6/11/73

BEFORE THE UNITED STATES

ATOMIC ENERGY COMMISSION

TYPED

In the Matter of	)	
	)	
CONSOLIDATED EDISON COMPANY	)	
OF NEW YORK, INC.	)	Docket No. 50-247
	)	
(Indian Point Unit No. 2)	)	

THE STATE OF NEW YORK'S MEMORANDUM OF LAW IN SUPPORT OF ITS PROPOSED FINDINGS OF FACT

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It is clear at the outset that applicant has not met its burden of establishing that its present once-thru-cooling system will not have a substantial adverse impact on the environment of the Hudson River and contiguous waters. Since this is a proceeding where grave consequences may result to the fisheries of New York, applicant has the burden of establishing clearly that its plan, coupled with other power plants along the Hudson, will not have such an adverse effect on the striped bass, white perch, and other indigenous species. The scientific evidence submitted by the Regulatory Staff and the HRFA indicate that 30% to 50% of the annual striped bass population would be destroyed by the operation of applicant's once-thru-cooling system

at Indian Point 2. Applicant's five-year study is a request, it seems, to play Russian roulette with the natural resources of the People of New York State.

Under § 11-0105 of the Environmental Conservation Law, the fish and game of New York belong to the State in its sovereign capacity for the benefit of all the people. This ownership is of long standing and deeply rooted in the common law. Geer v. Connecticut, 161 U.S. 519 (1896); Barrett v. State of New York, 220 N.Y. 423, 116 N.E. (1917). These fish are a natural resource of the State and an irreplaceable one, a source of food and of recreational enjoyment as well as a basis for employment in the commercial fishing, boating and other related industries. They do not belong to Con Edison or any other company choosing to operate a plant along the Hudson in such a way as to kill large numbers of them. The right and responsibility of the Legislature to regulate and restrict the taking of fish from the rivers and streams of the State, and even from private waters, has been exercised from the earliest days of the common law and sustained by both federal and state courts. See, e.g., Lawton v. Steele, 119 N.Y. 266 (1890), aff'd 152 U.S. 133; Barrett v. State of New York, supra; In re Fishway, 131 App. Div. 403 (3rd Dept. 1909).

The Attorney General is confident that the Federal government and its agencies will seek to act in accordance with the State in its responsibilities to protect the Hudson's fisheries. And there is no doubt on this record that the utilization of a once-thru-cooling system at Indian Point 2 will seriously undermine the Environmental Conservation Law and frustrate State efforts (such as the 1972 Environmental Bond Issue) to clean up the waters of the Hudson River.

The State sees no justifiable reason for permitting the applicant to continue to irreparably damage, for decades, the public's fish resources, especially when there is a feasible and practical alternative to once-thru-cooling, i.e., closed-cycle cooling. It is one thing to experiment with one's own property, quite another to engage in experimentation that will inevitably damage public property. And the only justification offered for this is that the applicant is not convinced that the ecosystem will be substantially harmed.

It is important to remember that the applicant has been operating its once-thru-cooling system at Indian

Point 1 since 1961. It has had over a decade to conduct studies that would have been of benefit to this Honorable Board, but failed to do so. Furthermore, the five-year study now being undertaken by applicant is inadequate and will not add any meaningful data to what has already been accumulated and submitted to the Board at the Indian Point 2 hearing. As is detailed in the State's findings of fact, the proposed study, first of all, does not contain mechanisms which can clearly associate a decrease in the striped bass population with the actual operations of the plant. Second, the study period (which ends in 1977) is too short to measure the effect of Indian Point 2 on the striped bass generation of 1974, since that generation will not return to the estuary before 1979. Third, there is no basis in the record for applicant to allege, as it does on page 12 of its Memorandum, that damage to the estuary's fisheries can easily be repaired by "restocking" and "other remedial measures." Fourth, such a delay not only would produce little meaningful data but also would postpone the construction of a closed-cycle cooling system for another ten years or more. Even if the applicant, acting on data received in 1979, decides to construct a closed-cycle system, at least nine generations of striped bass will have been exposed to the grave stresses

caused by Indian Point 2 before the closed system becomes operational.* The State cannot agree to permit its natural resources to be devastated by applicant merely for the sake of compiling data of dubious significance. We know enough now, after over a decade of fish kills at Indian Point, to demand that this new plant be licensed only if the applicant constructs cooling towers to end this destruction.

It is interesting to note that applicant does not even propose to cease intake operations, even if its own study shows substantial damage, but rather fully intends to continue operations throughout the period of cooling system construction. Such a position is totally unacceptable and potentially disastrous to our fisheries.

Furthermore, Con Edison has failed to spend sufficient money on research and development aimed at minimizing the environmental impact of its operations, even when requested to do so by a State agency, the Public Service Commission. In Case 26105, 12 NYPSC 630 (March, 1972), the Commission criticized Con Edison for spending

*The applicant admits on page 7 of its Memorandum that it may request an extension of the September 1981 date for the once-thru-cooling, resulting in even further delay.

substantially less on research and development in previous years (1970 and 1971) than had been allocated for that purpose in the company's estimated budget. In 1972, even after the Commission's criticism and the granting of a substantial rate increase, the applicant spent 13% less on research and development than the amount contained in its own 1972 estimated budget. Such facts do not inspire confidence in applicant's proposed Indian Point environmental study.

In addition, there are substantial cost increases likely to be incurred by applicant if construction of a closed-cycle cooling system is deferred for several years. The first and most obvious cost will be the inevitable rise in the costs of construction the longer such construction is delayed. Second, a civil action is pending in New York's highest court, the Court of Appeals, to determine applicant's liability under § 11-1321(1)(b) of the Environmental Conservation Law, which prohibits the taking of fish from a body of water by drawing off the water. If the State's contentions are upheld, the applicant will be liable for a penalty of $10 for every fish that it takes from the river. This, incidentally, is a mandatory penalty; a court does not have discretion to decrease the amount. Needless to

say, such an operating cost would be prohibitive unless Con Edison takes steps to halt its decimation of Hudson River fish.*

Applicant's Memorandum abounds with the unsubstantiated assertion that the cost of a closed-cyle system must fall squarely on the heads of the public (Memorandum, pages 3, 4, 5). Fortunately, this assertion is not necessarily so. It is for the New York Public Service Commission to decide, after a public hearing, whether Con Edison is entitled to a rate increase. At hearings in 1972 and 1973, the Attorney General and other public and private groups objected to the granting of such increases without substantial changes in applicant's regressive rate structure, capital outlays, and methods of operation. At present, applicant encourages excessive use of electricity by charging less for additional units consumed. The State is encouraged by recent rulings of the Public Service Commission, and expects that the cost of cooling towers will not automatically be charged to the consumer, but will be related to a more equitable and progressive rate structure and a more efficient management of the utility itself.

*The lower courts which have ruled on this case so far have held that the statute is applicable to Con Edison's operations at Indian Point. The appeal turns on whether the statute requires proof that applicant intended to take the fish and whether its asserted use of the best available technology is a defense.

The record shows that any environmental disadvantages associated with closed-cycle cooling are trivial compared to the dangers of the flow-through system. The evidence submitted by the Regulatory Staff and the intervenors establishes beyond peradventure that natural draft cooling towers would have detrimental environmental effects, except possibly the subjective test of "aesthetics" -- a straw man raised by Con Edison since numerous power plants both in this country and Great Britain have had cooling towers for years.

The State is firmly opposed to applicant's use of the Hudson River to test its strange theories about species "rearrangement." State law and policy are designed to preserve natural indigenous species, not juggle them according to the views of private interests. Applicant has offered no credible evidence that any change in this State policy is needed in the public interest. On the contrary, the evidence presented indicates the gravest danger to one of the State's most commerically profitable fish species, the striped bass -- a species which is irreplaceable whether or not the applicant attempts to cloak its destruction with euphemistic pseudo-scientific cant.

On both the Federal and State levels, several acts have been passed in recent years to <u>protect</u> existing natural

systems and species (NEPA, the Conservation Amendment to the New York Constitution [Article 14 § 4], as well as laws protecting endangered species [16 U.S.C. § 668aa, et seq.; N.Y. Agriculture & Markets Law § 358-a]). They seek to minimize the effects of human intervention. The applicant's proposals in this area are retrogressive.

Further evidence of the State's concern for these fish is found in the Environmental Conservation Law sections establishing state ownership of all fish in public areas (§ 11-0105), prohibiting the killing of protected fish (§ 11-0107), and levying a $10 per fish fine for all fish taken by the drawing off of water (§ 71-0925[4]).

It is the firm policy of New York State to protect and maintain indigenous species within their respective ecosystems. The State Legislature has directed through the Fish and Wildlife section of the Department of Environmental Conservation that the present ecological balance be preserved by the propagation and maintenance of species within their habitats (see § 11-0305 of the Environmental Conservation Law).

Many laws and regulations have been enacted to effectuate this policy. The State regulates size limits

of catchable fish, type of gear, fishing seasons, geographic area, and bait to preserve the fisheries as they exist today (see Article 11 of the Environmental Conservation Law). Policies exist to actually control or eradicate non-indigenous predatory species such as the sea lamprey. The State has been acquiring and protecting wetlands to guard nursery and forage areas necessary for the maintenance of a viable fishery (see §§ 11-2101 and 11-2307 of the Environmental Conservation Law). Recently special efforts have been made to protect specific genetic strains of wild trout. In 1972, the People of the State ratified a $1.15-billion bond issue to further protect the resources of the State, much of which will be applied to the protection of the Hudson River and its fisheries. It would undermine the citizens' enormous financial stake in the Hudson for the State to permit this widespread disruption of its ecosystem. During the last ten years the State has been pursuing, at enormous expense, the goal of clean water in the Hudson, which in turn will greatly benefit fish life in the river. The State's Pure Waters Program and the recent bond issue have highlighted citizen demands for a river capable of recreational usage, water supply, and fish life. To allow disruption of the fishery by a once-thru-cooling system at

Indian Point would render meaningless much of this vast expense already incurred by Federal, State and local government to protect the resources of the Hudson.

