Dockets

MAY 18 1976

Docket Nos. 50-275
and 50-323

Mr. Kenneth R. Jones, Executive Officer
California Regional Water Quality
Control Board - Central Coast Region
1122 Laurel Lane
San Luis Obispo, California 93401

Dear Mr. Jones:

Thank you for providing the Nuclear Regulatory Commission (NRC) with copies of the National Pollutant Discharge Elimination System (NPDES) permit for the Diablo Canyon Plant adopted by the California Regional Water Quality Control Board on April 9, 1976. By means of telephone conversations, the NRC staff has made your office aware of our concerns regarding the discharge of chlorine and heated water. This letter confirms telephone conversations which Messers W. Ross, J. Gill, T. Cain, and R. Samworth held with you and other members of the Control Board during January, February, and March of 1976.

As you know, the Commission (then the AEC) published its findings of expected environmental impacts in a Final Environmental Statement (FES) for Diablo Canyon in May, 1973. We have updated this review as part of our Operating License review and in preparation for establishing the Technical Specifications under which the plant will operate.

We have assessed the impacts that discharge water 19°F warmer than the intake water (ΔT of 19°F) would have on the aquatic biota in Diablo Cove. However, the methods and models available have not served to define the thermal plume as accurately as we would like and relatively little is known about the tolerance of most of the Cove's biota to heated water. On balance, however, our best assessment indicates that the biological impacts of a ΔT of 19°F are acceptable. We understand that the nominal ΔT of 19°F would be exceeded only when the cooling system cannot be operated at the design level, approximately 10 percent of the operating time.

In its proposed Environmental Technical Specifications dated June 13, 1975, Pacific Gas and Electric (PG&E) submitted the same thermal discharge limitations (ΔT of 22°F) as appear in the NPDES Permit. We responded to PG&E that additional thermal and biological information will be required to justify a ΔT higher than 19°F since all of our evaluations

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are based on this increment. We will assess the expected impacts of the higher ΔT based on the new data to be supplied by PG&E and on information gathered through a surveillance program during the early period of operation.

We have no problem with the limit of total residual chlorine in the NPDES permit because it is the same as recommended in our FES. Enclosed is a portion of one of our recent environmental statements showing our assessment of the potential danger of chlorine to marine life. Some of these data indicate that chlorine can be toxic in very low concentrations; however, the setting of very low limits must be tempered by the state-of-the art for measuring and dispersing such small amounts.

Thank you for the courtesy which you and your staff extended to the NRC staff during our review of the Diablo Canyon Plant. Your cooperation is in the spirit of the Memorandum of Understanding recently signed by EPA and NRC. We will advise you when PG&E submits its next draft of the Environmental Technical Specifications revised in response to our comments on the first draft. We invite your participation in the review and preparation of the final specifications.

Sincerely,

Original signed by
George W. Knighton

G. W. Knighton, Chief
Environmental Projects Branch 1
Division of Site Safety and
Environmental Analysis

Enclosure:
As stated

cc: See next page

CRESS:NL OFFICE▶	DSE/EP-1	ORB4:DOR	ELD	DSE/EPP-1		
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cc:

Mr. John C. Morrissey
Vice President and General Counsel
Pacific Gas and Electric Company
77 Beale Street
San Francisco, California 94106

Philip A. Crane, Jr., Esq.
Pacific Gas and Electric Comapny
77 Beale Street
San Francisco, California 94106

Andrew J. Skaff, Esq.
California Public Utilities
Commission
350 McAllister Street
San Francisco, California 94102

Mr. Frederick Eissler, President
Scenic Shoreline Preservation
Conference, Inc.
4623 More Mesa Drive
Santa Barbara, California 93105

Mrs. Elizabeth E. Apfelberg
1415 Cazadero
San Luis Obispo, California 94301

Ms. Sandra A. Silver
5055 Radford Avenue
North Hollywood, California 91607

Mr. Gordon Silver
5055 Radford Avenue
North Hollywood, California 91607

Mr. John Forster
985 Palm Street
San Luis Obispo, California 93401

Mr. William P. Cornwell
P.O. Box 453
Morro Bay, California 93442

Mr. W. J. Lindblad, Project Engineer
Pacific Gas and Electric Comapny
77 Beale Street
San Francisco, California 94106

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Enclosure 1

Section from the Draft Environmental Statement (NRC) for the Atlantic Generating Station

5.3.4 Chemical discharges

5.3.4.1 Sodium hypochlorite

Sodium hypochlorite will be produced for use as an antifouling agent as described in Sect. 3.7.1. These terms are used in connection with the following discussion on chlorination:

1. Free residual (available) chlorine — the portion of the reactive chlorine injected into water that remains as molecular chlorine, hypochlorous acid (HOCl), or hypochlorite ion (OCl^-) after the chlorine demand has been satisfied.

