# MAY 1 8 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 ( $\Delta T$  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  $\Delta T$  of 19°F are acceptable. We understand that the nominal  $\Delta T$  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 ( $\Delta T$  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  $\Delta T$  higher than 19°F since all of our evaluations

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ర్శెంటింగ్ కొరికి సహదార్థింగింగ్ ఉంది. సౌకర్గు సౌకర్గు సౌకర్గు అల్లి ఉంది. సంగర్ధింగ్ శ్రీ ఉన్నాడు సౌకర్గు ఉంది సాకర్ కోడు సౌకర్గు ఉన్నో సౌకర్గు కింటింద్ సౌకర్గు కారం సోకర్గు కిండానింగి సర్వర్గు సౌకర్గు సౌకర్గు సౌకర్ సాకర్ స సౌకర్ కొర్డింగి సౌకర్గు సౌకర్గు సౌకర్ స్రార్థి సౌకర్ సౌకర్ సౌకర్ సౌకర్ సౌకర్ సౌకర్ సౌకర్ స్రార్థింగి స్రార్థింగి సౌకర్ సౌకర్ సౌకర్ స్రార్థింగి సౌకర్ స్రార్థి సౌకర్ సౌకర్ సౌకర్ సౌకర్ సౌకర్ సౌకర్ సౌకర్ స్రార్థింగి సౌకర్ సాకర్ సౌకర్ సౌకర్ స్రార్థి స్రార్థింగి సౌకర్ సౌకర్ సౌకర్ సౌకర్ సౌకర్ సౌకర్ సౌకర్ సౌకర్ సౌకర్ స్రార్థింగి సౌకర్ సౌకర్ సౌకర్ సౌకర్ సౌకర్ స్రార్థింగి సౌకర్ స్రార్థింగి సౌకర్ సౌకర్ సౌకర్ సౌకర్ సౌకర్ సౌకర్ సౌకర్ స్రార్థి సౌకర్ సౌకర్ సౌకర్ సౌకర్ సౌకర్ సౌకర్ సౌకర్ సౌకర్ స్రార్థింగి స్రార్ సౌకర్ సౌకర్ స్రార్థి సౌకర్ సౌకర్ సౌకర్ స్రార్థింగి సౌకర్ సౌకర్ సౌకర్ సౌకర్ సౌకర్ స్రార్థింగి స్రార్థింగి సౌకర్ స సౌకర్ సౌకర్ స్రార్థింగి సౌకర్ స్రార్థి స్రార్థింగి స్రార్థింగి సౌకర్ సౌకర్ సౌకర్ స్రార్థింగి స్రార్థింగి స్రార్ స్కర్ సౌకర్ స్రార్థి స్రార్థిలు స్రార్థిలు స్రార్థింగి స్రార్థింగి సౌకర్ సౌకర్ స్రార్థింగి స్రార్థింగి స్రార్థి