It is the Attorney General's considered and firm opinion, based on extensive scientific documentation, that once-thru-cooling at Indian Point 2 would have a devastating environmental impact on the Hudson River estuary and, indirectly, on Long Island Sound and the Atlantic Ocean as well. Certification of Indian Point 2 with wasteful once-thru-cooling would amount to authorization for Con Edison to interfere with the fishing industries of sister States. The danger to the striped bass fishery due to the entrainment of fish eggs and larvae, as documented by the AEC staff, will likely result in the loss of 30% to 50% of the annual reproduction of that species. These staggering projections compel the State of New York to insist that Con Edison install a closed-cycle cooling system at Indian Point 2.

The applicant should not be given until January 1, 1978 to install cooling towers at Indian Point 2. Serious environmental damage to the State's fish resources would result if Con Edison is allowed to employ the once-thru-cooling system at Indian Point for such a protracted period.

The Staff's own analysis demonstrates the potentially disastrous effects of once-thru-cooling on the annual striped bass population in the estuary. The Attorney General therefore recommends that Con Edison be required to install cooling towers at Indian Point 2 on or before January 1, 1977. In the interim while the plant is operating with the flow-through system, the Commission should direct that any shutdowns for repairs or refueling should be timed to coincide with the striped bass spawning season and the high impingement season. Extra work shifts should be employed if necessary to speed up completion of the installation. If applicant complains that overtime work will increase costs, it should be remembered that a longer time schedule will inevitably incur inflation costs. The State assures this Board that there will be no unreasonable delay in the issuance of necessary State permits for a closed-cycle system in view of the serious threat posed to the Hudson River fisheries by the present mode of operation.

The Attorney General urges the Board to consider the cumulative effect of aother Hudson River power plants in

determining the environmental effect of Indian Point 2 on the estuary. Soon there will be nine power plants on the Hudson (in addition to the proposed Storm King hydroelectric pumped-storage project) which will, if Con Edison has its way, be drawing off huge quantities of water from the river resulting in thermal pollution as well as heavy egg and larvae entrainment and fish impingement. The ultimate environmental impact of Indian Point 2, when considered as part of the total phenomenon, thus assumes even graver proportions.

The State will not allow a single private utility, to thus experiment with the fish life of the highly complex Hudson River estuary. Con Edison's proposals are an invitation to destroy one of the very few highly productive estuaries left in the Middle Atlantic region which contribute to our fishery stocks. Extensive damage to the fisheries will have detrimental effects throughout the State of New York, from the fishing industry to the consumer. Disruption of the Hudson River estuary is likely to have effects throughout the East Coast, impairing commerical and sport landings from Maine to the Chesapeake. This radical suggestion to tamper with an entire ecosystem and then expect to artifically restore it carries with it the risk of injury to the resources of other States and the Federal Government, which have not

participated in these proceedings or given their consent to any such experimentation.

Based on all of the evidence submitted, the State of New York respectfully requests this Honorable Board to require the installation of a closed-cycle cooling system by January 1, 1977, at Indian Point 2 as a condition for the granting of an operating license to the applicant.

Dated: New York, New York
June 11, 1973

Respectfully submitted,

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Title Page

Appendix To Memorandum Of New York State Attorney General

This Appendix summarizes the findings of fact presented by the Attorney General of the State of New York.

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Environmental Engineer

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Assistant

Appendix

I Matters in Controversy and Recommendations

II Value of the Fisheries

III Stock of Striped Bass

IV Contribution From Other Estuaries

V Miscellaneous Effects

VI Research Program

VII Hatcheries

VIII Closed-Cycle Cooling System

Appendix

I. Matters in Controversy and Recommendations

In weighing the cost of a cooling tower against the environmental damage its absence will cause, the Board must first make decisions on creditability of competing scientific predictive models and hypotheses. In general, the State urges the Board to adopt the conclusions of the AEC staff concerning the extent and criticalness of the impact Indian Point 2 is likely to have on Hudson River biota, particularly striped bass. This facility, when considered in the context of the rapidly growing use of the Hudson River by power plants, poses a threat too imminent to delay commencement of remedial measures while yet another study is made. These reasons enumerated briefly in the Appendix and spelled out in greater detail in the Findings of Fact indicate the position the Board should take toward the environmental issues discussed in the record. The State urges the Board to order Con Edison to complete construction of natural draft cooling towers by January 1, 1977.

Appendix

II. Value of the Fisheries

The combined sport and commercial fishing industries provide the most available figures on the annual worth of the striped bass fish population. The total value of Hudson River bass is estimated to be $13-million. This figure is obtained by calculating the portion of the value of the total commercial Mid-Atlantic catch which can be attributed to Hudson River striped bass. To that figure is added an estimate of the amount that sport fishermen spend on equipment, transportation and other expenses associated with angling for striped bass.

In addition to monetary values, all parties agree that the continued existence of striped bass in the Hudson River is essential in many other ways. Not only naturalists and fisherman but consumers and the public in general have a stake in preserving an ecological balance in the Hudson which has existed for centuries. Both the State and Federal Governments have translated this concern into legislative policy in a series of conservation acts, such as NEPA (P.L. 91-190 1970) the New York Environmental Conservation Law (§ 11-0105, et seq.) and the Environmental Protection Amendment to the New York State Constitution (Article 14, § 4).

The loss of striped bass will impair these interests permanently and irrevocably.

Appendix

III Striped Bass

To determine the overall effect of Indian Point 2 on the striped bass population of the Hudson River, the Board considered the following points:

A. The Life History of the Bass

Striped bass spawn in the upper reaches of the Hudson. Both the striped bass eggs and the juveniles in the planktonic stage float past the plant and are susceptible to the flow-through cooling system.

B. The Hudson River

The Hudson River flows south emptying into the Atlantic. Salt from the ocean moves up the river in a wedge formation, creating a salt front, often in the vicinity of the plant. Soon there will be power plants/all along the river, drawing off water for their cooling systems.

C. Operational Plant Impacts

1. Impingement

The major effects of Indian Point 2 occur when water is drawn off from the river and circulated through the cooling system. Impingement happens when larger fish are killed as they collide with the screens in front of the intake pumps. Most of the fish killed by this process are white perch and striped bass.

2. Entrainment

Many species of fish in the egg and larval form are small enough to slip through the 3/8" mesh of the screens and are sucked into the cooling water intake. 30 to 50% of the organisms passing by the plant are so entrained. The mechanical, thermal and chemical stresses from passage through the cooling system causes up to 100% mortality.

3. Miscellaneous Effects

The plant also subjects the Hudson estuary to thermal and chemical discharges, dissolved oxygen reductions, and other miscellaneous effects. (See Chapter V).

D. Derivation of Population Models

In order to quantity one of the major plant impacts, recruitment reduction on a yearly basis for striped bass, Con Edison, the Staff, and HRFA introduced predictions based on mathematical analysis. This analysis was based on hydraulic and biological processes of power plant operations thought to be controlling the reduction of this species in the estuary.

1. Hydraulics

Con Edison utilized a classical, one dimensional, segmented, mathematical transport model with longitudinal dispension coefficients to account for all particle movements except downstream fresh water flow. The Staff felt that explicitly accounting for the particle movements by variable input values represented a more useful method. Implicit in the staff analysis is a "circulation belt" near the salt front which raised the estimates of entrainment impact. HRFA, through Mr. Clark, utilized observed egg and larval concentrations directly to calculate the impact. The Board was more convinced by the staff approach in this regard.

2. Biological Processes

Con Edison reduced its predictions of impact by assuming that the concentration of organisms entrained in the cooling water's flow would be less than the average organism concentrations observed in the river and that less than 100% mortality would occur in the plant. Fish population compensation in the first year of life also reduced the Con Edison estimates of impact. The Board concludes that the Staff approach in this matter represented a more reasonable approach - no concentration reductions, 100% mortality and no compensation. The Staff also did not consider the

impingement of striped bass in their model, which biased their figures downward. Mr. Clark assumed the same conditions as the Staff but included impingement.

E. Reliability of Model Predictions

The Con Edison and Staff models were tested with data from Carlson-McLann to verify their capability to predict observed larval distributions. Despite their divergent methods, both models performed nearly the same in reproducing observed phenomena. So the Board judges them as equal in respect to this criteria. Mr. Clark could not verify his model's predictions.

Overall, the Board felt historical data generally bore out the Staff analysis.

F. Conclusions

The predictions of the various models were difficult to compare:

Con Edison	-	17%
The Staff	-	26.8%
Mr. Clark	-	30%

Appendix

IV. Contribution From Other Estuaries

The Delaware estuary is too polluted to be a major contributor of striped bass to the mid-Atlantic fisheries. Of the remaining two possible sources, Chesapeake Bay has traditionally been favored over the Hudson by experts, among them Con Edison's Dr. Raney. However, more recent tag and recapture studies have noted the absence of virtually any Chesapeake Bay two-year-old striped bass in the mid-Atlantic. Since they are the major recruits to the fishery, this leaves the Hudson as the only remaining source for the age group on which the total population is dependent.

In addition, correlation studies show an exact duplication of catch curves for the Hudson and mid-Atlantic, when the latter's figures are moved back five years to account for the lag due to the striped bass life cycle. This correlation was not duplicated in comparisons of Chesapeake Bay and Atlantic catches, nor with comparisons of mid-Atlantic to Hudson River catches. Outside factors, such as compensation or variances in the fishing effort, that might otherwise account for the correlation, have not been shown to be applicable to this situation.