2. Combined residual chlorine — the portion of the chlorine that remains combined with ammonia or nitrogenous compounds after the chlorine demand has been satisfied (chloroamines).

3. Total residual chlorine — free residual chlorine plus combined residual chlorine.

4. Chlorine demand — the difference between the amount of chlorine injected into the water and the total residual chlorine remaining at the end of a specified period.

The number of chemical species produced and their concentrations vary with the amount of chlorine applied, temperature, time of contact, and chemical content of the water.[97]

The applicant has proposed to chlorinate continuously and to limit the total residual chlorine concentration to 0.1 ppm at the station discharge (ER, Suppl. 8, p. 134). The cooling water discharge will be monitored continuously for total residual chlorine by the amperometric method. The equipment used for monitoring chlorine concentration incorporates an automated control mechanism that can reduce the rate of addition of sodium hypochlorite when a preselected concentration of chlorine is exceeded.

The presence of total residual chlorine in the discharge must be limited to 2 hr/day, in view of the fact that the Environmental Protection Agency Guidelines state, "Neither free available chlorine nor total residual chlorine may be discharged from any unit for more than two hours in any one day and not more than one unit in any plant may discharge free available or total residual chlorine at any one time unless the utility can demonstrate ... that the units cannot operate at or below this level of chlorination" (Sect. 423.13).

These guidelines allow chlorination to be performed so that free available chlorine is discharged in the cooling water at a maximum concentration of 0.5 mg/liter and an average concentration of 0.2 mg/liter (based on monthly averages and measured amperometrically) for a total period not exceeding 2 hr/day. No limits are placed on the amount of chlorine that can be discharged as combined residual chlorine during this 2-hr period.

That compliance with EPA Guidelines will be achieved does not fix the amount of toxic chlorine compounds that will be discharged. This arises from the fact that the chlorine demand fluctuates with time. Thus, the total amount of chlorine to be added is not predictable. Even if the concentration of free residual chlorine is maintained at 0.2 mg/liter for 2 hr/day, the concentration of combined residual chlorine will vary with demand and the amount of chlorine added (combined residual = total chlorine added - [chlorine demand + free residual]). This makes prediction of effects due to chlorine difficult, in that the indirect chlorine impact may to a large extent be caused by the combined residual chlorine (chlorinated hydrocarbons and chloroamines), part of the "unknown" in this case.

Toxicity to marine biota influenced by the cooling water discharge will, in general, not be attributable to the products resulting from the chlorine demand, but rather to the residual chlorine (free and/or combined). Figure 5.19 summarizes data from numerous sources concerning the toxicity of chlorine to marine life. In this figure the data points are not differentiated with respect to types of residual chlorine measured. Brungs concluded, however, that in most cases the concentration of total residual chlorine (without regard to type) is a satisfactory criterion to define acute toxicity.[98] A measure of free available chlorine only does not take account of the presence of combined residual chlorine (e.g., as chloroamines), which is also toxic; a criterion based exclusively on concentration of free available chlorine is not, therefore, a satisfactory safeguard with regard to the toxicity to marine biota.

