem of the Hudson River.

2.0 LIMITING CONDITIONS FOR OPERATION

2.3.2 Corrosion Inhibitors

Objective

To limit the concentration and amount of chromate or other corrosion inhibitors discharged to the river.

Specification

The average incremental increase in the concentration of chromium (as CrO_4) in the circulating cooling water resulting from equipment leakage shall not exceed 0.05 ppm. Annual release of potassium chromate shall not exceed 11,000 lbs per year.

Bases

Leakage of corrosion inhibitors from auxiliary systems ~~and the reactor primary coolant systems will~~ *may* result in release of chromate ions in the liquid discharges ~~through the radwaste system. The use of chromium inhibits corrosion of the primary coolant steel internals. Release of small amounts is indicative that sufficient amount has been added to insure component integrity of the stainless steel material~~. Limiting the concentrations in amounts of chromium to small releases will assure that aquatic biota will be protected since many species can reconcentrate this ion once absorbed into the body tissues.

3.0 MONITORING REQUIREMENTS

3.3.2 Corrosion Inhibitors

Objective

To monitor the concentration and amount of chromate or other chemicals used as a corrosion inhibitor.

Specification

~~Duplicate samples~~ *Samples* of the circulating water shall be taken at 1 meter and 3 meter depth in the discharge canal and analyzed for the hexavalent chromium and total chromium using an appropriate colorimetric method. ~~Accuracy of measurements shall be 1-3%.~~

Bases

Sampling and analysis of the incremental amount of chromium present in the discharge canal will serve at least two purposes. One is to validate the extent of corrosion of the stainless steel in the primary coolant system and the other to know the amount and concentration of releases to the river to assure compliance with applicable regulations. Analysis of samples taken from the auxiliary building line will monitor the leakage from the primary coolant system and incremental concentrations will reflect corrosion rates of stainless steel components or equipment malfunction. Monitoring releases in the discharge canal will provide assurance of protecting the aquatic biota. Any accidental releases from equipment malfunction will also be noted and reported in the semiannual operating report.

2.0 LIMITING CONDITIONS FOR OPERATION	3.0 MONITORING REQUIREMENTS
2.3.3 Chemicals Which Affect the Water Quality	3.3.3. Chemicals Which Affect the Water Quality
Applicability	Applicability
Applies to the release of process chemicals used for treating the reactor primary and secondary coolant system and for maintenance and cleaning of equipment.	Applies to routine measurements and recording of chemical or other discharges.
Objective	Objective
A. Liquid Releases To identify and quantify all treatment chemicals used and to limit the concentrations of chemicals released into the discharge canal prior to entry into the river at the confluence to less than the values listed in Table 2-1. To identify and limit the release of miscellaneous substances which in concentrations or combinations are toxic or which produce unreasonable physiological responses in humans, fish and other biotic life and plants or which cause objectionable color, odor, taste or turbidity; or floating debris, oil, scum, and other matter; or materials that will settle to form objectionable deposits.	To monitor all chemical discharges of liquids, gases and solids from the site.

TABLE 2-1

LIQUID EFFLUENT MONITORING SURVEY

Parameter Analyzed for	Max. Conc. (ppm)	Collection and Analyses Frequency	Uses of Chemical
Phosphate (Orthophosphate)	1.5	WK	Used for maintaining the chemistry in the secondary system
Hydrazine	0.1	MO	Used for oxygen scavenger of secondary system
Cyclohexylamine	0.1	MO	Used to adjust pH of feedwater to steam generator
pH - (units)	6.5 - 8.5	~~HR~~ *WK*	
Lithium Hydroxide	0.01	~~D~~ *WK*	Used to adjust pH of primary coolant
Boron	9	D	Used as chemical shim in primary coolant
Chromium (Hexavalent)	0.05	WK	Used as corrosion inhibitor
Residual Chlorine (free and combined)	0.5	D	Used as a biocide to treat condenser and auxiliary cooling water systems
Chlorine Demand	-	WK	
Sodium Hydroxide	10	~~1/2~~ ~~HR~~ *WK*	Used as a chemical regenerant
Specific Conductance (*Salinity*)	-	WK	
Soda Ash	5	~~MO~~ *WK*	Used to wash Unit No. 1 flue gas passages
Sulfuric Acid	10	~~1/2~~ ~~HR~~ *WK*	Used to treat flash evaporators

TABLE 2-1 (continued)

Parameter Analyzed for	Max. Conc. (ppm)	Collection and Analyses Frequency	Uses of Chemical
Turbidity		WK	
Dissolved Oxygen		~~1/2~~ ~~HR~~ *WK*	
Detergent	1.0	MO	Used for cleaning and laundry
~~Salinity~~		~~1/2~~ ~~HR~~	

Notes for Table 2-1:

1. WK (weekly), MO (monthly), D (during discharge) Samples will be taken hourly during accidental or unplanned discharges.

2. ~~Duplicate samples~~ *Samples* for the analyses of all parameters except chlorine demand and residual chlorine will be taken at the plant intake and at the confluence of the discharge canal with the Hudson River.

3. Chlorine demand will be taken at the plant intake. Samples for residual chlorine measurement will be taken at both the condenser outlet water box and at the confluence of the discharge canal with the Hudson River. The latter measurements are performed at approximately ten minute intervals while chlorination is taking place.

4. No heavy metal discharges are planned or anticipated other than those listed on the above table.

5. All samples shall be taken and analyzed in accordance with approved standard methods.

   Approved standard methods are published by: (1) the American Society for Testing and Materials in the "Annual Book of ASTM Standards, Part 23, Water: Atmospheric Analysis," (2) Water Works Association and the Water Pollution Control Federation in the book "Standard Methods for the Examination for Water and Waste Water," and (3) "Methods for Chemical Analyses for Water and Wastes," Publication No. 16020, Environmental Protection Agency, 1971. In cases where: (a) the existing standards are not applicable; (b) conflicts exist between standards; (c) no standards exist; or (d) newer technology outdates existing standards, an evaluation will be made by Con Edison in light of the latest technology as to the applicable standard method to be used.

TABLE 2-1 (Continued)

6. Sodium Hydroxide, *Lithium Hydroxide*, Sulfuric Acid, and Soda Ash shall be determined by monitoring pH. ~~Lithium shall be measured by atomic absorption techniques~~.

TABLE 2-2 ANTICIPATED RELEASES

CHEMICAL AND HOW RELEASED	MAXIMUM SUSTAINED RELEASE, (lb/day) Unit No. 1	Unit No. 2	CONCENTRATION WITH DILUTION FLOW OF 100,000 GPM* (ppm) (Column B)	RATIO;**** COLUMN B / COLUMN A (Table 2-1)
(A) Released Continuously				
Phosphate	15	24	3.2×10^{-2}	2.2×10^{-2}
Hydrazine	Na	5	4.2×10^{-3}	4.2×10^{-2}
Cyclohexylamine	2.5	12	1.2×10^{-2}	1.2×10^{-1}
Sodium Hydroxide	36	Na	3.0×10^{-2}	3.0×10^{-3}
(B) Released on the Assumption of System Leakage				
Potassium Chromate (as Chromium)	Na	30	2.5×10^{-1}	5.0×10^{-1}
(C) Released on a Batch Basis				
Residual Chlorine	----------see text----------			
Detergent	3 (2 hr/day)	Na	3.0×10^{-2}	3.0×10^{-2}
Sodium Hydroxide	120 (1 hr, once a day)***	Na	2.4×10^{o} (2.6×10^{o})**	2.4×10^{-1} (2.6×10^{-1})**
Sulfuric Acid	450	Na	9.0×10^{o}	9.0×10^{-1}

TABLE 2-2 ANTICIPATED RELEASES (Continued)

CHEMICAL AND HOW RELEASED	MAXIMUM SUSTAINED RELEASE, (lb/day) Unit No. 1	Unit No. 2	CONCENTRATION WITH DILUTION FLOW OF 100,000 GPM* (ppm) (Column B)	RATIO;**** COLUMN B / COLUMN A (Table 2-1)
(C) Released on a Batch Basis (continued)				
Soda Ash	1000 (2-4 times/year)	Na	2.5×10^{0}	5.0×10^{-1}
Hydrazine+	24 (once/year)	Na	2.0×10^{-2}	2.0×10^{-1}
(D) Released on a Batch Basis, in Event of Evaporator Breakdown				
Lithium Hydroxide++	2.5	2.5	4.2×10^{-3}	4.2×10^{-1}
Boric Acid++	600	600	1.0×10^{0}	2.0×10^{-2}
Sodium Hydroxide	Na	12 (2 hrs. once every 4-7 days)	1.2×10^{-1}	1.2×10^{-2}

Na Not Applicable (Chemical is not discharged from Unit)

* Concentration calculated under most adverse condition, simultaneous release from Units 1 and 2. Normal dilution flow is 1,188,000 gpm; hence with this flow concentrations would be 1/10 as much.

** Concentration calculated considering sodium hydroxide release from (A) in addition.

*** This release results from regeneration of mixed bed ion exchangers. Sulfuric acid and sodium hydroxide are also released simultaneously during this regeneration for 1 hour and neutralization occurs. Neutralized chemicals are not included in this table.

TABLE 2-2 ANTICIPATED RELEASES (Continued)

**** This is the ratio of the most adverse concentration (Column B) to the maximum release concentration (Column A). It is an indication of the degree of protection afforded the environment without consideration of normal dilution flow and further dilution in the river itself.

+ Chlorination will not take place at the same time hydrazine is released from Unit 1 (once/year).

++ This release (in lbs/day) is based upon the direct release of maximum reactor coolant system concentrations at the maximum rate of the waste disposal system. The occurrence of this release is therefore very unlikely.

2.0 LIMITING CONDITIONS FOR OPERATION	3.0 MONITORING REQUIREMENTS

B. Gaseous Effluents

To limit the release of gaseous pollutants in accordance with air quality regulations.

C. Solid Effluents

~~To limit the amount of solid wastes collected at the trash racks and travelling screens and other solid wastes collected from various operating processes and procedures involving nonradioactive material.~~
To dispose of solid wastes collected in the intake forebay in accordance with applicable regulations.

Specification

A. Liquid Release

The release of the chemical discharges shall not exceed the concentration levels in the discharge canal as listed in Table 2.1 prior to entry into the river (i.e., at the confluence).

They can be discharged in the following manner:

-released continuously
-released batchwise
-released only in the event of evaporator breakdown
-released on assumption of system leakage.

Specification

The survey for liquid effluents shall be conducted in accordance with Table 2-1. Sampling and analysis of all discharges shall be conducted using approved standard methods. ~~Duplicate~~ *Samples* shall be taken at one (1) meter and three (3) meter depths at the intake and discharge canal. During unplanned accidental releases ~~or during maintenance~~, samples shall be taken hourly during the event. Records shall be kept of the concentrations measured, amounts used, and the rate of discharge on a daily and yearly basis. Records shall be kept on the sampling techniques and analytical procedures used. All analytical equipment shall be periodically calibrated. A backup method shall be made available in the event that the analytical instrument used is not functioning.

2.0 LIMITING CONDITIONS FOR OPERATION	3.0 MONITORING REQUIREMENTS
Table 2-2 lists the conditions under which the chemicals may be released, the maximum sustained release, and the concentration under the most adverse condition. All the chemical discharges, whether released continuously or intermittently, shall not exceed the concentration levels shown in Table 2-1 in accordance with applicable regulations. The water quality of the cooling water discharge shall be maintained such that the discharge of the condenser cooling water shall not cause the dissolved oxygen level at any point in the receiving water to fall below 5 ppm. When the site river water concentration of DO is below 5.5 ppm the maximum decrease in concentration of DO, at the confluence of the discharge canal and the river, shall not be more than 0.5 ppm. When the DO is 5.5 ppm or above, the concentration of DO at the confluence of the discharge canal and the river shall not be less than 5.0 ppm. Discharges, whether released batchwise or continuously, containing heavy metals shall be diluted such as to result in an undetectable concentration. ~~Discharges of copper, zinc, chromium, nickel and iron from the Unit No. 1 superheater and air preheater cleaning operations shall be limited to 0.1 lbs/batch discharge for each of these metals~~. Discharges of heavy metals from both units shall be limited to concentration levels found not to be harmful to aquatic life.	Records shall be kept of such events and reasons reported if the original equipment is not functioning properly within two weeks. Samples of the steam generator blowdown shall be analyzed for phosphate (PO_4) and total nitrogen from the hydrazine and ~~cyclehexylanene~~ *cyclohexylamine* on a ~~weekly~~ *monthly* basis. Analysis for boron and ~~lithium~~ *pH* shall be conducted on a daily basis in the event of evaporator breakdown. ~~Lithium shall be analyzed by atomic absorption during this event.~~ Such events shall be recorded and reported in the semi-annual operating reports. ~~Dissolved oxygen, along with salinity, pH and cupric ion are automatically measured continuously by the AES. Calibration and membrane replacement is carried out at least once a week or more frequently whenever a daily check shows unexpected values. Salinity and pH are determined by standard methods. Copper ion is monitored by a specific ion detector having a sensitivity of 0.1 ppm.~~

2.0 LIMITING CONDITIONS FOR OPERATION	3.0 MONITORING REQUIREMENTS
Discharges shall not contain concentrations of oil and grease that would produce a sheen in the receiving waters nor shall oil be discharged in any quantities that are harmful as defined pursuant to 40 CFR 110.	Visual inspection shall be made and if oil is present in discharges, amounts released shall be estimated and any detectable effects on biota shall be reported in the semi-annual operating report.
All industrial wastes, sludge deposits, sanitary sewage or discharges containing toxic contaminants or impurities, deleterious substances, or refuse shall be effectively treated and the amounts and concentration levels released shall be limited in accordance with the water quality classification established by the State for the Hudson River estuary. No taste or odor producing substances in amounts that will interfere with use for primary contact, recreational use or will transmit any undesirable taste or odor to edible aquatic life shall be released. The discharges shall not contain any visible foam or floating solids.	~~Visual inspection and any other general inspection of the environs shall be made to assure that the environs are kept aesthetically desirable and provide for a healthy environment and a high water quality of the Hudson River.~~
B. Gaseous Effluents	B. Gaseous Effluents
The release of gaseous pollutants in combustion products from Unit No. 1 superheaters, the site's plant package boilers and any diesel powered units (such as auxiliary generators shall be limited through the use of low sulfur fuel oil in accordance with appropriate Federal, State and local regulations. Any other gaseous emissions containing waste gases and particulate matter from existing and future waste treatment facilities associated with the	Records shall be kept ~~on the amount, the type, and estimated concentrations released from the superheater stack.~~ *of the amount and composition (batch basis) of fossil fuels utilized at Indian Point.*

2.0 LIMITING CONDITIONS FOR OPERATION	3.0 MONITORING REQUIREMENTS
discharge shall be limited to less than permissible levels in Federal and State air quality standards.	
C. Solid Effluents	C. Solid Effluents
Solid wastes collected from the intake screens and trash racks shall be dispersed in such a manner as to prevent its entry into navigable waters ~~or their tributaries~~, *except that which may return with the impinged fish.*	Reports shall be kept on the sources of solid wastes, sludges, debris, approximate volumes disposed, the methods used for removal and transportation, and the location of the disposed materials.
Bases	Bases
Chemical releases from Units No. 1 and 2 are subject to the same dilution in the circulating water system discharge prior to release into the river as the radioactive effluents. The resulting concentrations during any prior operation of Unit No. 1 have not exceeded the limits established under these specifications. No adverse effects have been observed from these discharges and therefore added assurance is gained that future operations under a similar program will also produce no adverse effects to the Hudson River.	The liquid effluent monitoring program is designed to demonstrate that the plant is being operated in accordance with Environmental Technical Specifications with respect to chemical discharges, water quality, changes in dissolved oxygen and other parameters. Administrative controls will be such that all releases meet applicable regulations. The liquid effluent monitoring program also provides a means of ensuring that the administrative controls are effectively meeting these regulations.
The New York State Department of Environmental Conservations has established water quality standards depending upon water use. Applicable criteria classifies the Hudson River at Indian Point as "Class SB" (6NYSCRR 701.4).	Dissolved oxygen concentrations of the circulating water system will be measured to note any changes from continued operation of Unit No. 2. Any large reduction in dissolved oxygen may be harmful to certain aquatic life during periods when the dissolved oxygen levels are low as a result of occurrences not related to the operation at Indian Point. The concentration level of 5.0 ppm has been established by the New York
All discharges are subject to regulation by the State and local organizations. The licensee has applied for appropriate permits from these	

agencies to regulate discharges. The licensee has proposed to meet certain discharge limits with respect to concentrations of various chemicals at the discharge into the river which the licensee believes satisfy the State water quality criteria. The basis for the limits listed in Table 2-1 was obtained in part from bioassay work performed by consultants for the licensee. These concentration limits were developed from the evaluation of the toxic potential of the enumerated chemicals, utilizing values from the literature along with the toxicity bioassays (References 2-1, 2-2).

Oil and grease spills in the facility are cleared up, drummed, and carted to the local dump (Croton) by a commercial carting service. Should any oil or grease inadvertently enter any drain, their discharge to the river will be prevented through the use of an oil slick boom placed across the discharge canal.

Consolidated Edison Company is currently using fuel oil with a sulfur content or not more than 0.30 percent by weight, thus currently meeting a New York State regulation (Reference 2-3) that does not become effective until September 30, 1973. In addition, the annual average concentrations for the emissions of NO_x and particulates from the sites package boilers and superheaters are currently in compliance with the Federal Air Quality Standards that have to be achieved by 1975 (Reference 2-4 and 2-2).

Incorporated as part of the intake structure of the circulating water system for Unit No. 2 are a sequence of screens; first a fixed screen,

State Department of Environmental Conservation for the protection of aquatic life.

In addition to the liquid effluent monitoring schedule detailed in Table 2-1, the licensee has embarked on an extensive chemical monitoring survey in the environs of Indian Point (see Section 4.1.2a, ECOLOGICAL SURVEY), the objective of which is to determine the significance of the liquid effluents on the biota.

then a trash bar rack, and finally travelling screens. This arrangement is designed to both prevent solid waste material from being drawn from the river into the system and thereby cause damage to equipment such as the travelling screens and the circulating water pumps, and to minimize any impact on the environment. When the fixed screens are raised (about once a day), logs and other large waste material (e.g., plastic bags and large shrubbery) that were on the fixed screens are caught by the trash bar racks. When these racks are cleaned the debris on them is taken off and carried away. These solid wastes are carried away by a commercial service to the Croton dump. The specification to carry away this solid waste rather than throw it back into the river (from whence it came) is consistent with the licensee's commitment to protect the environment.

Experience has shown that fish impingement can be expected to occur on the fixed screens and that those fish, in a weakened condition, are collected on the travelling screens when the fixed screens are raised for cleaning.

The fish are removed from the travelling screen and conveyed via a sluiceway back to the river. As part of the licensee's efforts to minimize the effect of impingement, a fish pump has been installed on the sluiceway and is currently being tested to determine its effectiveness.

2.0 LIMITING CONDITIONS FOR OPERATION	3.0 MONITORING REQUIREMENTS

The fish pump discharges the impinged fish away from the intake screens so that they are not re-impinged.

Fish collected on the travelling screens and counted and/or analyzed for research purposes will be disposed of as trash in accordance with local regulations.

