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50-361/362

JUN 0 6 1973

Dr. B. Gordon Blaylock
Oak Ridge National Laboratory
Oak Ridge Operations Office
P. O. Box X
Oak Ridge, Tennessee 37830

Dear Gordon:

Please retype, execute and have notarized (fill in COUNTY) the enclosed affidavit, and return to me by mail as quickly as possible.

Sincerely,

Lawrence J. Chandler
Counsel for AEC Regulatory Staff

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UNITED STATES OF AMERICA
ATOMIC ENERGY COMMISSION

In the Matter of SOUTHERN CALIFORNIA EDISON COMPANY AND SAN DIEGO GAS & ELECTRIC COMPANY (San Onofre Nuclear Generating Station, Units 2 and 3)	)	Docket Nos. 50-361 50-362

AFFIDAVIT OF B. GORDON BLAYLOCK

I, B. Gordon Blaylock, being duly sworn, do depose and state that:

1. I am an ecologist on the senior staff of the Environmental Sciences Division at the Oak Ridge National Laboratory, Oak Ridge, Tennesee;

2. I prepared or caused to be prepared under my direction and supervision those portions of the Final Environmental Statement of the U. S. Atomic Energy Commission's Directorate of Licensing in the captioned proceeding (Staff Exhibit-2) relating to the impact of the proposed facilities on the natural biota;

3. I have previously testified in the captioned proceeding and my professional qualifications have been incorporated into the record of this proceeding (Tr. 2563-2579);

4. I have prepared the staff's response to questions by Board member Dr. Daiber on May 16, 1973 (Tr. 2254-2259), as follows:
I.2, I.3, I.4, II.1, II.2, III.2, IV.2a, IV.2b, IV.3, IV.4, IV.5, IV.6, V.2, V.3;

5. Said responses are true and correct to the best of my knowledge and belief;

6. If called upon to testify orally with respect to said questions, I would testify as set forth in said written responses.

____
B. Gordon Blaylock

Subscribed and sworn to before me this

__________ day of ______________, 1973.

____
Notary Public

STATE OF TENNESSEE, COUNTY OF

My Commission expires: ________________

B. G. BLAYLOCK

STAFF RESPONSE TO SUPPLEMENTAL ASLB QUESTIONS

PROPOSED DURING ENVIRONMENTAL HEARINGS FOR

SAN ONOFRE NUCLEAR GENERATING STATION UNITS 2 AND 3

A. Questions by Dr. Daiber:

I.1 What are the dimensions of the opening beneath the velocity cap?

Assuming the dimensions of the intake crib lip to be 28.25 ft. x 41 ft., and that the velocity cap will be supported by four 3-ft. dia corner columns and ten 2-ft. dia intermediate columns, the opening beneath the velocity cap for a 2.5 fps intake velocity will be 6.9 ft.

I.2 What is the minimum fish size that could detect and react to this current?

Juvenile fish, as soon as they become free swimming, are usually capable of detecting currents. Since fish of various sizes have been found in the traveling screens for Unit 1, it is evident that there is no minimum cut-off size for fish which will be taken into the intake structure.

I.3 Can Juvenile and Larval fish respond as well as larger or older individuals?

Juvenile and larval fish are weaker swimmers, therefore, they cannot respond as well as larger and older individuals.

I.4 What can be done to reduce or remove the problem of egg and larval intake?

The first solution is to circulate less water. However, this would result in an increased temperature rise through the condenser, and would violate the Federally approved State Water Quality Control Board limitation of a 20F° maximum increase in water temperature. In the FES, Section 12.4.1, alternative cooling systems were considered which would tend to mitigate this problem. The staff concluded that the once-through diffuser discharge system was preferred overall.

The most promising solution is to locate the intakes such that the offshore location of the intake structure and the position of the intake within the vertical water column is optimized with respect to the year-round concentration of eggs and larvae. The latter position will be limited at the lower end by the necessity of avoiding entrainment of particulate material from the ocean floor, and at the upper end by navigational hazard factors and by the potential problem of ingesting heated water found in the upper few feet of the water column. Within these constraints, the depth of the intake structure for its present location could not be changed appreciably. Moving the intake structure to a different location in search of a zone having a smaller population of eggs and larvae would involve distances of several miles.