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್ರಿ ಸಂಗಾರ್ಥಿಕ ಸಂಸ್ಥೆ ನಿರ್ದೇಶನ ನಿರ್ಧಾರ್ಶನ ಬಿಸ್ ಪ್ರೇಕ್ರಿ ಸಿಲ್ಲಿ ಸ್ಥಾನಿಸಿ ಸಂಗ್ರೆ ಸ್ಥಾನ ಸೇರಿ ಸೇರೆ ಸಂಗ್ರೆ ಸಂಗ್ರೆ ಸ್ಥ ಸ್ಮೇಭದಲ್ಲಿ ಆಗಳಾಗಿಗಳಿಗೆ ಸಿಲ್ಲಿಸ್ ಸ್ಥೆಯಿಸಿ ನಿರ್ದೇಶನ ಸಾಹಿತಿ ಸಾಹಿತಿ ಸಾಹಿತಿ ಸೇರಿ ಸ್ಥೇನ ಸ್ಥಾನಿ ಸುತ್ತಿದೆ. ಸಾಹಿತಿ ಸಿಲ್ಲ ಸರ್ಗೆ ಸಿಲ್ಲಿಸ್ ಸ್ಟ್ರಿ ಸಿಲಿನ್ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲಿಸ್ ಸ್ಥಿತಿ ಸೇರಿ ಸ್ಥೆಯಿಸಿ ಸಿರ್ದೇಶನ ಸ್ಥೆತಿ ಸಿಲ್ಲಿಸಿ ಸಿರ್ದೇಶನ ಸ್ಲ್ರಿ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲಿಸ್ ಸ್ಥಾನಿಸಿ ಸಿರ್ದೇಶನ ಸ್ಥೆಯಿತು ಸಿಲ್ಲ ಸಿಲ್ಲಿಸಿ ಸಿರ್ದೇಶನ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲಿಸ್ ಸ್ಥೆಯಿಸ್ ಸಿಲ್ಲೆಸ್ ಸಿಲ್ಲೆಸ್ ಸಿ ಸಿಲ್ಲಿಸಿ ಸಿರ್ದೇಶನ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲೆಸ್ ಸಿಲ್ ಸಿಲ್ಲಿಸಿ ಸಿರ್ದೇಶನ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಸ್ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಸ್ ಸಿಲ್ಲಿಸಿ ಸಿರ್ದೇಶನ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಲ್ ಸಿಲ್ಲಿಸ್ ಸಿಲ್ಸ್ ಸಿಲ್ಸ್ ಸಿಲ್ಸ್ ಸಿಲ್ಸ್ ಸಿಲ್ಸ್ ಸಿಲ್ಸ್ ಸಿರ್ಗ್ ಸಿರ್ದ್ ಸಿಲ್ಸ್ ಸಿರ್ಗ್ ಸಿರ್ಗ್ರಿಸ್ ಸಿಲ್ಸ್ ಸಿಲ್ಸ್ ಸಿಲ್ಸ್ ಸಿಲ್ಸ್ ಸಿಲ್ಸ್ ಸಿಲ್ಸ್ ಸ್ಟ್ ಸಿಲ್ಸ್ ಸಿಲ್ಸ್ ಸಿಲ್ಸ್ ಸಿಲ್ಸ್ ಸಿಲ್ಸ್ ಸಿಲ್ಸ್ ಸಿಲ್ಸ್ ಸಿರ್ಸ್ ಸಿರ್ಗ್ ಸಿಲ್ಸ್ ಸಿರ್ಸ್ ಸಿರ್ಸ್ ಸಿರ್ಸ್ ಸಿಲ್ಸ್ ಸಿರ್ಸ್ ಸಿರ್ಸ್ ಸಿರ್ಸ್ ಸಿಲ್ಸ್ ಸಿರ್ಸ್ ಸಿಲ್ಸ್ ಸಿರ್ಸ್ ಸಿರ್ಸ್ ಸಿರ್ಸ್ ಸಿಲ್ಸ್ ಸಿರ್ಸ್ ಸಿಲ್ಸ್ ಸಿಲ್ಸ್ ಸಿಲ್ಸ್ ಸಿಲ್ಸ್ ಸಿಲ್ಸ್ ಸಿಲ್ಸ್ ಸಿಲ್ಸ್ ಸಿಲ್ಸ್ ಸಿರ್ಸ್ ಸಿರ್ಸ್ ಸಿರ್ಸ್ ಸಿಲ್ಸ್ ಸಿಲ್ಸ್

Kenneth R. Jones

are based on this increment. We will assess the expected impacts of the higher  $\Delta T$  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 stateof-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. Kalghton

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

Enclosure: As stated

cc: See next page

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Kenneth R. Jones

cc:

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Mr. W. J. Lindblad, Project Engineer Pacific Cas and Electric Comapny OFF77EBeale Street San Francisco, California 94106

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# 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:

Υ.

- 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 chlerine the portion of the chlorine that remains combined with amonia 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.

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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.