Materials collected at the intake screens, including dead and/or injured fish shall be disposed of in such a manner as to prevent its entry into navigable waters or their tributaries, *except that fish collected on the intake screens, if not counted, may be returned to the river together with nonseparable trash.*

2.3.4 Hydrogen Ion

Objective

To limit the pH range of the circulating water discharge between 6.5 and 8.5.

Specification

The discharges of acids or bases shall be controlled such that hydrogen ion concentration of the discharges diluted in the circulating cooling water shall be maintained between 6.5 and 8.5 pH units. No instantaneous bulk amounts of acids or bases shall be discharged without prior neutralization. ~~No single unit of discharge to change the water in the discharge canal more than 0.1 pH units shall be maintained.~~

3.3.4 Hydrogen Ion

Objective

To measure the hydrogen ion concentration of discharges.

Specification

The pH of the discharge circulating water will be measured ~~continuously at the cooling water forebay at one of the intakes at Unit No. 2 and No. 1 and at the discharge canal at the point of confluence to the river. The pH will be measured by means of a glass electrode method with a detection limit of 0.1 pH unit,~~ *as indicated in Table 2-1.* The pH will be measured from samples taken at least one meter depth and 3 meter depth and the pH change of the circulating water shall be calculated ~~prior to release~~.

2.0 LIMITING CONDITION FOR OPERATION	3.0 MONITORING REQUIREMENTS
Bases	Bases
The limiting condition is established to minimize the effect on the natural aquatic ecosystems. ~~Normal range of pH must not be extended at any location by more than +0.1 pH unit~~. By restricting the amounts of acids and bases released to the environment and controlling the pH levels, the biota will be protected.	Monitoring pH at the cooling water forebay of both units and in the cooling water discharge canal prior to release to the river will provide the change due to station operation. ~~Continuous~~ Sampling is based on assuring that no sudden changes or excesses of acidity or basicity will occur to result in damage to the aquatic life since large amounts of acids and bases are disposed of daily from the station. All pH measurements shall be permanently logged and reported upon in the semiannual operating report.

References

2-1 Testimony of Gerald J. Lauer, PhD., New York University, "Effects of Chemical Discharges from Indian Point Units 1 and 2 on Biota and on River Chemistry," Docket No. 50-247, April 5, 1972.

2-2 "Final Environmental Statement, Indian Point Unit No. 2," United States Atomic Energy Commission, Directorate of Licensing, September 1972.

2-3 New York State Department of Environmental Conservation, Title 6, Chapter III, Air Resources, Subchapter A, Prevention and Control of Air Contamination and Pollution, Part 225, Fuel Composition and Use - New York City Metropolitan Area.

2-4 Consolidated Edison of New York, Inc., Supplement No. 3 to the Environmental Report for Indian Point Unit No. 2, Benefit-Cost Analysis, February 1972.

2.0 LIMITING CONDITIONS FOR OPERATION	3.0 MONITORING REQUIREMENTS
2.4 Radioactive Discharge	3.4 Radioactive Discharge
Effluent release limits are described in Section 3.9 of Appendix A, Technical Specifications.	Monitoring the radioactive discharges from Unit No. 2 and Unit No. 1 is described in Section 4._ of Appendix A, Technical Specifications.

4.1 Nonradiological Surveillance

4.1.1a Thermal Plume Mapping

Applicability

Applies to measurements of the thermal plume dispersed throughout the Hudson River as the thermal discharges are released from the Indian Point Station through the discharge structure into the Hudson River.

Objective

To provide the following:

(i) establish the relationship between the thermal discharge to the river and the thermal response of the river,

(ii) determine if the thermal discharge is in compliance with the New York State Thermal criteria, and

(iii) provide data for comparison with the results predicted by mathematical and physical models so as to improve and modify those models as analytical predictive tools for future thermal discharges under any anticipated conditions.

Specification

The thermal discharges resulting from operations of Units Nos. 1 and 2 shall be limited so as not to exceed the New York State Thermal Criteria (6 NYCRR 704.1 (B) (4)):

"The water termperature at the surface of an estuary shall not be raised to more than 90°F at any point provided further, at least 50 percent of the cross sectional area and/or volume of the estuary including a minimum of one third of the surface as measured from water edge to water edge at any stage of tide, shall not be raised to more than 4°F over the temperature that existed before addition of heat of artificial origin or a maximum of 83°F, whichever is less. However, during July through September if the water temperature at the surface of an estuary before the addition of heat of artificial origin is more than 83°F, an increase in temperature not to exceed 1.5°F, at any point of the estuarine passageway as delineated above, may be permitted."

Specification (Continued)

The thermal measurements shall be made in sufficient locations to cover the full extent of the thermal plume and sufficient frequency to reflect the behavior of the plume during different phases of the tidal cycle as well as under varying river ~~and meterological~~ conditions. In each case, the measurements should allow for construction of isothermal maps with 1.0°F contour intervals.

During the survey the following conditions shall be recorded ~~hourly:~~ *as needed to assess the extent of the thermal plume:*

(1) Plant conditions (condenser flow, intake temperature, discharge temperature, pressure head or discharge velocity).

(2) River conditions (river ambient temperature, fresh water flow, salinities, tidal stages).

~~(3) Ocean conditions at the Battery (ambient water temperature, water levels, salinities).~~

(4) Meteorological conditions (wet and dry bulb temperatures, humidity, wind speed and direction, solar radiation).

Specific details of the types of measurement, the schedule of measurements, the number and location of sampling stations to be used will be presented and reported in the semiannual operating report. ~~Monthly surveys shall be made during the first year of normal power operation of Indian Point Unit Nos. 1 and 2.~~

The following field survey and analysis program for the thermal discharges from the Indian Point facility, commencing with full power operation of Unit No. 2, has been designed to achieve the objectives enumerated above.

The survey can be conveniently divided into the following areas:

A. Preliminary

An introductory analysis will be made, using both the mathematical and physical models (References 4-1, -2, -3, -4, -5, and -6), to determine the location for possible surface and subsurface transects. These predicted thermal plumes will be compared to the plume obtained via infrared over-flights and/or surface measurements and subsurface measurements in order to determine

Specification (Continued)

and optimize the station locations for the transects. Possible interaction between the thermal plumes of Indian Point and other power plants operating on the Hudson River will be considered.

B. Near-Field Measurements

The near field is defined as the region within which effluent momentum is detectable as compared to natural dispersive processes and tidal momentum. For several discharge port configurations, thermal plume velocity (speed and direction) as well as temperatures will be obtained. The results will be time dependent three-dimensional temperature and velocity profiles (over a tidal cycle and over a number of required cycles).

C. Far-Field Measurements

The far-field program will include aerial temperature surveys along with tri-axial measurements through the detectable plume along with velocity measurements. The interaction between the near field and far field will be considered. The results will be time dependent three-dimensional temperature and velocity profiles (over tidal cycle and during a number of required cycles).

D. Measurement of River Parameters

This aspect will determine the salient river and atmosphere parameters, such as salinity, net non-tidal flow, fresh water run-off, heat exchange (or heat transfer) coefficient, dispersion coefficient, and the local meteorology.

E. Analysis

The near field measurements will be compared to the results of the undistorted hydraulic model and the submerged discharge mathematical model. The far field measurements will be compared to the distorted physical model and the far field mathematical model. The results of both the far field and near field will be integrated to present the spatial and temporal temperature distribution in the river.

Bases

Con Edison has initiated a program that entails an extensive thermal monitoring survey in the neighborhood of Indian Point. ~~Consonant with the incremental increased power levels from Unit No. 2, thermal~~ *thermal* plume measurements will be made to: (1) determine the extent and intensity of the thermal plume as a function of time and compare with the applicable thermal criteria; (2) supplement previous studies and provide information to verify the mathematical and physical hydrothermal models; (3) compare the model analyses with the measured response of the river to the heat load from Indian Point, and enable the licensee to improve the model for predicting the intensity and extent of the thermal plume and demonstrate compliance with applicable criteria through the above specification, under anticipated severe conditions.

~~Computer simulation, hydraulic modeling, aerial infrared measurements at all tidal stages (correlated with control measurements in the river), and a 25 station thermal grid are being used to derive the intensity and extent of thermal discharges (Unit Nos. 1 & 2). Thermal infrared imagery will be collected during four overflights to coincide as close as possible to the major phases of the tidal cycle (e.g., high and low slack, maximum ebb and flood). These overflights will be replicated with Unit Nos. 1, 2 and 3 as a battery. The thermal imagery will be used to compile isothermal maps with 1°C contour intervals from Stony Point to Annsville Creek and inclusive. The 25 station thermal grid is placed in the river once a month to permit the construction of axial and cross section isothermal plots of the thermal plume. The grid system will be located in the vicinity of the Indian Point station. The exact location will depend on biological needs and findings.~~

Infrared overflights performed while Indian Point Unit No. 1 was operating in conjunction with Lovett have indicated that the critical tidal phase, with respect to the surface area and surface width limitations of the New York State Thermal criteria, is in the slack period of low tide (Reference 1). Transects will be made within the Indian Point-Lovett region during the period to determine if the Indian Point facility is operating in compliance with applicable criteria. Temperature probes, placed in the region of the outfall structure during the months of July and August, will demonstrate whether the Indian Point facility is operating within the maximum surface temperature limitations delineated by the New York State Thermal Criteria.

By determining the location and extent of the thermal plume, fish and other aquatic life can be protected from thermal blocks during migration of the fish up and down the river. By limiting the thermal discharges from the Indian Point station, the discharges shall not be injurious to fish or shellfish or the culture or propagation of a balanced indigeneous population in the Hudson River.

References

4-1 Quirk, Lawler and Matusky Engineers, "Effect of Submerged Discharge of Indian Point Cooling Water on Hudson River Temperature Distribution," October 1969, Appendix M, Supplement No. 1 to Environmental Report, Indian Point Unit No. 2, September 9, 1971.

4-2 Ibid, "Supplemental Study of Effect of Submerged Discharge of Indian Point Cooling Water on Hudson River Temperature Distribution," May 1972, submitted as Appendix B-2 to the ASL Board for the licensing Hearing Docket No. 50-247.

4-3 Testimony of John P. Lawler, Quirk, Lawler and Matusky Engineers, "The Effect of Indian Point Units 1 and 2 Cooling Water on the Hudson River Temperature Distribution," April 5, 1972, Docket No. 50-247.

4-4 Ibid, "The Thermal Effects of Indian Point Cooling Water on the Hudson River," February 5, 1973, Docket No. 50-247.

4-5 Alden Research Laboratories, "Indian Point Cooling Water Studies: Model No. 2, May 1967, "Appendix O, Supplement No. 1 to Environmental Report, Indian Point Unit No. 2, September 9, 1971.

4-6 M. Siman-Tov, Preliminary Study of the Expected Temperature Distribution in the Hudson River as a Result of Operation of Danskammer, Roseton, Indian Point Units Nos. 1 and 2, Lovett, and Bowline Power Stations, February 8, 1973.

4.1.1b Meteorological Monitoring

Objective

The objective of meteorological monitoring is to *satisfy the requirements of the Contingency Plan for Indian Point and to* adequately measure and document meteorological conditions at the site *to assess the impact of cooling towers.*

Specification

~~The meteorological monitoring system shall conform to the recommendations in Regulatory Guide 1.23, Onsite Meteorological Programs, and shall include instruments to sense dewpoint or humidity. In addition to the sets of instruments located at elevations which represent conditions at 10 meters and 40 meters above plant grade, a set of instruments shall also be located at an elevation such that meteorological conditions at the proposed cooling tower height can be represented.~~

A. *The meteorological monitoring system shall be continued at Indian Point and shall satisfy the requirements of the Contingency Plan for Indian Point (FSAR for Indian Point No. 2, Vol. 6, Response to Question 12.5). Wind speed, wind direction and temperature difference instrumentation shall be maintained up to 100 feet AGL on a tower base at approximately 100 feet MSL. Important parameters shall be available in the control room.*

B. *A meteorological program shall be developed to assess the impact of hyperbolic cooling towers on the Indian Point environs. The program shall be of approximately one year duration.*

Reporting Requirements

If the outage time of any of the meteorological instruments exceeds seven consecutive days, the total outage time and dates of outage, the cause of the outage and the instrument(s) involved shall be reported within 30 days of the initial time of the outage to the Directorate of Licensing, U.S. Atomic Energy Commission, Washington, D.C. 20545.

Bases

The collection of meteorological data at the plant site will provide information which may be used to develop atmospheric diffusion parameters to estimate potential radiation doses to the public resulting from actual routine or accidental releases of radiactive materials to the atmosphere. A

meteorological data collection program as described above is necessary to meet the requirements of subparagraph 50.36a(a)(2) of 10 CFR Part 50 and Appendices D and E to 10 CFR Part 50.

4.1.2a Biotic-Aquatic

4.1.2a (1) General Ecological Survey

Objective

The major objective of the Indian Point Ecological Surveillance and Special Studies program is to evaluate the effects of operation of the once-through cooling system of the Indian Point Units Nos. 1 and 2 on the Hudson River ecosystem, to determine the effects on the biotic stresses in the river and to devise means and methods for minimizing adverse effects. *Figure 5 sets forth the schedule for the General Ecological Survey and the Special Studies which are described below.*

Specification

A. Specific objectives of the Indian Point Ecological Surveillance program include the following:

(1) determine the biological significance of impingement of screenable fishes at the intake of Indian Point Units Nos. 1 and 2.

(2) determine effects of plant operation on non-screenable organisms ~~(eggs, larvae and plankton)~~ *(fish eggs and larvae)* in the coolant water passing through the once-through cooling systems for Units Nos. 1 and 2.

(3) determine the biological significance on the Hudson River ecosystem of thermal and chemical additions from Indian Point Units Nos. 1 and 2.

(4) determine the biological significance on the Hudson River ecosystem of aquatic organisms passing through or being attracted to the thermal plume and/or into the effluent canal or intake.

(5) determine the acute and chronic effects of temperature on life stages and migratory habits of key fish species, on the behavior of these organisms, the upper and lower temperature tolerance of these organisms and relate these data to plant operations.

(6) ~~develop-and-use-mathematical-models-to-predict-the-effects-of-entrainment-and-impingement on-the-population-of-striped-bass.~~

B. Specific aims of the ecological survey are as follows:

(1) Identify and quantitate the nature and the extent of changes in the distribution and abundance of ~~phytoplankton,-zooplankton,~~ benthos and fish in the vicinity of the Indian Point Station from plant operation.

(2) Identify the species which can be used as key indicators and establish the biological sampling and analytical methods for laboratory and field studies to indicate as early as possible and as accurately as possible the magnitude of impact on once-through cooling on the aquatic ecosystem. The sampling locations for ~~phytoplankton,-zooplankton,-benthos-and~~ fish are illustrated in Fig. 1. *The sampling locations for benthos are illustrated in Figure 4.* The frequency of sampling will vary and will be contingent on weather and seasonal conditions.

(3) Provisions will be made for the degree of flexibility necessary for ~~effluent~~ *effective* operation and effective performance of this program. ~~Any-changes-in-the-survey-will-be subject-to-review-and-approval-by-the-Director-of-Licensing.~~ Administrative controls presented in Section 5.0 outline the reporting requirements for this program and the provisions of changes in the program. Changes to the ~~study~~ program and review of such changes by the Regulatory Staff shall be as follows:

(a) Biological studies involving the sampling of the Hudson River for phytoplankton, zooplankton, benthos, fish and organism entrainment and impingement to determine plant impact shall not be terminated without prior review and approval by the Directorate of Licensing. Special field and laboratory studies as set forth in Section 4.1.2 shall also require prior review and approval before termination.

(b) Changes involving Hudson River sampling locations, *frequency* and methodology, laboratory techniques and data analysis shall be permitted without ~~prior~~ review and approval of the Director of Regulation. Similar changes relating to special studies and/or laboratory investigations shall also be permitted. However, all such program modifications shall be documented in the next submittal of the Semi-Annual Operating Report, and described in detail with respect to the reasons requiring the changes and their effect on past and future impact evaluations.

C. Biological Monitoring Program

~~(1)--Phytoplankton~~

~~For the period of May through September, duplicate samples will be collected every two weeks from one (1) meter below the surface at each of the 16 sampling locations (Figure 1). From October through April monthly samples will be taken.--Phytoplankton density will be determined for total phytoplankton, diatoms, green and blue-green algae.--Chlorophyll a (as determined by light-dark ^{14}C-method) and primary productivity will also be determined at each of the 16 sampling stations once a month during the months of May through September for the first year of plant operation.--Where possible, algal identification will be to species and the density of dominant organisms, chlorophyll a, and primary productivity values will be reported.--Differences in distribution and abundances, species composition and sampling stations differences as determined by appropriate statistical procedures will be provided.~~

~~(2)--Zooplankton~~

~~Zooplankton samples will be collected on the same schedule as the phytoplankton.--Duplicate tows will be made at each station both during the day and at night.--Three one-half meter plankton nets will be towed simultaneously, one just below the surface, one at mid-depth and one approximately two feet above the bottom.~~

~~All micro and macrocrustacea will be identified by specie except immature copepods and taxonomically indistinct adult forms.--Density in number per m^3 will be determined for the major zooplankton taxa and dominant species.--Differences in distribution and abundance, species composition, station location and night day will be determined on a statistical basis and reported.~~

~~(3)~~ *(1)* Benthos

Benthic ~~and epibenthic~~ organisms will be sampled at the *stations shown in Figure 4.* ~~16 stations once per month during the first year of plant operation.--Duplicate samples will be taken and the organisms will be enumerated, weighed and identified to the lowest possible taxa.--Density in numbers per m^2 and grams per m^2 for the major taxa will be determined and any differences in distribution and abundance, species composition and station location~~

~~will be reported. A discussion of the field and laboratory procedures used in the benthic monitoring program can be found in Reference 4-2.~~ *A comparison of the population dynamics, community structure and variability of estuarine isopod, Cyathura polita, will be made between a test region at Con Edison's facility and a control region on the opposite side of the river beyond the effects of the plant. Monthly sampling will consist of three replicate 0.1 m^2 Petersen grab samples taken at random from twelve stations equally divided between the test and control regions. One biological dredge sample will be taken monthly in each region. The samples are processed according to procedures outlined in Vol. 2 of Hudson River Ecological Study, 1st Semiannual report, Procedure No. 4 except for the substitution of 500μ screens for the 250μ size described. All speciments of Cyathura polita will be measured (length) and sexed and these data analyzed by station and region.*

~~(4)~~ *(2)* Fish (adult, immature, larvae and eggs)

Adult and immature fish will be collected every two weeks *through 1975* at the 16 sampling stations, starting the first week in May and continuing until late fall, by trawling ~~and gill nets~~ and at 15 stations by seines. Surface and bottom trawling at each of the stations will be performed for at least 10 minutes at each sampling. ~~Gill nets will be set overnight and contain as a minimum mesh size at least a 50 foot panel of 1 1/2 inch stretch mesh.~~ Beach seining at each station will be performed during the day and at night. Number, size and weight of fish will be recorded and differences, based on appropriate statistical tests, in distribution, abundance and species composition as a function of station location will be reported. Duplicate samples of fish eggs and larvae will be collected *through 1973* with a one-half meter plankton net at the 16 stations every week from May through August. Three one-half meter plankton nets will be towed simultaneously, one just below the surface, one at mid-depth and one approximately two feet above the bottom. Duplicate samples will be collected both during the day and at night. ~~From September through April duplicate samples will be taken at the three depths during the day and at night once a month, weather permitting.~~

Where ~~possible,~~ *practicable,* identification will be to species and the number per m^3 and stage of development (i.e., egg, yolk-sac larvae and larvae) will be provided. Statistically determined differences in distribution, abundance, species composition and day-night samples with respect to station location will be reported.

