M.V. WILLIAMSON

ADDENDUM TO THE FINAL ENVIRONMENTAL STATEMENT FOR THE OPERATION OF THE DIABLO CANYON NUCLEAR PLANT UNITS 1 AND 2

PACIFIC GAS AND ELECTRIC COMPANY

Docket Nos. 50-275 and 50-323

May 1976

UNITED STATES NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION

SUMMARY AND CONCLUSIONS

This Addendum to the Final Environmental Statement was prepared by the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation.

1. The action is administrative.

2. The proposed action is the issuance of Operating Licenses to the Pacific Gas and Electric Company for Diablo Canyon Units 1 and 2 located on the California Coast 12 miles southwest of San Luis Obispo, California (Docket Nos. 50-275 and 50-323).

   Both Units employ pressurized water reactors to produce up to 3568 megawatts thermal (MWt) each. Each turbine generator will use this heat to provide about 1150 MW of electrical power capacity. The exhaust steam will be cooled with a once-through flow of water from the Pacific Ocean.

3. A "Final Environmental Statement related to the Nuclear Generating Station Diablo Canyon Units 1 & 2 (FES)" was published by the Directorate of Licensing of the Atomic Energy Commission (now the Nuclear Regulatory Commission) in May 1973. Paragraph 2 of the Summary and Conclusions stated, in part, that the action under consideration was " ..the continuation of Construction Permits Nos. CPPR-39 and CPPR-69 and (the) issuance of operating license to the Pacific Gas and Electric Company for Diablo Canyon Units 1 & 2..." The information in this Addendum represents an updated assessment of the environmental impacts associated with the operation of the Diablo Canyon plant pursuant to the guidelines of the National Environmental Protection Act of 1969 (NEPA~ and the Commission's Regulations.

   The staff has developed this Addendum with the same format as that used in the FES, but has included only those sections and topics where revised or new information has become available. The sections of this Addendum carry intermittent numbers because only certain sections of the FES required updating. By this means, the staff considers the FES, as modified by this Addendum, to represent a current assessment of the environmental impacts associated with the operation of both Units 1 and 2. To the extent that the conclusions in this Addendum differ from those in the FES, the former conclusions are considered superseded.

4. Summary of environmental impacts and adverse effects

   a. The staff now identifies two impacts that resulted from the construction of the plant which had not been completely redressed;

      (1) Construction of the transmission lines from the plant has been completed and a program of restoration of scarred and eroded areas has been in effect for three years. Complete redress has been achieved in some places while satisfactory efforts are continuing at other locations (p. 4.1).

      (2) The benthic ecosystem of Inlet Cove was essentially destroyed by siltation of the cove during construction activities associated with the intake structure. Extensive efforts have been made to remove the silt. Although these efforts have not been completely successful, the staff believes a new, but different benthic community has been initiated. A program of erosion control is underway to minimize siltation of both Inlet and Diablo Coves through runoff of waters from the plant site (pgs. 4.1-4.2).

   b. Operation of the plant is expected to result in the following impacts, some of which are now considered to differ in extent and/or intensity from those described in the Final Environmental Statement.

      (1) At design power, the condenser cooling water will be discharged into Diablo Cove with a temperature approximately 19°F above ambient and this heat burden will be efficiently dissipated to the ocean and atmosphere. The staff's assessment (p. 3.3), based on the results of the applicant's physical model studies, indicates that:

i. The temperatures and area of the thermal plume will vary with the tidal cycle and current regime and will be most adverse when the offshore currents move in a northerly direction.

ii. The temperatures and area of the thermal plume as established by the physical model are greater than previously calculated by analytical and extrapolation methods.

iii. Outside of Diablo Cove there will be little change from the ambient temperatures occurring naturally in water more than 10 feet beneath the surface.

(2) Doses of radioactivity will be released to the environment, but the levels will be insignificant (p. 3.9).

(3) The risk of accidental radiation exposure has been addressed in depth in the Commission's Reactor Safety Study (WASH-1400, NUREG-75/014) and found to be acceptably low.

(4) Excessive amounts of copper were discharged into Diablo Cove during the testing of the cooling water system of Unit 1 and resulted in significant damage to the benthic community of the cove. Through substitution of titanium tubing in the main condenser, the source of this problem has been eliminated (p.5.2).

(5) Excessive amounts of foam have been formed in Diablo Canyon when the cooling water system of Unit 1 was tested. The applicant has developed a plan of action to study the formation and control of foam (p.5.3).

(6) The loss of as much as 10 to 20 acres of bull kelp in Diablo Cove will not adversely affect the regional marine life that is dependent on kelp (p. 5.6).

(7) Because the populations of abalone and sea urchins within Diablo Cove have been reduced to a small fraction of their former abundance primarily due to factors unrelated to the plant, the additional impact of the thermal plume will be small (p. 5.7).

(8) The effect of the plant on loss of pelagic larval fishes through entrainment will be negligible (p. 5.8).

(9) Loss of finfish through impingement will be low during winter months (p. 5.8).

(10) The effect of thermal plume outside Diablo Cove is expected to be minimal (p. 5.6).

c. The accuracy of the staff's predictions related to biological impacts should be verified through a comprehensive operational monitoring program (p. 6.2). This program should be coordinated with the applicant's demonstration for an exemption under Section 316a of the Federal Water Pollution Control Act (FWPCA).

d. Limits on thermal effluents, that differ from the one assessed by the staff, have recently been set by the State of California in connection with the issuance of a five-year National Pollution Discharge Elimination System (NPDES) Permit. The Commission will evaluate the impact of the less stringent temperature prior to the operating license hearing, but has no jurisdiction to set different limitations (pp. 1.5 and 3.3).

e. The issue of alternative cooling systems will be decided by the California Regional Water Quality Control Board in connection with the applicant's request for an exemption from applicable thermal discharge prohibitions under Section 316(a) of the FWPCA (p. 1.3).

5. This Addendum to the Final Environmental Statement was made available in May 1976 to the public, to the Council on Environmental Quality, and to the agencies which commented on the Commission's Draft Environmental Statement.

6. On the basis of the analysis and evaluation set forth in this statement, and after weighing the environmental, economic, technical and other benefits against environmental costs and after considering available alternatives at the construction stage, it is concluded that the action called for under NEPA and 10 CFR Part 51, is the issuance of operating licenses for Units 1 and 2 of the Diablo Canyon Nuclear Generating Plant subject to the following conditions for the protection of the environment which supersede those in the Final Environmental Statement.

a. License Conditions

Before engaging in additional construction or operational activities which may result in a significant adverse environmental impact that was not evaluated or that is significantly greater than that evaluated in this Environmental Statement, the applicant shall provide written notification to the Director of the Office of Nuclear Reactor Regulation.

b. Significant Technical Specification Requirements

(1) The applicant will carry out the environmental (thermal, chemical, ecological, and radiation) monitoring program as well as special studies that will be made part of Appendix B to the operating license to confirm the biological impacts predicted by the staff.

(2) The applicant will perform the special studies related to chlorination, Befouling, and dye and thermal measurements as specified in Construction Permit CPPR-69.

(3) The applicant will operate the Befouling treatment system in such a manner that the thermal alteration of the receiving waters is no more than that for the treatment of one unit with the other unit in full operation.

(4) During operation, the applicant will insure that erosional problems do not occur within the transmission line rights-of-way or in the environs of the plant site.

(5) If other harmful effects or evidence of irreversible damage are detected, the applicant will provide to the staff an analysis of the problem and a proposed course of action to alleviate the problem.

Mr. John A. Gill is the NRC Project Manager for this Addendum. He may be contacted at (301) 443-6950 if there are questions regarding its contents.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

<u>List of Figures</u>

List of Tables

1. INTRODUCTION

1.1 STATUS OF THE PROJECT

The Diablo Canyon Nuclear Plant has been under review by the Commission (first the AEC and later the NRC) since receipt of applications to construct Unit 1 (January 16, 1967) and Unit 2 (June 28, 1968). Provisional Construction Permits (CPPR-39 and CPPR-69) were issued on April 23, 1968 and December 9, 1970 for the two units. After promulgation of the National Environmental Policy. Act of 1969 (NEPA) and the Commission's issuance of Appendix D to 10 CFR Part 50, (now 10 CFR Part 51) the applicant submitted in July 1971 an Environmental Report (ER) covering both units: Sub-sequently; in May 1973 the staff issued a Final Environmental Statement (FES) that addressed the environmental impacts associated with the construction and operation of both units.

Because Unit 1 had received its provisional construction permit (C.P.) prior to January 1, 1970, this unit was classified under Section C of Appendix D and received authorization for the continuance of its Construction Permit from the Commission when no request for a NEPA hearing was evidenced. Unit 2 was classified under Section B of Appendix D, thereby making a NEPA hearing mandatory. At the conclusion of this hearing the Commission continued CPOR-69 subject to ten conditions related to the protection of the marine environment.

Except for a labor-related work stoppage between July 1 and November 4, 1974, construction of the Diablo Canyon Plant has continued since CPPR-39 was issued. A temporary suspension of construction of one transmission line which was ordered by the Commission on February 4, 1972 was lifted on April 4, 1974. As of February 1, 1976, construction of Units 1 and 2 was approximately 96% and 74% complete, respectively, including all of the discharge structure for both units and the intake structure for Unit 1 (Figure 1.1). The applicant projects a fuel loading date for Unit 1 in 1976 if the necessary operating license is authorized. Completion of Unit 2 is planned to take place one year later. On February 25, 1976, the Commission extended the completion date for CPPR-39 (Unit 1) until July 1, 1976 and the completion date for CPPR-69 (Unit 2) until July 31, 1977.

1.2 STATUS OF APPLICATIONS AND APPROVALS

Other than the operating licenses for Units 1 and 2, the applicant has received all approvals and permits required by State and Federal agencies for the operation of the Diablo Canyon Nuclear Plant. A summary of the applicant's compliance with the various regulations related to the protection of the marine ecosystem is presented in Section 5.5 of this Addendum. The plant has been. performing all preoperational tests under the authority of a temporary National Pollution Discharge Elimination System (NPDES) Permit granted by the State of California in October 1974 pursuant to Section 402 of the Federal Water Pollution Control Act (FWPCA). This permit expired on May 1, 1976; however, a new 5-year NPDES permit was adopted by the California Regional Water Quality Control Board - Central Coast Region on April 9, 1976. The new permit requires, among other things, that the applicant submit within 8 months, any requests for exceptions from a provision that would prohibit the discharge of heat from the main condenser effective July 1, 1981 and to provide all supporting data. Also, within 8 months, the applicant shell complete all studies necessary to implement the provisions of all regulations relating to Section 316(b) of the FWPCA that requires the cooling water intake structures to reflect the best technology available for minimizing adverse environmental impact.

Under the Memorandum of Understanding between the NRC and the EPA (signed December 17, 1975) and as applied to this plant, any requirement for alternative cooling systems will be decided by the State of California. Thus, whether or not the applicant's FWPCA § 316(a) demonstration program will show that current water quality standards are "more stringent than necessary to assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the body of water into which the discharge is made" and thus allow the use of the present cooling system is a matter that cannot be decided by the Commission. The structure of the FWPCA provides that such a decision be made by EPA and the State of California.

On June 13, 1975 the applicant was placed under the constraints of Cease and Desist Order 75-1 by the California Regional Water Quality Control Board - Central Coast Region. This action was taken after the NPDES permit was allegedly violated through the release of unacceptable amounts of copper into Diablo Cove and the formation of excessive amounts of foam in this cove during the initial tests of the condenser cooling water system of Unit 1 during the summer of 1974.