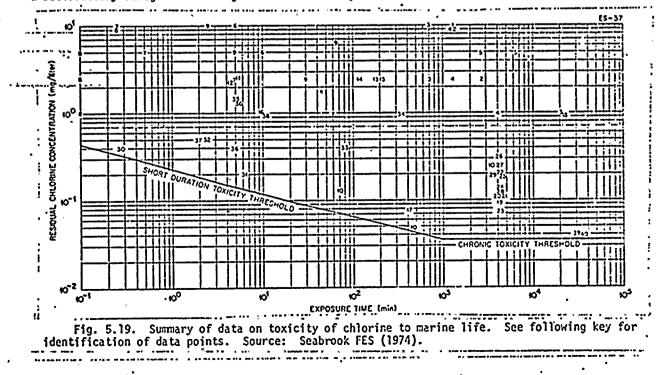
The applicant has proposed to chlorinate continuously and to limit the total residual chlorine concentration to 0.1 ppm at the station discharge (ER, Suppl. 8, p. 134). The cooling water discharge will be monitored continuously for total residual chlorine by the amperometric method. The equipment used 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 etrically) is a sol 2 mg/liter (based on monthly averages and measured amperometrically) for a total period not bloching total and 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 that 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 conthat a mount 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 struct). This makes prediction of effects due to chlorine difficult, in that the indirect chlorine impact may to a large extent be the "unknown" in this case.

iiii. in userToxicity to marine biota influenced by the cooling water discharge will, in general, not be issue of attributable to the products resulting from the chlorine demand, but rather to the residual issue of attributable to the products resulting from the chlorine demand, but rather to the residual issue of attributable to the products resulting from the chlorine demand, but rather to the residual issue of attributable to the products resulting from the chlorine demand, but rather to the residual issue of attributable to the products resulting from the chlorine demand, but rather to the residual its issue of the toxicity of chlorine to marine life. In this figure the data points are not differentiated issue 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 is a count of the presence of combined residual chlorine (e.g., as chloroamines), which is also account of the presence of combined residual chlorine (e.g., as chloroamines), which is also is a satisfactory safeguard with regard to the toxicity to marine biota.