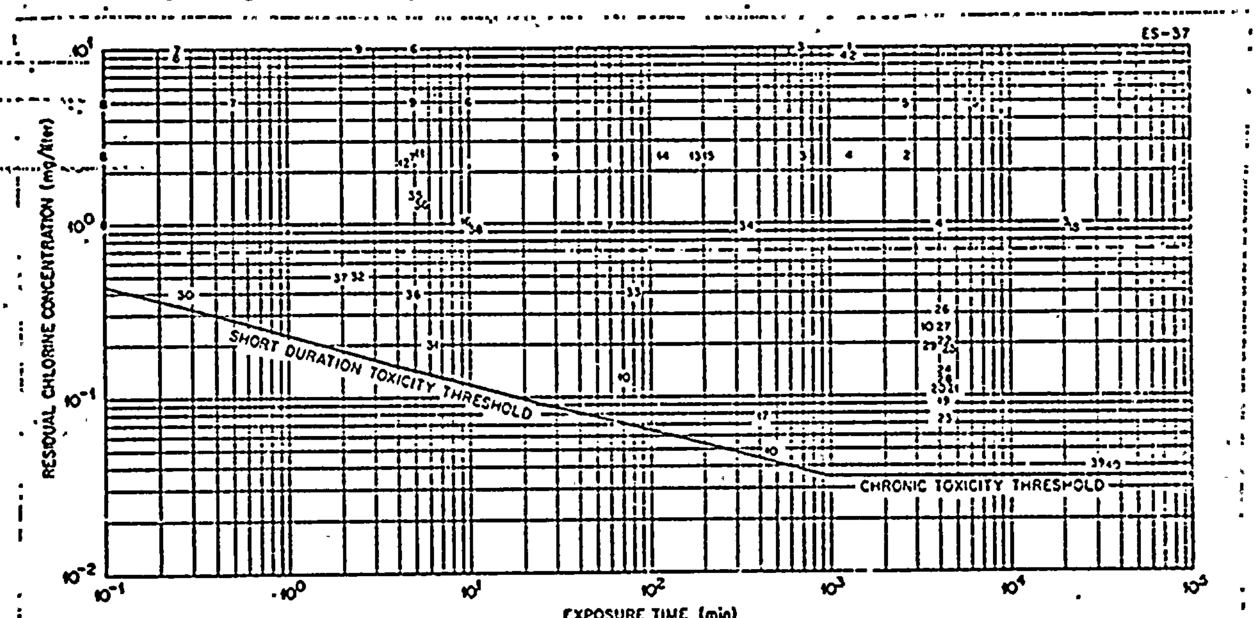

Fig. 5.19. Summary of data on toxicity of chlorine to marine life. See following key for identification of data points. Source: Seabrook FES (1974).

Key to Fig. 5.19

Point	Species name: Scientific	Species name: Common	Chlorine concentration (mg/liter)	Time	Effect	Footnote
	Plants					
	Chlorophyta					
21	Dunaliella tertiolecta		0.11	24 hr	50% stop growth	e
35	Chlamydomonas sp.		1.5	5–10 min	Time lag in growth effect recovered in 9 days	c
	Chrysophyta					
	Bacillariophyceae					
19	Skeletonema costatum		0.095	24 hr	50% stop growth	e
36	Skeletonema costatum		0.4–0.65	5 min	Adverse effect on growth	c
			1.5–2.3	5 min	Death	
23	Cyclotella nana		0.075	24 hr	50% stop growth	e
24	Chaetoceros decipiens		0.14	24 hr	50% stop growth	e
25	Thalassiosira nordensholkii		0.195	24 hr	50% stop growth	e
26	Thalassiosira rotula		0.33	24 hr	50% stop growth	e
27	Asterionella Japonica		0.25	24 hr	50% stop growth	e
28	Chaetoceros didymum		0.125	24 hr	50% stop growth	e
29	Detonula confervacea		0.2	24 hr	50% stop growth	e
30	Asterionella Japonica		0.4	16 sec	50% stop growth	e
31	Cyclotella nana		0.2	410 sec	50% stop growth	e
32	Skeletonema costatum		0.5	145 sec	50% stop growth	e
33	Detonula confervacea		0.4	5000 sec	50% stop growth	e
	Chrysophyceae					
20	Rhodomonas baltica		0.11	24 hr	50% stop growth	e
22	Monochrysis lutheri		0.2	24 hr	50% stop growth	e
	Phaeophyta					
5	Macrocystis pyrifera	giant kelp	5–10	2 days	10–15% photosynthesis reduction	b
			5–10	5–7 days	50–70% photosynthesis reduction	b
	Animals					
	Cnidaria					
	Bimeria franciscana	Hydroid	4.5	3 hr	None	d
		Sea anemone	1.0	15 days	None	c
	Mollusca					
3	Mytilus edulis	Mussel	1.0	15 days	100% mortality	c
			2.5	5 days	100% mortality	c
			10.0	5 days	100% mortality	c
	Crassostria virginica	Oyster	0.05	?	Pumping reduced	f
			1.0	?	No pumping	f
37	Ostrea edulis larvae	Oyster	0.5		After 2 min stop swimming	g
			1.0		After 2 min stop swimming	g
			2.0		Stop swimming immediately	g
			3.0		Stop swimming immediately	g
	Arthropoda					
	Corophium sp.	Tube dwelling amphipod	2.5	410 min	0 mortality after 24 hr	h
			5.0	410 min	0 mortality after 24 hr	h
			10.0	410 min	0 mortality after 24 hr	
14	Melita nitida	Amphipod	2.5	2 hr	50% mortality. Some deaths after 5 min	i
15	Gammarus tigrinus	Amphipod	2.5	3 hr	25% mortality after 96 hr	i
7	Acartia tonsa	Copepod	1	60 min	17% mortality	
			2.5	5 min	37.5% mortality	h
			5.0	0.5 min	20% mortality	h
			10.0	0.5 min	32% mortality	h