II.1 Can screens or louvers be placed at the velocity cap? And if not, why not?

The use of screens or louvers at the velocity cap to reduce the intake of fish has been considered. In the Units 2 & 3 ER, Section 8.4.4.3.1, page 8.4-17, the applicants discuss tests by Marineland of the Pacific at El Segundo Station, scheduled for 1972, but the staff has not been advised of the results.

The staff's analysis suggests that if screens were used the intake velocity would need to be reduced significantly. Data from Indian Point Station[1] taken by Consolidated Edison while varying intake velocity, indicated that reducing the intake velocity to about 0.8 fps effected a marked reduction in fish mortality. Reducing velocity by a factor of three (2.5 fps to 0.8 fps) would increase the intake flow area by a similar factor. A much larger intake structure would thus be required. Even at 0.8 fps provision would be needed for cleaning the screens to eliminate clogging by impinged organisms and other debris. To place traveling screen drives above water, the structures would have to extend above the surface.

The effectiveness of louvers has been investigated by the applicant in his fish return studies[2]. In the most successful configurations a flow of water was maintained at a narrow (20 degree) angle past (not through) the frame of louvers. Such a configuration is not readily adaptable to the velocity cap. In other tests, a simple arrangement of louvers across the flow stream failed to divert the fish. Actually the velocity cap could be regarded as a kind of louver arrangement, and is discussed in Section 5.3.2, page 5-12, of the staff's FES.

All of these considerations suggest that the designed system is preferable, particularly in view of the promising results of the fish return system tests which will be discussed in response to question II.2.

[1]Consolidated Edison Co., "Fish Protection at Indian Point", Environmental Report Supplement for Indian Point Unit No. 2, Appendix S, 1970.

[2]Applicants Response to Additional Agency Comments, Ortega to Youngblood, April 16, 1973.

II.2 What are the means by which fish will be directed to quiet zones away from the travelling screens?

The fish return system was mentioned briefly in the FES on page 5-12. More recently the applicants have presented additional

information and test results in connection with this system[1]. Of the various designs tested, the most promising interposed an array of louvers spaced one inch apart in a frame set at 20 degrees to the flow. The main flow is diverted through the louvers while the fish drift into the quiet zone straight ahead. Efficiencies of 95% or greater have been observed. If such efficiencies can be demonstrated in the final design, fish losses will be reduced significantly.

[1] Schuler, Victor J., Experimental Studies in Guiding Marine Fishes of Southern California with Screens and Louvers, Ichthyological Associates Bulletin 8, February 1973.

III.1 What is the rate of temperature rise as water passes through the condenser?

For the short (8 sec) passage through the condenser the staff has assumed a linear increase in temperature. Thus, it will be 20F°/8 sec or 2-1/2 F°/sec.

III.2 What studies have been made on the effect of this rate of rise on phytoplankton, zooplankton, or larval, juvenile, or adult fish species as they are taken through the condenser?

Studies on the effects of temperature increase on entrained organisms are discussed in the FES, Section 5.3.2. The applicants' study is also referenced in that section. This is a very active area of research and new data are appearing rapidly. At the present time, the prediction of mortality rate is uncertain because of the multiplicity of variables and paucity of data. This was borne out by papers presented at a recent symposium at John Hopkins University.

IV.1 What is the total volume of water per heat treatment and how many heat treatments will be conducted per year?

The total volume of water per heat treatment of each unit will be about 10 million ft^3 (230 acre-ft) of water heated to about 125°F. This is based on a 40% flow rate through the condensers for 4 hours. The applicants have indicated that heat treatments will probably be required every 5 to 6 weeks throughout the year. The staff has based its impact analysis on ten heat treatments per year.

IV.2.a What is the estimated total biomass attached to the inside surfaces of the (intake and discharge) pipes?