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Key	to	Fig.	5.	19

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Point	Species name Scientific Common		Chlorine concentration	Time	Elka	Footn
	Januar -		(mg/liter)		•	
-		Plan	ts		•	
	Chlorophyta	N Triat		24 hr	50% stop growth	
215.5	Panancia (critoreca		- 0.11 1.5	5-10 min	Time lag in growth	ć
35 .	Chlamydomonas sp.		1-2	3-10 mm	effect recovered	•
				•	in 9 days	
		7 -	e i			
	Chrysophyta		•	. •	•	
19	Bacillariophyceae	22 - 24 - 24 - 24 - 24 - 24 - 24 - 24 -	0.095	24 hr	50% stop growth	4
36			0.4-0.65	S min -	. Adverse effect on	c
20	Skeletonema costatum		0.4-0.00		growth .	•
• •	•	· · · · · · · · · · · · · · · · · · ·	1.5-2.3	5 min	Death	
23.1+-	Cyclotella nana	e shieterstreeter		24 hr	50% stop growth	
4			0.14	24 hr	50% stop growth	e
25			0.195	24 hr.	50% stop growth	· · · ·
26	Thalassiosira rotula	- • ·	0.33	24 hr	50% stop growth	
27	Asterionella Japonica	a 1	0.25	24 hr	50% stop growth	4
28	Chaetoceros didymum		0.125	24 hr	50% stop growth	a
29-14	"" Detonula confervacea	hitertying the state of		24 hr	50%stop growth	
30	Asterionella japonica	\$4.5° + + 7. 10 + 14 + 1	0.4	16 sec	50% stop growth	a
31	Cyclotella nana	***	0.2	410 sec	50% stop growth	a
32	Skeletonems contatium		10.5	145 sec	50% stop trowth	e
· 33 : 3"	Detonula confervacea	· · · · · · · · · · · · · · · · · · ·	. 0.4	5000 sec	50% stop growth	
	Chrysophycese				•	
20	Rhodomonas baltica	• •	. 0.11 •	24 hr	50% stop growth	đ
22	Monochrysis lutheri		0.2	24 hr	50% stop growth	3
	Phacophyta	· · .				
i-s'	Macrocystis pyrifera	gunt kelp	5-10	2 days	10-15%	ь
	7146	a 2 - 1 - 2 - 1 - 2 - 2 - 2 - 2 - 2 - 2 -	ę		photosynthesis	
					reduction	
795 -		ere tre tre e	5-10	5-7 days	50-70%	· · · b
******	· · · ·	a billion, and a fair	•.		photosynthesis	
	• *				reduction	
					<i>4</i>	
•	•	`Anin	als	2		
1,	Cnidaria	-	•	_		
				• •		
		Hydroid	4.5	3 hr	None	d
	Bimeria franciscana	Hydroid Sea anemoné	4.5 1.0	3 hr 15 days	None	d e
	Bimeria franciscana	Hydroid • Sea anemoné				d e
V.	Bimerla franciscana Mollusca	- Sea anemoné	1.0	15 days		d c
L.	Bimeria franciscana				None	d e e
V.	Bimerla franciscana Mollusca	- Sea anemoné	1.0 1.0	15 days 15 days 5 days	None 100% mortality	d c c c c
V.	Bimerla franciscana Mollusca Mytilus edulis	Sea anemoné Mussel	1.0 1.0 2.5	15 days 15 days	None 100% mortality 100% mortality	
3" 	Bimerla franciscana Mollusca	- Sea anemoné	1.0 1.0 2.5 10.0	15 days 15 days 5 days 5 days	None 100% mortality 100% mortality 100% mortality	
3" (] •	Bimerla franciscana Mollusca Mytilus edulis	Sca anemoné Mussel	1.0 1.0 2.5 10.0 0.05	15 days 15 days 5 days 5 days 7 7 7	None 100% mortality 100% mortality 100% mortality Pumping reduced	
12 13 <sup>11</sup> 1 <sup>1</sup> - 141	Bimerla franciscana Mollusca Mytilus edulis Crassostria virginica	Sea anemoné Mussel Para Sana Sana Oyster Oyster	1.0 1.0 2.5 10.0 0.05 1.0	15 days 5 days 5 days 7 days 7 7 8 After 2 r	None 100% mortality 100% mortality 100% mortality Pumping reduced No pumping aln stop swimming	
12 13 <sup>11</sup> 1 <sup>1</sup> - 141	Bimerla franciscana Mollusca Mytilus edulis Crassostria virginica	Sea anemoné Mussel Pristante Oyster	1.0 1.0 2.5 10.0 0.05 1.0	15 days 5 days 5 days 7 days 7 7 8 After 2 r	None 100% mortality 100% mortality 100% mortality Pumping reduced No pumping	