Bases:

The general ecological survey of the aquatic environment in the vicinity of the Indian Point facility will provide the necessary information to compare preoperational study with data taken during operation of Unit No. 2. In addition, the study program beginning with operation of Unit No. 2 contains suitable control sampling locations to afford a second reference for comparison effects. The program as it is now designed should differentiate between normal variability and station induced changes. Biological changes in the aquatic ecosystem that may result from station operation (e.g., changes in organism distribution, abundance and species composition) should be detected by the monitoring program, and an evaluation of these changes with other concurrent studies will allow a determination of the impact of the thermal and chemical discharges.

4.1.2a (2) Special Studies

In conjunction with the General Hudson River Ecological Survey, the licensee is conducting a number of field and laboratory studies which support the survey program and will aid in determining the ecological impact of the Indian Point facility.

Objective

(1) Determine the major elements of the population dynamics of the striped bass (Morone saxatilis) and the white perch (Morone americanus) and an evaluation of the impact of plant operation on these major elements.

(2) Determine the acute and chronic effects of temperature and life stages of key aquatic species, the effect of temperature on the behavior and physiology of these organisms, the upper and lower temperature tolerance of these organisms and the relationship of these data to plant operations.

Specification:

The following studies will be performed as described in References 4-2 and 4-13 and the additional references attached to the bases.

A. Population dynamics of the stiped bass and white perch which would include:

(1) determination of relative and absolute population densities,

(2) natural survival and mortality rates,
(3) age composition of the two populations and their growth rates,
(4) age at sexual maturation,
(5) population sex ratios,
(6) food habits,
(7) reproductive rates,
(8) migratory habits, and
(9) identification of sub-populations.

~~B. Identification of sub-populations and study of the ecological relationships of other major fish species which will include:~~

~~(1) determination of social composition;~~
~~(2) food habits;~~
~~(3) age composition,~~
~~(4) growth rate; and~~
~~(5) reproductive rate.~~

~~C.~~ *B.* Determination of the behavioral and physiological response of selected benthic, nektonic and planktonic organisms to plant discharges which will include:

(1) Determination of the degree of attraction of fish to the discharge canal with tagging experiments in the canal and plume to determine residence ~~and dispersion patterns~~ *periods and local dispersal.*

(2) Evaluation of the acute and chronic effects of temperature on behavior and survival of fish, fish eggs and larvae, benthic invertebrates and major zooplankton species.

(3) Determination of the thermal preferences and avoidances and the impact of thermal shock on selected fish ~~and invertebrates.~~

(4) Determination of ~~energy budgets~~ *active respiration rates* in the laboratory for selected fish and benthos in order to evaluate the effects of thermal discharges on secondary production rates.

(5) Evaluation on key organisms of the effect of temperature on different life stages and the upper and lower *tolerance* temperatures of these organisms.

(6) Determination in the laboratory of the effects resulting from temperature tolerance and shock experiments to the benthic organisms normally occurring in the discharge canal and, using in situ cage studies, compare the long-term survivorship of these organisms in the intake and discharge canal.

Bases:

I. Population Dynamics

Summary

Using data from studies completed between 1965-70 and from the Indian Point Ecological Study now underway and planned for completion in 1976, the following fish population parameters will be monitored for striped bass and white perch:

1. Population Density
2. Survival
3. Age Composition
4. Growth Rate
5. Age at Sexual Maturation
6. Sex Ratio
7. Identification of Sub-Populations

These parameters change in predictable ways as a result of serious exploitation; population density and survival rates decrease; reduced recruitment causes a predictable decline in the relative abundance of certain age groups in subsequent years reflected in age frequency distribution data; growth rate increases; sexual maturity may be attained at young ages; and aberrations in sex ratio may appear. A data base exists from which each of these parameters can be contrasted before and after operation of Indian Point Unit No. 2.

Discussion

POPULATION DENSITY

Five different measures of fish population density are available:

Catch/Effort Trawl data - relative abundance
Catch/Effort Seine data - relative abundance
Mark-Recapture population estimates - absolute abundance
Egg Deposition estimates - absolute abundance
Pelagic larvae estimates - absolute abundance

In addition, work is underway to develop echo-sounding techniques which would allow much broader collection of catch/effort data. It will be possible, if this technique is successful, to follow changes in abundance and seasonal movements to different locations in the estuary more closely than is possible through trawling techniques alone.

CATCH/EFFORT

The number of fish caught in a standardized amount of fishing effort using standardized collecting gears is a index of relative abundance of the fish population. Such indices are one of the longest established and most widely used types of data in the study and management of fish populations. Catch per unit of fishing effort - or catch/effort, the term used here - has been used to monitor changes in abundance from year to year and place to place in such widely differeing situations as the great high seas fisheries of the world and local, hook and line, sport fisheries.

Catch/effort data have been collected for striped bass, white perch and other species in the vicinity of Indian Point by the use of trawls and beach seines. In the Indian Point Ecological Study now underway, stations have been established from Haverstraw Bay to Denning Point. These sampling stations are distributed among three study regions, as shown in Figure 1, the most important being Region I, extending from Haverstraw Bay to the Bear Mountain Bridge, with a concentration of stations near the Indian Point power plant. The sampling effort is distributed as follows:

	Region I	Region II	Region III
Boundaries	Haverstraw Bay to Bear Mt. Bridge	Bear Mt. Bridge to Storm King Mountain	Storm King Mountain to Denning Point
Number of Trawl Stations	10	3	3
Number Seine Stations	8	4	3

This sampling effort continues in intensified form since the fish population monitoring begun in the Raytheon Study in June 1969. Because of the continuity in sampling, site, and methods from the Raytheon Study to the present Indian Point Ecological Study, it will be possible to contrast data from 1969, 1970, and 1972 - years free of Unit No. 2 effects - with data from 1973, 1974, and 1975, when Unit No. 2 is operative. At present it appears that Unit No. 2 may not go on line early enough in 1973 to affect fish populations significantly by entrainment, so the 1973 data may reflect either "pre-operational" or "operational" status of Unit No. 2, depending upon date of activation of Unit No. 2 and the nature of the fish population contrast being made.

In addition to the main body of data, two additional sources of information which provide some comparison of past conditions within the fish populations of the Hudson River exist. First, trawling stations have been established in the current Indian Point Ecological Study which correspond to some of the stations sampled in the Cornwall study in 1965 - 1968. Secondly, ancillary information is available from fishery studies on the lower Hudson by biologists from Texas Instruments, Quirk, Lawler, and Matusky, Vassar College, Duchess Community College, Boyce-Thompson Institute, and New York Department of Environmental Conservation. While relevant to the assessment of fish stocks in the Hudson, the second group of studies does not integrate directly with the design of the Indian Point Ecological Study.

Mark-Recapture Population Estimate

Unlike the catch/effort data which are indices of relative abundance, the mark-recapture methods provide estimates of absolute numbers in the population, and subsequently withdrawing a sample to determine the proportion of the population marked dates back to the latter years of the 19th century in fishery work (Reference 4-4). It has been applied to fish populations in almost every conceivable situation - small streams, large rivers, ponds, lakes, high seas. The same method is used to estimate the North American continental duck population, and has been applied to insect and mammal populations.

The basic method has been elaborated and adapted to a variety of complex situations, including the occurrence of mortality, emigration, and recruitment within the population being estimated (References 4-5, -6, -7, -8, -9, -10, -14, -15, -16). The same principles underly the technique in the many forms used today. For example, assume that 1000 Age-Group 0 striped bass are marked and released alive in the Hudson estuary in the vicinity of Indian Point. In subsequent trawling operations, 2000 striped bass of the same age are collected, of which 32 are recaptures of the previously marked fish. We then reason that:

(1) 1000 marked fish are at large in the population
(2) Our subsequent sample indicates that 32/2000 = 1.6% of the total population are marked fish
(3) Therefore, the total population in the locality under study must consist of 2000/0.016 = 125,000 fish.

The basis assumptions underlying the valid application of this method are given by Ricker (Reference 4-5). These have been examined during the fish collecting, marking and field trial work of 1972 at Indian Point in preparation for full scale mark-recapture estimates of the white perch and striped bass populations in 1973 and succeeding years. The basic assumption which has been problematic is that marked fish be distributed at random in the population. However, by reintroducing marked fish to the population in proportion to the abundance of the population in different habits (as determined from trawling data and possibly from echo-sounding) and by distributing recapture fishing effort proportionally across all segments of the population, this requirement for the valid use of the mark-recapture method can be fulfilled.

The developmental work of 1972 has already proven that large numbers of young white perch and striped bass can be successfully marked and released in healthy condition in the Hudson estuary to provide a basis for estimates of population size. Tentative plans are to proceed with this method full-scale in 1973.

Separate population estimates will be made for different age groups and size groups of fish, and for zones extending various distances from the Indian Point Station.

Through use of differential marking in different zones of the estuary, the origin of fish collected on intake screens at Indian Point can be determined. At present it is not known whether a very local area or an extensive area of the estuary is affected. Until reliable estimates of the absolute abundance of fish during the first twelve months of life are available, no accurate basis for assessing the importance of impingement losses is available. The absolute numbers of fish collected from intake screens of the Indian Point plant have been determined with suitable accuracy. What proportion of the stock from the estuary this loss represents can be directly determined from the population estimate data collected in the ongoing ecological study.

Collection of data from three successive years (1973, 1974, 1975) is important for two reasons:

(a) The first year will represent the influence of Unit No. 1 plus no influence or minimal influence of Unit No. 2 (depending upon the date of its activation); the second and third years will reflect full influence of Units Nos. 1 and 2.

(b) Survival rates can be calculated for those year classes of fish included in two or more successive years' population estimates. Not only abundance of fish, but also their survival rates (an important component of population turnover rate) are important in assessing an increment of mortality, such as expected from operation of the Indian Point power plant. In addition to

their direct use in assessing ecological impacts, these survival rate estimates will be most useful in "tuning" the parameters of the population dynamics model developed by QLM.

Because of greater abundance and vulnerability to collecting gear, the most precise population estimates will be obtained for the younger age groups of fish. It is planned to estimate the number of Age Group 0 and of Age Group I striped bass and white perch present in areas of the Hudson river adjacent to Indian Point. The best estimates will be for Age Group 0 in the fall. It is anticipated that the study will be able to discriminate a 25 percent change in abundance of these fish at the 5 percent probability level.

Estimates of absolute abundance of the fish stocks of the Hudson estuary are considered to be of great importance in assessing the ecological impact of the Indian Point Station. Accordingly, during the initial planning of the Ecological Study an alternative to the mark-recapture method - the catch-removal method of estimating absolute population size - was defined for use in the event that mark-recapture procedures were unworkable. It consists of intensitively fishing representative habitat types in the Hudson estuary with experimental gear and commercial gear under contract and removing all fish caught during a short interval of intensive fishing effort. The decline of catch-per-unit effort is plotted against cumulative catch and the regression line fit to the data is extrapolated to 0 catch-per-unit effort, at which point the corresponding values for cumulative catch is an estimate of total population size in the area fished. The estimates for a selected set of "typical" Hudson estuary sampling plots would then be expanded to an estimate of fish population size for the entire estuary, or major regions thereof.

Developmental work on population estimation techniques indicates that the mark-recapture method will yield usable data, and the use of the catch-removal alternative is not now envisioned.

Combined Use of Catch/Effort Data and Mark-Recapture Population Estimates

During 1973, 1974, and 1975, catch/effort data will be collected in the same time periods and localities in which the mark-recapture population estimates are made. A relationship between these two types of population data can be developed where the two are collected in parallel, and this relationship can be applied to the catch/effort data of earlier years (1969, 1970, 1972) to calculate approximate values for absolute abundance of fish.

Egg Deposition and Pelagic Larvae Estimates

Additional estimates of the size of white perch and striped bass populations, completely independent of the mark-recapture work described above, will be made by estimating total egg deposition and abundance of the pelagic larvae for each species, and reconstructing (with the use of age structure, sex ratio, sexual maturation, and fecundity data) the adult population size required for the spawning observed. While the promise of success of mark-recapture population estimates rising from work to date makes these estimates based upon egg deposition less critical, they nevertheless will constitute a valuable independent check on the mark-recapture work, and increase overall confidence in the assessment, of fish population size. Evaluation of present development of methods indicates that in 1973 a good estimate of the white perch population can be obtained through the egg deposition method. A preliminary estimate will be obtained for striped bass in 1973, and refined estimates of the size of the striped bass population would be expected in 1974 and 1975.

The estimate of striped bass eggs, and both striped bass and white perch larvae will be made using improved collecting gear and appropriate stratification of samples in time and space to provide population estimates applicable to the Indian Point region in particular, and the entire main spawning area of striped bass in the Hudson estuary.

Egg densities of striped bass and white perch will be corrected to daily deposition rates/m^2 (Reference 4-11) and summed over the season for stations spanning river miles 40 to 59. The areal deposition rates (eggs/m^2/day) will be compared for a first approximation of the importance of the various area for spawning of both species. The striped bass densities will be derived from plankton data due to the pelagic nature of their eggs, while benthic grabs will be used to obtain the demersal white perch eggs. The white perch egg data will then be applied to population parameters (sex ratio, age structure, and mean eggs per female) to derive an estimate of the total population in this area by an application of "backwards" population dynamics. Because mature females go into the breeding season with their full complement of eggs and no rejuvenation of ovaries or eggs occurs during the breeding season, the observed decrease in mean female eggs per female from time t_0 to t_1 in the population is a direct estimate of m_x (the mean number of female eggs produced by a female in a unit of time). A unity sex ratio is assumed, and the m_x value is multiplied by two and divided by the number of days between sampling for an estimate of the daily egg production rate (eggs/female/day). Parts of the two ratios cancel to yield females/m^2 ~~(and eggs/female/day).~~ *(eggs/m^2/day and eggs/female/day).*

In addition to their use in estimating total fish population size, estimates of eggs and pelagic larvae are of prime importance in calculation of survival rates.

The temporal sequence of the various population density estimates discussed above and the life history stages to which they pertain are summarized in Table 4-2.

Some important relationships among the different population data being collected for the Hudson Estuary fishes are:

(1) catch/effort data extend over the longest span of years; include the largest number of age groups of striped bass and white perch; and include comparative indices of relative abundance for other fish species. For maximum value catch/effort data must be corrected for size and species selectivity by utilizing data collected during mark-recapture studies.

(2) catch/effort data for all years can be used to calculate approximate values for absolute size of fish populations by the use of conversion factors developed from those years in which catch/effort data were collected concurrently with mark-recapture population estimates.

(3) mark/recapture data provide direct estimates of absolute abundance of fish. These estimates will be available from the three study regions and from 1973, 1974, 1975. The recapture on the water intake screens of the Indian Point Units Nos. 1 and 2 of fish differentially marked in zones of increasing distance from the plant will provide direct estimates of the fraction of the fish population in each zone which is impinged.

(4) estimates of the numbers of eggs spawned in the Hudson by the striped bass and white perch populations will provide a basis for calculation of the size of the parental stocks, and associated age groups of immatures. This reconstruction of population size will be used to verify the mark-recapture estimates.

(5) measurements of important environmental variables concurrently with fish population estimates will be used to account for the naturally occurring fluctuations in fish population size which tend to obscure the true effects of power plant operation.

II. MORTALITY AND SURVIVAL RATES

Collections of white perch and striped bass obtained from the standard trawl and seine stations are separated into four size groups (50, 50-125, 125, 250mm) and 15 individuals of each size (if available) are randomly picked for age determination by scale analysis. Both species show clear annuli and can be aged quickly and reliably so that relative age structure can be determined.

Both data on relative abundance of successive age groups, as obtained from catch/effort study, and data on absolute abundance, as obtained from mark-recapture, egg deposition, and fish larvae estimates can be used as a basis for calculating mortality rate, and its complement, survival rate.

Taking the data from the entrainment studies together with the survival data based on population estimates, the following sequence of calculations will be carried out:

(1) the number of eggs spawned in the estuary;

(2) the size of the larval population;

(3) from the entrainment study, the density of eggs and larvae in the immediate vicinity of the power plant water intake;

(4) from (1), (2), and (3) the fraction of the population of eggs and larvae subjected to the influence of the water intake;

(5) from the entrainment study, the number of fish entrained and the number passing alive through the cooling system - hence, the survival rate for entrained fish; these data will be integrated with those from laboratory studies of the impact of the physical-chemical conditions of entrainment upon young fish;

(6) from (1), (2), and (5) the fraction of the population killed during early life history stages by entrainment;

(7) from (1), (2), and estimates of juveniles (J_{II}, J_{III}), and Age Group I fish obtained from mark-recapture and catch/effort studies, the total mortality rates for each successive stage of the early life history: development of a survivorship curve will allow some useful interpolations, as for the J_I stage;

(8) from (6) and (7) by the use of standard actuarial calculations for survival under exposure to competing risks of death, the survival rate for each early life history stage in the absence of the operation of the power plant (note that Unit No. 1 and Unit No. 2 effects can be treated separately here and both can be differentiated from background natural mortality);

(9) from (7) and (8) the decrease in survival during the early life history due to operation of Indian Point Units Nos. 1 and 2.

The calculations of the fraction of the year class affected by entrainment are not sensitive to the natural fluctuations in year-class strength which complicate interpretation of population density changes. Entrainment affects a certain proportion of the fish population and is primarily a function of the fraction of the estuarine water withdrawn by the power plant cooling system. Appropriate allowance for non-random distribution of the fish and avoidance capability of the juveniles must be made, but again these phenomena are not believed to change because of year-class size.

The magnitude of natural mortality varies from year to year in the early life history stages, but is always quite high. The variations do influence the combined natural and power plant induced mortality, but the relationship can be predicted as in step (8) above for any observed or postulated natural mortality rate.

The spatial distribution of spawning and surviving young fish may vary, especially as a function of volume of freshwater discharge in the Hudson, and correlated physical and biological conditions. Such phenomena are casually related to variations in year-class size.

The spatial distribution of early stages of striped bass and white perch would influence the fraction of each year-class exposed to entrainment. By utilizing the population data discussed above in the models of the Hudson estuary striped bass population developed by Dr. John Lawler of QLM, Reference 4A-3, and Dr. Philip Goodyear of Oak Ridge National Laboratory, Reference 4-(414,15), the effects of any observed or postulated change in spatial distribution of spawning fish and early life states of the progeny on the entrainment phenomenon can be readily predicted.

The simulation model is simply a device for assessing the outcome of joint operation of the many population phenomena described individually through the field studies. This comprehensive response of an integrated biological system to impact is complementary to assessments of the individual population phenomena empirically studied in the field.

Criteria for Assessing Impacts on Fish Populations

Based upon the population data detailed in this section, the following criteria for assessing the impact of Indian Point Units Nos. 1 and 2 upon populations of striped bass and white perch are established. Each criterion is stated in terms of the symptoms of adverse impact.

(1) Decline in density of Juvenile II, Juvenile III, and Age Group I fish coincident with startup of Unit No. 2 and not accounted for by changes in egg production by parental stock or by natural environmental fluctuations.

(2) Large fraction of the population of eggs, larvae, or Juvenile I fish entrained and high mortality rate of entrained organisms.