Figure 1.1 Diablo Canyon Nuclear Plant
March, 1976.

The cause and consequences of the discharge of copper have been investigated thoroughly by the applicant2 and the State of California.3 The applicant believes the copper problem has been rectified through substitution of titanium tubing in place of the copper-alloy tubes that were in the main condenser. The staff has remained abreast of this situation and summarizes its current position in Sections 3.5.1 and 5.2.1 of this Addendum. The applicant has responded to another part of this order, i.e. to study possible means of reducing the foam produced in Diablo Cove, by investigating the hydraulic efficiency of the presently designed discharge system as well as through the development of a three-year plan of action to study alternative discharge structures and other means of controlling the formation of foam." The Water Quality Control Board is currently assessing these responses. Even though the staff has not been a party to this action, it has investigated this problem which is considered further in Section 5.2.2 of this Addendum.

1.3 STATUS OF THE STAFF'S ENVIRONMENTAL REVIEW

The staff's earlier NEPA review did not identify any adverse environmental impact significant enough to deny the continuation of construction permits for the two units of this plant. This review did uncover several potential impacts related to the marine ecosystem that could not be addressed with the thoroughness desired because of insufficient information. These concerns (FES, pp 1V-V1) were translated into Conditions for the issuance (continuation) of a construction permit for Unit 21 and consisted of requirements for submission of additional information related to: (1) the dissipation of heat from the main condensers in the receiving waters at Diablo Cove and nearby coastal waters and (2) a more complete description of the marine ecosystem in Inlet Cove, Diablo Cove, and the inshore waters near the site.

The applicant complied with the second condition of the construction permit by continuing a comprehensive biological monitoring program that has supplied the new information (E.R. Supplements 4, 5, 6 and 8) that is addressed in Sections 2.7.2 and 5.3 of this Addendum. The applicant has also responded to the staff's request for experimental data to supplement the analytical treatment of the thermal plume used in the earlier review. In October 1975, the staff received the preliminary results of experiments performed with a physical model of the plant's discharge system (E.R. Supplement 7). The final report of these tests was submitted in February 1976 (E.R. Supplement 8) and has been evaluated in Section 3.3.3. The physical model has been useful in establishing general estimates of plume location and size. Based on this improved understanding of the marine ecosystem and the dissipation of heat from the plant, the staff has re-evaluated the potential impacts of the heated water on the biota of the surrounding marine environs (Section 5.3). The state of the art for thermal modeling continues to have recognized limitations; therefore, the staff believes that the general conclusions and predictions based on analytical and physical models should be verified through a comprehensive monitoring program when Unit 1 becomes operational. Furthermore, by using the information collected by monitoring the thermal plume behavior of Unit 1 in conjunction with the results acquired from model studies of one and two unit operation, reasonable predictions of the plume formed by both units can be made. Such a study program will be incorporated into the Environmental Technical Specifications of the operating license so that a better understanding of thermal and biological impacts from a 2-unit operation can be achieved. The applicant will also be expected to fulfill the other outstanding conditions related to chlorination, Befouling, and dye and thermal measurements when the plant is operating.

1.4 LIMITATIONS IN THE STATE OF CALIFORNIA'S NPDES PERMIT

New limits on thermal and chemical effluents for the Diablo Canyon Plant have been set by the California Regional Waste Quality Board - Central Coast Region (the Board) through the adoption, on April 9, 1976, of a five-year National Pollution Discharge Elimination System (NPDES) Permit under Section 402 of the Federal Water Pollution Control Act (FWPCA). Effluent discharges will be regulated by the State of California as described in this Permit.

The NPDES limits for chemical effluents are consistent with those evaluated by the staff in the FES.

The new Permit, however, specifies that the increase in temperature of the condenser cooling water as measured at the point of discharge (ΔT) shall not exceed the temperature of the intake water by more than 22°F for more than 12 hours in any calendar day or 24 hours in any calendar week. In addition, the maximum ΔT, exclusive of heat treatment discharge, shall not exceed 25°F. These temperature limits are higher than the nominal ΔT (19°F) that has been evaluated in the FES and this Addendum. The staff has been in frequent discussion with the State Board related to these environmental appraisals and to the significance of the differences in ΔT limitations.

The applicant has requested that the higher temperature limits be used in the Technical Specifications because the nominal design ∆T of 19°F may be exceeded occasionally due to circumstances which were not described in the Environmental Report. For example, the cooling-water flow rate may be reduced through plugging of condenser tubes or reduction of circulating water pump capacity. Although the total heat load will not vary, the applicant estimates that the ∆T may exceed 19°F as much as 10 percent of the total generating time in any single year.

With the limited amount of thermal plume modeling performed to date, the staff cannot confidently extrapolate the conclusions based on the 19°F analysis to establish what the environmental impacts will be if the ∆T is 22°F. Consequently, in order to permit an adequate NEPA evaluation of the NPDES limits to be made, the staff has requested the applicant to propose additional environmental justification (predictive modeling data or based on a program of operational surveillance with the plant operating with a nominal ∆T of 19°F) for incorporating the higher limits in the Environmental Technical Specifications. This information and the staff's evaluation will be made part of the staff's position through submission of supplemental testimony at the operating license hearing.

References

1. Construction Permit CPPR-69, Amendment No. 3, August 14, 1974.

2. Pacific Gas and Electric Co., "Chemical, Biological, and Corrosion Investigations Related to the Testing of Diablo Canyon Unit 1 Cooling Water System," May 9, 1975.

3. M. Martin, "A Summary of the Cause and Impact of an Abalone Mortality-Diablo Canyon, San Luis Obispo County, California." State of California Department of Fish and Game, December 12, 1974.

4. Pacific Gas and Electric Co., "Foam Control At Diablo Canyon - Report to the California Regional Water Quality Control Board - Central Coast Region," January 15, 1975.

2. THE SITE

The staff has not considered it necessary to revise those sections of the FES that relate to the demographic and historic aspects of the Diablo Canyon site. Other sections of this descriptive chapter have been modified by the inclusion of more current or more complete information than was available during the earlier NEPA review.

2.2.3 Ocean Use

The staff requested the California Department of Fish and Game to provide an assessment of the present status of Intake and Diablo Coves for recreational or commercial fishing. The response, presented as Appendix A to this Addendum, reveals that both coves have suffered significant depletion of sea life in the past few years.

The applicant is endeavoring to reverse the degradation of Intake Cove that resulted from siltation, and this activity is discussed further in Section 4.3. Diablo Cove has been degraded significantly as a viable fishery for abalone, *Haliotis* spp., and sea urchins, *Strongyloncentrotus* spp., by both natural predation and human activities. Although the future of these economically valuable species depends to a large extent on the migratory patterns of the sea otters, *Enhydra lutris*, the staff has attempted to predict any additional adverse impacts that may result from the discharge of heated water into Diablo Cove (Section 5.3.2).

2.4 GEOLOGY AND SEISMOLOGY

At the conclusion of its earlier NEPA review, the staff made brief reference in the FES to the geological and seismological characteristics of this portion of the California coastal area. These topics are two of the primary subjects of all safety reviews performed by the staff, and the Commission's positions on these subjects are published in the Safety Evaluation Report (SER). Because of the importance of the geologic stability of the Diablo Canyon site, this seismic review has continued throughout the construction phase. The results of this investigation, with increased emphasis on offshore fault zones, will be published in the staff's Operating License SER.

2.7 ECOLOGY OF THE SITE AND ENVIRONS

2.7.2 Aquatic Environs

Introduction

The anticipated effects on the biota from operation of the plant were described in the FES. The FES also specified requirements for the collection of additional baseline data. This section will be limited to updating information on only those communities or species which were determined to be important in the original review. The biological studies at the site are being conducted by both the applicant and the California Department of Fish and Game under contract to the applicant.

California Department of Fish and Game - Diablo Cove Studies

During 1970 and 1971 the California Department of Fish and Game (CDF&G) biologists conducted studies of intertidal and subtidal plant and animal communities to establish baseline ecological data for the Diablo Canyon area (E.R. Appendix X). These studies placed special emphasis on the distribution and abundance of abalone and boney fishes and were designed to determine the possible effects on the important species from thermal discharge resulting from the Diablo Canyon Nuclear Power Plant. These studies were described and summarized in the FES.

In 1972, sea otters began foraging north of the power plant site, and by mid-1973 they were making occasional feeding forays into Diablo Cove and the cove just north of Diablo Cove. Two of the major components of the sea otters diet are abalone and sea urchins.

In addition, commercial sea urchin fishermen began harvesting in the Diablo Canyon area, and commercial abalone fishermen were increasing their efforts in this area due to loss of traditional beds from the sea otter foraging north of Morro Bay.

As a consequence of these developments, the applicant contracted with the CDF&G in June 1973 to conduct new ecological studies in Diablo Cove to evaluate the effects of sea otters and commercial fisheries at permanent intertidal and subtidal stations.

Permanent stations and random stations were used to describe the distribution and density of the macro invertebrates, brown algae and fish in the subtidal areas of Diablo Cove. Intertidal surveys were performed using random and permanent stations. Subtidal and intertidal sampling were also conducted at a control area immediately north of Diablo Canyon. Sea otter counting began in July 1973 and is ongoing. Commercial sea urchin and abalone fishermen were interviewed to determine the extent of removal of their resources from Diablo Cove. Red abalone, Haliotis rufescens, temperature tolerance studies were made in the laboratory and are discussed later.

The California Fish and Game work provides extensive baseline information for this region. These reports are available in Environmental Investigations at Diablo Canyon 1972-73 (E.R. Supplement 4) and 1974 (E.R. Supplement 5). Consequently, the discussion here will be limited to updating changes in the populations of the important species of bull kelp (Nereocystis leutkeana), abalone, urchins, and sea otters.

The report for the period July 1, 1973 to June 30, 1974 (E. R. Supplement 5) noted declines in the subtidal populations of red abalone, giant red sea urchins (Strongylocentrotus franciscanus), and the rock crabs, Cancer antennarius (Table 2.1, Figure 2.1). However, population estimates for the red abalone and black abed one (Haliotis cracherodii) in the intertidal zone (Table 2.2) did not differ significantly from those made in 1970 and 1971 (E. R. Appendix X). The intertidal in North Diablo Cove apparently provided better habitat for both red abalone and black abalone than any of the other study areas. The bull kelp increased considerably in 1973 compared to previous years (Figure 2.2). From 1971 to 1973 the number of stipes of kelp in Diablo Cove doubled.

Sea otter surveys were made between Point Buchon and Pecho Rock. The number of otters near Diablo Cove increased from a low of 26 in July 1973 to a high of 124 otters in April 1974 and then decreased to a mean count of 60 in June 1974 (Table 2.3). In May 1974, otters were first observed in Diablo Cove and by June the numbers in the cove had increased to between 30 and 40 animals. At subtidal stations surveyed in June, otter foraging was indicated by the presence of broken empty giant red sea urchins and red abalone shells. Abalone appeared predominate in the diet of sea otters in the area.

Surveys of the sea urchin fishery revealed that commercial divers have been harvesting giant red urchins from the Diablo Canyon area since 1972. The fishery does not operate throughout the year because of the poor condition of the urchin's gonads after spawning. Table 2.4 lists the annual commercial landings for the region including Diablo Cove. Divers interviewed in the site vicinity averaged 234 kg of urchins per hour.