The proponents of the Chesapeake Bay theory of contribution suffered from a lack of assurance (in Dr. Lawler's case) and a lack of analysis of tag and recapture statistics on the part of Dr. Raney. The record confirms the staff's conclusion that the Hudson River is accountable for as much as 80% of the population of the mid-Atlantic fishery.

Appendix

V Miscellaneous Effects

Material presented in testimony and the Final Environmental Statement isolated several miscellaneous effects traceable to power plant operations on the Hudson River. Other than impact from other power plants, these effects were not quantified.

A. Multi-Plant Effects

1. Striped Bass

Presented below are the percentage of recruitment reduction figures relied upon by the Board, although they are not exactly comparable:

Con Edison	5-30%
The Staff	38-64%
Mr. Clark	56%

2. Heat load

The Board relied on the following figures for the heat load accumulated by the river from the various power plants:

Con Edison	1.5° F maximuim increase
The Staff	6° F " "

Mr. Clark also indicated that damage might occur to the biota at 6° F high ambiant temperatures in the river.

B. Impingement of White Perch

Up to 5.2 million white perch (depending on which of the widely differing estimates of the total number of fish impinged is employed) are expected to be impinged and killed by Indian Point yearly. The Board believes this reduction could deplete the total stock in the Hudson and might thereby affect the populations of their predators, which includes striped bass. Impingement of fish is also against New York State Law.

C. Other Effects

Inadequate information was presented in the record to quantify the impacts associated with disruption in other fish, zooplankton, and phytoplankton populations due to chemical discharges, thermal additions, and organism entrainment mortality.

Appendix

VI. Research Program

A. Mechanisms

Con Edison proposed that a research program now underway at Indian Point should be concluded before the commencement of any cooling tower construction. The crucial flaw in the research plan Con Edison proposes to pursue is that vis-a-vis the impact of once-through-cooling on striped bass recruitment, the program design fails to include explicit causal mechanisms. The data it accumulates, therefore, cannot be related back to plant operation. Although its architect, Dr. McFadden, admits the need for such associative hypothesis, his subsequent testimony fails to present any.

B. Data

Secondly, the study intends to gather information in seven areas and compare it with similar statistics gathered before the plant's existence. However, there is doubt whether the earlier data is adequate to support any detailed comparisons. Also, the study

will end too early in the fish's life cycle and generational history to provide meaningful information on some of the criteria.

C. History

Thirdly, Con Edison's past studies have been so inadequate as to raise questions about its desire or ability to manage a comprehensive scientific research project. Moreover, the past studies of striped bass conducted for more than twenty years in an estuary similar to the Hudson, the San Joaquin, failed to deliver universally accepted scientific findings.

D. Conclusion

For these reasons, the Board finds that this study project is inadequate and does not justify a delay in the construction of cooling towers; nor does it excuse a continued interference with striped bass while the plant operates under its current flow-through system.

Appendix

VII. Hatcheries

Con Edison proposes to remedy the impact of Unit 2 by restocking the river with hatchery fish. However, the following points undermine the credibility of this method:

(1) The uncertain state of the art of raising striped bass in hatcheries makes it unlikely that adequate numbers could be regularly produced to replenish the stock. Con Edison's own expert admits both that he "knows nothing" of the Hudson and that knowledge of the river and the species (which would take at least 3 years to obtain) is crucial to success of the project. Previous efforts have largely been successful only in fresh, not estuarine waters and with a southern stock of the species. There is no evidence that such experience can be transferred to the Hudson.

(2) The magnitude of the effort necessary to keep the striped bass population up to their pre-Unit 2 numbers makes the plan highly impracticable. All experts conclude that natural reproduction is more efficient than hatchery raising, with the survival rate of fish raised in the latter

condition estimated to be as low as .8%. Yet Unit 2's taking might obligate the company to replenish 50% of the striped bass population, clearly impossible under the circumstances.

(3) Finally, nothing is known of the impact that reductions of other Hudson River species (which the company does not even propose to replace) may have on striped bass numbers.

For these reasons, the Board holds that the company has failed to demonstrate that hatcheries are a reasonable or adequate way of replacing striped bass decimated by Unit 2.

Appendix

VIII. Closed-Cycle Cooling System

All the parties agreed that the adverse environmental effects of a closed-cycle cooling system are minimal. It was on the extent of the real obstacles -- cost and time necessary for completion -- that they disagreed.

Other utilities have constructed such a facility in 2 1/2 to 3 yeras. Con Edison's own engineer acknowledged that it could be done in 3 years. The company is presently designing a tower, so it is already into the construction schedule. Therefore the Board concludes that it is reasonable to demand that Unit 2 have a completed closed unit system by January 1, 1977. Upon showing of a good faith effort and extenuating difficulties, the company may ask for an extension of time for completion to January 1, 1978. Otherwise, the plant may not operate without a closed-cycle cooling system after January 1, 1977.

Swift completion of the plant will also help minimize construction costs, attributable to inflation and the ever-increasing labor costs of construction. Even without

these cost factors, the staff, HRFA and EDF arrived at substantially lower cost estimates than Con Edison's $20-million per year figure. The company, based on its greater experience with such construction, might be presumed to have more accurate estimate. However, its estimate includes a vague but sizable (20%) contingency factor which is unassociated with the particular project. Thus, the credibility of the total is undermined.

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Chapter I

Matters in Controversy and Recommendations

At this juncture, the Board is to decide, under NEPA and the AEC regulations implementing that Act, under what conditions Con Edison may receive an operating license for its Indian Point 2 plant. Both the applicant and the Staff have prepared environmental reports on the subject. Intervening parties - the Hudson River Fisherman's Association and the State of New York - have filed briefs in opposition to the applicant.

Con Edison asked for an license to engage in 50% testing, while it engages in research programs to gauge the effect of such operations on fish in the Hudson. Unless Con Edison asks for an amendment to the license, it is obliged to construct cooling towers by Sept. 1, 1981. [Con Edison's Proposed Finding of Fact, March 17, 1973, Appendix at 4]. The State of New York, the Staff and HRFA maintain that completed research indicates sufficient danger to Hudson River populations, particularly striped bass, to require the immediate construction of cooling towers. The Staff and Parties were also asked to consider the impact of Indian Point 2 in the context of the rapid growth of power facilities along the River. The plants at Bowline Point and Roseton will draw off 1,424,000 gallons of water per minute and increase water temperature by 13.5° and 15.4° before returning it to the river. When the environmental

costs are coupled with the multi-million dollar fines Con Edison may be liable for under New York Law [§ 71-0925(4) of the Environmental Conservation Law] for destruction of these fish, the construction of a closed-cycle system becomes an absolute necessity.

The State agrees in general with the conclusions of the Staff and only differs in suggesting an accelerated construction schedule. The State agrees with the Hudson River Fisherman's Assocation and the Environmental Defense Fund that Jan. 1, 1977, is an reasonable date by which to demand completion of the closed-cycle cooling system. The State also accepts HRFA and EDF's changes in the license conditions requiring the maintenance of a timeable for permit applications.

Chapter II

Value of the Fishery

On several occasions, the Staff found that the incalculable value of the Hudson fishery, and particularly the commercially-valuable striped bass population, justified immediate installation of a closed-cycle cooling system. [XI-26, 28, 7Y FES; Oestmann on Impact, April 6, 1973 at 3; Tr. 6988.]

A. Non-Quantifiable Considerations

A significant element of the worth of the striped bass population which the operation of this plant without cooling towers will inevitably reduce is the non-quantifiable value that free-swimming fish evoke among people. Apart from the importance of the striped bass to the economy of New York and sister States, it has an aesthetic and biological value as well. See testimony of McFadden. [Tr. 9418, *et seq.*].

B. Monetized Values

The fishery has a substantial monetary value, though the extent of that sum was contested. Several

factors contribute to the controversy. Firstly, no one knows the total number and poundage of striped bass caught because the recreational anglers' share is difficult to calculate. Also, the exact contribution of the Hudson estuary to fisheries other than the mid-Atlantic is unknown. [Tr. 8823, 9862, 9181.] It is agreed that the Hudson's annual contribution to the catch of sport and commercial fishermen runs to several million striped bass a year. [Ibid., Tr. 8560 et seq.]

Secondly, there is no clear method of giving a dollar value to the catch, even once its total is known. The commercial fishermen's take may be calculated on the price per pound. But it is extremely difficult to put a price tag on fish caught by sportsmen. It was also noted that striped bass fishing is a sport enjoyed by the average person and not confined to the wealthy. [Tr. 9647.]

One approach is to analyze the size of the catch and the expenditures associated with it. That method, when added to the commercial total, produced a $13-million figure for striped bass losses attributable to Unit 2. [Clark on Effects of Indian Point, Oct. 30, 1972 at 2-3; Clark Redirect, Feb. 12, 1973 at 17-18.] This is a

conservative figure and does not include the loss to the New England fishery which would result, nor for the loss of profits due to anticipated striped bass population increase which would occur but for once-thru-cooling at Indian Point. Con Edison offered figures of the same sort as Clark's and another set whose basis was unexplained. [Lawler, Tr. 9635-36; Tr. 9647-48.]

C. Conclusions

In reality, it is impossible to assign a strict dollar value to the striped bass fisheries. However, that does not mean their worth is not real and substantial. The loss once-thru-cooling at Unit 2 would impose, when multiplied over the years, fully justifies the imposition of an order to build a closed-cycle system at the earliest possible date.

Chapter III

Impact of the Plant on Striped Bass Introduction

The Hudson estuary is an important spawning and nursery ground for striped bass. Due to its commercial, sport, and aesthetic value [see Chapter II and Chapter IV] this species has been studied in greater detail than other fish found in the estuary. The parties have all shown concern over the state of the striped bass population and have attempted to quantify the impact the operation of the plant will have on this species.