(3) Substantial reduction in survival rate from egg stage to Juvenile II, etc., accounted for by entrainment.

(4) Substantial percentage of stock from significant area of estuary impinged on intake screens.

(5) Lack of compensatory increase in survival rate among Juvenile II and Juvenile III fish following fulfillment of criterion (4).

(6) Lack of compensatory increase in survival rate among Juvenile III to Age Group I fish following fulfillment of criterion (5).

(7) Increase in growth rate of fish. Note that increased growth rate is both a classical indicator of a substantial decrease in stock density (hence an indicator of adverse impact) and a compensatory response to reduction in density (hence an indicator of some capability of the fish stock to sustain itself in the face of increased mortality).

(8) Attainment of sexual maturity at an earlier average age. The note in (7) above identifying the criterion as an indicator of both adverse impact and compensatory capability of the population applies here as well.

(9) Continuing decline in population size or stabilization at an undesirably low level following a period of decline, as predicted by a simulation model of the fish population which integrated the empirical data from the ecological studies.

III. BIOLOGICAL CHARACTERISTICS OF FISH POPULATIONS

Racial Composition
Food Habits
Age Composition
Growth Rate
Reproductive rate

Identification of sub-populations and study of ecological relationships of major fish species will be completed in 1973. These two studies will provide additional information on the resident or migrating nature of the subpopulations (vital to estimates of population size) and their respective food habits. The report on this phase of work is to be completed by May 1, 1974.

The study of biological characteristics and health of fish populations reached full scale in April 1973 and will continue until January 1, 1976. This is a continuation of efforts begun in 1972, which will provide information as to the age and growth of fishes in the area, sexual maturation, sex rate, fecundity and any possible effects by the once through cooling employed at Indian Point. Data of very high precision are being obtained in this part of the study. Many of the important uses of these data in reconstructing the dynamics of the fish populations have been described in the preceding sections.

Changes in age composition, growth rate, age at first sexual maturation, and fecundity are classical indicators of important changes in the mortality experience of fish stocks. The first two of these tend to have a historical character, often being detectable in the fish population for some time after their first occurrence. Additional comparative data on age composition and growth rates, predating 1969, is available from the New York University studies and from the New York Conservation Survey of 1936. All of these population parameters, when closely monitored, are useful in predicting population decline in advance of critical depletion. The first report of this phase of the work will be completed by May 1, 1975. The data are being collected and analyzed in such a way as to provide continuous monitoring of the fish populations with minimal lag time between field collection and examination against previous population trends.

IV. IMPACT OF THERMAL AND CHEMICAL EFFLUENTS ON ESTUARY

Summary

Measurements of the physical-chemical correlates of biological parameters are being made starting with April 1972 and continuing until January 1, 1976. It is essential that this information be gathered as supporting data relating to the condition, behavior and distribution of fish life. This information will be analyzed and factored into the final report issued from the study.

Thermal studies, attraction of fish to the discharge canal, infra-red mapping of thermal plume, acute and chronic effects of temperature on survival and behavior of fish and benthic invertebrates will be investigated during the period from April 1, 1972 to October 1, 1975. These studies are important to the success of the overall program but are not considered as critical in time as the population estimation part of the program. Studies of thermal preferences and the impact of thermal shocks on fish and invertebrates can be carried out simultaneously in the facilities available, and are planned for completion in 1973. They require a full year of effort due to seasonal changes in reactions to the organisms. The temperature avoidance study, which also required one year to complete, will be carried out in calendar year 1974. ~~Assay of chronic temperature effects through study of biological energetics will require two full years for completion. This work will extend through 1974 and 1975.~~ *Active respiration rates will be determined to define chronic effects of temperature on key fish species.*

The biological significance of thermal and chemical discharges from the plants will be determined by establishing the rate, quantity, and distribution of these discharges, and relating these to the densities and distributions of zooplankton, phytoplankton, fishes, and benthos in the study area on a seasonal basis. The population dynamics, turnover rates, productivity, and species diversity of plankton organisms are being determined and will be used to evaluate the significance of any observed effects on the ecosystem. Energy budgets will also be used to evaluate the effect of predicted thermal discharges on secondary production rates of selected fish and benthos. These rates will be determined through laboratory experiments. Additional laboratory experiments will be performed to determine the acute and chronic effects of temperature on the life stages of key aquatic species, the effect of temperature on the behavior of these organisms, the upper and lower temperature tolerances of these organisms, and the relationship of these data to plant operations.

Computer simulation, hydraulic modeling, aerial infrared measurements at all tidal stages (correlated with control measurements in the river), and a 25 station thermal grid are being used to derive the intensity and extent of thermal discharges (Units Nos. 1 & 2). Thermal infrared imagery will be collected during four overflights to coincide as close as possible to the major phases of the tidal cycle

(e.g., high and low slack, maximum ebb and flood). These overflights will be replicated with Unit No. 1 operating alone, Units Nos. 1 and 2 together, and Units Nos. 1, 2 and 3 as a battery. The thermal imagery will be used to compile isothermal maps with 1°C contour intervals from Stony Point to Annsville Creek and inclusive. The 25 station thermal grid is placed in the river once a month to permit the construction of axial and cross-section isothermal plots of the thermal plume. The grid system will be located in the vicinity of the Indian Point station. The exact location will depend on biological needs and findings.

Plant production records provide data on the frequency of chlorination, concentrations and durations by season as related to organic build-up in various water passages, and efficiency losses in order to establish the minimum amounts of chlorination that are absolutely necessary. Physical and chemical parameters are being measured in the intake bays and effluent canal and also at three transects (Figure 1-1): one from Verplanck southwest to Stony Point, one from Jones Point to Peekskill, and the third, a Y-shaped transect, at Indian Point. Each transect includes a main channel (deep) and a bay area (shallow) which allows for evaluations in different habitats. The northern transect serves as the control and the southern will show the effects of passing through the plant's influence. The middle transect is designed to sample close to the nuclear facility itself. The physical-chemical measurements (along with previous data) will define those physical and chemical properties of the estuary which have important influences on the biota. (Table 4-2)

The end result of this measurement program will be an atlas, which presents a multidimensional picture of the pertinent variables in the Indian Point area of the lower Hudson River. This reference will serve as a data base, in a readily usable format, which will allow investigators to quickly recognize the onset of unusual conditions of water quality. Current velocity (as a function of season and wind conditions) is being measured with depth for six tidal cycles spanning one lunar month. Dissolved ion ratios are being measured to ascertain the location of the migratory "salt wedge" which is a critical factor in several species' distributions. These data, along with temperature and specific conductivity, are used to define "salinity." Dissolved oxygen is measured to assist in the identification of water inputs that degrade water quality and will be included in the atlas via a grid system as will pH. Turbidity is also included because of its relationship to photosynthesis. Inorganic and organic carbon are monitored as indicators of organic pollution and because of their relationship to secondary production of filter feeders and dissolved oxygen levels. Chlorine demand, residual chlorine concentrations, and organo-chlorines are also measured as a direct chemical perturbation.

Fish density and distribution data come from the standard stations, catch per unit effort program (beach seines, bottom and surface trawls) and are supplemented by the sonar echo integration studies.

If the latter technique proves reliable, a very thorough small scale dispersion analysis will be made. The benthos densities are being enumerated via replicated Peterson bottom grabs while macro and microplankton densities are derived from appropriate sized plankton nets.

Laboratory experiments will be performed to establish the influence of ambient and elevated water temperatures on the physiology of key fish species. The temperature at which these species suffer equilibrium loss and death will be defined (i.e., thermal tolerance studies). The effects of short term exposure to "shock" temperatures (above or below ambient) will also be determined. ~~A bioenergetic budget (Reference 4-12)~~ *active respiration* will be determined to define the chronic effects of temperature on key fish species. ~~Measurement of internal energy transfers and utilization at specific temperatures will be used (food consumption, assimilation, active respiration, and growth).~~

Key benthic invertebrates will also be subjected to temperature tolerance and shock experiments and will be used to determine the long term effect of temperatures experienced in the effluent canal and discharge area on life table processes and growth rates. In addition, these species will be used for in situ cage experiments comparing long term survivorship in the intake and effluent canals. Laboratory findings from temperature preference and avoidance experiments of white perch and striped bass will be compared with field results (fish and temperature distributions). Pertinent temperatures for these experiments have been chosen from actual or predicted temperatures for the Indian Point area of the Hudson River (ambient and changed by plant operations).

The significance of attraction into the effluent canal and plume area is primarily directed at fish species. Fish traps, beach seines and electro-shocking are used to provide data on species composition, abundance, size, age, fecundity, and general condition in these areas. These are supplemented by the sonar studies. Temperature profiles are determined to verify the extent and location of the thermal plume itself. Similar data from Objective 1 (catch per unit effort) are used for comparative purposes. The results of the laboratory experiments on temperature preference and avoidance will be compared to aggregations of fish found in the effluent canal and plume area. A fish tagging program in the discharge canal and plume area will be used to determine residency periods and local dispersal. Tagging procedures will follow those found most efficient in the population dynamics studies.

Survival experiments will test the immediate effects of chlorine dosages routinely added by plant operations of fish residing in the vicinity of the effluent canal.

V. ENTRAINMENT

Objective

The purpose of the entrainment study is (1) to provide information on the types and quantities of ~~plankton;~~ *fish* eggs and larvae passed through the condenser cooling water system to determine the effect of passage on their survival, and (2) to determine if losses observed from condenser passage will create adverse effects on the existing populations in the receiving water.

Specification

The nature and magnitude of entrainment mortality shall be determined *through 1974* in order to evaluate the effects of thermal, mechanical, chemical effects on ~~phyto-,-zoo-,-ichthyo--plankton;~~ *fish eggs* and larvae present in the once-through condenser system. ~~Depending-on-the-type-of-sample,-water-samples-of-plankton,-fish~~ *fish* eggs and larvae will be collected by ~~either~~ plankton nets ~~or-pumps-at-the-condenser-cooling-water-intake-at-Unit-No.-1;~~ at one of the intakes of Unit No. 2~~;-at-the-corresponding-outlet-of-the-condenser-for-Unit-No.-1;-the-outlet-of-one-of-the-three-condensers-for-Unit-No.-2;~~ *and* at several locations in the discharge canal.~~-and-at-different-stations-in-the-Hudson-River.~~ The types and quantities of ~~larvae,~~ *fish* eggs and *larvae* ~~plankton~~ and survival of these organisms from passage through the cooling system shall be determined. ~~Suitable-control-stations-above-the-intake-and-below-the-influence-of-the-discharge-will-be-sampled-during-each-study-and-the-types-and-quantities-of-organisms-in-the-river-shall-be-determined.--The-licensee-shall-propose-a-program-of-sampling-frequency-and-methods-for-specific-species-to-obtain-statistically-valid-conclusions-on-mortality-rates-and-effects-on-the-population-of-the-fishery.-The-frequency-will-depend-on-the-concentration-of-organisms-at-any-particular-time-but-in-the-case-of-fish~~ *fish* eggs and larvae should be *sampled* weekly during spawning periods. ~~and-less-frequent-during-non-spawning-periods-of-the-year.--Species-composition,-including-producers-and-consumers,-shall-be-determined,-and-compared-with-these-in-samples-representative-of-the-river-water-upstream-of-the-Unit-Nos.-1-and-2-intakes.--Specific-species-to-investigate-include:~~

~~(a) Phytoplankton~~

~~At-least-once-every-two-weeks-the-viability-of-phytoplankton-subjected-to-condenser-entrainment-will-be-determined-for-duplicate-samples-(one-meter-depth)-collected-at-the-intakes-of-Units-Nos.-1-and-2,-duplicate-samples-taken-from-the-outlet-of-the-water-box-of-one-of-the-corresponding-condensers~~

~~from Unit No. 2 and that from Unit No. 1, duplicate one (1) meter samples from stations D-1 and D-2 (Figure 4-2); and duplicate one (1) meter samples taken concurrently at stations A-F as shown in Figure 4-3. The concentration of chlorophyll a and photosynthetic rate will be determined 7, 24, 48 and 72 hours after collection. Species composition and density will also be determined.~~

~~(b)~~ *(a)* ~~Zooplankton,~~ Fish Eggs and Larvae

Once per week for the ~~period of May through September, and per month for the other months of the year, zooplankton,~~ *spawning season (approximately May 1 - July 30),* fish eggs and larvae samples will be collected *every two hours at* ~~at one (1) meter depth of the Units Nos. 1 and 2~~ *one* intakes, *station* ~~duplicate samples taken from the outlet of the water box of one of the condensers~~ for Unit No. 2 ~~and for the one condenser for Unit No. 1, and duplicate one (1) meter samples at stations D-1 and D-2 in the~~ *and the* discharge canal *stations* as indicated in Figure 4-2. *Sampling will last during a 24 hour cycle.* ~~Approximately 12 hours later (at night) the same stations will be sampled again in duplicate. Duplicate zooplankton, fish eggs and larvae will be collected at stations A-F (Figure 4-3) concurrently with the station and sampling. Sampling in the river will be put below the surface, at mid-depth, and within 1 meter of the bottom.~~

Analysis will consit of counting live and dead ~~zooplankton,~~ fish eggs and larvae ~~as soon as possible~~ after collection. ~~and again 4 and 24 hours later. A spectrum of different zooplankton will be measured to assess the effects of the magnitude of mortality from mechanical, thermal, chemical or other shock during and after passage through the condenser. Species composition, density, and viability of the dominant organisms in all collections will be determined.~~

Bases

The biological significance of ~~aquatic organisms~~ *striped bass eggs and larvae* being drawn or attracted into the intake canal is being quantitatively determined ~~by measuring the longitudinal and vertical distribution of planktonic organisms~~ on a diel basis, applying these densities to the actual water mass subject to entrainment on a diel basis, comparing these theoretical entrainment values to observed densities of entrained organisms, and finally establishing the immediate ~~and delayed~~ effects of entrainment (passage) of ~~non sereenable organisms~~ *fish eggs and larvae* through the condenser system of the plant.

Quantitative sampling is being done in the ~~river,~~ intake bays and discharge canal. ~~during all seasons of~~ the year. Survivorship and behavior of ~~zooplankton and fish~~ larvae *of striped bass* are immediately compared to see if any statistically significant differences are observed between the control group (intake

bays) and the treated group (discharge canal) which passes through the condenser tubes. In addition, a series of experimental laboratory studies are keyed to combination of ΔT~~,-chemical-discharges,~~ and residence times through the system produced by various plant operational schemes. Effects measured are ~~lethal,-behavioral,-and-reproductive-for-zooplankton;~~ lethal and behavioral for fish larvae~~;. and-photosynthetic-capability,-chlorophyll-concentration,-and-cell-damage-for-phytoplankton.--Studies-include sequential-trials,-trials-of-different-size-groups-of-key-species,-and-multi-species-trials.--When possible,-all-life-history-stages-of-each-organism-are-studied.~~

~~The-reproductive-status-and-food-requirements-of-the-more-abundant-consumer-species-should-be-determined. The-species-of-crustaceans-included-need-to-be-those-which-appear-to-be-most-susceptible-to-entrainment or-thermal-damage.--The-fish-species-involved-include-those-species-which-have-eggs-or-larval-stages susceptible-to-withdrawal.--Among-these-the-bay-anchovy,-white-perch,-tomcod,-blue-back-herring,-alewife, smelt,-American-shad,-and-striped-bass-are-included.~~

The ecological significance of the effects of entrainment by the plant on the ~~fish~~ *striped bass* population will be determined by comparing the concentrations of larvae ~~and-plankton~~ passing through the condenser (noting those surviving and those dead) with that in the river. An evaluation program of effects of entrainment as well as impingement will be used to determine the changes in *striped bass* population size, ~~species-size-and-composition,~~ growth rate, mortality rates, size distribution and other ecological parameters. ~~and-to-determine-the-extent-compensatory-reserves-are-in-operation.~~ Data collected will be used to improve the accuracy of entrainment models to determine the magnitude of damage to the ~~total-fish~~ *striped bass* population over the ~~short-term-and-long-term~~ operation of the Indian Point Units ~~Nos.-1-and~~ ~~2~~.

The determination of ~~types~~ quantities and survival of ~~plankton,~~ *striped bass* eggs and larvae by means of the current program will provide an estimate of the diel ~~and-seasonal~~ effects of circulating water entrainment. Sampling of the intake and discharge canal will provide an indication of the amount of mortality experienced due to condenser passage alone. ~~Sampling-of-the-plume-will-enable-an-evaluation-of-the effects-of-condenser-passage-plus-residence-time-in-the-plume-assuming-minimal-reincorporation-effects-in the-plume-an-organism-survival.--Measurements-of-types-and-quantities-of-planktonic-organisms-alone (Stations-A-and-B),-below-(Station-F-and-G)-and-in-the-thermal-plume-(Stations-C-and-E)-area-can-be-used to-predict-the-effects-of-entrainment-on-plankton-and-larval-populations-in-the-receiving-waters.~~

VI. IMPINGEMENT OF ORGANISMS

Applicability

Applies to the reporting of the measurement made at the intake structure as to the number, size, weight and species of fish killed by impingement at the site's intake screens and evaluation of data on collection of fish by impingement.

Objective

To provide a determination of:

(i) the number, size, weight and species of fish killed by impingement on the intake screens

~~(ii) a limit of the number of fish killed on the fixed and/or traveling screens~~

~~(iii)~~ *(ii)* a study of the causes of impingement

~~(iv)~~ *(iii)* an evaluation of the effectiveness to reduce impingement by fish protection devices such as the air bubbler or other techniques

~~(v)~~ *(iv)* an evaluation of the ecological significance of the effects of fish impingement on population density, size, abundance and diversity of the fishery of the river

(v) establish a schedule for immediate reporting of data on fish collected at the site's intake screens

Specification

The magnitude of mortality due to impingement on the fixed and traveling screens in the intake structure shall be determined by ~~daily~~ estimating the number collected on the outer fixed screens and counting the number on the traveling screens~~; the number collected in the sluice way;~~ estimating the size, length and weight of the fish, and identifying them. ~~All fish pump collections shall also be included.~~ A running tally shall be kept for each species, ~~including a running daily average kill (RDAK)~~ *including a seasonal average kill (SAK)* and the time of day the number collected was made will be recorded.

For large numbers ~~(>7500)~~ of fish subsampling of the impinged fish population shall be performed to estimate number, size and weight. ~~Such~~ *The* subsampling will ~~consist of measuring and weighing at least 10%~~

~~of the total impinged population of each species.~~ *be done in a statistically valid manner.* ~~Species selected for subsampling will be representative of the range of sizes collected in the trash basket.~~ If the daily kill exceeds the ~~RDAK~~ *SAK* by a factor of three ~~or more,~~ *during the winter or a factor of ten during other times of the year,* it shall be regarded as a ~~significant~~ reportable kill (SRK) and immediate corrective action shall be taken to reduce the number killed.

The monitoring program shall consist of washing down the fixed screens at least once per day ~~and running all~~ *followed by the running of the* traveling screens approximately ~~30~~ *15* minutes ~~during each 8 hour shift.~~ *once each day.* The number and species of fish washed off the fixed screens which do not enter the forebay shall be estimated. ~~each day and recorded separately.~~ Running the traveling screens at the time the fixed screens are raised and backwashed shall be carried out. Operational experience of the air bubbler to prevent fish from being attracted to the intake screens shall be documented. The effectiveness to reduce impingement by other fish protection devices shall be evaluated.