The commercial abalone fishery in Diablo Cove declined during the study. Overall, the landings for the region including Diablo Cove have been steadily declining (Table 2.4). Although part of the decline is due to fluctuations in survival of red abalone populations, the sharp drop occurring in 1972 and 1973 directly reflects the movement of sea otter populations to the area between Morro Bay and Diablo Cove.

Subsequent reports (E.R. Supplements 5 and 6) indicated further declines in sea urchin populations and in subtidal red abalone populations. The sea otter population remained stable. South Diablo Cove surveys in the first quarter of 1975 detected no red urchins and the disappearance of this species was attributed to five possible factors: (1) otter predation, (2) commercial sea urchin harvest, (3) copper discharge from the plant, (4) red tide (high densities of marine dino-flagellate photoplankton) and (5) sanding in of reefs. CDF&G biologists believed that red tide was the most likely factor.

Populations of red abalone and sea urchins both in Diablo Cove and control areas north of the plant have declined dramatically since initial 1970-1971 surveys made by CDF&G. It is believed

TABLE 2.1

Comparison of Mean Counts* of Selected Invertebrates at
Permanent Subtidal Stations - Diablo Canyon Power Plant Site

Station:	7	8	9	10	11	12	15	16
Year								
				Cancer antennarius				
1970	0	2.0	0	0.3	0	0	3.5	1.0
1971	1.3	1.7	0.3	0	0	0	1.3	1.5
1973	0	1	0	0	0	0	5	1
1974	1	-	-	0	0	-	-	-
				Haliotis rufescens				
1970	3.7	2.0	0.7	0	0.3	0	9.0	65.0
1971	5.0	1'.7	0.3	0	0	0	6.0	89.5
1973	1	7	2	0	1	0	4	48
1974	0	-	-	0	0	-	-	-
				Pycnopodia helianthoides				
1970	2.0	1.0	1.0	2.7	0.7	0.3	0	0.5
1971	3.0	1.3	4.3	3.3	1.0	0.3	1.3	3.5
1973	0	1	5	4	11	4	0	1
1974	1	-	-	0	1	-	-	-
				Strongylocentrotus franciscanus				
1970	188	149	296	78	92	41	152	53
1971	275	258	355	109	84	31	252	118
1973	131	222	363	86	89	29	289	73
1974	137	-	-	56	81	-	-	-

*Mean counts for 1970 and 1971 from Burge and Schulz (1975)

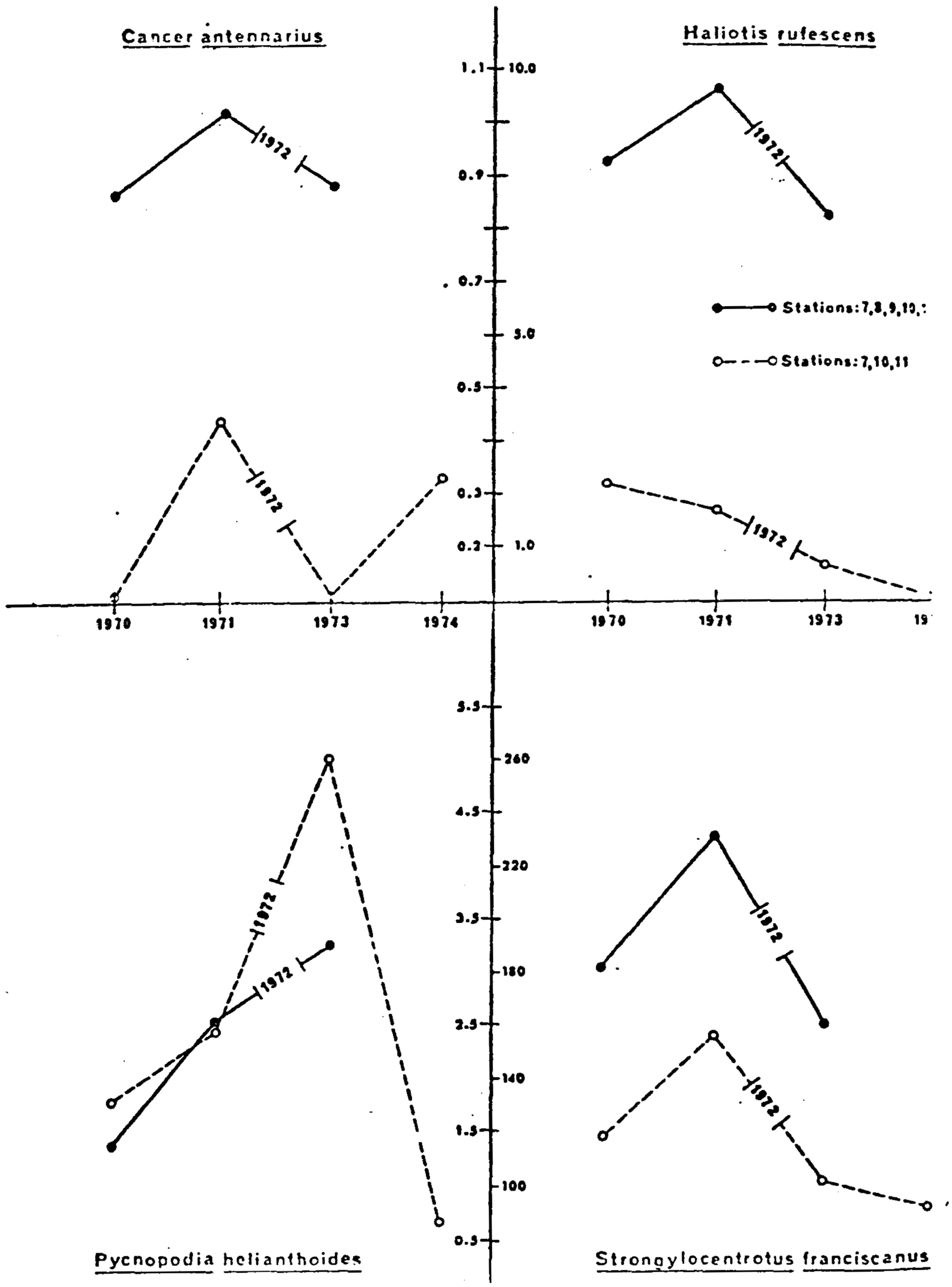


FIGURE 2.1 Mean counts of selected invertebrates at permanent subtidal stations Diablo Canyon Power Plant site - 1970 -1974 (Stations 7,10,11 presented separately as they are the only stations surveyed in 1974).

TABLE 2.2

Comparison of Abalone Counts Made at Intertidal Permanent Transects During 1971 and 1974. Diablo Canyon Power Plant Site.

Transect	1971*		1974	
	Haliotis cracheriodii	Haliotis rufescens	Haliotis cracheriodii	Haliotis rufescens
2A	267	2.7	250	1
2B	113	3.6	133	3
3A	22	2.3	21	0
4B	55	0	32	0
4C	44	0	28	0

1971 counts are means from 3 surveys.

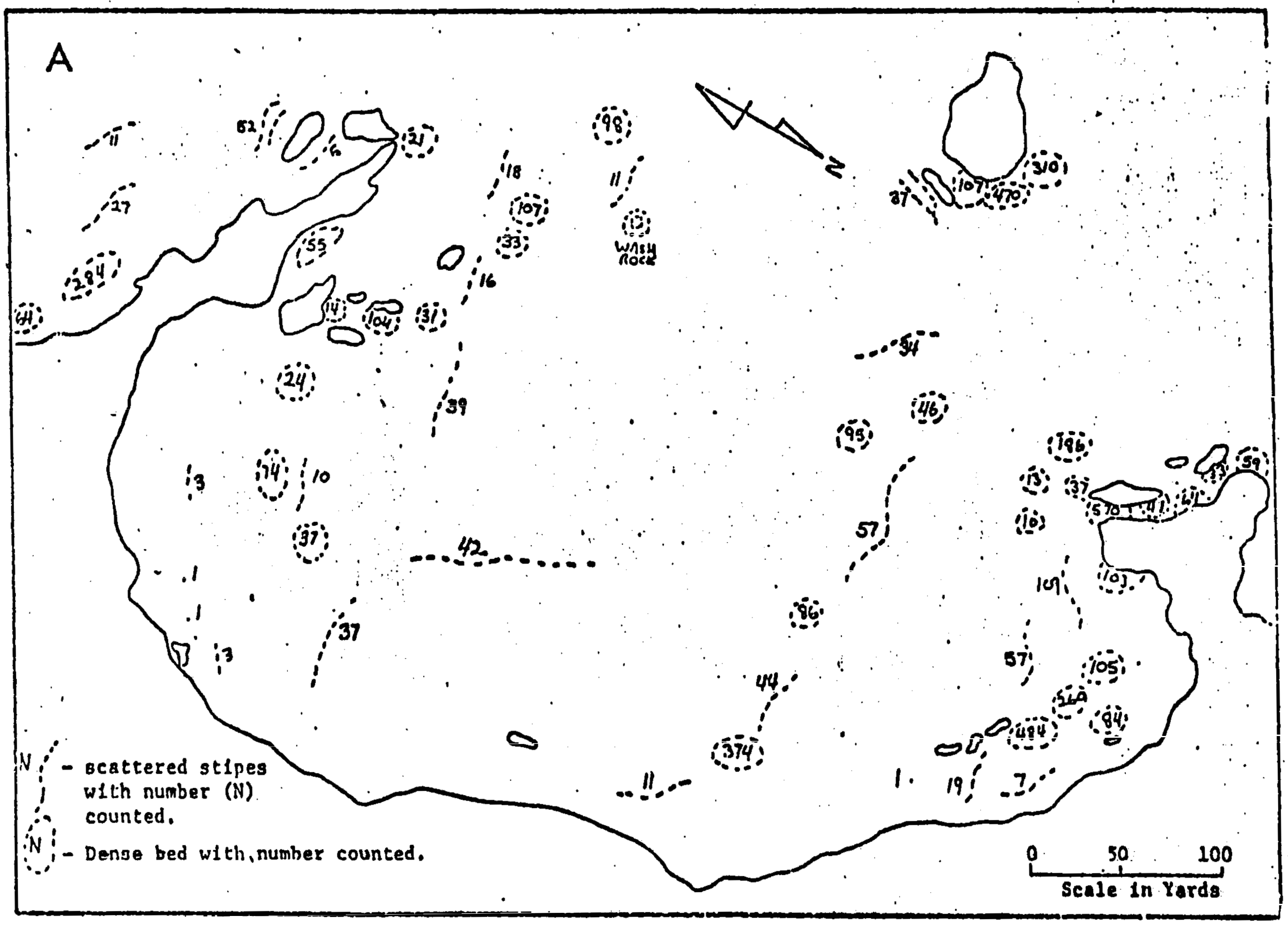


FIGURE 2.2 A, Distribution and counts of *Nereocystis leutkeana* in Diablo Cove on October 20, 1970 (Burge and Schultz 1973).