This Chapter has been organized into sections which deal with the aspects critical to the evaluation of plant impact on striped bass. These are:

A. Life Cycle of the Striped Bass

B. The Hudson Estuary

C. The Cooling System Effects on Striped Bass

   1. Impingement

   2. Entrainment

D. Derivation of the Population Impact Assessment models

   1. Hydraulics

   2. Biological Factors

E. Reliability of the Estimates

F. Conclusions

A. Life Cycle of Striped Bass

The contours of the life of striped bass are generally agreed upon. They are anadromous fish, returning from the ocean at the age of five to migrate upstream to spawn in fresh waters. This occurs in May and June when the water temperatures reach 50 - 70° F. [1-FES-V-40]. After about 2 days, the free floating eggs hatch into equally drifting yolk-sac larvae. Within 2 weeks they reach 6 or 7 mm lengths and begin feeding on zooplankton and moving diurnally through the water column. These young, called juveniles, remain in a planktonic stage for 6 to 8 weeks. During this time they drift toward the salt front and tend to concentrate there. [1-FES at XII-26]. After the planktonic stage, they move into shallow water, along the shore or on shoals. [1-FES-V-40; Clark on Effects of Indian Point, Oct. 30, 1972 at 5-6]. It is during this planktonic stage that the striped bass can be drawn through the plant with the cooling water flow.

These young-of-the-year fish winter in the southern part of the estuary. It is then that the fish larger than 40-45 mm are vulnerable to the intake waters at the plant. [1-FEs at A-II-21-23, V-26-32].

At age 2 or 3 the striped bass migrate to sea to repeat the process.

B. The Hudson Estuary

The Hudson River drains a 13,370 square mile watershed as it flows south to the Atlantic from the Adirondacks. The State of New York has taken great efforts to protect the quality of the water and the indigenous fish life. [Memo of the N.Y.S. Attorney General 1-FES at II-9-14].

In the record, the parties disputed some of the physical parameters associated with the Hudson River. The factors isolated by the parties to be of requisite importance were the following:

1. Monthly averages of fresh water flow during drought, mean, and wet years;
2. the magnitude of tidal flow at different portions of the estuary;
3. the location and shape of the salt front or wedge;
4. the circulation patterns in the vicinity of the salt front.

Although the first three factors were generally agreed upon, the fourth became the focus of intense controversy. Since much of the data defining these circulation patterns remains to be developed, the individuals using these data developed their own ways of simulating them. (See section on model derivation).

C. Cooling System Effects on Striped Bass

1. Impingement

The presence or absence of impingement inputs affected the results of the conflicting simulation models. The inclusion of impingement in Lawler's increased his predicted kill percentage from 28.61% to 30.64%, a factor of 7% consideration. [Lawler on Sensitivity, April 20, 1973] The absence of such in Goodyears' impeeds the comparison of the two, unless his results are increased correspondingly.

Lawler used an absolute number, 46,000, fish to represent the impingement factor [Lawler on Effects Oct. 30, 1973 at 64] The absolute number chosen is important. Although striped bass figure is a small percentage of the total number collected on the screens [I-FES V-30, Alevres on Impingement Feb. 5, 1973 at 16, Stipulation on Impingement] the actual number that do not survive is important to the prospects of the species on the whole. In order to evaluate Mr. Clark's figures, the Staff used an entrainment estimate of 190.000 [See Sec. E on Reliability herein]

However the actual number appears difficult to calculate because, although figures, ie the Staff's 4%, [I-FES at V-30], have been generated to represent the striped bass proportion of the totals impinged, there are no reliable estimates of the total number of fish likely to be impinged. Predictions range from less than a million by Con Ed [Alevres on Impingement, Feb. 5, 1973 at 1F] to 2-5 million by the Staff [I-FES iii] and 6 1/2 million by Clark, [Oct. 30, 1970 p. 45.]

2. Entrainment

By drawing off water from the Hudson, the open-cycle cooling system will entrain all planktonic organisms too small to be impinged. Associated with passage through the cooling system will be substantial mortalities to many of the organisms so entrained. [See Derviation Section]. The probability that a planktonic organism in the river passing the plant will pass through the cooling system depends on the fresh water flow; dry years having much higher percentages than wet years. [1-FES-V-22-V-26] The probabilities of entrainment is also dependent in a positive or negative way or any species specific circulation patterns the fish maintain. [1-FES-V-48, Lawler on Effects, Oct. 30, 1972, at 48-61] Factors such as these must be accounted for in any model purporting to quantify the numbers of organisms passing through the plant.

D. Derivation of the Population Impact Assessment Models

1. Hydraulics

In order to model the hydraulic transport mechanisms of an estuary, partial differential equations are usually used to describe distributions of material in 3 dimensions and with time [Goodyear Factors Re: Striped Bass April 9, 1973] 3 dimensional descriptions such as these are presently computationally intractable and necessitate accurate data on the details of tidal action, salinity mixing and river-specific current flows. Adequate data on these are not available. [Tr. 9260-9263] Therefore the Staff and Dr. Lawler simplified this analysis in different ways, but both arrived at a discreet segmented or compartmental approach to describe the actions of the river. By simplifying the analysis, potential sources of error were introduced into both simulations. Mr. Clark presented a description of the river hydraulic processes, but did not consider them directly in his predictions of the percentage of organisms entrained. The discussion which follows relates to the differences between the approaches of Dr. Lawler and the Staff and how errors are minimized in each. [Clark on Effects Oct. 30, 1972]

Lawler describes the mathematical model as an "unsteady state, one-dimensional, longitudinally segmented model, in which the basic mechanisms of transport are . . . net downstream movement of freshwater flow and . . . the net additional mixing and dilution of materials due primarily to tidal oscillation and salinity-induced density currrents." [Lawler on Entrainment, October 30, 1972 at 12] This model is adapted from an earlier model used by Lawler to predict concentrations of dissolved oxygen and salinity. [IBID at 12]

To move the organisms downstream and circulate them through each segment, the model employs the net fresh water flow and a longitudinal dispersion coefficient, E_L. E_L represents a term introduced to account for all movements within estuary not otherwise stimulated by the freshwater flow and varies from segment to segment depending on distance from the ocean. Lawler stated that the mathematical computation of the values other than freshwater flow is impossible at the present time. [Tr. 7760-61, 9261]

The following processes distribute any particles existant in a given segment in presently unquantifiable spatial and temporal directions:

1. Mixing due to tidal movement.
2. Circulation due to the presence of more saline water.
3. Mixing from temperature and non-uniform velocity gradients.
4. Miscellaneous circulations caused by man, the wind, eddy and molecular diffusion.

Lawler on Cumulative Effects, March 30, 1973 at III-8 to 9.

The coefficient as Dr. Lawler describes is the residue of a "manipulative mathematical process." [Tr. 7761.]

Assigning an absolute value of E_L to long segments such as the Croton or Peekskill segment represents a difficult task. In fact Lawler changed his value for E_L during the proceeding from 8 to 12 newer information [Tr. 7752, Lawler model April 5, 1972 - Oct. 30, 1972]

Dr. Goodyear's model, on the other hand, was developed specifically for the transport phenomena in the Hudson estuary and the existing data base. [1-FES-A-V-81] He broke the Hudson into compartments and then accounted for the movement of organisms within each compartment and between them. [Goodyear on Factors Re: Striped Bass, Ap. 19, 73 at 5] These units, unlike Lawlers were moved up and down the river with the tide. [Tr. 9257] This minimized the use of arbitrary mathematical terms to account for as-of-yet unquantified phenomena. He feared developing an overly-sophisticated mathematical model founded on inadequate information. [Tr. 9270-9273]

Within each compartment, Goodyear forecast organism movement based on a variety of assumed coefficients, which represented factors like the organism's own motive power and the action of salinity-induced currents. [Tr. 9242-9268]

The Clark model estimated the percentage of striped bass that would be eliminated as they passed the plant. He based it on the concentration of vulnerable larvae and juveniles reported by Carlson-McCann for 1966-1967. The abundance of each life history stage was averaged over the period of time that stage appeared near Peekskill. The plant withdrawal was based on the number of organisms contained in the number of cubic feet drawn through the plant during the same period of time. [Clark on Effects, Oct. 30, 1972]

2. Biological Factors

a. "f" Factors

Of the three models only the Lawler model presumes that the concentration of striped bass larvae is not equal to average concentration found throughout in the river. He presents three mechanisms by which he feels this concentration would be reduced in the vicinity of the intakes:

1. "f_1" is to account for data he feels shows higher concentrations of striped bass larvae away from the intakes.

2. "f_2" is to account for data he feels shows intake avoidance by older larvae and juveniles.

3. "f_3" is to account for data he feels shows the effects of organism drawn down by water withdrawn by the plant. [Lawler on Effects, Oct. 30, 1972, pp. 48, 60, 61.]

Although this analysis represents an eminently reasonable approach towards simulation of observed behavior of aquatic biota, insufficient evidence exists to substantiate his values for these figures.

The value for "f_1" was computed by assuming that the plant withdraws water from the upper east quadrant of the river, not from the quadrants near the bottom.

Through analysis of 1971 New York University data he determined the ratio between the concentration in the upper east quadrant and the concentration in the other quadrants. Generally this ratio became the value for "f_1". [Ibid. at 50-59.]

The error in the analysis stems from the boundaries of the quadrants. [Goodyear on Susceptibility, Feb. 22, 1973, Fig. 3.] Water for the plant is not withdrawn from the top of the water column, but essentially from the bottom. Also, testimony was introduced indicating that the actual values for the organism concentration in the upper east quadrants were not significant statistically from the other three quadrants he was comparing. [Lawler on Effects, Oct. 30, 1972 at 50-59; Griemsmann on Distribution at 1-3.]