~~The causes of fish impingement shall be evaluated, including the magnitude of the approach or intake velocity.~~ The ecological significance of the effects of fish impingement on population density, size, abundance, and diversity of the fishery of the river shall be determined along with the effects of entrainment, thermal and chemical discharges as a function of plant operating variables. The evaluation program shall include the parameters investigated in Section 4.1.2a(1). These include studies of population dynamics, behavior characteristics, fish movements and other ecological parameters. Environmental factors such as temperature, river flow, salinity and plant operational variables which influence the extent of fish impingement shall be evaluated.

Reporting Requirement

Records of routine fish kills and ~~significant~~ reportable kills shall be kept and summarized in monthly reports which shall be forwarded to the Director of Regulatory Operations, Region 1, containing the ~~daily~~ data on the number, size, weight and species of fish collected at the intake screens (except for collections made during testing of the structure). The number of counts during any month shall be statistically analyzed. Any corrective action taken to reduce a significant reportable fish kill shall also be reported. The monthly report shall be submitted to the AEC by the 10th day of the following month. A ~~significant~~ reportable kill (SRK) shall be reported to the AEC within 24 hours of the event as per specification 5. The format of the report shall be such that nonroutine events can be noted immediately and can be recalled on demand. ~~If the daily kill for three consecutive days exceeds the RDAK, the licensee shall report to the AEC as per specification 5.6.~~

Basis

Collection of impinged fish at the Indian ~~River~~ *Point* Station will assure that the majority of fish killed in the intake structure will be identified and enumerated. The identification, counting and length-weight data obtained for all impinged fish of importance, ~~numbering less than the three times~~ the ~~RDAK~~ will assure documentation for expected fish losses resulting from normal plant operation. The number for the ~~RDAK and significant~~ reportable kill will be established after the first year's operation of Indian Point Station. This number will be subject to change as new information is being gathered from operating experience, as an evaluation of the licensee's continuing efforts to reduce impingement losses is made, and an evaluation of the ecological significance of the losses is made. During any fish kill of large numbers ~~(>1000 per day),~~ estimation by subsampling ~~of similar parameters for the impinged species, numbering greater than 1000~~ will provide sufficient accuracy to determine if deviations from the expected fish mortalities are occurring.

The ~~RDAK~~ *SAK* report levels for striped bass, white perch and other fish of importance which can be impinged will also be compared with value~~d~~s obtained in studies of previous fish kills. ~~Loss~~ *Impingement estimates* of these species made since the mid 1960's at Indian Point ~~by impingement~~ at rates below the report levels will be evaluated to determine if they will be compatible with normal plant operation. The report levels will be used to evaluate the effects on population levels, species abundance and diversity of fish to be impinged at Indian Point Station. The information gathered at this site will be useful to predict effects at other sites along the Hudson River. Impingement of fish at rates specified in the RDAK levels for periods up to several days should not be considered to imply adverse effects on the fishing; rather it should be considered as indicative of a sufficient change from past experience to warrant reevaluation of protection limits designed to minimize the extent of fish impingement. Results of evaluation of reducing flow of water withdrawn by the Station during the winter time and the operation of the air bubbler curtains shall also be factored into reducing impingement effects. Studies of the fishery indicated that continued losses of fish at rates approaching the report levels ~~is not~~ *are* compatible with maintaining the existing species composition of the fishery ~~or~~ *and* population numbers. Specific studies described in Section 4.1.2a on the ecology of the existing fishery are continuing in order to evaluate (1) methods of further reducing the loss of fish at the plant due to impingement in the intake structure and (2) ~~the validity of fishery dynamics models used and their assumptions in determining the report level.~~ *to determine significant reportable levels of impingement.* Thus the collection of data will permit a more definite assessment of (a) the environmental significance of collections of fish at the intake screens and (b) what a significant collection consists of.

Basis (cont'd)

Pending development of information from the ecological survey presented in Section 4.1.2a (1), this specification of a reporting level provides a mechanism for the AEC's Regulatory staff to be kept currently advised of the number of fish being collected at the intake screens to determine what further methods can be developed to reduce these numbers.

The ~~RDAK~~ *SAK* provided in this specification will aid in the development of interim operational procedures and corrective actions to be taken to minimize the Station's impact on the fisheries resources.

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4-2 "Hudson River Ecological Study," First Semiannual Report, Prepared for Con Edison by Texas Instruments, July 1972.

4-3 Testimony of John P. Lawler, Ph.D., Quirk, Lawler and Matusky Engineers, "The Effect of Entrainment and Impingement at Indian Point on the Population of the Hudson River Striped Bass," October 30, 1972, Docket No. 50-247.

4-4 Peterson, C. G. J., "The Yearly Immigration of Young Plaice into the Limfjord from the German Sea," Rept. Danish Biol. Stat., 6, p. 1-77 (1895).

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4-7 Delury, D. B., "On the Planning of Experiments for the Estimation of Fish Populations," J. Fish. Res. Bd. Can., 8 (4), p. 281-307 (1951).

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4-9 Chapman, D. G., "Inverse, Multiple and Segmential Sample Censuses," Biometrics, 8 (4), p. 286-306 (1952).

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4-11 Edmondson, W. T., "Reproductive Rates of Rotifers in Natural Populations," Nem. Ist. tal. Idrobio., 12, 21-77 (1960).

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4-12 Warren, C. E., and Davis, G. E., "Laboratories Studies on the Feeding, Bioenergetics, and Growth of Fish," The Biological Basis of Freshwater Fish Production, p. 175, Shelby D. Gerkin (ed.), Blockwell, Oxford (1967).

4-13 Testimony of Gerald J. Lauer, Ph.D., New York University, "Effects of Indian Point Units 1 and 2 Operation on Hudson River Biota", October 30, 1972, Docket No. 50-247.

4-14 Appendix V-3, "Entrainment of Larval Striped Bass," Final Environmental Statement, September 1972.

4-15 Dr. C. P. Goodyear, "Mathematical Model Used by the Staff to Estimate the Effect of Indian Point Units 1 and 2 Entrainment on Hudson River Striped Bass," February 22, 1973.

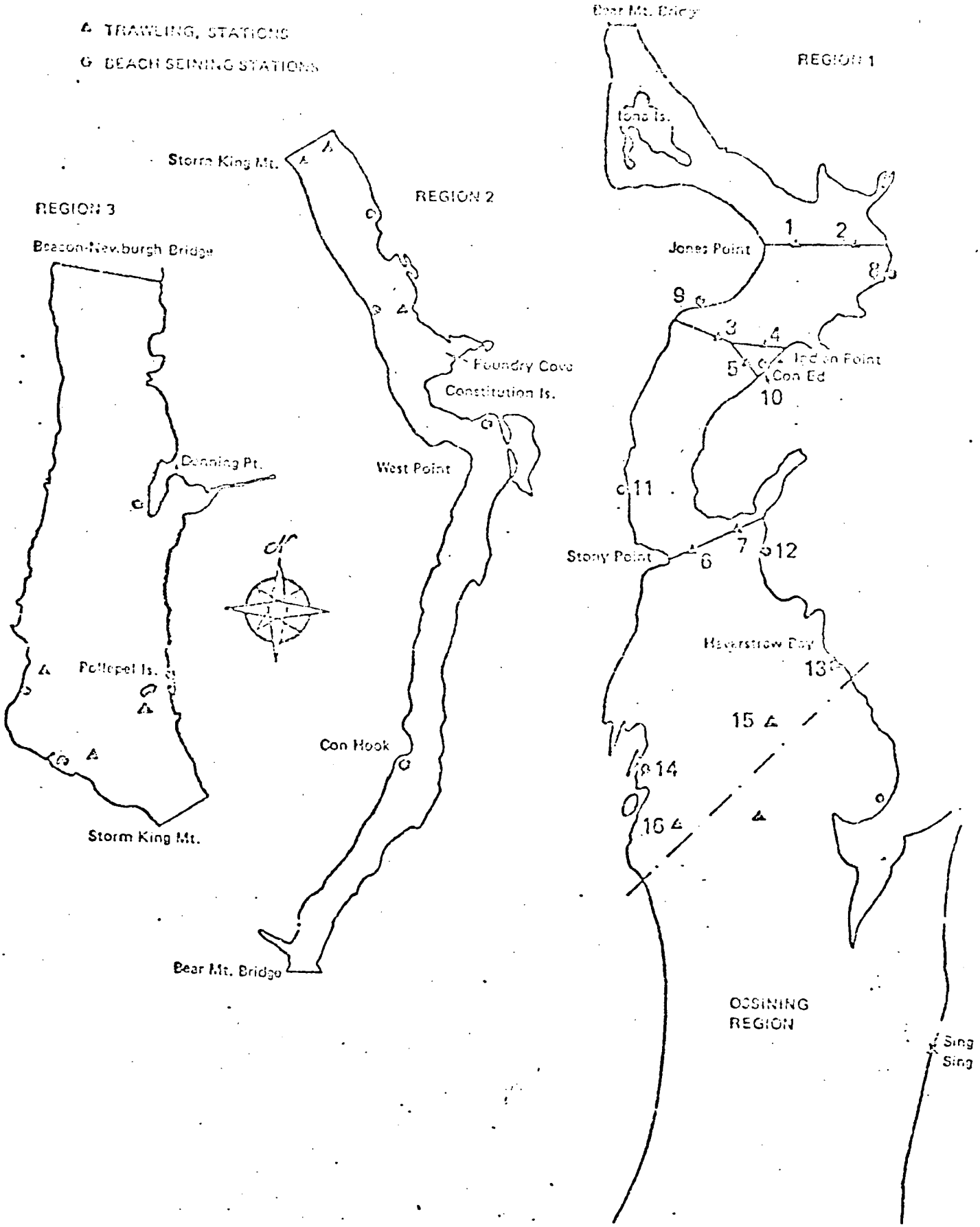

Figure 1. Indian Point Ecological Study Regions

Table 4-7 Population Data for Assessment of Impact of Indian Point Unit #2 Upon Population Density of Striped Bass and White Perch in Hudson Estuary

Year	Power Plant Impact: Unit #1	Unit #2	Data on Fish Populations: Age Group 0 — Eggs	Larvae	Juvenile I	Juvenile II	Juvenile III	Age Group I	Age Group II	Age Group III	Age Group IV
1969	Entrainment Impingement	None	–	–	–	△1 ①1	△1 ①1	△1 ①1	△1	①1	
1970	Entrainment Impingement	None	–	–	–	△1 ①1	△1 ①1	△1 ①1	△1	①1	
1971	Entrainment Impingement	None	–	–	–	–	–	–	–		
1972	Entrainment Impingement	None	–	–	–	△1 ①1	△1 ①1	△1 ①1	△1	①1	
1973	Entrainment Impingement	Impingement	◇1	◇1	–	△1 ①1 □1	△1 ①1	△1 ①1 □1	△1	①1	
1974	Entrainment Impingement	Entrainment Impingement	◇2	◇2	–	△2 ②2 □2	△2 ②2	△2 ②2 □2	△2	②2	
1975	Entrainment Impingement	Entrainment Impingement	◇2	◇2	–	△2 ②2 □2	△2 ②2	△2 ②2 □2	△2	②2	

Legend for Table 4-1

△1 Raytheon — Trawl Catch/Effort — Unit 1 effect only

△1 Texas Instruments — Trawl Catch/Effort — Unit 1 effect only*

△2 Texas Instruments — Trawl Catch/Effort — Unit 1 + Unit 2 effect

(1) Raytheon — Seine Catch/Effort — Unit 1 effect only

(1) Texas Instruments — Seine Catch/Effort — Unit 1 effect only*

(2) Texas Instruments — Seine Catch/Effort — Unit 1 + Unit 2 effect

[1] Texas Instruments — Mark Recapture population estimate — Unit 1 effect only

[2] Texas Instruments — Mark Recapture population estimate — Unit 1 + Unit 2 effects

◇1 Texas Instruments — Population estimate eggs and larvae — Unit 1 effect only

◇2 Texas Instruments — Population estimate eggs and larvae — Unit 1 + 2 effects

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* Impingement effects of Unit #2 if operational during last half of 1973.

