10-16-72

BEFORE THE UNITED STATES

ATOMIC ENERGY COMMISSION

In the Matter of Consolidated Edison Company of New York, Inc. (Indian Point Station, Unit No. 2)	)))))	Docket No. 50-247

Affidavit of John R. Clark

CALCULATION OF EFFECTS OF ROSETON AND BOWLINE PLANTS ON HUDSON RIVER AQUATIC LIFE.

JOHN R. CLARK, being duly sworn deposes and says,

1. The AEC's final environmental statement on Indian Point 2 (1, pp. iii-iv) states: " . . . during June and July of most years from 30 to 50% of the striped bass larvae which migrate past Indian Point from upstream spawning areas are likely to be killed by entrainment. There is a high probability that the combined effects of entrainment and impingement will also result in a similar decrease in recruitment to the adult population of striped bass in the New York, New Jersey, and New England regions".

This loss will be augmented by losses from the operation of new fossil fuel plants that will have the same adverse effects of entrainment and impingement of young striped bass and other species of interest in the Hudson Estuary.

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2. It is thus clear that any analysis of the effects of Indian Point No. 2 must consider the concurrent effects of the other new power plants. Therefore, I have undertaken to calculate the effect of removal of 0+ age class striped bass by the Roseton and Bowline Point plants.

3. The Roseton plant is situated in an area of heavy spawning of striped bass and an area of moderate abundance of larvae (3, fig. 1). The plant will remove a significant number of the larvae. The Bowline Point plant is located in an area of moderate abundance of larvae and a heavy abundance of juveniles, (3, fig. 1). This plant will remove a significant number of these stages. As with the Indian Point analysis, (3), the destruction of eggs is not included in these calculations.

4. Stage II Early Larvae. The average density of early larvae (average of 1966 and 1967) from the Carlson and McCann data (2) is 0.34 per 1000 cu. ft. for Bowline Point (Croton sector) and 1.06 per 1000 cu. ft. for Roseton (Marlboro sector) for the 28-day early larvae period, June 1-28, (see 3). With Bowline Point (both units) and Roseton (both units) at full power they will pump respectively 1,730 and 1,460 cfs (4, 5) or 4.2×10^9 and 3.5×10^9 cu. ft. in the 28-day

period. Thus Roseton will remove, in the typical year, 3.71 x 10^6 early larvae, as shown in Table 1. The population levels are relative rather than absolute and relate to the magnitudes given by available sample data (2, 3). The calculations for Bowline (which lies seaward of Indian Point) were corrected for removals by Roseton (Table 1) and Indian Point plants 1 and 2 (Table 2) as shown in Table 3. Bowline, with both units operating, would kill 1.32 x 10^6 larvae per year.

5. Stage III Later larvae and prejuveniles. The density of this 45-day stage is estimated at 8.5% of the peak density of early larvae (see 3, p. 26) corresponding to 7 3/4 weeks after hatching, the median of the period. Peak density was respectively 0.62 and 2.08 per 1000 cu. ft. at Bowline Point and Roseton (for 1966 - 1967: 2, App. tables 2-7, 10; 3-7, 10) and the densities at the median are 0.053 and 0.185 per 1000 cu. ft. In the 45-days, Bowline Point and Roseton would pump, respectively, 6.8 x 10^9 cu. ft. and 5.6 x 10^9 cu. ft. and the plants would have removed 0.36 x 10^6 and 1.03 x 10^6 or a total of 1.39 x 10^6 later larvae and early pre-juveniles in the 45-day period, if some of the population had not been removed in the early larvae stage. Adjusting for this previous loss (and the effects on Bowline of Indian

Point), the removal would be 1.03×10^6 fish by Roseton and 0.25×10^6 fish by Bowline.

6. Stage IV - Early juveniles -- entrainment. The density of juveniles is based upon the ratio of their abundance to Cornwall where the only good samples are reported: Bowline Point, 77%, and Roseton, 8.7%, (3, table 4). The Cornwall density was 0.11 per 1000 cu. ft. for 1966-1967 (3, p. 28). Therefore the estimated abundance at Bowline is 0.085 per 1000 cu. ft. and at Roseton is 0.01 per 1000 cu. ft. In the 28 days, the Bowline Point and Roseton plants would pump, respectively, 4.2×10^9 cu. ft. and 3.5×10^9 cu. ft. and would have removed 0.36×10^6 and 0.035×10^6 early juveniles or a total of 0.395×10^6 early juveniles, if the population had not already been reduced at Stage II and III by these plants and by Indian Point, and if this stage were not becoming progressively less pelagic and vulnerable to entrainment and more screenable (50% vulnerable and 77.5% screenable) (3, p. 29). The entrainment losses must be added to the impingement losses for a total mortality for this stage.