The value for "f_2" was also disputed. "F_2" was based on differences Dr. Lawler felt he saw in organism concentrations near the intake compared to those in the upper east quadrant; i.e., the larvae wanted to swim away from the intake. Beyond the questionableness of the concept, testimony indicated that:

1. Sampling procedures in various locations differed. [Tr. 7358-62.]

2. Only one day of simultaneous samplings was undertaken. [Tr. 7103, 7104.]

3. No striped bass larvae or eggs were found on that day. [Tr. 7370.]

4. No statistically significant difference existed between intake concentrations and that of the upper east quadrant. [Goodyear on "F_2", Feb. 22, 1973.]

These four areas essentially invalidate the values Dr. Lawler assigned for "f_2".

Dr. Lawler lacked significant information on the value of "f_3" and therefore assumed it to be 1. [Lawler on Effects, Oct. 30, 1972.]

b. Mortality Rate in Condensors

The fourth F factor Con Edison introduced in its model to decrease anticipated fish kills was a figure for less than 100% mortality of fish passing through the cooling process. Con Edison obtained such a result from laboratory tests by Dr. Lauer simulating entrainment conditions and from a small number of field tests. [Lauer on Effects of Operations, Oct. 30, 1972 at 49-51; Lauer on Effects of Entrainment, Feb. 5, 1973].

However, the Board doubts that these experiments adequately mirrored the true range of stresses which Indian Point 2 would present. Firstly, a more accurate replication would duplicate the full power of operations of the plant during which there is a 15° F increase in heat, for these are the conditions underwhich the plant intends to operate. Testing for small or no increments of heat looks at an unrealistic situation.

Secondly, samples during the field tests should have been taken at the end of the discharge canal. Survival rates of less than 10% have been found there. [Clark, Redirect Feb. 12, 1973 at 1-5]. Thirdly, the additional, though delayed, effects should be included.

Because these factors were not explored adequately in the tests conducted by Dr. Lauer, the Board doubts the validity of his conclusions. Moreover, there is contrary evidence from other power plants where white perch (which Lauer did not distinguish from striped bass) were studied. [Lauer on Effects of Operations, Oct. 30, 1972 at 49-51; HRFA Exhibit 2; 1 FES A-V-16; Clark on Effects at 5, Oct. 30, 1972 at 47-49]. For these reasons, the Board accepts Clark's and Goodyear's estimates of nearly 100% mortality, and thus an F_c factor of 1, for entrainment.

C. Compensation

The concept of biological compensation for fish populations was introduced by Dr. Lawler early in the proceeding. [p. 47-53, April 5, 1972.] He states that this mechanism must be operating in any population to ensure "...that at least a certain complement of the year class (the larger individuals) will survive." [p. 49 Ibid..]

Although no documental example in East Coast striped bass populations was ever introduced in the proceeding, Lawler posited that "these mechanisms are varied in form, but they often can be explained in terms of available food supply." [p. 48, Ibid.] Without the introduction of this factor into the model at some quantified level (which he arbitrarily picked to be .8) the model predicted either a population growing without bounds or "crashing" to zero. [TR 7292-94, 7258-59, 9807-11, April 5, 1972 Lawler]

Goodyear and Clark take the position that no available evidence indicates that density-dependent survival would bolster the Hudson River striped bass populations when the plant would begin to crop part of the recruitment to the nursery. Although Goodyear agreed with Dr. Lawler and

Dr. McFadden that compensatory mechanisms are available during equilibrium conditions, he demonstrated that the fishery, not density-dependent factors in the estuary, controls the population levels (See contribution discussion). [TR 6657-6670, 6724.] In essence Goodyear maintains that a population can grow to a point where some compensation takes place to limit its numbers, but during a decline may "...not necessarily..." limit its decline. [TR 6656]

Both Goodyear and Clark examined the relative growth rate, a traditional indication of scarce food, or density-dependent effects, to demonstrate supersaturation in the Hudson white perch and striped bass populations. [Clark, October 30, 1972; Goodyear, February 22, 1973, TR 11278] Goodyear also indicated temperature and special food habits may account for higher growth rates observed in other populations of striped bass. (February 22, 1973] Also Goodyear points out that "... no important change in growth rate has been observed, (in the striped bass larvae) although population densities have increased by an order of magnitude on the Atlantic Coast." [V-56 FES]

Dr. Lawler and Dr. McFadden both defend the model's need for compensatory feedback during the first year recruitment. Lawler's decision to use .8 as a "relatively minimal" compensation ratio was challenged by the Board and

the other parties. He admitted openly that he "...found none (literature discussions of compensation) for striped bass in estuaries," and had no tests to confirm the .8 value. [TR 9807-08.] Soon after that, Mr. Briggs stated that the Board was "...sort of at a loss as to what compensation factor one really ought to expect in nature and in the Hudson River." [TR 9811]

Compensation as a viable mechanism for offsetting the loss to the yearly recruitment by plant operation is not recognized by the Board to be operative in the Hudson River striped bass population.

F. Conclusions

1. Model Predictions

Some difficulty was encountered by the Board in arriving at comparable figures for the three models. In fact, a major revision of Mr. Clark's presentation was necessitated to make it comparable with the other figures given in the table which follows.

Mr. Clark's prediction of 40% yearly reduction in striped bass recruitment was disputed for its component due to impingement in stages IV and V. [Tr. 8822-8827.] Con Edison maintained that his resulting percentages of 3.0 and 18.6% were far too high because he underestimated the striped bass population at these life stages.

The phenomena of gear avoidance, where unusually high numbers of specimens escape the sampling equipment, may indicate Carlson-McCann did not report the absolute abundance of fish in the river. Therefore, the Board suspected that any impingement percentages based on these numbers would be too high.

In order to utilize Mr. Clark's analysis, the Board has made the following calculations:

A. Dr. Lawler's model reacted to 46,000 fish impinged by reducing recruitment by an added 7% beyond the deficit due to entrainment. [Lawler on Sensitivity of Multiplant, April 20, 1973.]

B. It took the number of fish impinged as the average between the varying estimates of 1 to 6.5 million, i.e. 3.75 million. [Alevras on Impingement, Feb. 5, 1973 at 17; Clark on Effects, Oct. 30, 1972 at 33.]

C. It accepted Clark's estimate that of 5.1% of the fish impinged were striped bass. [Ibid., Table 6.]

D. The number of striped bass impinged a year = 5.1% x 3.75 million = 190,000.

E. Lawler's model was increased 7% on the basis of 46,000 fish impinged. If the true figure is 190,000 fish impinged, his model would increase 29%.

$$\frac{7\%}{46{,}000} = \frac{x}{190{,}000} \qquad x = 29\%$$

F. Total reduction to recruitment based on Table 7 [Clark, Ibid.] then becomes:

Stage II		5.1	
Stage III		16.7	
Stage IV	*3.0/2 =	1.5	
		23.3	= Reduction due to entrainment

*Only half the stage was considered subject to impingement.

G. A 29% increase in the 23.3% entrainment figure = 6.75%.

H. Thus, the total entrainment figure = 23.3 + 6.75 = 30%.

From this manipulation of various materials in the record, Clark's approximate figure for recruitment reduction becomes 30% yearly. The Board has utilized this figure for comparison purposes.

Now that all the input factors are almost the same for each model, the models predict the recruitment reduction to be:

Clark	30%
Staff	26.8%
Dr. Lawler	17%

This does not consider compensation in the first year of life nor "f" factors.

2. Seriousness of Predicted Impacts

The Board found it difficult to weigh the benefits and costs in regard to this decision. The Board considered the degree of seriousness each party and commentor to the draft environmental statement attached to the issue of cooling towers.

Dr. McFadden for Con Edison felt as "much as a 90% reduction" in the 1950 population could occur before a "serious" situation would develop. [Tr. 11359, 11360 On the opposite side, Mr. Clark indicated that over a 10% reduction in yearly recruitment would have a demonstrable and seriously adverse effect on the striped bass population and the fisheries of the Hudson and Atlantic. The Staff's decision for cooling tower installation was based on various impacts, among them the 14-50% reduction in striped bass recruitment.

These and the opinions of other major commentators on Environmental matters are presented below in tabular form:

	Group	Criterion	Comments
1.	Con Ed (McFadden)	90% reduction from 1950 population level	More study
2.	Staff	14-50% plus miscellaneous impacts	Cooling towers sought on the basis of cost-benefit analysis
3.	Clark	10% reduction in recruitment	Build cooling towers
4.	NYS Attorney General	Staff position	Cooling towers will also avoid lawsuits for public nuisance and fishkill fines
5.	U.S. EPA	DES; i.e. 15-20% reduction plus miscellaneous effects	Build cooling towers
6.	USDI	DES position	Build cooling towers
7.	HRFA -EDF	DES position	Build cooling towers
8.	Scenic Hudson Preservation Conference	DES position	Build cooling towers
9.	Congressman Jonathan B. Bingham	15-20% annual loss of all fish in Hudson	Build cooling towers
10.	Congressman John Dow	Same as above	Build cooling towers

11. NYSDEC	DES Position	More clarification of issues necessary by FES.
12. Richard Ottinger	DES Position	Build Cooling Towers
13. John M. Burns III	DES Position	Build Cooling Towers

References for the Above

1. Tr. 11,359-11,360
2. See chapter III herein, 1-FES
3. Clark on Roseton Bowline effects at 7
4. Memorandum of Law in Support of Proposed Findings of Fact, June 11, 1973
5. II-FES A-XII-11
6. *Ibid*. A-XII-45
7. *Ibid*. A-XII-97
8. *Ibid*. A-XII-134
9. *Ibid*. A-XII-142
10. *Ibid*. A-XII-144
11. *Ibid*. A-XII-55
12. *Ibid*. A-XII-152
13. *Ibid*. A-XII-148

Chapter IV

Contribution of Striped Bass From Other Estuaries

A. The Assumption of Chesapeake Bay's Contribution is Unsupported

Of the three estuaries on the East Coast capable of being major contributors to the striped bass fishery, Chesapeake Bay has long been presumed to be the major source of striped bass. Dr. Raney continues to passionately maintain that position but his arguments are not supported by analysis of tagging results. [Raney on Striped Bass, Tr. 9036, Oct. 30, 1972 at 8-10.] Dr. Lawler's defense of the Chesapeake Bay theory was more tentative and was phrased in the negative. He deprecated his own testimony as not necessarily "proof of what is actually happening...but solely intended to illustrate that the Chesapeake Bay hypothesis cannot be rejected at the present time." [Lawler on Contribution, April 20, 1973 at 1 quoting his Cumulative Effects, March 30, 1973 at 8.]