12 13 <sup>11</sup> 1 <sup>1</sup> - 141	Bimerla franciscana Mollusca Mytilus edulis Crassostria virginica	Sea anemoné Mussel Para Sana Sana Oyster Oyster	1.0 2.5 10.0 0.05 1.0 0.5 1.0	15 days 5 days 5 days 7 7 7 After 2 r After 2 r	None 100% mortality 100% mortality 100% mortality Pumping reduced No pumping alln stop swimming	
12 13 <sup>11</sup> 1 <sup>1</sup> - 141	Bimerla franciscana Mollusca Mytilus edulis Crassostria virginica	Sea anemoné Mussel Para Sana Sana Oyster Oyster	1.0 2.5 10.0 0.05 1.0 0.5	15 days 5 days 5 days 7 7 7 After 2 r After 2 r	None 100% mortality 100% mortality 100% mortality Pumping reduced No pumping aln stop swimming	
12 13 11 11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Bimerla franciscana Mollusca Mytilus edulis Crassostria virginica	Sea anemoné Mussel Para Sana Sana Oyster Oyster	1.0 1.0 2.5 10.0 0.05 1.0 0.5 1.0 2.0	15 days 5 days 5 days 7 7 After 2 r After 2 r Stop swi	None 100% mortality 100% mortality 100% mortality Pumping reduced No pumping aln stop swimming aln stop swimming mming immediately	
3" 	Bimerla franciscana Mollusca Mytilus edulis Crassostria virginica	Sea anemoné Mussel Para Sana Sana Oyster Oyster	1.0 2.5 10.0 0.05 1.0 0.5 1.0	15 days 5 days 5 days 7 7 After 2 r After 2 r Stop swi	None 100% mortality 100% mortality 100% mortality Pumping reduced No pumping alln stop swimming	6 6 7 7 8 8 8 8 8 8 8 8 8
3" 	Bimerla franciscana Mollusca Mytilus edulis Crassostria virginica Ostrea edulis larvae	Sea anemoné Mussel Para Sana Sana Oyster Oyster	1.0 1.0 2.5 10.0 0.05 1.0 0.5 1.0 2.0	15 days 5 days 5 days 7 7 After 2 r After 2 r Stop swi	None 100% mortality 100% mortality 100% mortality Pumping reduced No pumping aln stop swimming aln stop swimming mming immediately	
3" 	Bimerla franciscana Mollusca Mytilus edulis Crassostria virginica Ostrea edulis larvae Asthropoda	Sca anemone Mussel State Oyster Oyster	1.0 1.0 2.5 10.0 0.05 1.0 0.5 1.0 2.0 3.0	15 days 5 days 5 days 7 7 8 After 2 r After 2 r 5 top swi	None 100% mortality 100% mortality 100% mortality Pumping reduced No pumping all stop swimming ming top swimming mming immediately mming immediately	-
3" 	Bimerla franciscana Mollusca Mytilus edulis Crassostria virginica Ostrea edulis larvae	Sea anemoné Mussel Para Sana Sana Oyster Oyster	1.0 1.0 2.5 10.0 0.05 1.0 0.5 1.0 2.0	15 days 5 days 5 days 7 7 After 2 r After 2 r Stop swi	None 100% mortality 100% mortality 100% mortality Pumping reduced No pumping alla stop swimming min stop swimming mming immediately mming immediately 0 mortality after	•
12 13 11 11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Bimerla franciscana Mollusca Mytilus edulis Crassostria virginica Ostrea edulis larvae Asthropoda	Sca anemone Mussel State Oyster Oyster	1.0 1.0 2.5 10.0 0.05 1.0 0.5 1.0 2.0 3.0 2.5	15 days 5 days 5 days 7 7 After 2 r After 2 r Stop swi 5 top swi 410 min	None 100% mortality 100% mortality 100% mortality Pumping reduced No pumping all stop swimming mming immediately mming immediately 0 mortality after 24 hr	ĥ
3" 	Bimerla franciscana Mollusca Mytilus edulis Crassostria virginica Ostrea edulis larvae Asthropoda	Sca anemone Mussel State Oyster Oyster	1.0 1.0 2.5 10.0 0.05 1.0 0.5 1.0 2.0 3.0	15 days 5 days 5 days 7 7 8 After 2 r After 2 r 5 top swi	None 100% mortality 100% mortality 100% mortality Pumping reduced No pumping all stop swimming mming immediately mming immediately 0 mortality after 24 hr 0 mortality after	ĥ