7. State IV - Early juveniles - impingement.

The number of early juveniles which will be killed on the screens in this 28-day period is calculated from the historical rate of kills at Indian Point No. 1 (3, table 6) because there is no information available on fish kills for plants any closer to Bowline Point and Roseton. Using the abundance ratios of 77% and 8.7% to express the relative unit abundance of juveniles at Bowline Point and Roseton and pumping ratios of 73% and 62% on the Indian Point No. 1 and 2 kill of 0.020×10^6 predicted for this period (3, p. 29), I calculate 0.011×10^6 and 0.001×10^6, or a total of 0.012×10^6 early juveniles that would be killed by the screens if they had not already been reduced at stages II and III by these two plants and Indian Point 2. These previous losses are adjusted for and added to entrainment losses to get the total killed.

8. Stage IV - Early juveniles - combined mortality. Adding the entrainment and the screen kill losses for the 28-day period we estimate a total removal of $.035 \times 10^6$ early juveniles by Roseton and $.036 \times 10^6$ for Bowline.

9. Stage V - Later Juveniles. The only basis for estimating this loss is the Indian Point experience where an estimated reduction of 18.6% of the population would take place in the 261 days of this period (3). Using

the ratios of juvenile fish abundance and pumping rate already developed (for early juveniles) and using a cooling water flow reduction (15 percent) in order to compare to Indian Point Nos. 1 and 2 impingement kills based on reduced flow (3), Bowline Point would kill 56% and Roseton 5.4% of the amount of Indian Point Nos. 1 and 2. After corrections for previous reductions in Stages II-IV we find a loss of .018 x 10^6 at Roseton and 0.092 at Bowline (Tables 1 & 3).

10. The removals at each stage are listed in Table 1 along with calculations to show their effect on the population of striped bass. The calculations are based upon the assumption of total mortality of all removals (3, p. 38).

11. Because Indian Point alone would remove 40% of each year class of striped bass (3) and together they take 56% (Table 3) it is clear that the Bowline Point and Roseton plants would remove 16 percent of each year class of striped bass during the first year of life. The proportion removed by the plants is highest during the later larval stage (from entrainment) and the later juvenile stage (from impingement).

12. With Indian Point 1 and 2 and Roseton and Bowline Point all operating at full power, and the

total removal reaching to 56.0 percent of the 0+ year class (fish at the end of one year of life), there would be only 44.0 percent as many 0+ striped bass in the Hudson with all four plants on line as there would be if none operated. This is based upon the assumption that all striped bass impinged or entrained are killed (1). If only 1 of 2 units at Bowline were operating, the total kill would be about 52.5% of the 0+ class.

13. Reduction of breeding success to 44.0 percent of normal would have a disastrous effect on the striped bass population. In a theoretical study of brook trout populations, Jensen (6) showed that the population went to extinction when 50 percent of the 0+ group were exterminated. Jensen further showed that if even 5 percent were exterminated, the yield of the trout population was reduced.

14. In my opinion anything over a 10% reduction in the 0+ year class will have a demonstrable and seriously adverse effect on the striped bass population and the fisheries of the Hudson and the Atlantic (1). This amount of damage will in all probability be caused by the Bowline Point and Roseton plants. Added to the damage from Indian Point No. 1 and No. 2 operated with a once-through cooling system, this would raise the damage to

a possibly disastrous level for striped bass.

15. Similarly serious adverse effects can be expected for the white perch and the other valuable species of the Hudson. However, the data base is inadequate to compute with any reliability the magnitude of the damage, but by analogy to striped bass results, reductions of all important species can be expected, running from light (perhaps 10%) to very heavy (30-70%).

Table. I Striped bass reduction from impingement and entrainment. Roseton (two units).