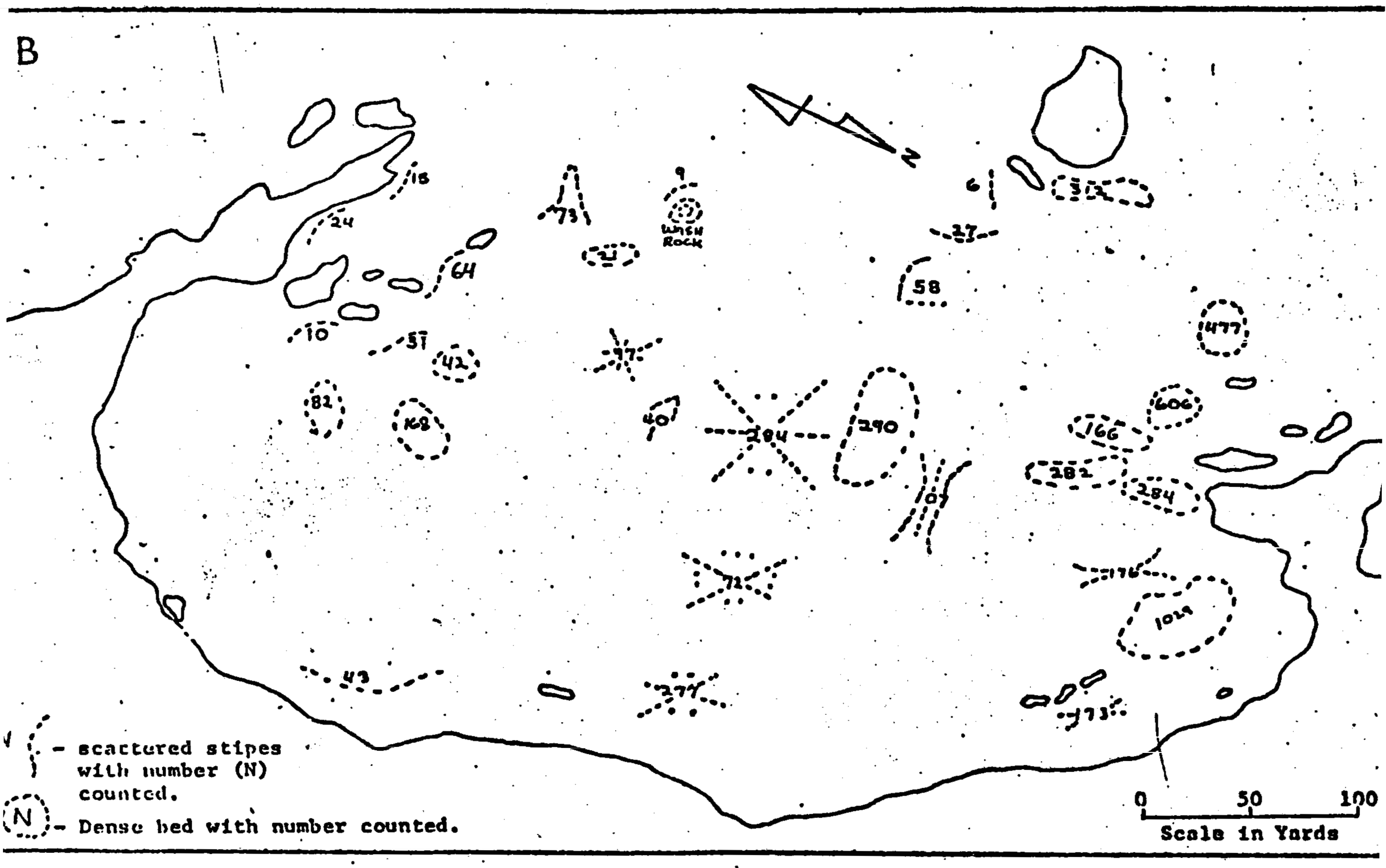
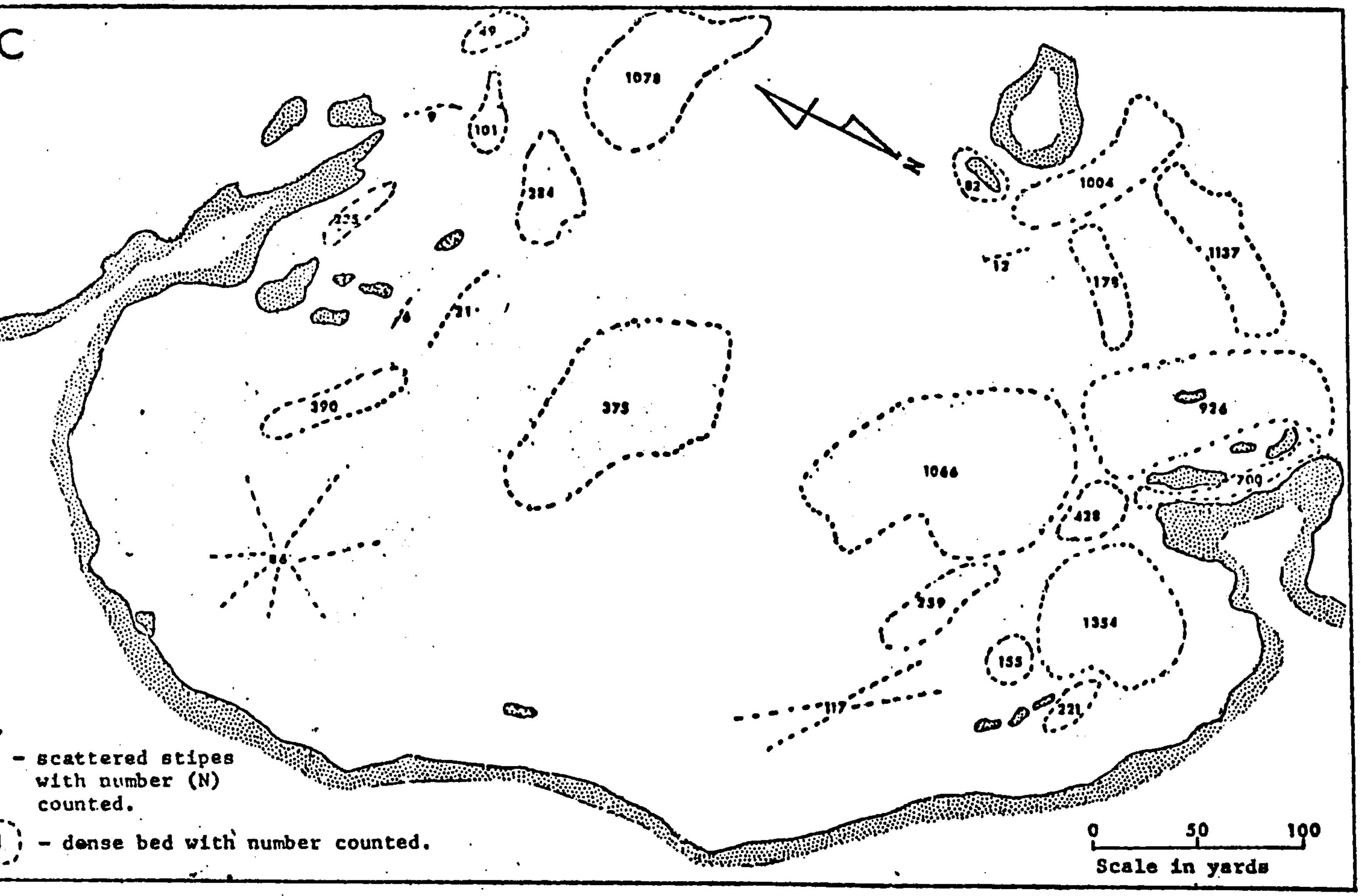


FIGURE 2.2 (cont) B, October 1, 1971 (Burge and Schultz 1973).



IGURE 2.2 (cont) C, September 20, 1973.

TABLE 2.3

Monthly Mean Count of Sea Otters and Observed Feeding Habits
Point Buchon to Lion Rock - July 1973 through June 1974.

Date	Mean count	Number of counts	Number observed feeding			
			Abalone	Urchin	Crabs	Unid.
July 1973	26	1				
August 1973	69	4	11			3
September 1973	0	0				
October 1973	37	4	7	1	1	1
November 1973	40	4	3	3		
December 1973	42	4	1	2		
January 1974	84	3	5	1		1
February 1974	85	4	7	3		1
March 1974	120	4	3	6	1	2
April 1974	124	4	9	8		15
May 1974	89	5	5			40
June 1974	60	4	8			15
Totals			59	24	2	78

TABLE 2.4

Annual Commercial Landings of Red Abalone and Giant Red Sea Urchin
Morro Rock to Avila - 1965 through 1973.

Year	Red abalone		Red urchins	
	lb	kg	lb	kg
1964	730,947	(331,484)	0	(0)
1965	606,109	(274,870)	0	(0)
1966	389,919	(176,828)	0	(0)
1967	296,814	(134,605)	0	(0)
1968	365,767	(165,875)	0	(0)
1969	284,417	(128,983)	0	(0)
1970	190,504	(86,394)	0	(0)
1971	272,271	(123,475)	0	(0)
1972	84,500	(38,321)	69,861	(31,682)
1973	103,468	(46,923)	264,968	(120,163)

that the following factors were responsible for the declines: sea otter predation, increased commercial abalone harvest, red tide, and the release of toxic concentrations of copper during pump testing (see Section 5.2.1). The CDF&G has described the percentage decreases of red abalone and sea urchins in Diablo Cove and control areas (Appendix A) to be as follows. In subtidal permanent stations for red abalone, Diablo Cove showed a 95 percent decrease in abundance while control areas showed an 80 percent decrease from 1970. In stratified random surveys, Diablo Cove red abalone declined 85 percent and 75 percent at control areas. Red sea urchin populations declined at similar rates in Diablo Cove and at the control areas.

Supplement No. 8 to the Environmental Report includes the CDF&G annual report for the period July 1974 to June 1975. Data from the random intertidal stations indicated a general decline in red abalone and black abalone. At permanent subtidal stations, red sea urchins and red abalone continued to decline. Red abalone numbers declined in subtidal study areas to a point where they can no longer be considered a major component of the subtidal community.

Numbers of rock crabs and sun stars increased. However, the most abundant macro-invertebrates in Diablo Cove and the North Control Cove were the red urchin and the sea bat, Pateria miniata.

The annual surface census of bull kelp was performed in October 1974. Canopy density was so great that separate beds within the cove were not as well defined as before and the count had to be done by "wedges". The 1974 count of over 18,000 plants was 80 percent greater than the 1973 count of 10,263 plants (Figure 2.3).

Divers observed 29 species of fish in Diablo Cove. Fishing was conducted in the cove to determine catch-per-unit-of-effort rates for the major species of sportfish. Diablo Cove fishing stations yielded 0.11 fish per hour, while control stations in North Cove produced 1.63 fish per hour. Blue rockfish were the most numerous species caught and observed by divers in Diablo Cove. Fishing in Diablo Cove during late spring and summer was hampered by the dense bull kelp canopy.

Pacific Gas and Electric Company - Diablo Cove Studies

PG&E is conducting studies on various aspects of the aquatic ecology of the Diablo Canyon area. These studies include surveys of Diablo Cove, bull kelp field surveys, bull kelp laboratory thermal tolerance, ichthyoplankton and zooplankton, thermal shock tolerances of red abalone, thermal tolerance of adult red abalone, marine mammal surveys, and breakwater recolonization studies. PG&E has initiated studies on the potential impingement of fishes at the intake as requested in the FES.

The applicant has been conducting transect studies on Diablo Cove and control areas since 1968. The data up to 1974 are presented in E. R. Supplement 5. In 1974 all previous data were placed on computer cards and an updated species list for Diablo Cove was provided in E. R. Supplement 4. Subtidal transects in December 1974 noted the absence of urchins in South Diablo Cove (E.R. Supplement 5).