12 13 11 11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Bimerla franciscana Mollusca Mytilus edulis Crassostria virginica Ostrea edulis larvae Asthropoda	Sca anemone Mussel State Oyster Oyster	1.0 1.0 2.5 10.0 0.05 1.0 0.5 1.0 2.0 3.0 2.5 5.0	15 days 5 days 5 days 7 7 After 2 r After 2 r Stop swi 5 top swi 410 min	None 100% mortality 100% mortality 100% mortality Pumping reduced No pumping all stop swimming mming immediately mming immediately 0 mortality after 24 hr 0 mortality after 24 hr	ĥ
3" 	Bimerla franciscana Mollusca Mytilus edulis Crassostria virginica Ostrea edulis larvae Asthropoda	Sca anemone Mussel State Oyster Oyster	1.0 1.0 2.5 10.0 0.05 1.0 0.5 1.0 2.0 3.0 2.5	15 days 5 days 5 days 7 7 After 2 r After 2 r Stop swi 5 top swi 410 min	None 100% mortality 100% mortality 100% mortality Pumping reduced No pumping all stop swimming mming immediately mming immediately 0 mortality after 24 hr 0 mortality after 24 hr 0 mortality after	ĥ
12 13 1 37 37	Bimerla franciscana Mollusca Mytilus edulis Crassostria virginica Ostrea edulis larvae Asthropoda Cosophium sp.	Sca anemone Mussel Star a "	1.0 1.0 2.5 10.0 0.03 1.0 0.5 1.0 2.0 3.0 2.5 5.0 10.0	15 days 5 days 5 days 7 7 8 After 2 r After 2 r 5 top swi 5 top swi 410 min 410 min	None 100% mortality 100% mortality 100% mortality Pumping reduced No pumping all stop swimming ming immediately 0 mortality after 24 hr 0 mortality after 24 hr	ь Л
12 13 11 11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Bimerla franciscana Mollusca Mytilus edulis Crassostria virginica Ostrea edulis larvae Asthropoda	Sca anemone Mussel State Oyster Oyster	1.0 1.0 2.5 10.0 0.05 1.0 0.5 1.0 2.0 3.0 2.5 5.0	15 days 5 days 5 days 7 7 After 2 r After 2 r Stop swi 5 top swi 410 min	None 100% mortality 100% mortality 100% mortality Pumping reduced No pumping all stop swimming mming immediately 0 mortality after 24 hr 0 mortality after 24 hr 0 mortality after 24 hr 0 mortality after 24 hr	, ,
13 1 1 1 37 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Bimerla franciscana Mollusca Mytilus edulis Crassostria virginica Ostrea edulis larvae Asthropoda Cosophium sp.	Sca anemone Mussel Star a "	1.0 1.0 2.5 10.0 0.03 1.0 0.5 1.0 2.0 3.0 2.5 5.0 10.0	15 days 5 days 5 days 7 7 8 After 2 r After 2 r 5 top swi 5 top swi 410 min 410 min	None 100% mortality 100% mortality 100% mortality Pumping reduced No pumping all stop swimming mming immediately 0 mortality after 24 hr 0 mortality after 24 hr 0 mortality after 24 hr 0 mortality after 24 hr 0 mortality after 24 hr	, ,
14	Bimerla franciscana Mollusca Mytilus edulis Crassostria virginica Ostrea edulis larvae Arthropoda Corophium sp. Melita nitida	Sea anemone Mussel () () () () () () () () () () () () ()	1.0 1.0 2.5 10.0 0.05 1.0 0.5 1.0 2.0 3.0 2.5 5.0 10.0 2.5 5.0 10.0 2.5 5.0	15 days 5 days 5 days 7 7 After 2 r After 2 r Stop swi 5 top swi 410 min 410 min 410 min	None 100% mortality 100% mortality 100% mortality Pumping reduced No pumping all stop swimming mming immediately 0 mortality after 24 hr 0 mortality after 24 hr 0 mortality after 24 hr 50% mortality. Some deaths after 5 min	л Л