Key to Fig. 5.19 (continued)

Point	Species name: Scientific	Species name: Common	Chlorine concentration (mg/liter)	Time	Effect	Footnote
11	Acartia tonsa	Copepod	2.5	5 min	90% mortality measured after 3 hr	i
	Pseudodiaptomus coronidae	Copepod	1.0	24 hr	No deaths	h
			2.5	30 min	19% mortality	h
			5.0	5 min	6% mortality	h
			10.0	2.5 min	24% mortality	h
34	Eurytemora affinis	Copepod	1.0	360 min	51% mortality	h
	Elminius modestus	Barnacle	0.5	10 min	Little effect	g
		Nauplii	1.0	10 min	Heavy losses. No growth	g
12	Balanus improvisus	Barnacle	2.5	5 min	80% mortality after 3 hr	i
18		Barnacles	1.0	15 days	Most dead	e
6	Crangon septemspinosus larvae	Sand shrimp	5	10 min	37% mortality	h
			10	5 min	55% mortality	h
13	Palaemonetes pugio	Grass shrimp	2.5	3 hr	98% mortality after 96 hr	i
	Ectoprocta					
2	*Bugula sp.*		2.5	48 hr	100% mortality	e
			10.0	24 hr	100% mortality	e
	Chordata					
	Ascidiacia					
4	Molgula sp.		1.0	3 days	100% mortality	e
			2.5	1 day	100% mortality	e
			10.0	1 day	100% mortality	e
	Tunicata					
1	Botryllus sp.		10	24 hr	100% mortality	e
	Pisces					
8	Pseudopleuronectes americanus	Winter flounder	1	0.1 min	9% mortality	h
			2.5	0.1 min	6% mortality	h
			5.0	0.1 min	15% mortality	h
			10.0	0.25 min	32% mortality	h
	Pseudopleuronectes americanus eggs	Winter flounder	10.0	0.33 min	0% mortality	h
10	Pleuronectes platessa larvae	Plaice	0.05	460 min	50% mortality	h
	Pleuronectes platessa larvae	Plaice	0.13	70 min	50% mortality	j
	Pleuronectes platessa eggs		0.25	3 days	Critical level	j
17	Oncorhynchus kitsutch	Coho salmon	0.1	3 days	Critical level	k
39	Oncorhynchus tshawytocha	Chinook	0.05	23 days	Critical level	k
40	Oncorhynchus gorbuscha		0.05	23 days	Critical level	
	Marine fish		1.0		Slight irritant response	l

[a]C. S. Hegre, "Toxicity to Marine Organisms of Free Chlorine and Chlorinated Compounds in Sea Water," Environmental Protection Agency, National Marine Quality Lab, Progress Report, 1971.

[b]J. E. McKee and H. W. Wolf, "Water Quality Criteria," Publication No. 3-2, California Water Quality Control Board, 1963.

[c]K. Hirayama and R. Hirano, "Influences of High Temperature and Residual Chlorine on Marine Phytoplankton," *Mar. Biol.* 7: 205–213 (1970).

[d]R. I. McLean, "Chlorine Tolerance of the Colonial Hydroid," Bimeria franciscana *Chesapeake Sci.* 13: 229–230 (1972).

[e]H. J. Turner, D. M. Reynolds, and A. C. Redfield, "Chlorine and Sodium Pentachlorophenate as Fouling Preventatives in Sea Water Conduits," *Ind. Eng. Chem.* 40: 450–453 (1948).

[f]P. S. Galtsoff, "Reaction of Oysters to Chlorination," U.S. Fish and Wildlife Service, Dept. of Interior, Res. Rept. No. 11, 28 pp., 1946.