Studies on the bull kelp have also been conducted by PG&E (E.R. Supplement 4). This species is the principal canopy-forming algal species in the Diablo Canyon site and its general life history is given in the FES (p. A2-6-9). Since August 1972 the life histories of three bull kelp beds near the Diablo Canyon site have been investigated. These three beds were selected based on their past productivity and location relative to the plant discharge structure. The Diablo Cove bed will be exposed to the greatest water temperature increases. Bull kelp in Field's Cove slightly north of Diablo, Cove may experience subtle water temperature increase, while the Pecho Rock bed two miles south of Diablo Cove will not be affected by the thermal plume (Figure 2.4). In conjunction with the kelp study, benthic seawater temperatures have been recorded at three depths in Diablo Cove since 1972 and temperature data from August 1972 to December 1974 have been submitted by the applicant (E.R. Supplement 5). This information will provide the necessary background data for defining the physical environment during each stage of the algae's annual life cycle and furnish base-line information for any subsequent changes in the kelp density. (See Section 5.3.2)

Zooplankton

The temporal distribution of zooplankton populations in the Intake Cove has been described by PG&E (E. R. Supplement 4). Zooplankton samples were taken weekly from June 1972 to June 1973. The largest biomass was present during the upwelling period, which is one of the three character istic oceanographic periods of the California coastal waters. Nutrients and photoperiod were

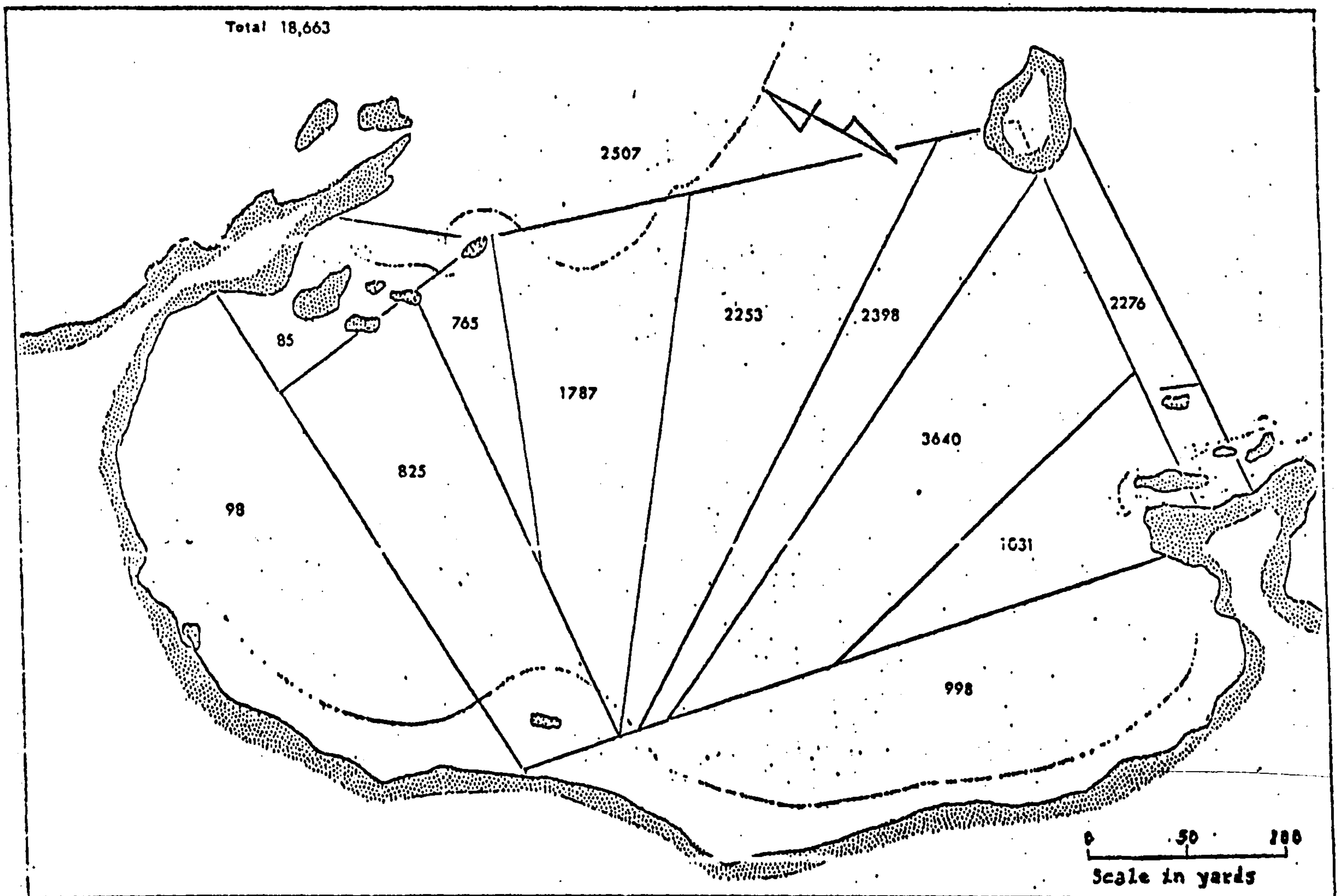


FIGURE 2.3 General distribution and counts of *Nereocystis leutkeana* in Diablo Cove during October 1974.

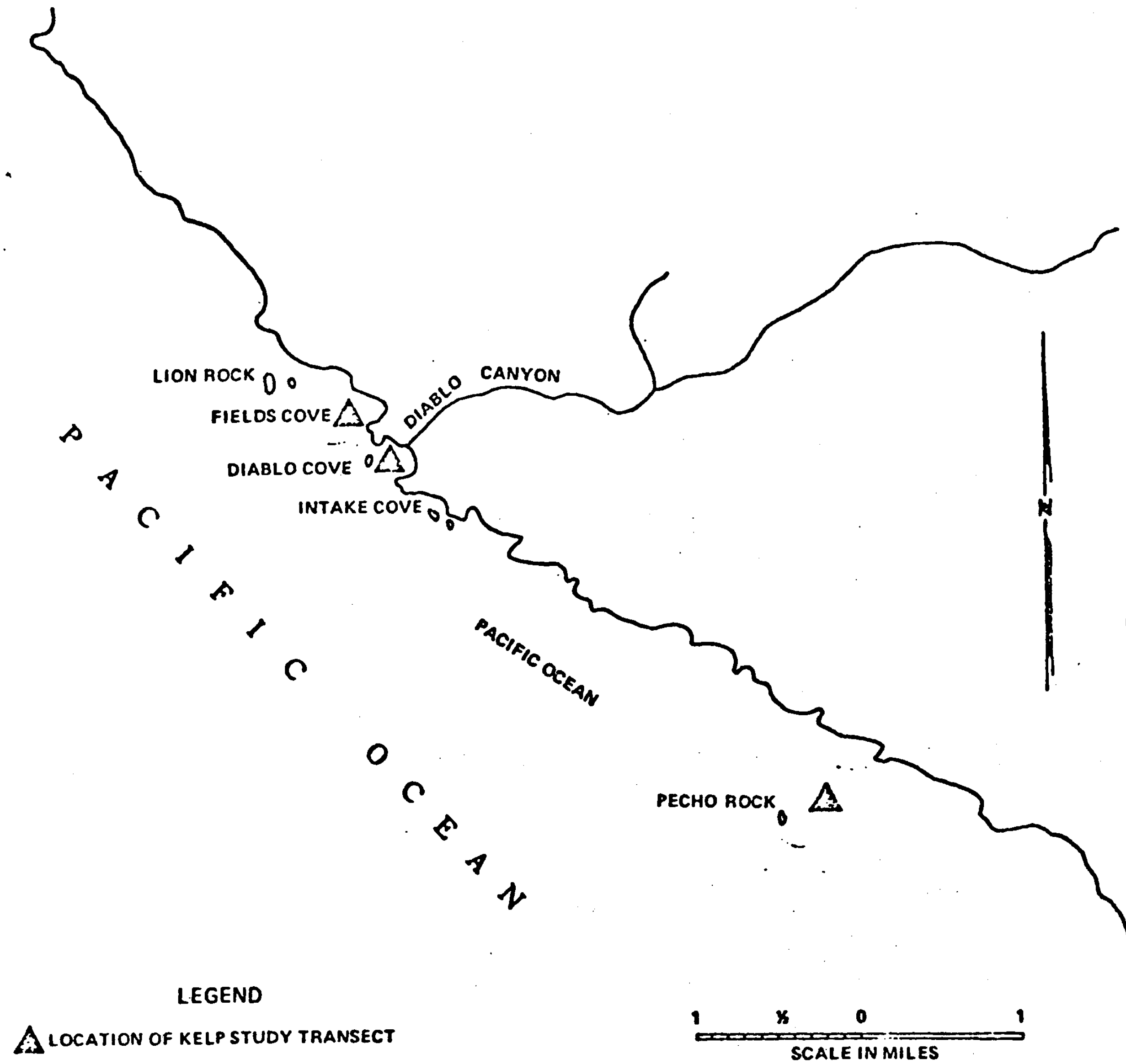


FIGURE 2.4 LOCATIONS OF DIABLO CANYON KELP STUDY TRANSECTS

maximal during this period. Five groups: barnacle nauplii, harpacticoid copepods, calanoid copepodites and nauplii, and Oithona similis comprised 97 percent of the total biomass. Great variation was noted in the weekly densities of most groups. This variation probably resulted from sampling inefficiencies, wind and wave action, diel distribution and species-specific production times. Power plant entrainment mortality estimates for the dominant zooplankton groups were reevaluated (E.R. Supplement 4). The new net percent mortality figures were not significantly different from those given in the FES. Long term delayed mortality was investigated bythe applicant at its Morro Bay plant. Preliminary results indicated insignificant mortality over a five-day period after entrainment.[l] These data form the basis of the staff's updated assessment of entrainment impacts. (See Section 5.3.2)

Ichthyoplankton

A fish egg and larvae study was initiated offshore of the Diablo Canyon site in March 1974. (Zooplankton and phytoplankton were also collected simultaneously with the larval fish and eggs and the zooplankton data will supplement that from weekly collections.) Replicate samples were collected biweekly at two stations: (1) nearshore (outside of Diablo Cove); and, (2) one mile offshore (E.R. Supplement 6). Preliminary data have been submitted on the seasonal distribution and abundance of larval fish and fish eggs from March 1974 to May 1975 (E.R. Supplement 4). Six thousand and thirty larval fish and 9,839 fish eggs were collected over the 28 biweekly sampling period. The yearly mean inshore larval fish and fish egi densities were $0.33/m^3$ and $0.70/m^3$, respectively, and offshore densities, $0.38/m^3$ and $0.58/m^3$, respectively. PG&E found no statistically significant differences in larval fish and fish egg densities between the inshore and offshore stations.

Peaks of about $1/m^3$ were noted in February and December 1974 (Figure 2.5). Although the identity of most larvae found at Diablo Canyon is known, actual identification of the individuals in the samples has not been provided. Although it is not known what species made up these high densities, these larvae are most likely those of the common inshore fish such as rockfish, anchovies, blennies, and sculpins.

Abalone Laboratory Studies

The red abalone is the most important commercially harvested resource in Diablo Cove. This species and the black abalone are also favored by sportsmen. Because of the potentially direct and indirect effects of plant operation on this species, additional detailed laboratory work is being conducted by both PG&E and CDF&G.