Schematic of Indian Point Cooling Water System

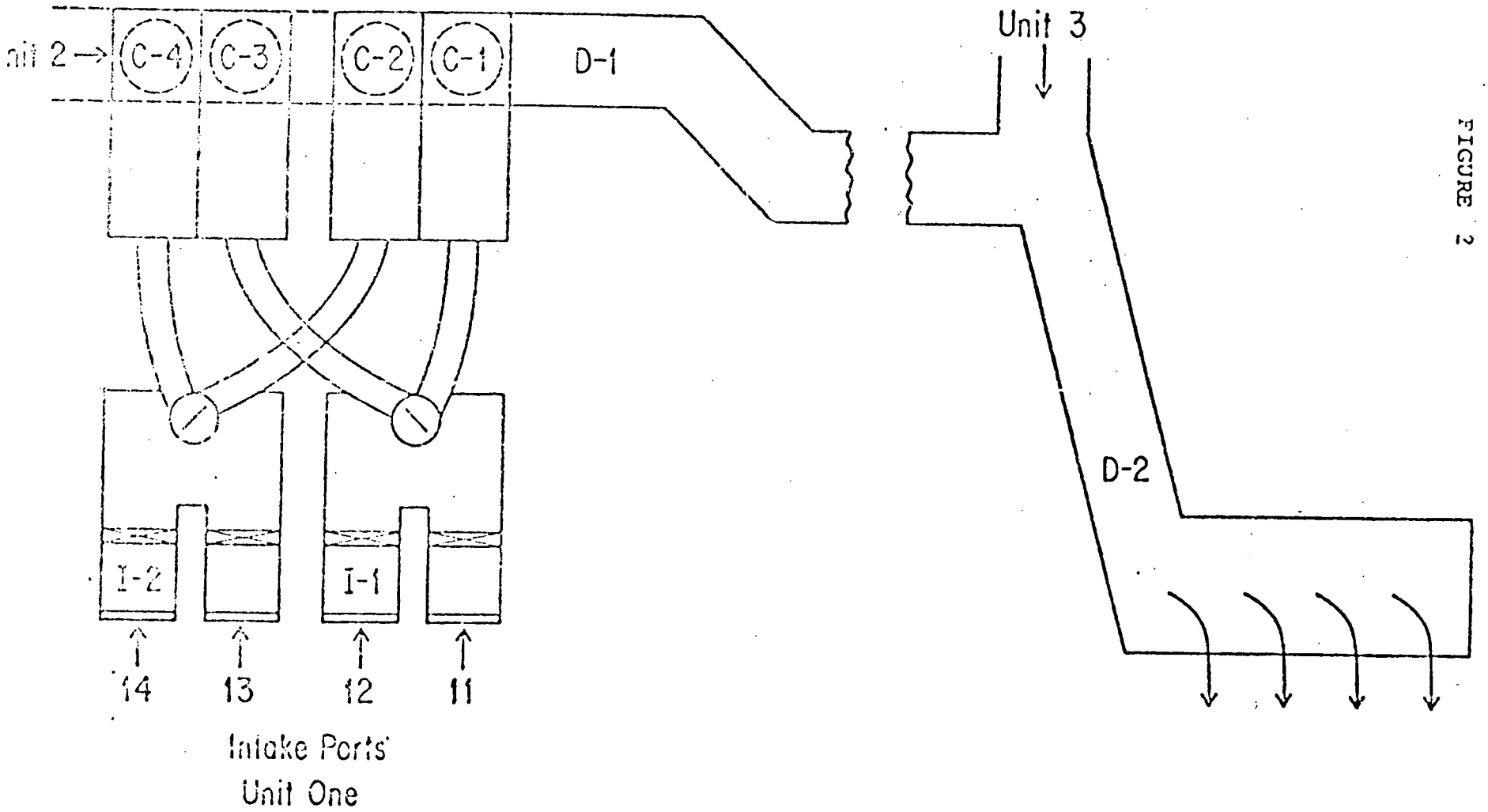

FIGURE 2

Figure 4-3 is deleted

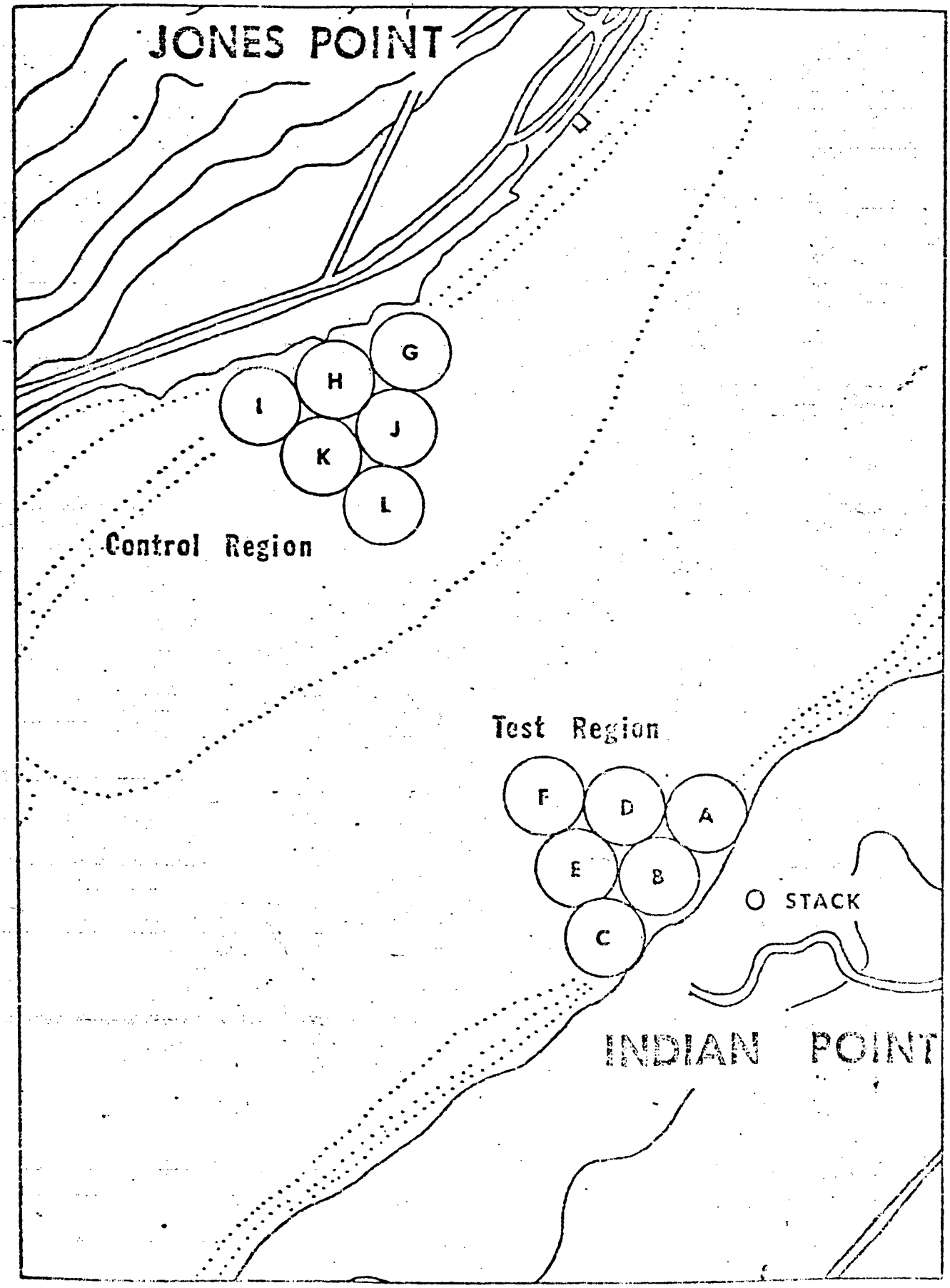

Figure 4. Test and Control Areas for Benthic Studies

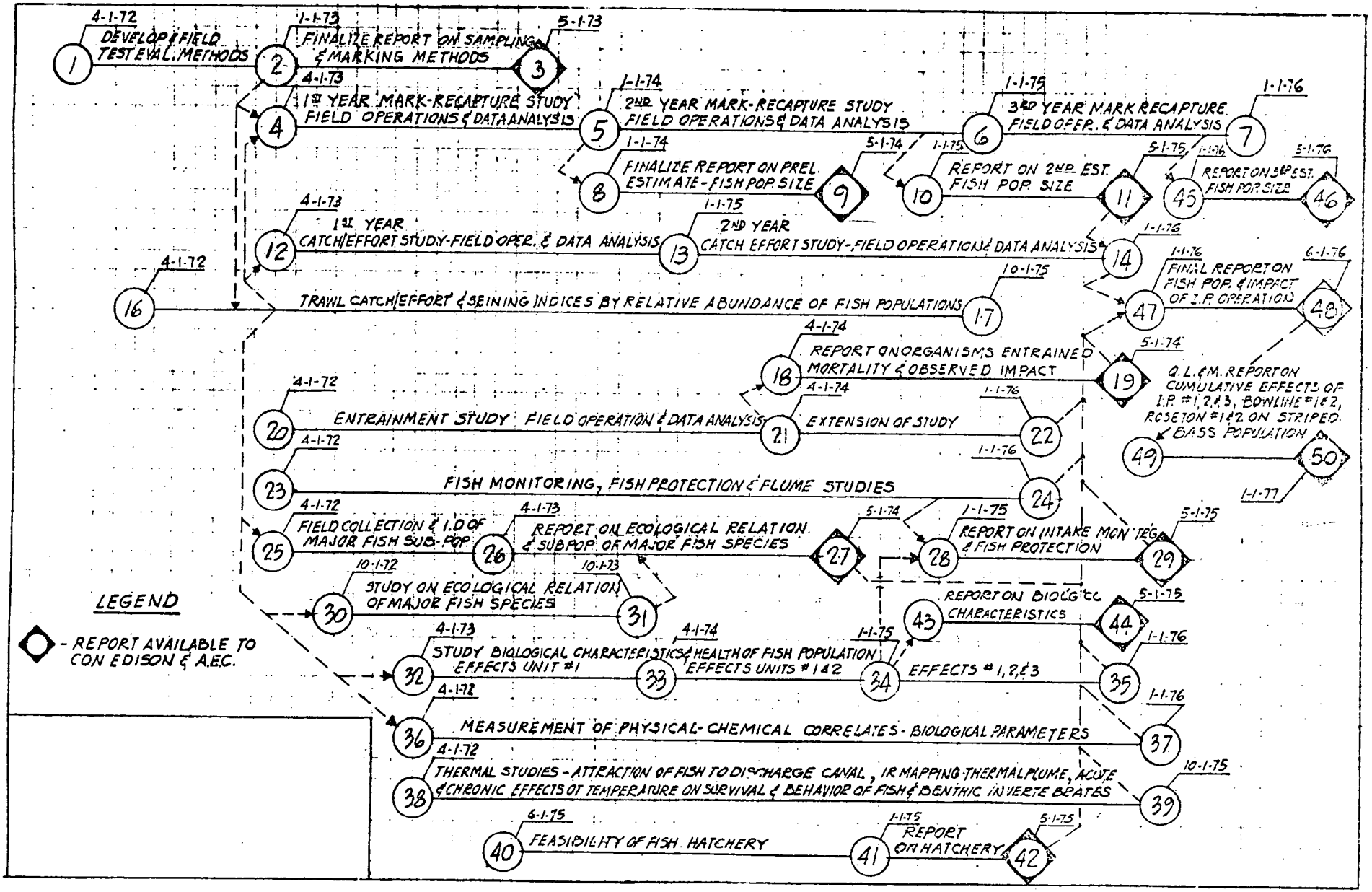

Figure 5. Schedule for Indian Point Studies

TABLE 4-2

ECOLOGICAL SURVEY

WATER QUALITY MEASUREMENTS AT PLANT INTAKE AND DISCHARGE

AND AT THREE TRANSECTS IN THE RIVER

Parameter	Frequency
Temperature	~~Daily~~ *Weekly*
pH	~~Daily~~ *Weekly*
Conductivity (salinity)	Weekly
Turbidity	Weekly
Alkalinity	Monthly
Bicarbonate	Monthly
Ammonia	Monthly
Orthophosphate	Monthly
Nitrates	Monthly
Carbon (inorganic and organic)	Monthly
Chlorine demand	Weekly
Free Chlorine	Weekly
Residual Chlorine	Weekly
~~Dissolved Oxygen~~	~~Weekly~~
~~Biochemical Oxygen Demand (5-day-20°C)~~	~~Monthly~~
~~Water current speed~~	~~Weekly~~
~~Water current direction~~	~~Weekly~~

4.1.2b (1) General Terrestrial Ecological Survey

Applicability

Applies to the reporting of the potential effects on terrestrial flora and fauna from salt deposition and drift from closed-cycle cooling systems.

Objective

To provide determination of the threshold values for physiological damage to the most susceptible species of vegetation in the site and nearby surroundings to the deposition of salt and other compounds contained in drift.

Determination of the interaction of the effluents from the superheater stack of Unit No. 1 and the effluent from closed-cycle cooling systems. Other factors such as noise from these systems will be studied.

Specifications

Laboratory tests will be carried out in accordance with the licensee's proposal to investigate effects of salt deposition on typical flora of the site and surroundings of the plant. A general survey to evaluate effects of the effluents on vegetation and wildlife from closed-cycle cooling system will be evaluated.

A study shall be made to investigate the potential for effects from the interaction of the effluents from the superheater stack and a closed-cycle cooling system.

Bases

The operation of certain closed cycle cooling systems may result in effluents which may cause damage to nearby terrestrial ecosystems. A survey to evaluate potential effects of the effluents on vegetation and wildlife may be undertaken. Such effects may be a result of the closed-cycle cooling system evaporation, drift, fogging or icing, convential fuel pollutants, etc., from the station.

Species which are sensitive to such effluents will be selected and exposed to these effluents in laboratory tests in a study to determine potential effects on the terrestrial biota. Results will be reported in the semiannual operating reports.

a Radiological Environmental Monitoring Survey

Applicability

Applies to routine testing of the radioactivity in the plant environs.

Objective

To establish a sampling schedule which will recognize changes in radioactivity in the environs, and assure that effluent releases are kept as low as practicable and within allowable limits in accordance with 10 CFR 50 and 10 CFR 20, respectively.

Specification*

1. Liquid Discharges

The survey for liquid discharges shall be conducted in accordance with Table 4.2.-1 as specified below:

a. If the gross-beta-gamma activity of the station releases to the river is less than 1% of MPC during the month just ended, the environmental survey shall be conducted in accordance with Program 1 for the subsequent month.

b. If the gross beta-gamma activity of the station releases to the river is greater than 1% of MPC but less than 10% of MPC during the month just ended, the environmental survey shall be conducted in accordance with Program 2 for the subsequent month. If the samples taken under Program 2 do not indicate any significant increase in environmental radioactivity, the survey shall revert to Program 1.

c. If the gross beta-gamma activity of the station releases to the river is greater than 10% of MPC during the month just ended, the environmental survey shall be conducted in accordance with Program 3 for the subsequent month. If the samples taken under Program 3 do not indicate any significant increase in environmental radioactivity, the survey shall revert to Program 2.

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hnical Specification for Radioactive Effluent Releases Section 3.9 appears in Appendix A of Technical cifications.

Specification (Continued)

d. Irrespective of release levels, once each year the survey shall be taken under Program 3 for a 3 month continuous period.

2. Gaseous Discharges

The survey for the gaseous discharges shall be conducted in accordance with Table 4.2-2 as specified below:

a. If the average release rate from the plant vent is less than 1% of the annual allowable release rate as specified in Paragraph 3.9-C1 of Section 3.9 of Appendix A, Technical Specifications, during the month just ended, the environmental survey shall be conducted in accordance with Program 1 for the subsequent month.

b. If the average release rate from the plant vent is greater than 1% but less than 10% of the annual allowable release rate as specified in Paragraph 3.9-C1 during the month just ended, the environmental survey shall be conducted in accordance with Program 2 for the subsequent month. If the samples taken under Program 2 do no indicate any significant increase in environmental radioactivity, the survey shall revert to Program 1.

c. If the average release rate from the plant vent is greater than 10% of the annual allowable release rate as specified in Paragraph 3.9-C1 during the month just ended, the environmental survey shall be conducted in accordance with Program 3 for the subsequent month. If the samples taken under Program 3 do not indicate any significant increase in environmental radioactivity, the survey shall revert to Program 2.

d. Irrespective of release levels, once each year the survey shall be taken under Program 3 for a 3 month continuous period.

3. Additional Sampling Analysis

The sampling survey and method of analysis used shall follow that presented in Table 4.2-3. The maps in Figures 4.2-1 and 4.2-2 show the locations of the sampling stations. The monitoring program has been expanded to include tritium in water measurements, marine life, station and offsite well water

and changes of the onsite air monitoring station. Selected samples of sediments, water and soil samples will be analyzed for Sr-89 and Sr-90 and Cs-134 and Cs-137 semiannually. Twice a year, selected samples of fish, aquatic vegetation, algae and mud taken from different locations offsite will be analyzed for Cs-134 and 137, Co-60, Rh-106, Zr-Nb-95, Mn-54, Sr-89 and 90, and Ce-144 and results will be reported in the semiannual report. Results will be compared with those obtained since about 1966, when the surveys were conducted by the New York State Department of Conservation.

The measuring and reporting of radioactivity in the environs will follow that recommended in the AEC's Regulatory Guide 4.1, and in Section 5.6 of these Technical Specifications.

Basis

Programs for monitoring the adjacent area of the Hudson River will be conducted by the Consolidated Edison Company, by the New York State Department of Health, and by the New York University Institute of Environmental Medicine. The New York State program includes measurement of samples of air, water, milk and wildlife. The New York University Medical Center research program includes the biology of the Hudson River, the distribution and abundance of fish in the river, pesticides and radio-ecological studies.

Consolidated Edison's radiological environmental monitoring program will include measurements of radioactivity in fresh water, river water, river sediments, fish, aquatic vegetation, vegetation, soil, air, and milk in the vicinity of the Indian Point Station. This program began with a survey instituted in 1958 (four years prior to operation of Unit No. 1) to determine the radioactivity in the environment in the vicinity of the Indian Point Station. The purpose of this survey was to determine the natural background radioactivity and to show the variations in the activities that may be expected from natural sources, fallout from bomb tests, and other sources in the vicinity. The program has been continued to the present so that changes in the environment resulting from operation of Unit No. 1 could be accounted for, and will be continued throughout the operating lifetime of all three units.

As a part of this program, rain is collected at the Indian Point Station and at a point fifteen miles south of the station. This is a continuous collection which is sampled monthly and analyzed. Air samples are collected at four points on site by means of fixed-membrane filters followed by charcoal filters. Air collections are also made offsite at selected points with similar equipment.

Basis (Continued)

Drinking water is sampled from nearby reservoirs. Hudson River water is sampled at the inlet to the Indian Point Plant and at the plant discharge canal. This is a continuous collection which is sampled and measured weekly. The lake on site, the Trap Rock Lake and other lakes in the vicinity are sampled monthly and measured for gross beta activity and tritium content. Two wells, one onsite and one in Verplanck, are sampled monthly and also analyzed for gross beta activity and tritium content.

Aquatic vegetation from the lake on site and other nearby lakes is sampled during the growing season and analyzed for gross beta activity, and a gamma spectrum is also run. Aquatic vegetation is collected from the Hudson River at points at the discharge canal, one-half, one and two miles downstream from the plant. This vegetation is analyzed in the same manner as the Lake aquatic vegetation. Bottom sediment is taken from the Hudson River in the vicinity of the plant and at points one-half, one and two miles downstream. This sediment is measured for gross beta activity and is also analyzed for gamma activity and radionuclide content.

River fish caught in the vicinity of the plant are measured for gross beta and a gamma spectrum analysis made. Land vegetation is sampled primarily in the downwind direction from the plant at points one-quarter, one-half, one and two miles south of the plant.

The direct gamma background is measured yearly along principal roads within a five-mile radius of the plant, at approximately 0.10 mile intervals. Direct gamma monitoring is made continuously at selected locations in Buchanan, Verplanck, Montrose, Peekskill and at a number of points on the site perimeter. This measurement is made with TLD's (thermo-luminescent-dosimeters) at 11 points on the site boundary.

Gamma spectroscopy of drinking water, Hudson River water and lake water is routinely performed. Tritium (^{3}H) measurements are currently made on samples of drinking water. The current environmental monitoring program at the Indian Point Station, together with sampling frequency, is set forth in more detail in Table 4-2-3. Sampling locations are indicated in Figure 4.2-1.

Basis (Continued)

The radiological environmental monitoring program conducted by the Consolidated Edison Company will supply sufficient data to determine the compliance of the Indian Point Station with the requirements of 10 CFR 20. The schedules for liquid and gaseous discharges will insure that changes in the environmental radioactivity will be detected.

Although the design of the proposed facility and administrative controls will be such that gaseous and liquid effluents will be released in accordance with the requirements of 10 CFR 20 and 10 CFR 50, the environmental monitoring program of the Consolidated Edison company provides a redundant means of insuring that the operation of the proposed facility does not pose any undue risk to the health and safety of the public. The New York State and New York University programs provide an independent means of verifying the proposed facilities compliance with 10 CFR 20 and 10 CFR 50.

TABLE 4 2-1

Environmental Monitoring Survey - Liquid Discharges+

Media of Sample	No. of Samples/ Collection	Programs 1 Collection Frequency	1 Analysis*	2 Collection Frequency	2 Analysis*	3 Collection Frequency	3 Analysis
Hudson River Water	2	W	GBG	TW	GBG	D	GBG
	2	MC	T		GSA		GSA
				MC	T	MC	RA
							T
Hudson River Aquatic Vegetation	15	SSF	GBG	MDGS	GBG	MDGS	GBG
					GSA		GSA
							RA
Hudson River Bottom Sediment	5	SSF	GBG	M	GBG	M	GBG
					GSA		GSA
							RA
Hudson River Fish	2	M	GBG	TM	GBG	W	GBG
					GSA		GSA
Benthos	2	M	GBG	TM	GBG	W	GBG
					GSA		GSA

+ Samples will be taken whenever biologically available.

* Minimum equipment sensitivity shall be those given in FSAR Table 11.11-1.

Nomenclature for Sample Frequency

W - Weekly
TW - Twice Weekly
D - Daily
M - Monthly
MC - Monthly Composite
TM - Twice Monthly
SSF - Once each in Spring, Summer and Fall
MDGS - Monthly during the Growing Season

Nomenclature for Analysis

GBG - Gross Beta-Gamma
GSA - Gamma Spectrometer Analysis
T - Tritium
RA - Radiochemical Analysis to determine biologically important isotopes.
TLD - - Thermoluminescent Dosimeters

TABLE 4.2-2

Environmental Monitoring Survey - Gaseous Discharges+

Media of Sample	No. of Samples/ Collection	Programs 1 Collection Frequency	1 Analysis*	2 Collection Frequency	2 Analysis**	3 Collection Frequency	3 Analysis
Fallout (Rainwater)	2	M	GBG T*	M	GBG GSA T*	TM MC	GBG GSA RA T*
Air Particulate & Organic Iodide	9	W	GBG GSA	TW	GBG GSA	TW	GBG GSA RA
Drinking Water Supplies	3	M	GBG T	TM MC	GBG GSA T	W MC	GBG GSA RA T
Lake Water & Well Water	6	M	GBG T	TM MC	GBG GSA T	W MC	GBG GSA RA T
Lake Aquatic & Vegetation & Land Vegetation	8	SSF	GBG	MDGS	GBG GSA	MDGS	GBG GSA RA
Soil	5	A	GBG	M	GBG GSA	M	GBG GSA RA
Direct Gamma (Spot Readings)	180	A	GBG	MSL	GBG	WSL	GBG
Direct Gamma (Continuous)	11 (site boundary)+	SA	TLD	M	TLD	M	TLD

TABLE 4.2-3

INDIAN POINT STATION ENVIRONMENTAL SURVEY

(Sheet 1 of 3)

No.	Media	Type	Sampling Frequency	Method of Collection	Location	Analysis	Minimum Sensitivities	Measurement Instrumentation	Remarks
1	Fallout	Continuous	Monthly	Open pot type collector	Point 1; 15 miles south of site of Eastview	Gross beta and tritium	1 picocurie per liter for gross beta	Gas flow, windowless proportional counter for gross beta Nuclear Measurement Corporation Type PC 3A Type PC 11A Type PC 11T	Measurements made 48 hours after collection to allow for decay of radon-thoron daughters
							3000 picocuries per liter for tritium		
2	Air Particulate and Organic Iodide	Continuous at 1 CFM	Weekly	Two fixed membrane filters (0.8 micron size) preceding a charcoal filter	Points 1, 2, 3, 4 and 5 and in addition off-site at points in Peekskill, Buchanan, Croton and Springdale for one week periods consecutively	Gross beta and gamma spectrum	0.1 picocurie per cubic meter for gross beta	Same as 1 for gross beta	Measurements made soon after collection and 48 hours later to allow for decay of radon-thoron daughters
							2 picocuries per cubic meter for I-131	Gamma spectrum with 4" x 4" NaI crystal with 400 channel analyzer Radiation Instruments Development Laboratories Model 3412 Gamma Spectrometer	
3	Drinking Water Supplies	Grab	Monthly		Points 7 and 8	Same as 1	Same as 1	Same as 1	Same as 1
4	Hudson River Water	Continuous	Weekly	Continuous flow regulated to fill 2 gallon drums. Representative sample taken once a week and drums emptied	Hudson River inlet pipe into the plant, and at plant discharge canal. Points 9 and 10	Same as 1 and tritium on monthly composite	Same as 1	Same as 1	Same as 1

TABLE 4.2-3

(Sheet 2 of 3)