Estimating the total biomass of organisms attached to the inside surfaces of the pipes and conduits is almost impossible without specific studies. Many conditions influence the growth of fouling organisms - water quality, temperature, water velocity and the availability of food. On some surfaces the buildup of encrusting organisms could be several inches; however, this should not occur on all surfaces. If for example, we assume a buildup of biomass of 1/16 of an inch on the 1.1 million square ft of internal surfaces, this could represent some 200 tons wet wt of biomass.

IV.2.b What are the estimates of total biomass of fish, invertibrates, eggs, larval stages, zooplankton and phytoplankton that would be trapped inside the pipes during heat treatment?

The estimated pounds of fish which could be killed by heat treatment is discussed on page 5-15 of the Final Environmental Statement. These estimates, which were extrapolations from Unit 1 data, indicate that from 1,100 to 2,800 lb of fish could be killed during each heat treatment of Units 2 or 3. However, an appreciable fraction of those fish are assumed to be trapped in the screenwell at the time that heat treatment is initiated; thus, an effective fish return system can be expected to reduce this figure significantly.

At this time, no adequate data is available to permit the staff to estimate the biomass of eggs and larvae that would be killed during heat treatment. The mean wet wt of zooplankton is given in the FES on page 5-31 as 16 to 256 g/1000 m^3 for different seasons. The combined volume of the cooling water systems for Units 2 and 3 is approximately 4.8×10^6 ft^3 (137,000 m^3). Based on these data, a maximum of 35 Kg (77 lbs) of zooplankton would be trapped inside the pipes. Similarly for phytoplankton, page 14-4 of the FES gives biomass estimates as 12.5 times that of zooplankton. From this an estimated 400 Kg (900 lbs) of phytoplankton would be trapped inside the pipes.

IV.3 What is the seasonal periodicity of abundance of nekton and plankton in the shore zone whereby there could be time periods of greater kill during heat treatment?

The staff has provided some seasonal data on fish species in Section 5.3.2 of the FES. Improved data, including diurnal periodicity, is needed for both fish and plankton.

IV.4 Can the heat treatment periods be scheduled about such periods of abundance?

Eight to ten heat treatments are used per year to remove fouling organisms from the intake and discharge conduits (FES Table 5.3, Page 5-14). There is not a regularly scheduled time for heat treatments, but treatments are employed when a buildup of fouling organisms occur in the conduits. The buildup of fouling organisms is usually greater during the warm water months when the population densities increase. Although it may be possible to fit the period of heat treatments about the periods of abundance, detailed studies would be needed to determine the abundances of the different species throughout the year. The staff anticipates that a determination of this abundancy will be made during the pre-operational environmental monitoring program for Units 2 and 3.

IV.5 Will fish and other organisms be attracted to dead fouling organisms (i.e, mussels, etc.) and others (i.e., fish) trapped during heat treatment?

Fish and other organisms would probably be attracted to dead fish and biota which are killed during heat treatment and discharged either through the intake or discharge structures.

IV.6 Could the discharge of organisms (killed during heat treatment) serve as a chronic inducement that could enhance entrainment of fish and other organisms into the cooling system?

Since the heat treatments are employed only eight to ten times a year, we would not consider this as a chronic condition which would increase the entrainment of organisms.

IV.7 Have any feasibility studies been carried out to find positive constructive means to utilize the heat generated by Units 1, 2 and 3, rather than discharging it to the ocean?

The staff has not conducted feasibility studies on the use of waste heat from Units 1, 2 and 3. In view of the limited space available to the applicants, the geographical restraints imposed by Camp Pendleton and San Onofre State Beach, and the terms and conditions of the applicants' easement, the staff has concluded that at this time no practical means have been identified for utilizing the waste heat from Units 1, 2 and 3.

V.1 What is the volume of water per day that will periodically receive chlorine treatment?

Each unit cycles 830,000 gpm of cooling water, or 1845 cfs. At six 15-min periods per day, this amounts to a volume of about 10 million cubic feet per day, or approximately 230 acre-feet of water.