LIFE STAGE AND DURATION	ORIGINAL POPULATION MEDIAN (millions)	REMAINING POPULATION 1/ (millions)	ADJUSTED POPULATION 2/ (millions)	PLANT REMOVAL 3/ (millions)	PERCENT OF ADJUSTED POPULATION REMOVED	REDUCED SIZE OF POPULATION (millions)
II. Early larvae 28 days	112.0	112.0	112.0	3.71	3.3	108.29
III. Later larvae 45 days	9.5	9.5	9.2	1.03	11.2	8.17
IV. Early juvenile 28 days	3.5	3.5	3.0	0.035	1.2	2.965
V. Later juvenile 261 days	1.9	1.9	1.6	0.018	0.9	1.582
Percentage of original population remaining at end of year					83.5%	

1/ Reduced by effect of other Hudson River plants. Negligible for Roseton.

2/ Adjusted at each stage for removals of prior stage.

3/ See text for explanation.

Table 2 Striped bass reduction from impingement and entrainment. Indian Point, calculated with Roseton in operation (two units)

LIFE STAGE AND DURATION	ORIGINAL POPULATION MEDIAN (millions)	REMAINING POPULATION 1/ (millions)	ADJUSTED POPULATION 2/ (millions)	PLANT REMOVAL 3/ (millions)	PERCENT OF ADJUSTED POPULATION REMOVED	REDUCED SIZE OF POPULATION (millions)
II. Early larvae 28 days	112.0	108.3	108.3	5.52	5.1	102.78
III. Later larvae 45 days	9.5	8.2	7.76	1.30	16.7	6.46
IV. Early juvenile 28 days	3.5	3.0	2.34	0.07	3.0	2.27
V. Later juvenile 261 days	1.9	1.6	1.21	.22	18.6	0.99
Percentage of original population remaining at end of year					52%	

1/ Reduced by effect of other Hudson River plants.

2/ Adjusted at each stage for removals of prior stage.

3/ See text for explanation.

Table. 3 Striped bass reduction from impingement and entrainment. Bowline (two units), calculated with Roseton and Indian Point operating.

LIFE STAGE AND DURATION	ORIGINAL POPULATION MEDIAN (millions)	REMAINING POPULATION 1/ (millions)	ADJUSTED POPULATION 2/ (millions)	PLANT REMOVAL 3/ (millions)	PERCENT OF ADJUSTED POPULATION REMOVED	REDUCED SIZE OF POPULATION (millions)
II. Early larvae 28 days	112.0	102.8	102.8	1.32	1.28	101.5
III. Later larvae 45 days	9.5	6.46	6.38	0.25	3.92	6.13
IV. Early juvenile 28 days	3.5	2.27	2.144	0.036	1.67	2.11
V. Later juvenile 261 days	1.9	0.99	0.923	0.092	10.0	0.83
Percentage of original population remaining at end of year					44%	

1/ Reduced by effect of other Hudson River plants.

2/ Adjusted at each stage for removals of prior stage.

3/ See text for explanation.

<u>REFERENCES</u>

1. "Final Environmental Statement Related to Operation of Indian Point Nuclear Generating Plant, Consolidated Edison Company of New York, Inc. Docket No. 50-247" U.S.A.E.C. Directorate of Licensing (September, 1972).

2. Carlson, Frank T. & James A. McCann, Hudson River Fishery Investigations 1965-1968: 50 pp & App.

3. Testimony of John R. Clark on Effects of Indian Point Units 1 & 2 on Hudson River Aquatic Life, submitted in this proceeding on April 5, 1972.

4. Quirk, Lawler & Matusky, "Effect of Roseton Plant Cooling Water Discharge on Hudson River Temperature Distribution and Ecology" (December 1969).

5. Quirk, Lawler & Matusky, "Environmental Effects of Bowline Generating Station on Hudson River" (March 1971).

6. Jensen, A.L., "The Effect of Increased Mortality on the Young in a Population of Brook Trout, A Theoretical Analysis," <u>Trans. Amer. Fish. Soc.</u> 100 (3), (July 1971).

Sworn to before me this

16th day of October, 1972

Lenore Mannes
LENORE MANNES
Notary Public for
District of Columbia

John R. Clark
John R. Clark

My Commission Expires May 14, 1976