INDIAN POINT STATION ENVIRONMENTAL SURVEY

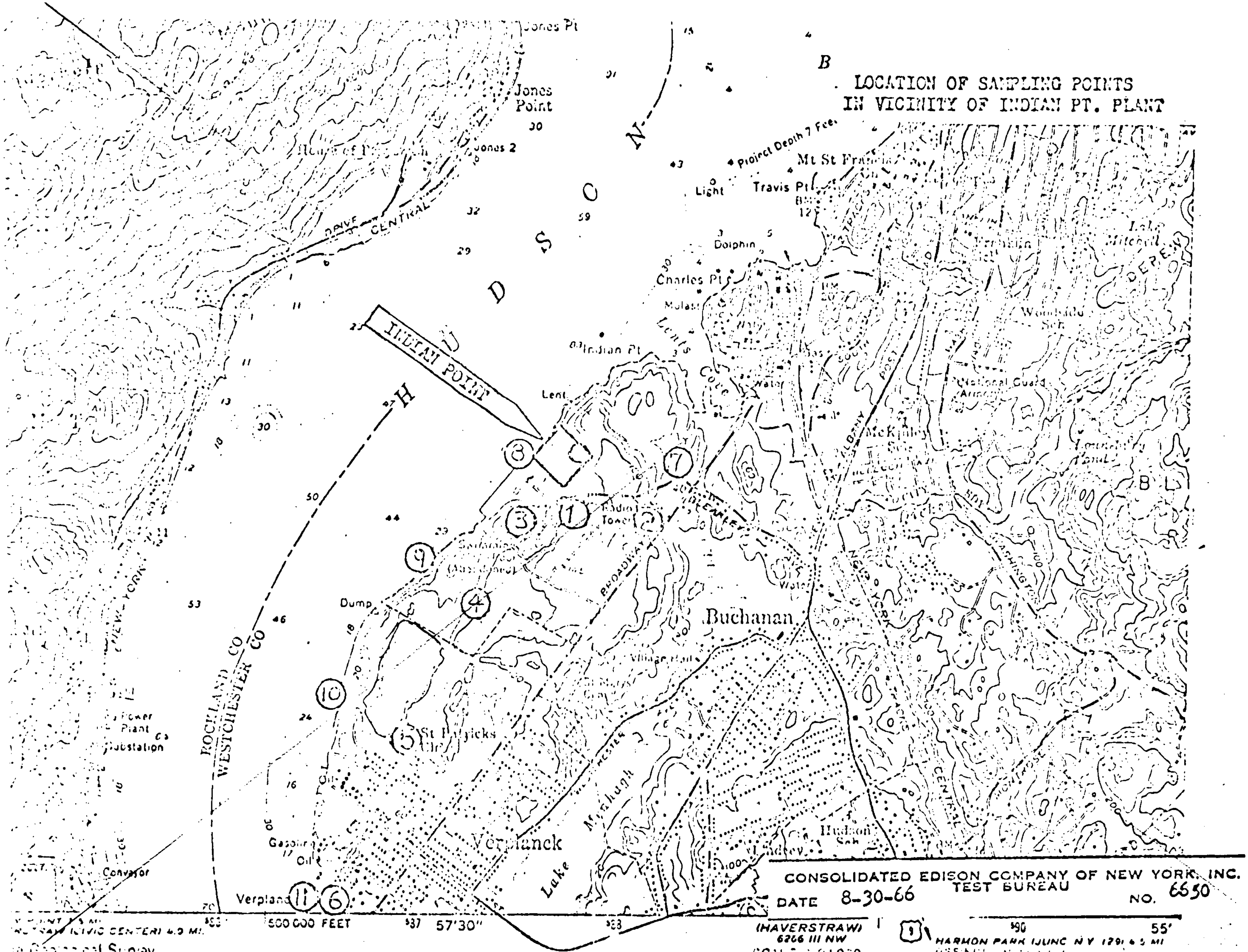
No.	Media	Type	Sampling Frequency	Method of Collection	Locations	Analysis	Minimum Sensitivities	Measurement Instrumentation	Remarks
5	Lake Water	Grab	Monthly	1 liter sample off-shore	Points 11, 12, and 13	Same as 1	Same as 1	Same as 1	Same as 1
6	Well Water	Grab	Monthly	From deep-well pumps	Points 6, 14 and Verplanck	Same as 1	Same as 1	Same as 1	Same as 1
7	Lake Aquatic Vegetation	Grab	Once each in Spring, Summer and Fall	Along the lake shore	Same as 5	Same as 2	3 picocurie per gram for gross beta	Same as 2	Dry weight for spectrum soon after collection. Sample ashed and counted 48 hours after collection for gross beta
8	Hudson River Vegetation	Grab	Same as 7	Along river shore	Points 10, 15, 16 and 17. At mouth of discharge canal, Peekskill Bay, Tompkins Cove, off Verplanck and at Lovett Plant of Orange & Rockland Utilities	Same as 2	Same as 7	Same as 2	Same as 7
9	Hudson River Bottom Sediment	Grab	Same as 7	Same as 8	Same as 8	Same as 2	Same as 7	Same as 2	Mud dried for both measurements
10	Hudson River Fish	Catch	Monthly	Same as 8	Where available near site	Same as 2	Same as 7	Same as 2	Sample ashed and counted 48 hours after collection for gross beta and gamma spectrum taken
11	Vegetation	Grab	Same as 7	Grab samples with 100 ft^2 area	Points 6, 18, 19, 20 and 2a	Same as 2	Same as 7	Same as 2	
12	Soil	Grab	1 per year	Grab samples 2" in diameter by 2" deep	Same as 11	Same as 2	Same as 7	Same as 2	Soil dried for spectrum and measured soon after collection. Gross beta of dried soil made 48 hours after collection.

TABLE 4.2-3

(Sheet 3 of 3)

INDIAN POINT STATION ENVIRONMENTAL SURVEY

No.	Media	Type	Sampling Frequency	Method of Collection	Location	Analysis	Minimum Sensitivities	Measurement Instrumentation	Remarks
13	Direct Gamma	Spot Readings	Once a year		Along principal roads within a 5 mile radius of plant	Gross gamma background	Minimum sensitivity = 1 μr/hr	Franklin Systems Inc. Model 15-2	Instrument readings in counts per minute measured at approximately 1/10 mile intervals. Readings converted to microrem per hour
5/14	Direct Gamma	Continuous	Monthly		Selected locations in Buchanan, Verplanck, Montrose, Peekskill, and at a number of points on-site at the plant perimeter	Same as 13	1 mr	Victoreen Ionization Chamber Model 239 0-10 mr or Film badges or TLD-Thermoluminescent dosimeters	


LOCATION OF SAMPLING POINTS
IN VICINITY OF INDIAN PT. PLANT
INDIAN POINT
HUDSON
Jones Point
Charles Pt
Indian Pt
Buchanan
Verplanck
Lents Cove
Travis Pt
Mt St Francis
Dolphin
Light
Radio Tower
Dump
Village Hall
St Patricks Ch
National Guard Armory
McKinley Sch
Woodside Sch
Hudson Sch
Lake Mitchell
Lake Meahagh
Project Depth 7 Feet
ROCKLAND CO
WESTCHESTER CO
Power Plant
Substation
Conveyor
Gasoline
Oil
BROADWAY
CENTRAL
NEW YORK
1
2
3
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57'30"
55'
(HAVERSTRAW)
6266 III NW
HARMON PARK (JUNC N Y
CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
TEST BUREAU
DATE 8-30-66
NO. 6650

2.1b Radiological Monitoring of Iodine-131 via Air-Pasture-Cow-Milk Pathway

Objective

To measure the amount of I-131 contained in the air, grass and milk of cows in the vicinity of the Indian Point Station in accordance with AEC regulations of 10 CFR 20 and 10 CFR 50, in order to assure that the dose rate from radioiodine is 15 mrem per year or less to the thyroid of a child.

Specification

During the seasons when the cows are in pasture, samples of fresh milk of cows located in the vicinity of the Indian Point Station shall be taken and analyzed in accordance with the AEC Regulatory Guide 1.42. Duplicate samples shall be taken on a weekly basis from farms such as Hanover Hill Farm, Grasslands and one located seven miles in the south south-west direction of the plant site (in critical wind sector). Duplicate samples shall also be taken on a monthly schedule from milk processing dairies, Dairymen's League, and Crowley Milk Company and analyzed for their radioiodine content calculated as Iodine-131. At least a 4-liter sample of milk shall be taken and analyzed with state-of-the-art counting equipment for gamma radiation.

Analysis shall be carried out within eight days (one I-131 half-life) of sampling. Suitable analytical procedures should be used to determine the radioiodine content to a sensitivity of 0.5 picocuries per liter of milk at the time of sampling. Counting statistics will be such that the standard deviation (one sigma confidence level) of the net counting rate will be 10% or less. Overall error of the analysis will be within ± 25%. Results will be reported, with associated calculated error, as picocuries of I-131 per liter of milk at the time of sampling, in accordance with Reporting Requirements for Environmental Radiological Monitoring.

Sampling and analysis of grass and air at the above mentioned farms shall also be carried out once a month in accordance with Appendix D, Regulatory Guide 1.42. Air samples shall be collected by means of a bed of potassium iodide impregnated charcoal at a rate of 3 to 5 ft^3/min. continuously for several days. The expected amount collected is from 2.7 to 4.5 pCi I-131, yielding 6 to 10 dpm per sample. The sample, including a prefilter may be counted on a suitable Ge(Li) detector for 1000 minutes to give counting statistics of ± 50% or better. Adequate samples of grass shall be collected to measure I-131 in grass at concentrations of 15 pCi/600 gm(wet). During sampling the meteorological conditions shall also be recorded and the radioiodine in reactor effluents shall also be measured in accordance with Section 3.9 of Technical Specifications, Appendix A.

Soil samples shall be collected once per month at the same location as land vegetation and analyzed for radioiodine, Cesium-134 and 137, and Strontium-89 and 90. Once a month, samples of milk taken at the farm in the SSW direction shall be analyzed for Cesium-134 and 137 and Strontium-89 and 90.

Reporting Requirement

(1) If the measured concentration of I-131 in the milk exceeds 19.2 picocuries per liter, a report will be made to the Region I of Regulatory Operations office within 24 hrs. by telephone or telegraph, and a plan will be submitted within one week to determine the cause of the elevated levels and reduce the dose to 15 mrem/yr.

(2) If milk samples collected over a calendar quarter show total levels of radioactivity that could result in accumulated doses to a child of 7.5 mrem for that quarter, the results will be reported within 10 days, and a plan will be submitted to limit conditions so that a dose exceeding 15 mrem/year to a child will not occur.

(3) If milk samples collected over any two calendar quarters show total levels of radioactivity that would result in accumulated doses to a child of 11.4 mrem in those two quarters, the results will be reported within 10 days and a plan will be submitted to limit conditions so that a dose exceeding 15 mrem a year to a child will not occur.

Bases

To assure that no one child will receive a dose of greater than 15 mrem/year to the thyroid, it is necessary to know the radioiodine concentration in the milk to the sensitivity given above: 0.5 pCi/liter.

A concentration of I-131 in milk of 2.4 picocuries per liter will result in a dose to the thyroid of a 0-2 year old child of 15 mrem/year, based upon consumption of one liter per day for the year.

In accordance with the AEC's regulations, Paragraph 20.1(c) of 10 CFR 20 requires that radiation exposures and releases of radioactive materials in effluents to unrestricted areas be kept as low as practicable. In regards to radioiodine, the release rate of this radioisotope from the Indian Point Station should be kept to such levels that a dose rate to the thyroid of a child through the grass-cow-milk pathway will be 15 mrem per year at the points of maximum concentration at or beyond the site boundary where dairy cows are present or could be pastured. To assure this dose rate shall not be exceeded, the licensee will carry out a radioiodine monitoring program.

The licensee has been carrying out a cooperative radiological environmental monitoring program with the New York State Department of Health since 1958 in conjunction with Indian Point Unit No. 1. From the postoperational survey done in 1971, there are five milk processing or receiving plants in the study area covered which receive milk from 47 dairy farms, 36 of them within the 20 mile radius. There are 268 individual dairy farms within the study area. In Westchester County there are 18 farms and in Orange County, 219 farms. The farms selected for the study program are the Hanover Hill Farm, near Yorktown, about 17 miles east of the site, and the Guard Hill Farm, near Bedford and Grasslands near Mt. Pleasant, ten miles south east from the station. However, the most critical wind sector is in the south, south-west direction. The licensee has reported that the closest dairy farms are located at seven miles in the SSW, WSW, W, WNW, SE, ESE, E, NE, and NNE. The licensee will arrange to obtain fresh milk samples taken from the farm located at seven miles SSW from the Station. If the results of the analysis of the samples indicate values of greater than 2.4 picocuries per liter, the licensee will arrange to obtain samples from the other farms within seven miles of the Station. Meteorological conditions will be recorded. All results will be reported in the semiannual operating report.

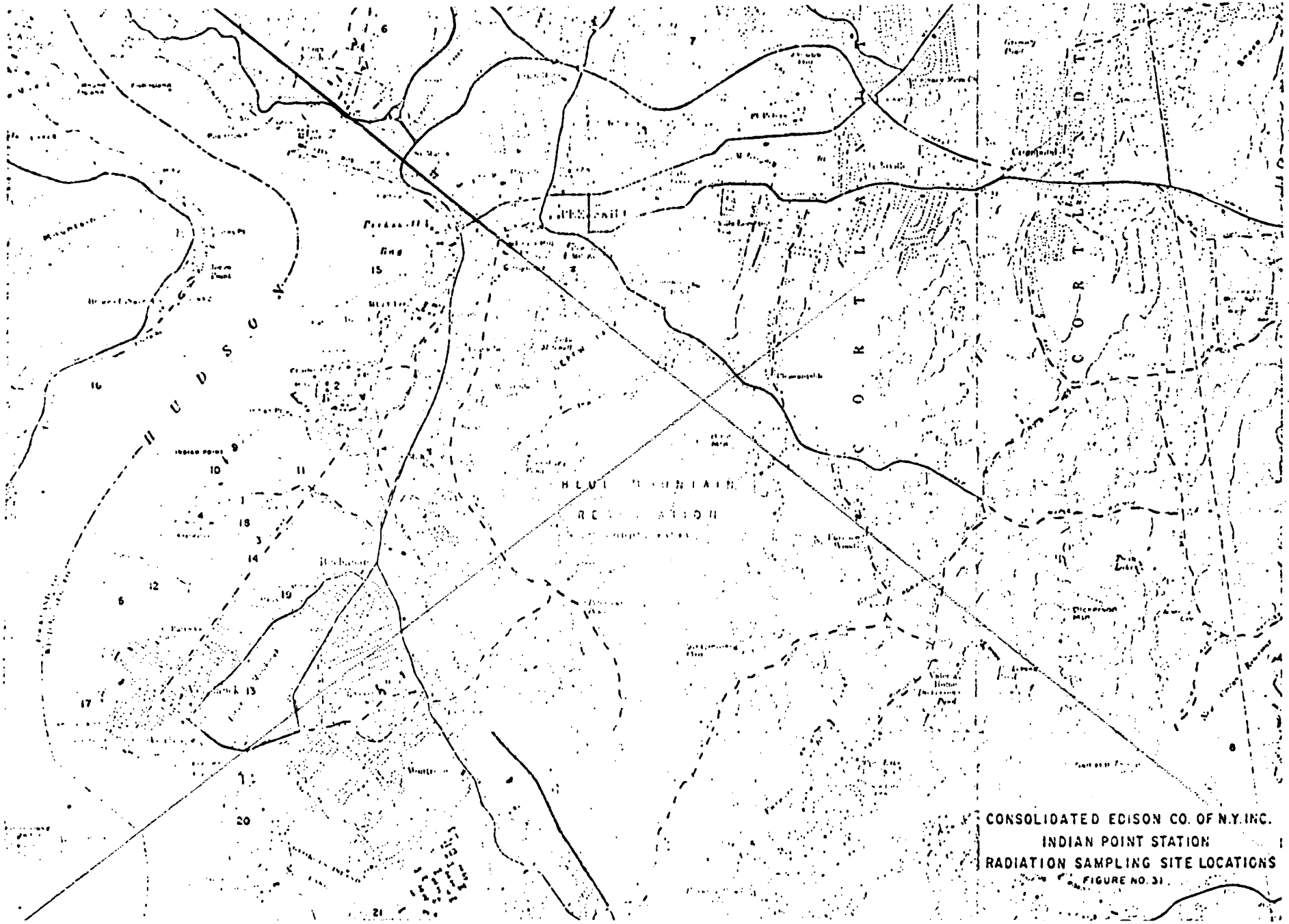
In terms of milk processing facilities used in the study area, the Crowley Milk Company, Newburgh, processes 28,000 quarts per day collected from 32 farms located within 20 miles of the Station. Similarly the Dairymen's League in Goshen processes 121,398 quarts per day from 121 dairy farms, of which 25 of them are located within 20 miles radius from the Station.

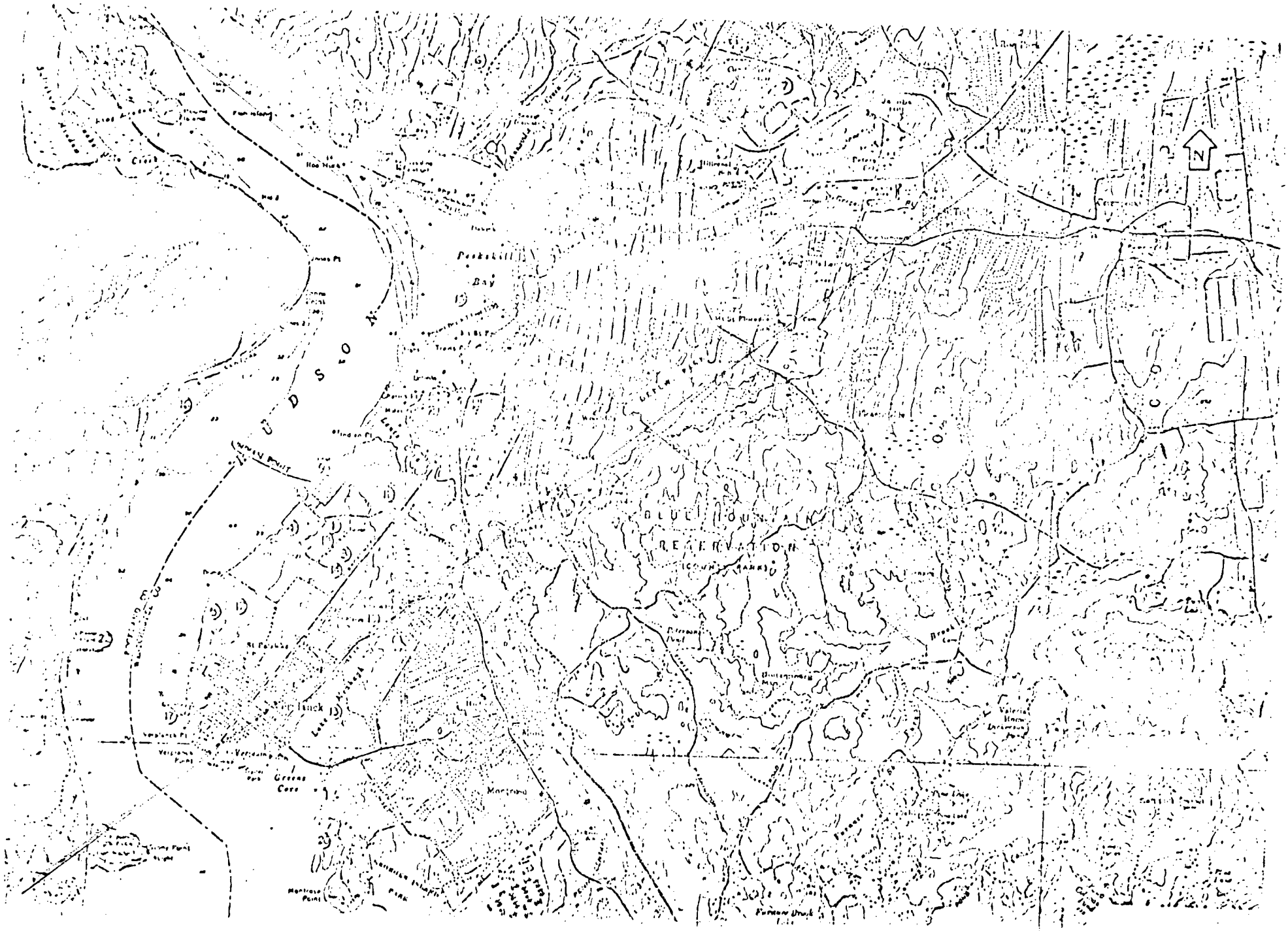
Milk samples taken in the New York State Department of Environmental Conservation also included analysis for Cesium-137 and Strontium-90.