CDF&G (E.R. Supplement 5) acclimated adult abalone to temperatures of 10, 15 and 20°C (50, 59, and 68°F) and then exposed all animals to a temperature between 20 to 30°C (68 to 86°F). Results of the various tests indicate that the upper lethal temperature can be increased by increasing the acclimation temperature to 20°C (68°F). Adult abalones acclimated at 10°C (50°F) and exposed to a temperature of 23°C (73°F) experienced a 50 percent mortality within 36 hours while those acclimated at 20°C and subjected to 23°C survived till the end of the 120-hour test. At a test temperature of 27°C, (81°F), 50 percent mortality occurred in 14 hours with total mortality at 24 hours. The upper temperature limit at which abalones may be acclimated is approximately 22°C (72°F).

Embryonic red abalone were less tolerant of higher temperatures-than the veliger stage larvae. Veligers incubated at 20°C did not experience any mortality when subjected to the 25°C (77°F) temperature.

One series of tests simulated the entrainment time of one minute predicted for the transit through the cooling system. These tests consisted of exposing test animals to a selected temperature elevation for one minute and then to their incubation temperature. No mortality of embryos was observed for the simulated entrainment tests. Neither was mortality noted for veliger larvae incubated at 20°C and subjected to the simulated entrainment test after a 26-hour observation period.

PG&E (E.R. Supplement 4) performed studies on thermal shock tolerances of larval red abalone wherein 40-and 60-hour old veligers were subjected to a temperature-decay regime which simulated that of the plant (Figure 2.6). Insignificant mortality was found for larvae exposed to 18°C for one-minute and 10-minute periods (Table 2.5). The effects of turbulence and pressure were not tested in PG3E's experiments because previous studies had indicated little additional mortalities resulted from these mechanical effects. Studies on trochophore larvae at their operating plants indicated insignificant mortality to soft-bodied forms in general. These temperature tolerances are used in Section 5.3.2 to predict the thermal effect of the plant on the abalone community.

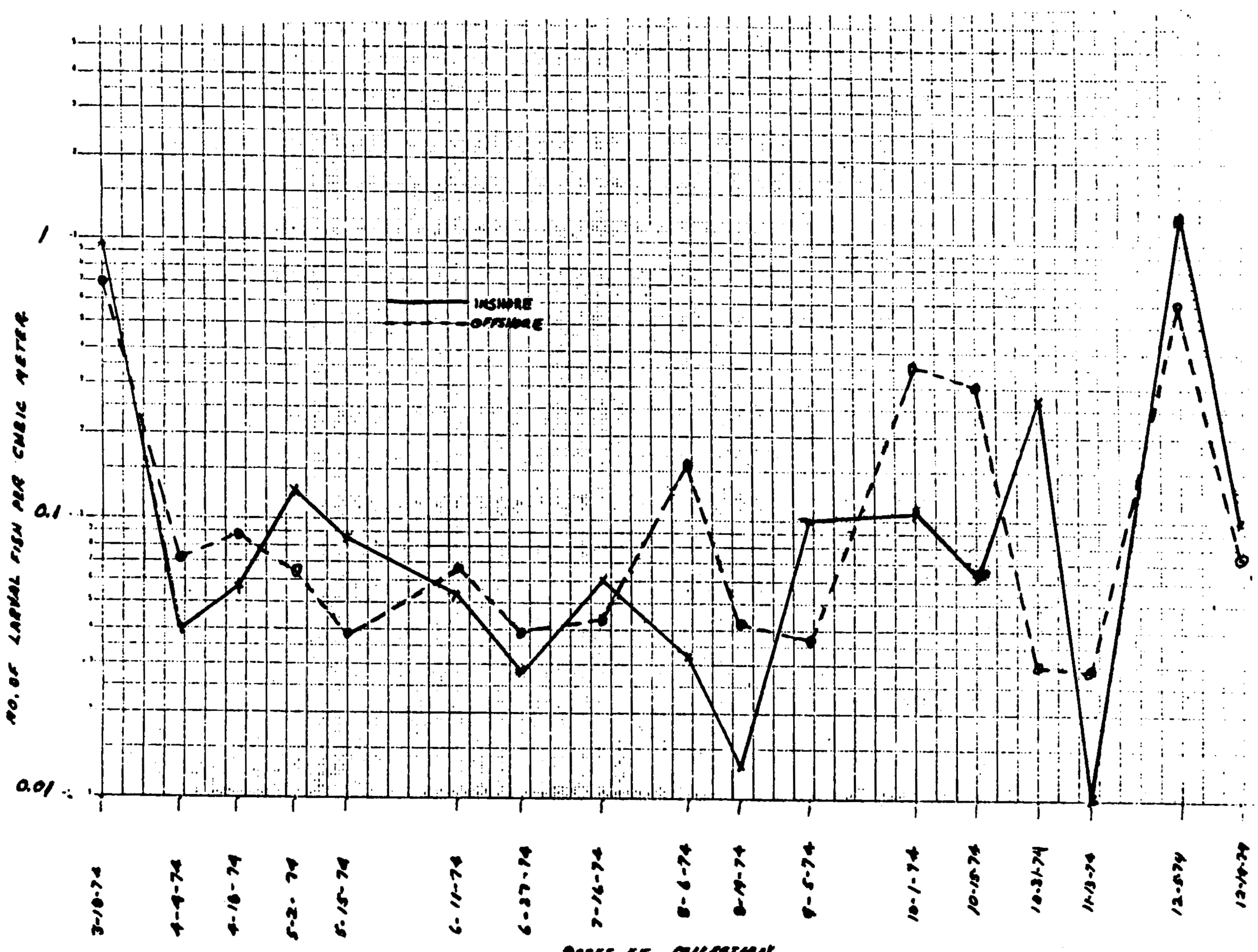


FIG. 2.5 LARVAL FISH DENSITIES MEASURED AT INSHORE AND OFFSHORE STATIONS AT BIOBIO CANYON IN 1974

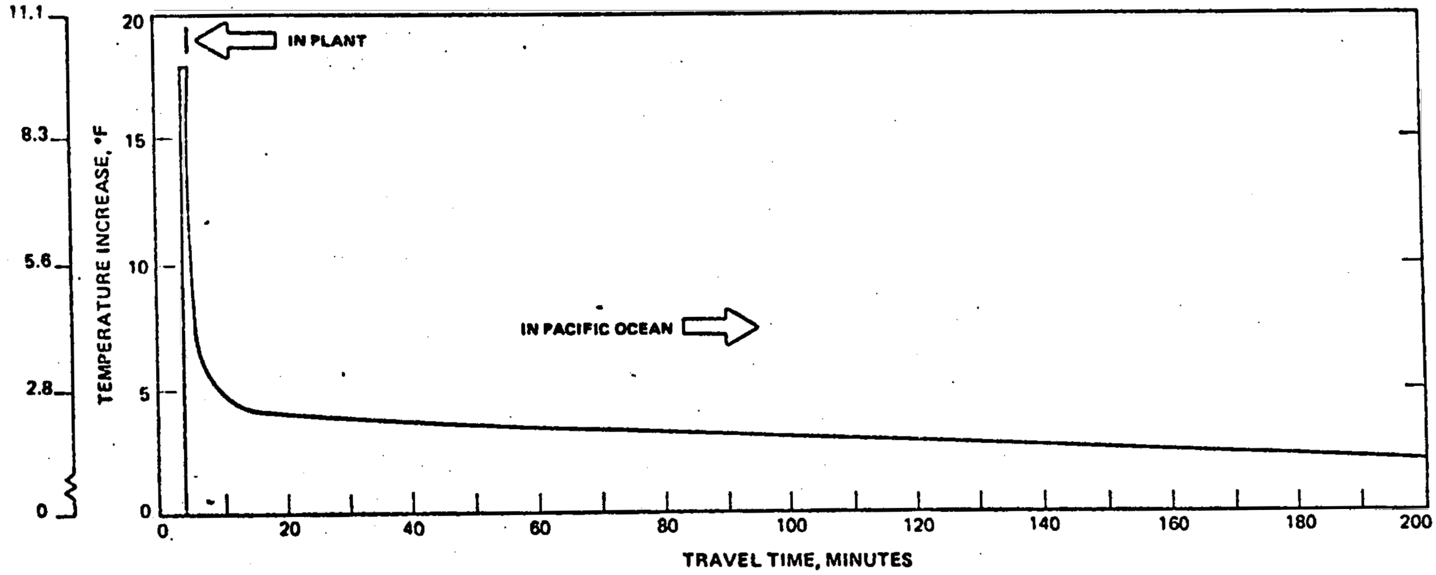


FIGURE 2.6 PREDICTED TEMPERATURE DECAY FOR A MASS OF WATER MOVING THROUGH THE COOLING WATER SYSTEM

DIABLO CANYON NUCLEAR POWER PLANT

TABLE 2.5

Average Mortality Rates (in Percent) for Larval Abalone
Experimental and Control Replicates

Experiment Number:	1 12°FΔT - 1 Min		2 24°FΔT - 1 Min		3 18°FΔT - 1 Min		4 18°FΔT - 10 Min	5 24°FΔT - 10 Min	6 18°FΔT - 1 M
	Initial	Final	Initial	Final	Initial	Final	Initial	Initial	Initial
Experimental	10.98	42.66	16.61	56.72	4.39	51.56	9.96	66.17	13.86
Control	12.34	41.50	3.02	53.64	3.91	54.17	14.14	23.02	10.76
Difference	(-1.36)	1.16	13.59	3.08	0.48	(-2.61)	(-4.18)	43.15	3.10

Recolonization of Intake Breakwaters

The impacts resulting from construction of the intake breakwaters were discussed in the FES along with preliminary data related to recolonization on the concrete tribars that line the breakwaters. The final report on breakwater recolonization (E.R. Supplement 4) indicates that tribars provide adequate substrate for general recolonization of intertidal marine life. The new substrate was thought to have replaced the natural rocky intertidal and some subtidal areas that were destroyed by construction activities in the inlet cove. Recolonization on the inside breakwater surfaces, however, was inhibited by the reduction of the intertidal splash zone and the turbidity from the cofferdam removal (see Section 3.2.1). Subsequent development of the inside breakwater tribars will be by species that exist in the littoral zone without direct wave action. The species composition and species zonation will, therefore, be different on the exposed and sheltered sides of the breakwaters. This new information has been used to make an assessment of the future ecosystem within Intake Cove. (See Section 4.3)

References

1. Pacific Gas and Electric Company, Letter to Gordon K. Dicker from Philip Crane, December 23, 1975, Docket Nos. 50-275 and 50-323.

3. THE PLANT

Since the construction permits were issued for Units 1 and 2, final plant designs and procedures have been developed by the applicant and submitted to the Commission in a Final Safety Analysis Report (FSAR). The physical plant remains essentially as summarized in the staff's FES except for the substitution of titanium for copper-nickel alloy in the main-condenser tubing. The significance of this change is presented in Sections 3.5.1 and 5.2.1. A better understanding of the dissipation of heat from the plant has been gained since the FES was issued. Because of the importance of this new information in predicting the ultimate impact of the plant on the biota of the near-plant ocean environs, the heat dissipation section of the FES has been revised extensively.