[g]G. D. Waugh, "Observations on the Effects of Chlorine on the Larvae of Oysters (*Ostrea edulis* L.) and Barnacles (*Elimimum modestus* Darwin)," *Ann. Appl. Biol.* 54: 423–40 (1964).

[h]J. H. Gentile, Unpublished Data, Environmental Protection Agency, National Marine Water Quality Laboratory, West Kingston, R.I., 1972.

[i]R. I. McLean, "Chlorine and Temperature Stress on Estuarine Invertebrates," *J. Water Pollut. Contr. Fed.* 45: 837–841 (1973).

[j]R. Alderson, "Effects of Low Concentrations of Free Chlorine on Eggs and Larvae of Plaice, *Pleuronectes platessa* L.," pp. 312–315 in *Marine Pollution and Sea Life*, ed. by M. Riuvo, FAO, Fishing News (Books, Ltd.), Surrey, England, 1973.

[k]G. A. Holland, J. E. Lasater, E. D. Neumann, and W. E. Eldridge, "Toxic Effects of Organic and Inorganic Pollutants on Young Salmon and Trout," Wash. Dept. Fish., Res. Bull. No. 5, 264 pp., 1960.

[l]R. W. Hiatt, J. J. Naughton, and D. C. Matthews, "Relation of Chemical Structure to Irritant Responses in Marine Fish," *Nature* 172: 904–905 (1953).

Most of the data points shown in Fig. 5.19 represent the concentration and duration of exposure that yield a 50% mortality. Thresholds are judged by the staff to fall below these points. A concentration of 0.5 mg/liter of free available chlorine plus a variable amount of combined residual chlorine, which theoretically could be equal to the total amount added less the free residual fraction,(93) could result in a chlorine concentration and duration of exposure (5.5 mg/liter total residual concentration in the discharge) toxic to a large number of marine organisms (Table 5.21, Fig. 5.19). Since the sensitivity to chlorine of most organisms has not been established, the staff has assumed as a conservative approximation that toxic levels for untested organisms will be the same as for the most sensitive organisms tested to date. Therefore, it is assumed that total chlorine at concentrations of free available chlorine of 0.5 mg/liter, together with what might be large concentrations of combined residual chlorine, could cause mortality of a large fraction of organisms.

Table 5.21. Dilution of residual chlorine concentration in the discharge plume of floating nuclear power plants

Distance from discharge point (ft)	Average travel time (sec)	Velocity (fps)	Chlorine concentration (ppm) as a function of distance and time from point of discharge when initial concentration is—			
			0.1 ppm	0.5 ppm	1.0 ppm	5.5 ppm
0	0	10	0.1	0.5	1.0	5.5
420	58	4.7	0.036	0.18	0.36	1.98
680	130	2.9	0.024	0.12	0.24	0.72
1850	950	0.8	0.012	0.06	0.12	0.36

[a] Reduction in concentration is by dilution only.

The Federal Water Pollution Control Act Amendments of 1972 require after 1983 the application of the best available technology economically achievable which will result in reasonable further progress toward the national goal of eliminating the discharge of all pollutants from the effluents of steam-electric power generating stations. In view of the above considerations regarding the toxicity of chlorine to marine organisms and the requirements imposed by the FWPCA Amendments, the staff judges that this legislation mandates that the cooling water discharged from each FNP into the offshore waters along the Atlantic and Gulf coasts of the United States should not contain total residual concentrations of chlorine which are in any way inimical to marine biota. From data in Fig. 5.19 it can be determined that total residual chlorine concentrations of 0.1 mg/liter are consistent with the intent of FWPCA mandates because of rapid dilution.

The staff concludes that, given the expected dilution rate, the mortality of marine biota in the immediate vicinity of the AGS will be confined to an acceptable extent if the concentration of total residual chlorine in the cooling water discharge is limited to values not exceeding 0.1 mg/liter.

CHLORINE REFERENCES

97. J. C. Merkins, "Studies on the Toxicity of Chlorine and Chloramines to the Rainbow Trout," *Water Waste Treat. J.* 7: 150-151 (1958).

98. U. A. Brungs, "Literature Review of the Effects of Residual Chlorine on Aquatic Life," *J. Water Pollut. Contr. Fed.* 45: 2180-2193 (1973).

99. R. Baker and S. Cole, *Ind. Water Eng.* 11: 70 (1974).