B. Tagging Studies

Only Dr. Lawler presented considered evidence to indicate that the Delaware estuary played any role in

the make-up of the mid-Atlantic striped bass stock. His testimony in this regard was characterized more by hypothetical analysis than by hard fact and may reflect his admitted lack of experience in this area. [Lawler on Contribution, Feb. 5, 1973 at 5, Tr. 9592, 9591-9634.]

No support was found in the record for the hypothesis that the Delaware is a major contributor. Since it has been characterized as being too polluted to be a major contributor [Goodyear Redirect Rebuttal, March 1, 1973 at 13], Chesapeake Bay and the Hudson River are left as the only real possibilities. However, tag and recapture studies have shown that in proportional and absolute numbers, the number of Chesapeake fish that leave the Bay is small. [Goodyear on Origins, March 1, 1973 at 7-8.] Although substantial numbers of 2-year-olds have been found off Connecticut and Long Island, virtually no Chesapeake fish of that age have ever been reported outside of that Bay. [Ibid., 7-8.] Both the lower catch size limits allowed by law in the Bay and the availability there of shoal areas, which tend to attract young fish, are factors which may account for their absence. [I-FES, XII 36, Tr. 9928.] However,

several studies show that the mid-Atlantic fisheries receive the great proportion of their initial recruits as two-year-olds. [Goodyear on Contribution, Mar. 1, 1973 at 10.] If these young fish are not from the Chesapeake, they can only be from the Hudson, and thus the Hudson is crucial in maintaining the mid-Atlantic population. [Tr. 9926, 9927.] In fact, Goodyear states that "...the last tagging study that was done that I know of, something like 90% of the fish which were tagged in the Hudson were recaptured outside the Hudson." [Tr. 9906.]

C. Catch Correlations

A second line of support for this argument emerges from a comparison of data on the correlation of the size of the Hudson catch with that of the mid-Atlantic over the last few decades. When figures from the two areas are adjusted for the 5-year time lag due to the migrational cycle of striped bass, the graphs match almost perfectly. [I-FES, V-57, V-58, XII-37, Tr. 9088.] Any increase or decrease in the size of the Hudson catch is nearly exactly reflected in the Atlantic five years later. Such a correlation suggests

virtual dependence on the Hudson population and justifies the Staff's estimate that the Hudson accounted for 80% of the mid-Atlantic fishery. [Goodyear on Recent Changes, Mar. 8, 1973 at 1.]

The correlation was attacked by the applicant on several grounds. First, it was suggested that additional factors, such as changes in the extent of the fishing effort or compensation, might account for mid-Atlantic fluctuations. However, commercial fishermen's efforts are closely attuned to the availability of fish. There was no showing that they will refrain from fishing when more are available and thus distort the catch statistics. [Tr. 9067, 9088, 10,133.] Shad fishing statistics bear out this dependency. [Goodyear on Factors re Hudson River Striped Bass, April 9, 1973, at 9, Tr. 9068-9020.] While compensation might be a factor, the striped bass do not seem to be in a position to take advantage of any reduction in density. [Goodyear, Tr. 6668.]

Secondly, further evidence shows that catch statistics are not always related. [I-FES, V-56-61.] No such correlation was found between landings in the Chesapeake Bay and in the mid-Atlantic. [Tr. 9196, 9910-9914.] This

evidence does not support the hypothesis that the Chesapeake contributes a major share of the mid-Atlantic catch.

Lawler's analysis used the cumulative effect of several unsupported hypotheses on which to rest his conclusion that the Chesapeake is the major contributor. [Lawler on Contribution, Mar. 30, 1973.] After Goodyear's criticism, he altered it substantially. [Lawler on Contribution, April 20, 1973.] Recent calculations using all his data for the most liberal contribution of the Chesapeake stock to the mid-Atlantic produced only 541,000 fish, or 28% of the total catch. [Goodyear, Rebuttal, April 9, 1973 at 21.]

In view of Lawler's own re-evaluation of his own theories and the convincing arguments of the Staff, the Board concludes that the Hudson contributes 80% of the striped bass fishery in the mid-Atlantic and an unknown percentage to the North Atlantic fishery.

Chapter V

Miscellaneous Impacts

A. Multi-Plant Impacts

In response to a request from the Board, the applicant, the Staff, and Mr. Clark considered the cumulative effects created by the whole array of power plants on the Hudson River near Indian Point. [TR 7788] Specifically, these analyses considered the average temperature rises throughout the river above ambient conditions due to the plants and the impact of entrainment mortality of striped bass at the following plants:

1. Bowline
2. Lovett
3. Indian Point Units I and II
4. Roseton
5. Danskammer
6. Multiples of the above.

The Board has considered the effects of Indian Point Unit II in relation to the impacts associated with the other plants. [TR 10,016, 10,020]

1. Heat Load

The Staff's presentation came in the form of a graph depicting the temperature above an ambient temperature of 79-80° F at Indian Point between Troy, New York and the Atlantic Ocean. [Siman-Tov on Prel. Multi-Plant, Feb. 8, 1973, at Figs. 4-9].

Under these conditions the Staff estimated that with all the power plants operating, the Hudson would be raised 6.14° F, and recirculation of heated water at the plant could raise that value even higher. [Ibid. p. 8-9] Additionally, the Staff indicated that they lacked confidence in applicant's assurances that it would meet the State thermal criteria. [Dr. Oestmann, April 6, 1973 at 8, Siman-Tov, on Preliminary Multi-Plant, at 7-9,] Dr. Lawler's testimony under the same conditions indicated a maximum temperature raise of 1.3° F. [Lawler on Cumulative Effects, March 30, 1973 at III-18] The Staff presented testimony indicating that Dr. Lawler utilized erroneous parameters and too high dispersion coefficients [See Chapter III, Siman-Tov - Additional Discussion Feb. 22, 1973 Siman-Tov April 11, 1973] Dr. Lawler himself feels prediction of these data is "a bit of a problem". [TR 10,556]

In light of the Staff's prediction of serious temperature rises in the Indian Point plant vicinity, the Board finds that the data upon which these predictions are based are unsatisfactory.

2. Biological Impacts

Dr. Lawler ran his striped bass model of Oct. 30, 1972 again with all plants under consideration. The result of these runs with and without compensation and with some "F" factor reductions is presented in the table which follows. [Lawler on Cumulative Effects, Oct. 30, 1972, Table II-4 Lawler on Sensitivity, April 20, 1973]

For the multi-plant analysis, the Staff updated its striped bass model in the Final Environmental Statement by including factors accounting for larval shoal area preference, simulating the actual downstream flow for various years, and other unmentioned improvements. The predictions for reductions in recruitment also follow. [Goodyear, Probable Reduction, Feb. 8, 1973]

Mr. Clark utilized his previous analysis and presented his own value for percentage reduction listed below:

Con Edison		- 5-30%
The Staff	(All plants)	- 38-64%
	(IPI&A)	- 14-43%
Mr. Clark		- 56%

The Board recognizes that similar inaccuracies afflict these predictions as were discussed in Chapter III

herein. However, in light of the Staff's improvements, the Board assumes that 14-50% now can be used to describe the Staff's overall estimate for striped bass recruitment reduction.

B. Impingement of White Perch

The screen kill figures at Unit I, stipulated to by the parties, indicate that the majority of fish collected are white perch. [Stipulation, Oct. 30] White perch do not represent a highly important commercial fish, but occupy an important place in the ecosystem of the river and may be food for striped bass. [1-FES at-A-II-6, TR 9475]

As many as 6.2-million white perch are decimated yearly by Units I and II. The most serious consequences are predicable with regard to the population of these fish. [Clark on Effects, Oct. 30, 1972 at 34] Although no predictions were made for the impact on the population due to these screen kills, there are indications that this fish population may already be declining, probably as a result of the history of past kills at Unit I and other plants. [1-FES-V-61-62, Goodyear on Population Trends Feb. 22, 1973]

The Board recognizes that the impingement of white perch may represent an additional disturbance of the striped bass population since the latter feed on white perch in the estuary. The Board also takes notice of the present State notice regarding fines levied for fish kills of this nature. [Memo, New York State Attorney General MARCH 6, 1973]

C. Other Effects

The record also indicates that other unquantified impacts on the ecosystem will be associated with thermal and chemical stresses.

Mr. Clark indicated that temperature rises such as the Staff predicted would be stressful or even lethal to aquatic biota in the vicinity of Indian Point. The Board finds that Mr. Clark's prognostication of increased mortality for entrained organisms due to these high temperatures is substantiated by Dr. Lauer's findings in this area. [Clark on Cumulative Effects, March 30, 1973, Griemsmann on Dist. and Mort., Feb. 19, 1973, at 3]

In the case of chlorine, which will be added to control slime growth on the condensors, sampling of entrained gammarus did reveal consistently fewer liver organisms on days when chlorine was released than when it was not. The same phenomenon appeared even more glaringly in the case of neomysis.