3.3 HEAT DISSIPATION SYSTEMS

3.3.1 General

During the earlier NEPA review, the staff devoted considerable effort to assessing the impacts that might result from the discharge of the condenser cooling water into Diablo Cove. This emphasis was caused by three major concerns: (1) the cooling water will be taken from the inshore areas where the marine ecosystem was poorly defined, (2) the design of the discharge system is unique in that the cooling water will cascade approximately 80 feet into Diablo Cove, and (3) difficulties are inherent in predicting the thermal characteristics of the discharge plume in the relatively shallow and restricted confines of this cove (Figure 3.1). The cooling water system was designed to dissipate up to 16.4 x 109 Btu per hour when both units are operating at full power. The temperature rise through the condenser was expected to be 19°F. The hydraulic efficiency of the discharge structure was based on the results of model studies which indicated that the exit velocity, flow configuration, and spreading characteristics would produce satisfactory hydraulic conditions for discharge. Based on the design of the discharge structure and the results of the applicant's and the staff's models of the thermal plumes, the staff did not identify any unacceptable environmental problem associated with the operation of the cooling water system. However, after reviewing comments of reviewers of the Draft Environmental Statement, the staff agreed that applicability was questionable of both its own analytical model and the applicant's technique of describing the complex behavior of the Diablo Canyon thermal discharges, both within Diablo Cove and in the nearby coastal waters. Rather than wait until the effectiveness and the impact of the discharge system could be established through operation of the plant, the staff considered it advisable to seek a more accurate basis for assessing biological impacts before the plant began operation. Consequently, at the staff's request, the applicant designed and constructed a physical model of the discharge system and its environs and has performed an extensive analysis of the thermal discharge under various oceanographic conditions.

During the initial tests of the intake pumps for Unit 1 the applicant observed that the discharge structure dissipated the energy of the falling water less effectively than expected. These tests also resulted in the formation of additional foam in Diablo Cove. This foam occurrence, which is discussed in more detail in Section 5.2.2 of this Addendum, may have been caused by the hydraulic characteristics of the discharge structure. In an effort to improve energy dissipation the applicant has made minor modification to the discharge structure and has designed alternative structures for use if environmental impacts are too severe to permit the continued use of the presently designed structure. Some of the alternatives, i.e., single spillway, enclosed or tunnel configurations, restrictions of the discharge with boundary jetties, and excavation of discharge channels, have been found to be efficient at other sites. The staff does not foresee the need for such extensive modifications unless a severe impact is identified from use of the present discharge structure.

Regulation of the thermal and chemical effluents from the Diablo Canyon Plant is an area where jurisdiction of the Commission under the NEPA must be carefully coordinated with jurisdiction of the State of California under the FWPCA and state laws. In general, effluent limitations for Diablo Canyon are set by the State of California Regional Water Quality Control Board as a permitting authority under the FWPCA. The Commission is precluded by Section 5.11(c)(2)(B) of that act from setting "effluent limitations different from" those established pursuant to the FWPCA. This Act and the Memorandum of Understanding signed by NRC and EPA make it clear that the exclusive jurisdiction over plant effluent discharges and water quality matters resides with the State of California and EPA.

Figure 3.1 Aerial View of the Discharge of Condenser Cooling Water into Diablo Cove.

NEPA and the Calvert Cliffs decision require that the environmental effects of the plant's discharges be assessed by the NRC prior to licensing. Even though it lacks jurisdiction to regulate liquid effluent discharged into Diablo Cove or to alter the design of the intake or discharge structures, the NRC has a mandated responsibility to assess the environmental effects of discharges proposed by the applicant or permitted by those agencies that have jurisdiction to enforce the FWPCA. The staff has been in frequent contact with the California Regional Water Quality Control Board - Central Coast Region, regarding mutual concerns related to the quality of water in Intake and Diablo Coves and the nearshore ocean waters in an effort to coordinate the limitations placed in the State's NPDES Permit with the Commission's Environmental Technical Specifications.

3.3.3 <u>Thermal</u>

3.3.3.1 <u>Currents</u>

As a result of the staff's decision to upgrade its assessment of potential impacts on the marine environment of the Diablo Canyon Plant, the applicant has been required to obtain more comprehensive data on the ocean currents adjacent to the plant. A better understanding of these currents is needed to (1) define baseline conditions for plant operation and for the physical model study in nearshore waters outside of Diablo Cove, and (2) permit accurate selection of locations of temperature monitors that will be needed to define the thermal plume during operation of one or both units.

During 1972 and 1974, the applicant measured near-surface currents, usually for one half tidal cycle, once each month, using a single fixed-current meter and near-surface drogues. The data, in tabular and graphical form, were presented by the applicant in supplements to the Environmental Report; however, no analysis or conclusions were provided. The staff has, however, undertaken a preliminary assessment of the current measurement results, in order to gain a better understanding of coastal current patterns and to assess the applicability of the currents used in the model studies.

In the absence of data from an array of fixed current meters, it is not possible to extrapolate the results of a single point measurement to cover the entire region of interest. The staff is, therefore, of the opinion that the drogue results furnish a more representative picture of the nearshore flow conditions prevailing during each set of measurements. During 1974, the data indicated current speeds averaging about 0.4 knots. The directions were variable; however, during the summer the predominant direction of flow was to the southeast (downcoast). The winds during this period were generally from the northwest. Similar flow patterns were also observed during the summer of 1972. The dominant coastal current near the site during winter is the northerly Davidson Current. Several drogue releases made at the site during the winter of 1974 showed northwesterly (upcoast) flows; however, the data indicate that this current pattern can be modified oh reversed by local winds. These data formed the basis for the currents that have been factored into the design of the physical model of the environs of the plant's discharge structure. Sufficient data are not available to allow an evaluation of flow patterns or directional persistence of winter flows in the site vicinity.

3.3.3.2 <u>Dye Dispersion Tests</u>

The applicant conducted aerial tracer dye surveys in September 1974 under several tidal conditions, during cold-water testing of the Unit 1 cooling system, to determine discharge movement, dilution rates and ambient flow patterns. The results of these tests have been used to evaluate the correlation of the physical model with the prototype.

3.3.3.3 Physical Model Studies

<u>Description</u>

One of the conditions for the continuance of the construction permit for Unit 2 required the applicant to plan and carry out extensive physical modeling of the present discharge system as well as to carry out modeling of alternative systems.2 To accomplish these objectives, an undistorted physical model of the coastal region including both Diablo and South Coves was constructed at the Richmond Field Station of the University of California. A 1:75 scale was used with a 64 by 85 foot section of the model basin representing a 4800 by 6400 foot area near the plant (Figure 3.2). Data from hydrographic surveys were used to scale the model bathymetry, with special care being taken to accurately represent the irregular bottom near the discharge structure. The model has the capability of simulating waves, currents and tides through the use

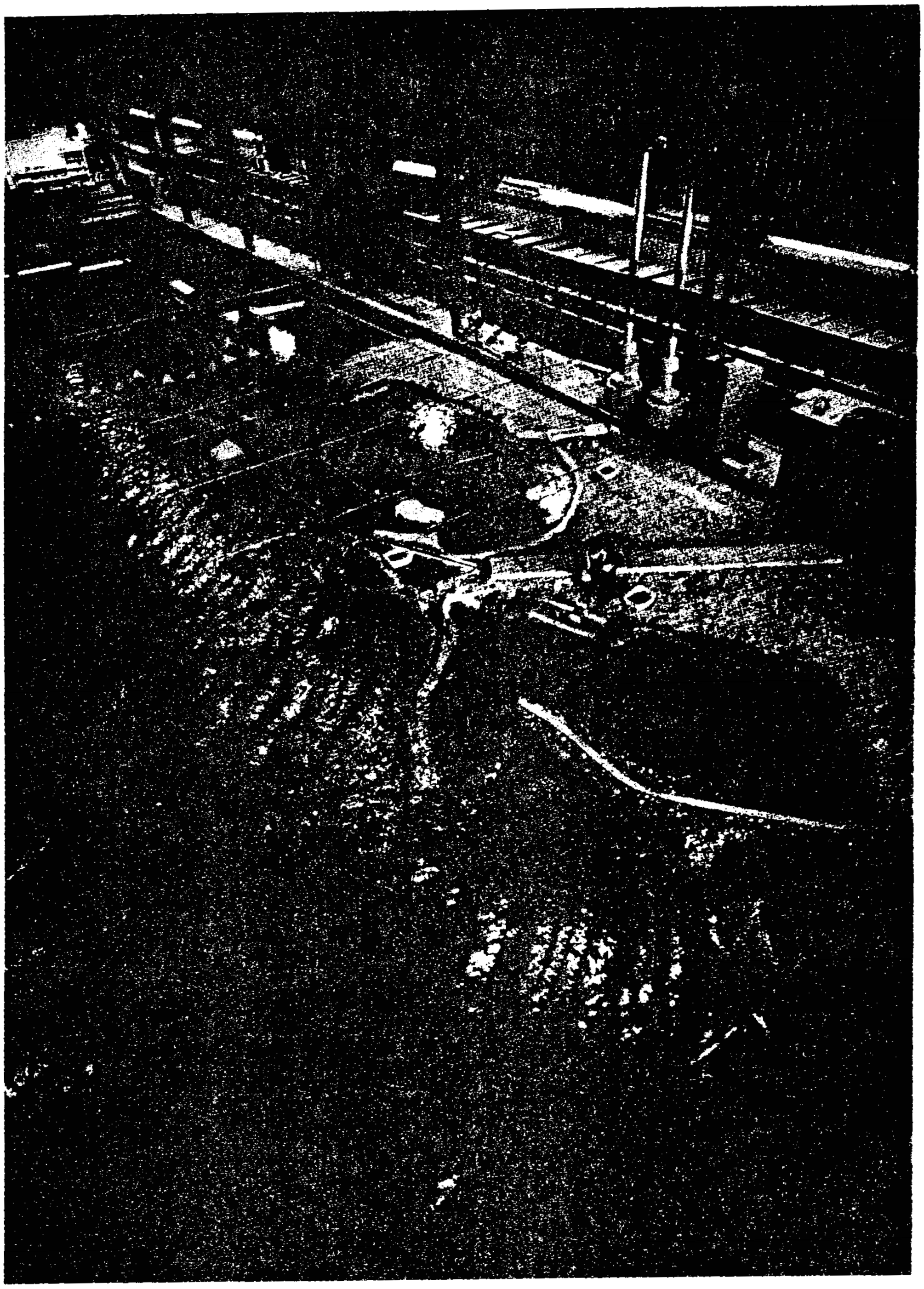


Fig. 3.2 Test Basin at Richmond Field Station
University of California

of various pumps, manifolds and paddles. The intake and discharge structures have been modeled and connected through pumps and heaters in such a manner that flow rates and temperatures can be accurately scaled. Staff members visited the facility in July 1975 to discuss the program with both the applicant and its consultants and to observe several preliminary tests with the model.

Model tests were run in August 1975, for both hot and cold discharges, with and without dye injection, for various combinations of waves, currents and tides. Dye concentration was measured with an aerial dye test imaging system mounted above the tank and by collecting small samples of water at various locations and analyzing the dye content of those samples in laboratory tests. Temperatures were measured with an aerial thermal infrared imaging system and with a three dimensional array of thermistors. The aerial imaging systems were operated by Battelle Pacific Northwest Laboratories. Another series of tests were conducted in January 1976, with currents flowing north to simulate the Davidson Current conditions (the earlier series modeled southerly and no-current conditions). A summary of the conditions during the various tests is given in Table 3.1.

The cold-water dye-test results acquired with the model were compared with those obtained during the September 1974 prototype dye tests in Diablo Cove and nearshore waters. Because of the spatial and temporal complexities in the current structure in both the model and prototype and because of the very irregular bathymetry in the cove, it is difficult to determine accurately the degree to which the model predicts the prototype behavior. The dye plumes in the model, however, were similar in general behavior to those observed in the prototype, with no major differences observed. These results strengthen the staff's belief that model results can be used to predict the general behavior of the thermal plume in the prototype.