Each 15-min chlorination period treats one half of the condenser of a unit. This means that, on a daily basis - 5 million ft^3 of water will be treated with 3 ppm of chlorine, which is reduced to 1 ppm in about 8 sec. At that point, the concentration will be further reduced to 0.5 ppm by dilution with untreated water from the other condenser half. This concentration continues to decrease as the water flows through the discharge conduit, and based on Unit 1 experience, will probably be on the order of 0.1 ppm at the points of discharge to the ocean.

V.2 What are the sublethal effects of chlorine on organisms?

Some of the sublethal effects of chlorine are: Effects on reproduction, avoidance reaction of fish, delayed growth of alga and a decrease in photosynthesis rate of phytoplankton. Reproduction in Gammarus pseudolimnaeus was reduced by a residual chlorine concentration above 0.012 mg/l and the number of eggs produced by the fathead minnow Pimephales promelas was reduced (Arthur and Eaton, 1972).

Esvelt et al. (1971) and Krock and Mason (1971) observed that a chlorine residual of .03 mg/l reduced plankton photosynthesis by more than 20 percent. Hirayama and Hirano (1970) observed delays of growth in alga at residual chlorine concentrations of 0.65 - 10.1 mg/l after 5 minutes of exposure. Effects on photosynthesis are discussed in the response to the next question.

V.3 What effect does free chlorine have on the photosynthetic activity of entrained plankton?

According to a progress report by the National Marine Water Quality Laboratory (1971) chlorination is the primary cause of destruction of entrained photoplankton. Studies showed significant decreases in photosynthesis and chlorophyll in the effluent channel. Complete destruction of chlorophyll was found in three instances. Toxicity studies showed that none of the species tested survived concentrations greater than 0.5 ppm, and that concentrations of 0.1 to 0.25 ppm reduced the growth rates of the test species by 50% during the first 24 hour of the experiment. Periods of almost

complete inhibition of carbon uptake by plankton were found by Morgan and Stross (1969) to correlate directly with chlorine additions at the Chalk Point Plant. Concentrations of chlorophyll a were also much reduced during chlorination, implying destruction of the algal cells. Hamilton et al. (1970) found significant reductions in the photosynthetic rate and chlorophyll concentrations of chlorinated effluent from the Chalk Point Plant. Hirayama and Hirano (1970) tested the effect of chlorine concentrations on *Chlamydomonas* sp. and *Skeletonema costatum*. *Chlamydomonas* was able to tolerate 20 ppm or more for exposures of 5 to 10 min and to resume growth on the ninth day after exposure. *S. costatum*, however, was damaged so badly by concentrations of 1.5 to 2.3 ppm that growth did not resume even on the 30th day after treatment.

References for responses to questions V.2 and V.3:

Arthur, J. W., and Eaton, J. G., "Chloramine Toxicity to the Amphipod, *Gammarus pseudolimnaeus* and the fathead minnow, *Pimephales promelas*. *Jour. Fish. Res. Bd. Can.*, 28, 1841 (1971).

Esvelt, L. A., et al., "Toxicity Removal from Municipal Wastewaters." Vol. IV of "A Study of Toxicity and Biostimulation in San Francisco Bay-Delta Waters." SERL Report No. 71-7, Sanitary Engineering Research Laboratory, University of California, Berkeley (1971).

Krock, H., and Mason, D. T., "Bioassays of Lower Trophic Levels." Vol. VI of "A Study of Toxicity and Biostimulation in San Francisco Bay-Delta Waters." SERL Report No. 71-8, Sanitary Engineering Research Laboratory, University of California, Berkeley (1971).

Hirayama, K., and Hirano, R., "Influences of High Temperature and Residual Chlorine on Marine Phytoplankton." *Marine Biol.*, (W. Ger.), 7,205 (1970).

National Water Quality Laboratory, Processed Report, Duluth, Minn., 1971.

R. P. Morgan and R. G. Stross, "Destruction of Phytoplankton in the Cooling Water Supply of a Steam Electric Plant," Chesapeake Sci. 10:1965 (1969).

D. H. Hamilton, D. A. Flemer, C. W. Keefe, and J. A. Mihursky, "Power Plants: Effects of Chlorination on Estuarine Primary Production," Science 169:197-198 (1970).