References

1/ U. S. Atomic Energy Commission, "Interim Licensing Policy on As Low As Practicable for Gaseous Radioiodine Releases from Light-Water-Cooled Nuclear Power Reactors," Regulatory Guide 1.42, June 1973.

2/ New York State Department of Environmental Conservation, Environmental and Postoperational Survey for Radioactivity, Consolidated Edison Indian Point Reactors, September 1971.


CONSOLIDATED EDISON CO. OF N.Y. INC.
INDIAN POINT STATION
RADIATION SAMPLING SITE LOCATIONS
FIGURE NO. 31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5.0 ADMINISTRATIVE CONTROLS

Objective

To describe the administrative controls that relate to management procedures, record keeping and reporting that are considered necessary to provide the assurance and evidence that the plant will be managed as prescribed by the Environmental Technical Specifications.

Specifications

5.1 Organization, Review and Audit

A. Organization

1. The Station Manager has on-site responsibility for the safe operation of the facility and to assure that the limits as noted in the environmental technical specifications as defined herein are not exceeded.
2. The Station Manager shall report to the Manager of the Nuclear Power Generation Department who reports to the Vice President of Power Supply. ~~In the absence of the Station Manager, the Plant Engineer will assume his responsibilities.~~ See Figure 6.1-1 of Appendix A (Radiological Technical Specifications) for a detailed description of responsibility.
3. ~~The Director of Technical Engineering, assigned to the Staff of~~ the Manager - Nuclear Services, *or appropriate designee* has primary responsibility for ~~the initiation and execution, by technically competent personnel, of the~~ *station* environmental *monitoring. The Chief Mechanical Engineer and the Director of the Biology Department have primary responsibility for execution of special environmental studies.*
4. ~~The Director of Technical Engineering has primary responsibility for directing the testing work as assigned to independent consultants who have the task of sampling and performing the studies.~~

B. Review and Audit

~~The Nuclear Facilities Safety Committee (NFSC), as described in the Technical Specifications, Appendix A, Section 6.0, supplemented as necessary by technically qualified personnel,~~ *An Environmental Protection Committee (EPC) shall be constituted and shall include but not be limited to, the Manager-Nuchear Services, the Chief Mechanical Engineer and the Director of the Biology Department or their designees. The EPC* shall have the responsibility of performing the review and audit of the *non-radiological* ~~environmental~~ monitoring, surveillance, and special studies programs-~~as they pertain to plant operations, and reviews and audits these sections of the program which refer to the allowable limits for temperature and chemical discharges.~~

As a minimum, the following should be independently reviewed and audited by ~~this NFSC:~~ *the EFC:*

1. Coordination of environmental technical specification development with the ~~safety technical specifications~~ *NFSC* to avoid conflicts and maintain consistency.

2. Proposed changes to the environmental technical specifications and the evaluated impact of the change.

3. Proposed written procedures, as described in 5.4, and proposed changes thereto which affect the plant's environmental impact.

4. Proposed changes or modifications to plant systems or equipment which would affect the plant's environmental impact and the evaluated impact of the changes.

5. Results of the environmental monitoring programs ~~prior to their submittal~~ in each semiannual Environmental Monitoring Report. See Section 5.6.A.

6. Investigations of all reported instances of violations of environmental technical specifications. Where investigation indicates, evaluation and formulation of recommendations to prevent recurrence are made.

5.2 Action to be taken in the Event of an Abnormal Environmental Occurrence

A. Any abnormal environmental occurrence shall be promptly reported to and investigated by the Station Manager.

B. The Station Manager shall promptly notify the Manager of the Nuclear Power Generation Department of any abnormal environmental occurrence.

C. The Station Manager shall prepare and submit promptly a report in writing to the Manager of the Nuclear Power Generation Department following the observation of an abnormal environmental occurrence. Such report shall describe the circumstances leading up to, and resulting from the occurrence, and shall recommend appropriate action to prevent or reduce the probability of a repition of occurrence.

D. The Vice President of Power Supply shall report the circumstance of any abnormal environmental occurrence to the AEC within 24 hours; as specified in Specification 5.6 "Plant Reporting Requirements," a written report shall follow within 10 *working* days. Each such occurrence shall be reported in the routine Semi-Annual Operating Report.

5.3 Actions to be Taken Prior to Special Tests or Changes

A. If the Station Manager decides to make a change in the facility or operating procedures, or to conduct a test or experiment, and concludes that the proposed change, test or experiment does not involve a change in the Technical Specifications or an unreviewed environmental question, he may order the change, test or experiment to be made, shall enter a description thereof in the operating records of the facility, and shall send a copy of the instructions pertinent thereto, to the Chairman of the Nuclear Facilities Safety Committee. If the Chairman of the Committee, upon reveiwing such instructions, is of the opinion that the change, test or experiment is of such a nature as to warrant consideration by the Committee, he shall order such consideration.

B. If the Station Manager desires to make a change in the facility or operating procedures or to conduct a test or experiment which in his opinion might involve a change in the *Environmental* Technical Specifications, might involve an unreviewed environmental impact question or might otherwise not be in accordance with said license, he shall not order such change, test or experiment until he has referred the matter to the ~~Nuclear Facilities Safety Committee~~ *EPC* for review and report. If the Committee is of the opinion that the proposed change, test or experiment does not require approval by the Atomic Energy Commission under the terms of said license, it shall so report in writing to the Station Manager, together with a statement of the reasons for the Committee decision and the Station Manager may then proceed with the change, test or experiment. If, on the other hand, the Committee is of the opinion that approval of the Atomic Energy Commission is required, the Committee shall prepare a request for such approval, including an appropriate environmental analysis in support of the request, and forward its report and request to the Vice Presidents in charge of Engineering and Power Supply for their review with a copy to the Station Manager. One of said Vice Presidents shall thereupon forward the report and request to the Atomic Energy Commission for approval unless, after review, the Vice Presidents either (a) disagree with the opinion of the Committee that approval of the Atomic Energy Commission is required, or (b) decide that the proposed change, test or experiment is not necessary from the standpoint of Company policy or operations.

5.4 Operating Procedures

A. Detailed written procedures including check-off lists and instructions, where applicable, shall be prepared, approved, and adhered to for the following:

1. Control of additions of chemicals for both the primary and secondary systems.
2. Control of release of chemicals in the circulating water discharge.
3. Control the flow of discharge waters to remain within the allowable rate of change and discharge temperatures.
4. Sampling methods, frequencies and locations.
5. Preventive or corrective procedures which could have an effect on the environmental aspects of the plant.
6. Calibration procedures for various instruments used in measuring and analyzing the samples which are required by these specifications.

B. All procedures, as they pertain to these specifications, shall be reviewed by the ~~NFSC~~ *EPC* and *if they affect plant operations* approved by the Station Manager ~~prior to implementation~~. *Such review and approvals shall occur prior to implementation of any procedures.* Temporary changes to procedures which do not change the intent of the original procedure may be made, provided such changes are approved by ~~a member of the plant management staff and the Director of Technical Engineering responsible for the program~~, *the cognizant member of the EPC and* Such changes shall be documented and subsequently reviewed by the ~~NFSC and approved by the Station Manager~~ *EPC*.

C. All standard procedures should include provisions to ensure the plant and all its systems and components are operated in compliance with the limiting conditions for operation established as part of the environmental technical specifications.

5.5 Record Retention

A. Record Retention - 6 Years

Records and/or logs relative to the following items shall be kept in a manner convenient for review and retained for six years:

1. Records of normal plant operation, including power levels and period of operation at each power level.

5.4 Operating Procedures

A. Detailed written procedures including check-off lists and instructions, where applicable, shall be prepared, approved, and adhered to for the following:

1. Control of additions of chemicals for both the primary and secondary systems.
2. Control of release of chemicals in the circulating water discharge.
3. Control the flow of discharge waters to remain within the allowable rate of change and discharge temperatures.
4. Sampling methods, frequencies and locations.
5. Preventive or corrective procedures which could have an effect on the environmental aspects of the plant.
6. Calibration procedures for various instruments used in measuring and analyzing the samples which are required by these specifications.

B. All procedures, as they pertain to these specifications, shall be reviewed by the ~~NFSG~~ *EPC* and *if they affect plant operations* approved by the Station Manager ~~prior to implementation~~. *Such review and approvals shall occur prior to implementation of any procedures.* Temporary changes to procedures which do not change the intent of the original procedure may be made, provided such changes are approved by ~~a member of the plant management staff and the Director of Technical Engineering responsible for the program~~, *the cognizant member of the EPC and* Such changes shall be documented and subsequently reviewed by the ~~NFSG and approved by the Station Manager~~ *EPC*.

C. All standard procedures should include provisions to ensure the plant and all its systems and components are operated in compliance with the limiting conditions for operation established as part of the environmental technical specifications.

5.5 Record Retention

A. Record Retention - 6 Years

Records and/or logs relative to the following items shall be kept in a manner convenient for review and retained for six years:

1. Records of normal plant operation, including power levels and period of operation at each power level.

2. Records of principal maintenance activities, including repair, substitution or replacement of principal items of equipment pertaining to environmental impact.
3. Records of occurrences in violation of environmental technical specifications.
4. Records of periodic checks, inspections and calibration performed to verify that environmental surveillance requirements are being met.
5. Records of any special operational modes (tests or experiments) *affecting environmental impact.*
6. Records of changes made to procedures, equipment, permits and certificates *affecting environmental impact.*
7. Records of changes to operating procedures *affecting environmental impact.*
8. ~~Plant Operations Review Committee meeting minutes.~~ *Environmental Protection Committee meeting minutes.*
9. ~~Nuclear Facilities Safety Review Committee meeting minutes.~~

B. Record Retention - Life of Plant

Records relative to the following items shall be kept in a manner convenient for review and retained for the life of the plant.

1. ~~Records of a complete set of as built drawings for the plant as originally licensed and all print changes showing modifications made to the plant.~~
1. Records of offsite environmental monitoring surveys.

5.6 Plant Reporting Requirements

In addition to reports required by applicable regulations, Consolidated Edison Company shall provide the following information:

A. Semi-Annual Operating Report

A Semi-Annual Station Operations Report shall be prepared *as part of the semi-annual report required in Appendix A* and submitted to the Director, Directorate of Licensing, USAEC, Washington, D. C. 20545 within 60 days after the end of each reporting period in accordance with the additional requirements of Appendix B to said license. The report shall provide the following information (summarized on a monthly basis) and shall cover the six-month period, or fraction thereof, ending June 30 and December 31. The due date for the first report shall be calculated from the date of initial criticality.

1. Non-Radioactive Effluent Releases

Information relative to the quantities of liquid, gaseous and solid non-radioactive effluents released from the plant and the diluted volumes used in maintaining the releases within the limits of appropriate regulations shall be provided as follows:

a. Chlorination of Cooling Water

-The dates on which chlorination was performed.
-Amount of sodium hypochlorite consumed during each chlorination.
-Concentration of sodium hypochlorite used.
-Analytical results of chlorine tests.
-Cooling water flow rate during chlorination.

b. Chemical Discharges and Water Quality

-Dates and times at which samples were taken and analyzed in accordance with Table 2-1.
-Analytical results of tests performed in accordance with Table 2-1.

c. Thermal Discharges

-Total thermal energy in Btu released through the discharge outfall.
-Maximum and average release rate of energy through the discharge outfall in Btu per hour.
-Data on ~~continuous~~ temperature measurements at the inlet and outlet of the condensers ~~and the excess temperature above ambient upon discharge into the river~~.

d. Calculated flow rate per intake screen, specifically indicating the dates when reduced flow takes place.

e. Measured head loss across the outer fixed screens prior to and immediately after screen wash.

f. Number of fish collected on the intake screens.

g. Amount of non-radioactive solid waste material collected (in cubic feet) and disposed of as solid waste in accordance with local regulations.

2. ~~Radioactive Effluent Releases~~

~~Results of sampling and analysis of all radiological samples taken in accordance with Section 3.9 & 6.6E. Appendix A of the Technical Specifications and Section 4.2 on radiological environmental monitoring shall be summarized on a quarterly basis following the format of Table 5-1 for inclusion in the semi-annual report. In the event that some results are not available within the 60-day period, the report shall be submitted noting and explaining the reasons for the missing results. The missing data shall be submitted as soon as possible in a supplementary report. Environmental monitoring data shall include:~~

a. ~~For each medium sampled during the six-month-period, the following information shall be provided:~~

   (1) ~~Number of sampling locations~~
   (2) ~~Total number of samples~~
   (3) ~~Number of locations at which levels are found to be significantly greater than local backgrounds.~~
   (4) ~~Highest, lowest, and the annual average concentrations or levels of radiation for the sampling point with the highest average and description of the location of that point with respect to the site.~~
   (5) ~~Method of measurements~~

b. ~~If levels of plant contributed radioactive materials in environmental media indicate the likelihood of public intakes in excess of 3% of those that could result from continuous exposure to the concentration values listed in Appendix B, Table II, Part 20, estimates of the likely resultant exposure to individuals and to population groups, and assumptions upon which estimates are based shall be provided. (These values are comparable to the top of Range I, as defined in FRC Report No. 2.)~~

c. ~~If statistically significant variations in offsite environmental concentrations with time are observed, and are attributed to plant releases correlation of these results with effluent releases shall be provided.~~

B. Reporting Requirement - 24 Hours

Events requiring notification within 24 hours (by telephone or telegraph) to the Director of Regulatory Operations, Region I, followed by a written report within 10 *working* days to the Director,

Directorate of Licensing, USAEC, Washington, D. C. 20545; with a copy to the Director of Regulatory Operations, Region I:

1. Abnormal Environmental Occurrence as Specified in Section 1.

   The written report, and to the extent possible, the preliminary telephone or telegraph report, shall describe, analyze and evaluate the environmental effect and outline the corrective actions and measures taken or planned to prevent recurrence of events above.

C. Reporting Requirement - 10 Days

A written report shall be submitted within 10 *working* days to the Director, Directorate of Licensing, USAEC, Washington, D. C. 20545, with a copy to the Director, Region I, Regulatory Operations Office, of any event previously reported under the provisions of 5.6.b. above. The written report shall describe the event, determine the cause of the violation, analyze and evaluate the implications, and prepare an outline of the corrective measures taken or planned to prevent recurrence. In addition, the report shall relate any violation of these specifications to any significant environmental impact.

D. Changes to the Plant or Procedures

A written report should be forwarded to the Director, Directorate of Licensing, USAEC, Washington, D. C. 20545 with a copy to the Director, Region I, Regulatory Operations Office, in the event of:

1. Proposed changes to the plant that would result in more severe environmental impact than evaluated in the Environmental Report and the Environmental Statement should be submitted for AEC approval. These changes do not preclude making changes on short notice that are significant in terms of decreasing the adverse environmental impact.

2. *Major* changes to environmental monitoring equipment or procedures.

3. Changes or additions to permits and certificates requested by Federal, State, Local and Regional authorities for the protection of the environment. When submittals of the changes are made to the concerned agency, the copy shall be submitted to the AEC as noted above. The report shall include an evaluation of the impact of the change.

4. Request for approval of changes *in the limiting conditions for operation* in the environmental technical specifications should be submitted to the Deputy Director of Reactor Projects, Directorate of Licensing, USAEC, for prior review and authorization. The request shall include an evaluation of the impact of the change, including a supporting benefit-cost analysis.

E. Special and Non-Routine Reports

1. Non-Radiological

A Progress Report shall be submitted within ~~90~~ *180* days after completion of six-month research studies to the Director, Directorate of Licensing, USAEC, Washington, D. C. 20545, describing activities of the Ecological Survey Program for the prior six-month interval. Information to be presented will include the following:

a. Effects of chlorine and other chemical discharges on the ecosystem of the Hudson River.

b. Effects of reduction in frequency of chlorination and concentration of free and combined chlorine on plant operation.

c. Thermal plume model verification and mapping (near and far field).

d. Ecological effects of thermal discharges.

e. Potential reduction in dissolved oxygen through the plant.

f. An assessment of performance of fish pumps as installed.

g. Ecological effects of entrainment of organisms.

h. Evaluation of head loss across the fixed intake screens as a function of ~~velocity through the screens and~~ fish collected.

i. Ecological effects of fish impingement.

Upon completion of the environmental surveillance studies as described in Section 4.1.1, a final summary report will be submitted within 6 months of completion of research studies to the Director, Directorate of Licensing, USAEC, Washington, D. C. 20545.

In addition, other semiannual and annual progress reports based on environmental studies being carried out on the Hudson River in conjunction with other power facilities shall be made available to the Director, Directorate of Licensing, within a reasonable period of time.

2.--Radiological

a.--If levels of radioactive materials in environmental media indicate that the resultant dose to an individual from these levels could equal or exceed 10 mrem/yr, estimates of the resultant doses to individuals and critical population groups, and the assumptions upon which the estimates are based shall be provided.

If levels of radioactivity in an environmental medium sample indicate that the resultant dose to an individual from these levels could equal or exceed 40 mrem/yr, a report will be made to the appropriate Commission Regulatory Operations Office within 24 hours by telephone or telegraph, and a plan will be submitted within one week to determine the cause of the elevated levels and to reduce the doses to the design objective.--For example, if individual charcoal filters show I-131 concentrations in air of 2.6×10^{-12} $\mu Ci/cm^3$ (2.6 pCi/m^3) or greater (1.1×10^{-14} uCi/cm^3 if the milk pathway is involved), or if individual milk samples show I-131 concentrations of 19×10^{-9} $\mu Ci/cm^3$ (19 pCi/l) or greater, the results will be reported within 24 hours along with a plan to determine the cause of and to reduce these levels submitted as above.

b.--If samples of environmental media collected over a calendar quarter show total levels of radioactivity that could result in accumulated doses to an individual of 2.5 mrem for that quarter, the results shall be reported and a plan submitted and implemented within 30 days to limit conditions so that the annual dose to an individual will not exceed the design objective.

If samples of environmental media collected over any two calendar quarters show total levels of radioactivity that would result in accumulated doses to an individual of 3.8 mrem in thos two quarters, the results shall be reported and a plan submitted and implemented within 30 days to limit conditions so that the annual dose to an individual will not exceed the design objective.

e. ~~If such levels as discussed in (b) and (c) can be definitely shown to result from sources other than the licensed plant (e.g., from testing of nuclear devices) by similar concentrations found in "background samples" - i.e., samples that could not be affected by emission from the licensed plant, this reporting action need not be taken. Justification for assigning high levels of radioactivity to sources other than the plant must be provided in the report.~~

d. ~~If statistically significant variations of offsite environmental radionuclide concentrations with time are observed, a comparison of these results with effluent releases shall be provided.~~

e. ~~Individual samples which show higher than normal levels (25% above background for external dose, or twice background for radionuclide content) should be noted in the reports.~~

13.3.6

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