13 1 1 1 37 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Bimerla franciscana Mollusca Mytilus edulis Crassostria virginica Ostrea edulis larvae Asthropoda Cosophium sp.	Sca anemone Mussel Star a "	1.0 1.0 2.5 10.0 0.03 1.0 0.5 1.0 2.0 3.0 2.5 5.0 10.0	15 days 5 days 5 days 7 7 8 After 2 r After 2 r 5 top swi 5 top swi 410 min 410 min	None 100% mortality 100% mortality 100% mortality Pumping reduced No pumping all stop swimming ming immediately 0 mortality after 24 hr 0 mortality after 24 hr 0 mortality after 24 hr 50% mortality. Some deaths after 5 min 25% mortality after	л Л
14 15.	Bimerla franciscana Mollusca Mytilus edulis Crassostria virginica Ostrea eaulis larvae Arthropoda Corophium sp. Melita nitida Gammarus tigrinus	Sea anemone Mussel Sea anemone Mussel Sea anemone Coyster Star Sea ane Sea anemone Mussel Sea anemone Sea anemone Mussel Sea anemone Sea a	1.0 1.0 2.5 10.0 0.03 1.0 0.5 1.0 2.0 3.0 2.5 5.0 10.0 2.5 2.5 2.5	15 days 5 days 5 days 7 7 7 After 2 r After 2 r Stop swi 5 top swi 410 min 410 min 410 min 2 hr 3 hr	None 100% mortality 100% mortality 100% mortality Pumping reduced No pumping all stop swimming ming immediately 0 mortality after 24 hr 0 mortality after 25% mortality after 96 hr	л Л
14	Bimerla franciscana Mollusca Mytilus edulis Crassostria virginica Ostrea edulis larvae Arthropoda Corophium sp. Melita nitida	Sea anemone Mussel () () () () () () () () () () () () ()	1.0 1.0 2.5 10.0 0.05 1.0 0.5 1.0 2.0 3.0 2.5 5.0 10.0 2.5 5.0 10.0 2.5 10.0 10.0 2.5 1.0 10.0 2.5 1.0 10.0 1.0 1.0 1.0 1.0 1.0 1.	15 days 15 days 5 days 5 days 7 After 2 m After 2 m Stop swi 5 top swi 410 min 410 min 410 min 2 hr 5 hr 60 min	None 100% mortality 100% mortality 100% mortality Pumping reduced No pumping all stop swimming mming immediately 0 mortality after 24 hr 0 mortality after 25% mortality. Some deaths after 96 hr 17% mortality	, , , , , , , , , , , , , , , , , , ,
14 15.	Bimerla franciscana Mollusca Mytilus edulis Crassostria virginica Ostrea edulis larvae Arthropoda Corophium sp. Melita nitida Gammarus tigrinus	Sea anemone Mussel Sea anemone Mussel Sea anemone Coyster Star Sea ane Sea anemone Mussel Sea anemone Sea anemone Mussel Sea anemone Sea a	1.0 1.0 2.5 10.0 0.05 1.0 0.5 1.0 2.0 3.0 2.5 5.0 10.0 2.5 5.0 10.0 2.5 5.0 10.0 2.5 5.0 10.0 2.5 5.0 10.0 2.5 1.2 1.2 1.2 1.2 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0	15 days 5 days 5 days 7 7 After 2 r After 2 r Stop swi 5 410 min 410 min 410 min 2 hr 3 hr 60 min 5 min	None 100% mortality 100% mortality 100% mortality Pumping reduced No pumping all stop swimming mming immediately 0 mortality after 24 hr 0 mortality after 24 hr 0 mortality after 24 hr 0 mortality after 24 hr 150% mortality. Some deaths after 5 min 25% mortality after 96 hr 17% mortality 37.5% mortality	, , ,
• • • • • • • • • • • • • • • • • • •	Bimerla franciscana Mollusca Mytilus edulis Crassostria virginica Ostrea edulis larvae Arthropoda Corophium sp. Melita nitida Gammarus tigrinus	Sea anemone Mussel Sea anemone Mussel Sea anemone Coyster Star Sea ane Sea anemone Mussel Sea anemone Sea anemone Mussel Sea anemone Sea a	1.0 1.0 2.5 10.0 0.05 1.0 0.5 1.0 2.0 3.0 2.5 5.0 10.0 2.5 5.0 10.0 2.5 10.0 10.0 2.5 1.0 10.0 2.5 1.0 10.0 1.0 1.0 1.0 1.0 1.0 1.	15 days 15 days 5 days 5 days 7 After 2 m After 2 m Stop swi 5 top swi 410 min 410 min 410 min 2 hr 5 hr 60 min	None 100% mortality 100% mortality 100% mortality Pumping reduced No pumping all stop swimming mming immediately 0 mortality after 24 hr 0 mortality after 25% mortality. Some deaths after 96 hr 17% mortality	.de e e e e e f f f f f f f f f f f f f f