It was also noted in samples of entrained morone sp. This last sample also found considerable increase in entrained larvae mortality when there was a substantial temperature change. [Dr. Lauer on Effects of Indian Point at 12, 19, 27, 32, 40]

Chapter VI

Research Program

A. Program Objectives

As the result of concern expressed over the effects of plant operation, Con Edison designed and contracted for a five-year $10-million biological monitoring study scheduled for completion by January 1, 1977. [McFadden and Woodbury on studies, Feb. 5, 1973 at 1.] The approach Con Edison has taken toward this study is that "should Con Edison conclude on the basis of information gathered during the five-year study period that the need has been demonstrated for modification of the once-through cooling system for Indian Point 2, Con Edison would on its own initiative propose such a modification..." [Ibid.]

Apparently Mr. Woodbury and Dr. McFadden collaborated on the scope and duration of the biological study at issue here [Ibid.] They indicate in their testimony that the governmental agencies involved will be able to utilize the results of this program as the basis on which to decide a course of action in reference to the continued operation of

once-through-cooling at Indian Point. [pp. 1-3, Ibid.] Striped bass data will be evaluated for ecological significance by the Lawler population simulation model. [Page 11 Ibid.]

B. Symptoms and Diagnosis

Generally the record indicates that although many symptoms of ecological disruption are to be considered by the study, the study is defective because species reduced will not be related to Applicant's Unit 2 intake operations. Although damage may be great, it will be difficult to determine by this study the causes of the damage. [TR 9502-3, 11,281]

Lawler states that, "It seems to me that there is a continuing developmental stage where data that is accumulated is used to assess which of the variety of proposed mechanisms may be occurring, and which aren't, and then in turn those proposed mechanisms and the model which describes them is used to suggest the types of data that ought to be sought out and how sensitive the system may be to...one phenomenon versus another." [TR 9838]

Specifically, with regard to the confidence that Dr. Lawler has in the ability of the study to predict the compensatory reserve of the striped bass, Dr. Lawler states that "I really can't answer that question at this time. I think the whole developing structure of what we find, and the various hypotheses that we may find ourselves postulating will at that time suggest to us the physical boundaries we should put on this thing (emphasis added)." [TR 9835]

The Board is not convinced by the record that Dr. McFadden, Applicant's chief consultant for biological research design, really believes the study he and Mr. Woodbury presented will answer the question before the Board. The question is:

> "Will the results of this study be sufficiently precise to show whether the plant operations have any serious impacts on the ecosystem?" [TR 11 377, 11373]

Earlier in the proceedings, Dr. McFadden answered this question in the affirmative. He stated that his goal was to show that the plant has no effect. [TR 7505] Later in the hearings, he expanded on the problems of achieving this end:

> "It would be necessary to separate those effects caused by operation of the power plant or any mitigating managerial measures that were implemented from natural causes of fluctuations in fish population numbers." [TR 11366]

In between those two statements however, he gave puzzling and contradictory testimony indicating an indifference to all but the most gross manifestations of species fluctuation, to wit:

1. TR 11383 - Dr. McFadden views a fishery decline of 1,950,000 lbs. to 1,300,000 lbs. as not serious.

2. TR 11359 - Dr. McFadden describes a 25% reduction from power plants as "not serious".

3. TR 11359-60 - Dr. McFadden defines threat of population extinction as a "really serious situation".

4. TR 11360-61 - For striped bass in the Mid-Atlantic region, there would be no threat of extinction to the species until 90% of its 1950 population were wiped out.

5. TR 11367 - With regard to applicant's study McFadden observed: "If you did have all this insight and understanding, (into causes and effects) its complexity would over whelm you and you couldn't effectively use it in a management situation."

6. TR 11367 - "...There is a great deal of random variation operative in the natural system (of fish population levels)... which are not ascribable to any measureable cause" and may be "...inherently unmeasureable..."

7. TR 11,381 - "...I try to sense some kind of historical trend (in fish population levels), what kind of level represents the average level at which the stock persists, and then I don't get much excited about these squiggles up and down around that line."

These citations indicate that Dr. McFadden as a biological investigator is not concerned with fluctuations in yearly recruitment (one of the critical facts to be investigated by the proposed study) on the order of ~~50~~ 25%, the magnitudes predicted by various population prediction models. [See Chapter III herein]. Considering these statements, the Board views the resultant predictive capability of Applicant's study with considerable skepticism.

C. Descriptive Components

The descriptive elements of the study proposed by Con Edison are 1. population density, 2. survival, 3. age composition, 4. growth rate, 5. age at sexual maturity, 6. sex ratio, 7. identification of sub-populations. The changes observed in these components of the fish populations in the lower Hudson estuary will be compared to the existing data base. [McFadden and Woodbury, Feb. 5, 1973, P. 11 12 Ibid.]

The Board found conflicting evidence on the adequacy of the existing data base as a basis for comparison with the proposed study outputs. Many aspects of the above

list of seven elements were questioned by the Staff as needing more data support for proper evaluation in the future. [TR 9311-9320 V-71e FES] Dr. Goodyear states in fact that "...about ten years would be necessary to design and carry out analysis on the reproductive status of the important fish species in the Hudson." [TR 9316]

The first of these, population density, will be measured by four basic methods:

1. Mark-recapture studies, which will be confined to the Hudson estuary, will indicate the absolute abundances of various striped bass pre-adult stages at critical times of the year.

2. Catch per unit of effort will yield information on the relative abundances of striped bass and white perch at various life history stages.

3. Plankton net tows, etc., will estimate absolute abundance of egg and pelagic larval stages of striped bass and white perch.

4. Mark-recapture studies of juvenile and adult stages of striped bass by the State of New York and Federal Government will aim at qualifying the contribution of the Hudson to the Atlantic fishery.

The Board found no evidence in the record to indicate that collection of these data would not be subject to the same basic disputes to which the existing data has been subjected. According to its own proponent, Dr. McFadden, mark-and-recapture data, apparently the most promising method for quantifying population fluctuations, has no absolute population estimates available to which plant induced reductions can be compared. [TR 9514] No discussion in the record appeared concerning the value of the Government tagging studies scheduled for operation during 1973. [McFadden and Woodbury on Studies Feb. 5, 1973, Appendix C]

The rest of the list of seven elements pertains to quantification of compensatory processes or indications of the Hudson's contribution to the Atlantic fishery. Information on these aspects will be vulnerable to similar sampling errors and data base limitations.

D. Analytical Components

The information from these methods will be analyzed under a set of ten criteria which are "...symptoms of adverse impact." Unfortunately, of the ten, only numbers 2, 3, and 5 can be directly associated with plant operation, and they are not directly related through the study design to the striped bass adult stages basic to the Hudson and Atlantic fisheries. [PP 33-34 Ibid, Goodyear, Redirect - Rebuttal on Research Feb. 22, 1973, at 1-5]

The seven criteria, although symptomatic of problems in pre-adult and adult fish populations, may not be completely tested in time, and cannot be connected directly to power plant operation by pre-demonstrated mechanisms in the Hudson River. [Goodyear on Research, Feb. 22, 1973, TR 6730, 9336] Therefore, analysis of data under the criteria established in this study will not establish whether Unit 2 is the cause of species reduction. In sum, the unreliability of this study renders it irrelevant to the decision at issue here.

E. History of Con Edison Studies

Ever since 1962 when Indian Point 1 began impinging large numbers of fish, Con Edison has been undertaking ever larger biological research activities (Ex. 3).

To the knowledge of the Board, no studies undertaken by applicant have presented conclusive evidence on any single issue before the Board or recommended any remedial measures, save more studies. Dr. Goodyear introduced testimony indicating that several of the research goals, besides being difficult to quantify, were actually beyond the present state-of-the-art. [Goodyear on Effects of Unit I and II, Feb. 22, 1973] In fact, controversy during the proceeding centered on the integrity of the applicant's presentations and the adequacy of the experimental design for the study. [Position HRFA Re.: Research.] One ecological investigator contracted by

Con Edison to prepare baseline data on the biota at Indian Point had to be discharged for inadequate service. [Ibid.]

Con Edison's study of impingement at Indian Point represents a case in point on this issue. The impingement problem has plagued Unit I since it started operations in 1962 [V-26 1-FES]. A variety of solutions, such as air bubble screens, pneumatic sound sources, and smaller mesh screens were installed with little success. [Ibid. V-26-27].

Yet during this period of experimentation, there was a startling absence of any systematic approach to the problem. Methods of counting fish kills inexplicably changed from year to year. Most of the applicant's records lack any classification of the impinged fish by species, weight or size. [Applicant's Exhibit 3-C, Appendix S] Nor is there any explanation of how the number of fish collected from the screens was calculated [Ibid. A-1]. The records vanish entirely between September 1967 and September 1969. [Alevras on Impingement, Feb. 5, 1973 at 3] The company itself stipulated that its counts were off by 25%. [Stipulation, Oct. 30, 1972 at 3]

Typical of this confusion was the introduction of fine mesh screens, which did indeed lower the impingement rates of the traveling screens - by moving forward the point

of contact to the mesh screens where kill counts were not normally tabulated [I-FES V-27]. The supposed decline in impingement rates since 1965 is illustrative of the misleading statistics that applicant has collected and presented to the Board. [Stipulation, Oct. 30, 1972, sched. A & C] While part of the decrease in impingement may be attributed to a reduction in the velocity of the pumps [Ibid., Sched. C] and the design of the discharge canals [Stipulation, Oct. 30, 1972 at 39-42], there is also evidence that the entire population of white perch, which makes up 90% of the fish impinged, is decreasing. [I-FES V-61 Goodyear on Trends, Chapter V Feb. 22, 1973, Misc. Effects herein] Of course, elimination of all fish is one way of preventing impingement.

Nor does the company's most recent research reveal a higher standard of competence. Barely one year into the current five-year study, the company is already behind. It is only now beginning to gather data on questions that were to be answered last year. [Memorandum, Texas Instruments Inc., June 2, 1972]

F. Other Study Failures

The study of the San Joaquin striped bass population yielded similar controversy over the causes of major population fluctuations after a full 20 years of intensive monitoring and analysis. [TR 9896, 9903, Goodyear, RR, Feb. 22, 1973 at 5 and 6]

G. Conclusions

In view of the following deficiencies the Board decides that the study will represent an unreliable basis on which to assign the causes of negative fluctuations in the population levels for striped bass, to wit:

1. the descriptive techniques will render unreliable results;

2. the analytical components will be unable to relate species reduction to the operation of the plant;

3. the study is geared for management of severe impacts, not scientific investigation;

4. past results of similar research at Indian Point and elsewhere make it unlikely that applicant's study will shed real light on this complex subject.

Chapter VII

Hatchery Replenishment

Con Edison's proposal to replace striped bass killed by Indian Point 2 with fish raised in hatcheries is fraught with uncertainties.

A. Past Experience

The applicant made much of other hatcheries' successes. The bulk of these successes involved stocking fresh-water lakes and reservoirs, not estuarine rivers such as the Hudson. [Stevens on Stocking, April 5, 1973] The present experiments with estuarine stocking are taking place in the South, in areas extremely different from the Hudson at Indian Point. [TR 10, 376] Their results are inconclusive, for few fish have been recovered and whether or not they can be bred successfully remains to be seen. While Hudson fish seek the sea, fish raised in these experiments seek fresh water. [Tr 10, 378-388; 11, 049-052; 11, 111] Thus the variables in these programs differ so greatly from Hudson River conditions that it is very unlikely that their successes could be repeated at Indian Point.

B. Likelihood of Survival at Hatcheries

Secondly, even the supposed "successes" of these hatcheries are limited. There are several stages along the

process where great reductions occur. The first, and perhaps most difficult, hurdle comes in the procurement of breeding stock. [Goodyear on Artificial Propagation, April 23, 1973] The hatcheries would have to make up for the generations lost through destruction of brood stock, over and above those directly killed by the plant. [TR 11, 147] Goodyear calculated that even if hatcheries were as efficient as natural production and completely replaced a 50% entrainment loss, the resulting production of fish would be only 75% of baseline conditions. [Ibid.]

At each successive stage of the developmental cycle, great reductions occur in hatchery stock. Con Edison's own expert gave an overall 10 or 11% figure for the percentage of striped bass eggs that could be raised to 2" fingerlings. [TR 11, 135] But Dr. Stevens had no data as to how many of these fingerlings would survive once placed into the natural environment. [TR 10, 382-828] Thus the entire concept of "hatchery replenishment" is pure unsubstantiated guess work -- no substitute for taking the available steps to prevent the needless destruction of the species. Cooling towers represent the classic code of the ounce of prevention.

The Staff's model was based on survival rates in each stage, including release to the natural setting. Their conclusion forecast a survival rate of only .8%. [Goodyear, supra] This was compared to a natural survival rate for Hudson bass of between 1.4 and 7.8%. Dr. Clark stated that without actual experimentation, it is impossible to tell whether natural or hatchery production is more efficient. [Clark on Hatcheries, April 23, 1973, TR 11, 097-99]

In addition, hatchery survival rates are by no means certain to be repeated. Stevens admits his successes are open to the vagaries of chance and nature. [TR 11, 182-83] He also stated that any success was dependent on intimate knowledge of the river and the race of fish in it. [TR 11,144] Then, the man who would presumably manage these hatcheries pointed out that he didn't know "a damn thing about the Hudson." [TR 11,145] It will admittedly take three years before the impact of stocking on migratory behavior can be measured and much longer to await the results from generation to generation. [Clark on Hatcheries, April 13, 1973; 11,096-97; 11,329-311] No one knows the effects of plant operation on other species, which the company makes no offer to replace, and how these effects may harm the striped bass. [See Clark on Effects of Indian Point, Oct. 30, 1972 at 51] It is now scientifically irrefutable that the destruction of one species causes an imblance which may unpredictably destroy other species and breed

other harmful consequences. To adopt Con Edison's wasteful "Kill them and replace them" proposal would be to turn our back on decades of scientific and biological research and to regress to a pre-"silent spring" simplistic view of food chains and the interdependence of biota which is the biological equivalent of believing the world to be flat.

Finally, there is evidence that the complex of power plants to be built on the Hudson may reduce annual production of striped bass by as much as 40-60%. [See Chapter III, herein] Therefore, to restock only the Unit 2 takings would merely replace one slice from a rapidly - diminishing pie. [Goodyear, TR 11,256]

C. Conclusions

Adequate replacement of 50% of the River's annual production thus looms as an enormous, and vitually impossible, goal. [See TR 11,126, 11,275] The magnitude of the project, the lack of experience in conditions similar to the Hudson, the general uncertainty of hatchery production, and the unknown influences of other plant effects on Hudson biota all establish that restocking is not a plausible method of replacing striped bass. The Board agrees with Dr. McFadden that they "are not sure that striped bass stocking would be successful in the Hudson". [TR 11,345] It is plainly no substitute for installing cooling towers and ending the wholesale destruction of these fish in the first place.

Chapter VIII

Closed-Cycle Cooling System

The Staff has concluded that the pressure which the current flow-through cooling system puts on the fish population of the Hudson requires installation and operation of a closed-cycle system as quickly as possible. Jan. 1, 1978 is posted as the deadline. [1 FES vii; Oestmann on Impact, Apr. 61, 1973 at 3.]

Con Edison has centered its objections on the expense and schedule of the project. There is no basis in the record for holding that the alleged adverse environmental impacts of cooling towers -- fogging, plumes, saline drift, aesthetics, noise -- are more than minimal. [Applicant's Environmental Report Supplement 3; HRFA Exhibit 5, Tr. 7562; 1 FES XI; Aynsley on Alternatives, Oct. 30, 1973, 1 FES XI, 65-66.] They are no more than make-weights when advanced by Con Edison as excuses for its oppositon to the only realistic means of halting destruction of the Hudson River fisheries.

A. Costs

Estimates for the total cost of the project vary with its projected date of completion. The Staff calculates that completion by 1975 would cost $97.5-million and completion by 1978 $116-million. [Carter, Indian Point 2, Feb. 14, 1973 at 3.] At one point Con Edison estimated that a single tower would run $138-million [Newman, Oct. 30, 1972 at 14.] However, the capital costs of plants that have actually installed natural-draft cooling towers have run from $17.5 - to - 30 million, exclusive of the auxiliary equipment which is required by the unit in any event. Some of these projects, like the one proposed for Indian Point 2, involved the retrofitting of the towers onto existing plants. [Aynsley on Alternatives, Oct. 30, 1972 at 8-9.] These figures were collected in 1969-70 and even allowing for inflation, there seem to be enormous discrepancies between the applicant's and those of more objective witnesses. Differences resulting from loss of efficiency of the plant due to the towers, outage, backfitting of condensors and pipes may account for part of the gap. [Newman, Oct. 30, 1972 at 10-11; Aynsley on Alternatives, Oct. 30, 1972 at 8-10.] However, realizing the uncertainties of all projected construction costs in these days of overruns, the Board need not commit itself to a specific figure and proclaim anything above as unacceptable.

It is convinced that the cost of the cooling towers is not an unreasonable sum for Con Edison to pay to avoid widespread destruction of Hudson River biota. Less than 1% would be added to the utility customer's bill to pay for a wet tower, according to Staff analysis. [Knighton, Rebuttal, Feb. 22, 1973 at 4.]

B. Schedule

The second point in controversy hovers over the schedule for completion. First of all, delay will cause substantial increases in costs through inflation. [Exh. 3, Carter on Revised costs, Feb. 14, 1973] Since its own conditions for the license assume that the tower will be required by 1981 unless reason for an amendment can be shown, [Applicant's Proposed Findings March 17, 1973, Appendix at 4] applicant seems to presume that it can better bear a far higher cost in 1981 than a lesser cost now. There is no mention in the record of factors in the company's financial position that would support such a conclusion.

According to Con Edison, there is little controversy over the actual ground construction time. [Newman, Feb. 5, 1973 at 27.] Thus it accepts HRFA's estimate of 18 to 24 months, with a possibility of speeding it to 12 months. [Aynsley on Alternatives, Oct. 30, 1972 at 25.] Earlier, Con Edison estimated 3 years of actual construction work. [Newman, Oct. 30, 1972 at 8.] The dispute lies in time estimates for

the preliminary steps. The company has already started designing the tower and thus is into the construction schedule. [Tr. 9710-12] Its own engineers indicate the total project, from design to delivery, could be finished in three years. [HRFA, ex. 5, ex. 9, sheet 1; Tr. 7556.]

The greatest expected delay the Company attributes to governmental requirements. Newman forecasts 2-2 1/2 years for governmental review. [Testimony Oct. 30, 1972 at 7] This was later shortened to 12 months. [Newman, Feb. 5, 1972 at 29] It is irrational for Con Edison to anticipate that having pressed for these towers, the State will delay their construction. The Board concludes that a Jan 1, 1977 deadline, with provision for extension up to Jan. 1, 1978 at the latest on a showing of a good faith effort and extraneous difficulties, more than provides for this and any other such contingency. To insure that all permits are applied for on schedule, the Board requires that a list of such and their dates be submitted to it. Explanations for any delay in making applications must be explained to the Board by Jan. 1, 1974.

C. Conclusions

In conclusion, the Board finds that, in light of the damage the current cooling system inflicts on Hudson River biota, the closed-cycle method must be installed and functional if the Unit 2 is to operate after Jan. 1, 1977.

Dated: New York, New York
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Respectfully submitted,

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