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Key to Fig. 5.19 (continued)

:	Point	Scientific Acartla tonsa Pseudodiaptomus coronidae Eurytemora affinis Elminius modestus Balanus improvisus	Copepod Copepod Copepod Barnacle Nauplii Barnacle	concentration (mp/liter) 2.5 5.0 10.0 1.0 0.5 1.0	Time S min 24 hr 30 min 5 min 2.5 min 360 min 10 min 10 min	Effect 90% mortality measured after 3 hr No deaths 19% mortality 6% mortality 24% mortality 51% mortality Little effect Ileavy Justes.	Footno
:  .  .  .  .  .  .  .  .  .	31	Pseudodiaptomus coronidae Eurytemora affinis Elminius modestus	Copepod Copepod Barnacle Nauplii	2.5 5.0 10.0 1.0 0.5 1.0	24 hr 30 min 5 min 2.5 min 360 min 10 min	measured after 3 hr No deaths 19% mortality 6% mortality 24% mortality 51% mortality Little effect	እ አ አ
21 22 22 22	18	Eurytemora affinis Elminius modestus	Copepod Barnacle Nauplii	2.5 5.0 10.0 1.0 0.5 1.0	30 min 5 min 2.5 min 360 min 10 min	19% mortality 6% mortality 24% mortality 51% mortality Little effect	ት አ አ
	18	Elminius modestus	Copepod Barnacle Nauplii	5.0 10.0 1.0 0.5 1.0	5 min 2.5 min 360 min 10 min	6% mortality 24% mortality 51% mortality Little effect	
2) 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	18	Elminius modestus	Copepod Barnacle Nauplii	10.0 1.0 0.5 1.0	2.5 min 360 min 10 min	24% mostality 51% mostality Little effect	
21 21 22 22 22 22 22 22 22 22 22 22 22 2	18	Elminius modestus	Copepod Barnacle Nauplii	1.0 0.5 1.0	360 min 10 min	51% mortality Little effect	
23 28 28 28 28 28 28 28 28 28 28 28 28 28	18	Elminius modestus	Barnacle Nauplii	, 0.5 1.0	10 min	51% mortality Little effect	h
22 22 24 24 24 24 24 24 24 24 24 24 24 2	18		Barnacle Nauplii	1.0		Little effect	
- [20 	18		Nauplii	1.0			
- ::  :: !/	18	Balanus improvisus		••••	10 min		•
- [8:  ::  ,	18	Balanus improvisus	Barnacle The results			No growth	•
::   /.	18	frannas improvisos	Eirnacle		• 1		.1
::  ,				2.5	S min	80% mortality	•4
						after 3 hr	
1	6		Barnacles	1.0	15 days	Most dead	<u>ج</u>
1. 1.		Crangon septemspinosus larvae	Sand shrimp	5	10 min	37% mostality	<i>n</i>
1			•	10	5 min	55% mortality	h
1 I I	-13	Palaemonetes pugio	Grass shrimp	2.5	3 hr	98% mortality	
	• • • •			- /	•	after 96 hr	
11	SU. S. Mira .	ctoprocta	LANK AND		•		
	2	Bugula sp.	1010 2000	2.5	48 hr	,100% mostality	e
	•••	•		10.0	24 hr	100% mortality	e
1	C	Thordata .		*	• •		
	و و د خرم تارو	Ascidiacia		•			
1	4	Molgula sp.		1.0	3'days	100% mortality	C
1	w	•		2.5	1 day	100% mostality"	e
. [3		•	* 2 G * * * ;	. 10.0	1 day	100% mortality	e
	to the second	Tunicata	د. در در بر ۳۰ رو ۲۰	• •		•	
	<b>'</b> 1' '	Botryllus sp.		10	24 hr	100% mostality	C
4	Server .	Pisces .				•	
	.8	Pseudopleuronectes	Winter flounder	1 I I I I I I I I I I I I I I I I I I I	0.1 min	9% mortality	۸_
1		smericanus	• •	2.5	0.1 min	6% mortality	Ē.h
1	- • •	• 1	•	· S.O ,	0.1 min	15% mortality	አ
	•." .•. s			10.0	0.25 min	32% mortality	<i>h</i>
-		Pseudopleuronectes americanus eggs	Winter Bounder	10.0	0.33 min	0% mostality	٨·
•	. 10	Pleuronectes platessa larvae	Philce	0.05	460 min	50% mortality	*
50	· · · · · ·	Pleuronectes platessa larvae	Plaice 1 4	0.13	70 min	50% mortality	Ÿ
•••	-	Pleuronectes platessa eres	1	0.25	3 days	Critical Icycl	<b>'</b>
		· · · · · · · · · · · · · · · · · · ·		V** 4			
l t	17	Oncorhynchus kitsutch	Coho salmon	0.1	3 days	Critical level	¥
	39.	Oncorhynchus tshawytocha	Chinook	0.05	.23 days	Citical level	F
• •		Oncorhynchus gorbuscha	Country a	0.05	23 days	Critical level	~
ť	40	Marine fish		1.0	*****	Slight Irritant	,
		#3015119 82342 *		, 1.0	•	iciponse	•

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Nost 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 (39 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.

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ar Lana da	Distance from	Average travel	Velocity	(fps)	functio	lorine concen n of distance : arge when init	and time from	point of		
:			discharge point (ft)	time (sec)		• • •	0.1 ppm	0.5 ppm	1.0 ppm	5.5 ppm
1	•		0	0	. 10		0.1	0.5	1.0	5.5
	•	•	420	. 58 -	4.7		0.036	- 0.18	0.30	1.98
:	7.75		C80 '	• 130	2.9		0.024	C.12	0.24	0.72
. :	، ہے متابع ہ		1850 -	• 950 -	Ó.8	· · ·	0.012	0.06	0.12	0.36
	•••;•		-Reduction in co	oncentration is by c	dilution only.				<b>t</b> • •	
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 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 ents 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.

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