A description of the model along with results of many model tests under various conditions have been reported in Supplements 7 and 8 to the Environmental Report. From these tests, a general picture of expected flow patterns and temperature distributions, especially within Diablo Cove during one-unit plant operation, has emerged. Figures 3.3 and 3.4 show schematic representations of the flow patterns observed in the model for downcoast and upcoast current conditions. The applicant has concluded that the temperature distribution within the cove during plant operation is controlled predominantly by the natural (without plant discharge) net flow through the north entrance. Determination of the degree of this control might provide guidance for the optimal design of future monitoring programs in both model and prototype.

Physical Model Studies - Applicant's Evaluation

From the data acquired from these tests, the applicant was able to draw a number of conclusions in regard to the temperature distribution expected from plant operation. The staff has determined that these conclusions, as summarized below, are supported by the data presented.

1. There was essentially no recirculation into the intake structure for any of the conditions tested (strong and moderate downcoast coastal currents, no coastal current, and a moderate upcoast coastal current, with waves from NW and without waves). This was true for Unit 1 operating under full load, and for Units 1 and 2 operating together under full load.

2. When there was either a downcoast current or no-coastal current, there usually was little temperature rise in the water in the north entrance of Diablo Cove. For the moderate upcoast coastal current, there was a rise of about 3 to 6 degrees C (5.5 to 11°F) above ambient at the surface, but of the order of only 1 degree C (2°F) above ambient near the bottom.

3. The discharge jet is pointed towards the west entrance of Diablo Cove. The mixing jet always moved in that direction for all conditions tested. The surface temperature at the center of this entrance was usually less than 6.5 degrees C (10°F) above ambient temperature, and the temperature about 13 feet beneath the surface (mean sea level) was usually less than 3 degrees C (5.5°F) above ambient for downcoast currents and for no currents and less than 3.5 degrees C (6.3°F) above ambient for the moderate upcoast current condition.

4. All of the evidence obtained from the thermal tests showed that the mixing jet was largely a surface phenomenon. Close to the discharge structure and for much of the southern part of Diablo Cove, the water was warm throughout the water column but it was mixing. By the time the mixing jet had reached the west entrance to the cove a strong vertical thermal gradient existed, with the temperature of the surface water considerably greater than that of the deeper water.

TABLE 3.1

LABORATORY DATA SHEET, UC BERKELEY, RICHMOND FIELD STATION, TEST SUMMARY
EXPERIMENTS ON 19-26 AUGUST 1975 and 12-16 JANUARY 1976

A. 19-26 AUGUST 1975

Test No.	Date	Time	Current N → S	Dis-charge Units	Dis-charge	Nominal ΔT_0 °F	°C	Tidal Mode	Tidal Level	Scanner Mode	Waves	Wave Conditions Period (sec.)	Height (ft.)
1	19 Aug	14:43	Moderate	1	Cold	0	0	Static	MSL	Dye	No	-	-
2A	19 Aug	16:20	Moderate	1	Hot	19	10½	Static	MSL	Dye	No	-	-
2B	19 Aug		Moderate	1	Hot	19	10½	Static	MSL	Therm-istors only	Yes		(Extreme
3	20 Aug	10:32	Moderate	1	Cold	0	0	Dynamic	¼ Cycle	Dye	No	-	-
4	20 Aug		Moderate	1	Hot	19	10½	Static	MSL	Thermal	No	-	-
5	20 Aug	22:44	Moderate	1	Hot	19	10½	Static	MSL	Thermal	Yes		(Extreme
											Yes		Steep
											Yes		Moderat
											No		- (Calm
6	21 Aug		Moderate	1 & 2	Hot	19	10½	Static	MSL	Thermal	Yes		(Moderat
7	21 Aug		Moderate	1 & 2	Hot	19	10½	Static	MSL	Thermal	No	-	-
8	21 Aug		Moderate	1	Hot	19	10½	Dynamic	1½ Cycles	Thermal	Yes		(Moderat
9	22 Aug	10:46	Moderate	1	Hot	22	12	Static	MSL	Thermal	Yes		(Moderat
10	22 Aug		Moderate	1 & 2	Hot	19	10½	Dynamic	1+ Cycles	Thermal	Yes		(Extreme
11	25 Aug	11:38	Strong	1	Hot	19	10½	Dynamic	1 Cycle	Thermal	Yes		(Moderat
12	25 Aug		Strong	1	Hot	19	10½	Static	MSL	Thermal	Yes		(Extreme
											Yes		(Moderat
											No	-	-
13	25 Aug		Strong	1 & 2	Hot	19	10½	Dynamic	¼ Cycle	Thermal	Yes		(Moderat
14	25 Aug		Strong	1 & 2	Hot	19	10½	Dynamic	≈½ Cycle	Thermal	Yes		(Extreme
15	25 Aug		Strong	1 & 2	Hot	19	10½	Dynamic	Fraction of Cycle	Thermal	No	-	-
16	26 Aug		None	1	Hot	19	10½	Static	MSL	Thermal	No	-	-
											Yes		(Extreme
17	26 Aug		None	1	Hot	19	10½	Dynamic	Fraction of Cycle	Thermal	Yes		(Moderat
18	26 Aug		None	1 & 2	Hot	19	10½	Dynamic	Fraction of Cycle	Thermal	Yes		(Extreme

Note: Wave Heights and Periods determined from Analysis of Wave Records.

TABLE 3.1

LABORATORY DATA SHEET, UC BERKELEY, RICHMOND FIELD STATION, TEST SUMMARY
EXPERIMENTS ON 19-26 AUGUST 1975 and 12-16 JANUARY 1976

A. 19-26 AUGUST 1975

Test No.	Date	Time	Current S → N	Dis-charge Units	Dis-charge	Nominal ΔT_o °F	Nominal ΔT_o °C	Tidal Mode	Tidal Level	Scanner Mode	Waves	Wave Conditi (Prototype) Period, T	Wave Conditi (Prototype) Hei H
20	12 Jan		Moderate +	1	Hot	22	12	Static	MSL	None	-	-	-
21	12 Jan		Moderate +	1	Hot	22	12	Static	MSL	None	Yes	4.6	2.
22	14 Jan		Moderate +	1	Hot	20	11	Static	MLLW	None	-	-	-
23	14 Jan		Moderate +	1 & 2	Hot	20	11	Static	MLLW	None	-	-	-
23A	14 Jan		Moderate +	1 & 2	Hot	20	11	Static	MLLW	None	-	-	-
24	14 Jan		Moderate +	1 & 2	Hot	20	11	Static	MSL	None	-	-	-
25	14 Jan		Moderate +	1 & 2	Hot	20	11	Static	MSL	None	Yes	4.6	3.
26	14 Jan		Moderate +	1	Hot	20	11	Static	MSL	None	Yes	4.6	3.
27	14 Jan		Moderate +	1	Hot	20	11	Static	MSL	None	-	-	-
28	14 Jan		Moderate +	1	Hot	21	11½	Static	HHW	None	-	-	-
29	14 Jan		Moderate +	1 & 2	Hot	20	11	Static	MSL	None	-	-	-
30	15 Jan		Moderate +	1	Hot	21	11½	Dynamic	MSL→/Cycle	None	-	-	-
31	15 Jan		Moderate +	1 & 2	Hot	20	11	Dynamic	MSL→/Cycle	None	-	-	-

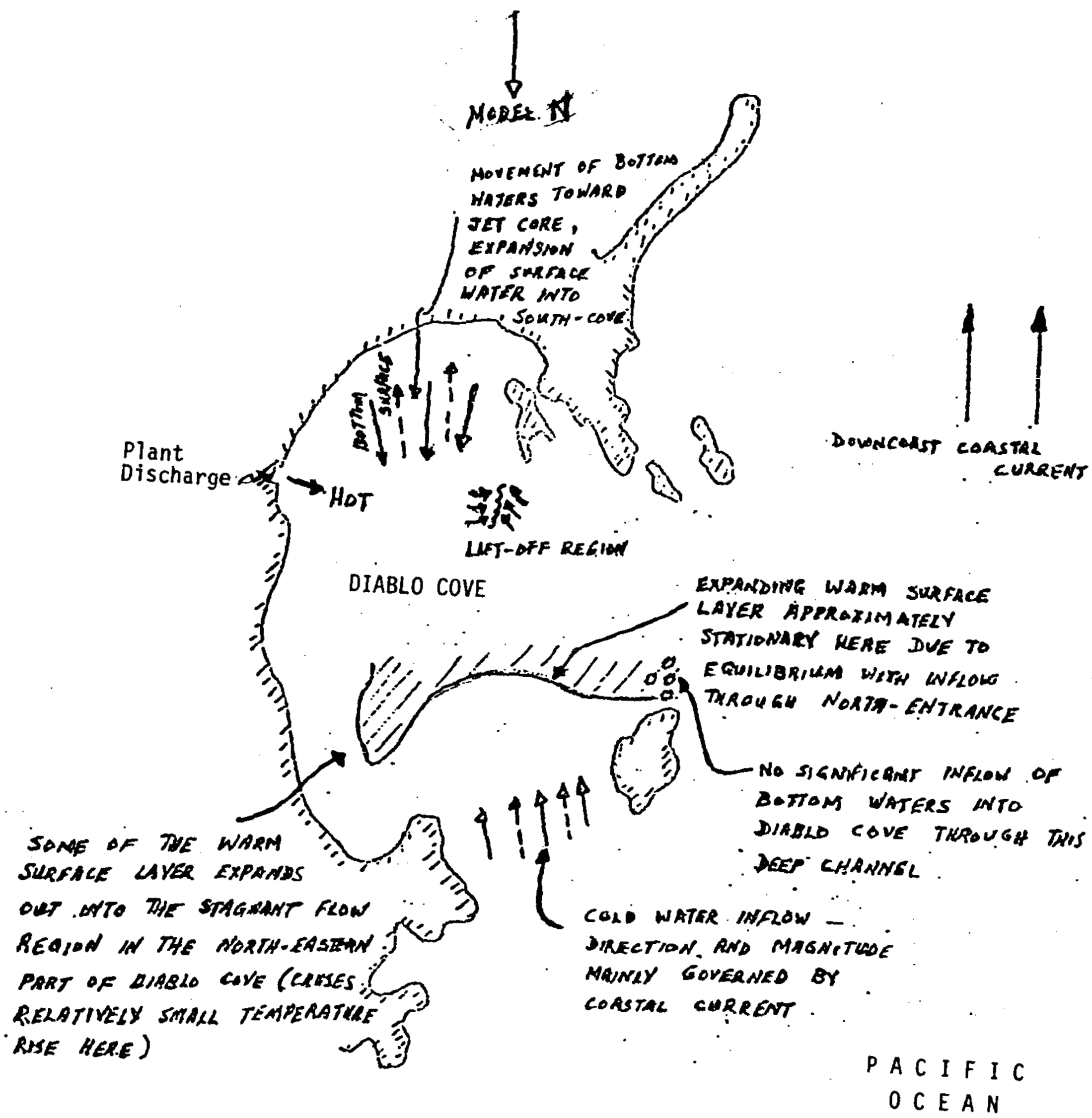


FIGURE 3.3 - Conceptual sketch of flow patterns for downcoast current (Unit 2, warm)

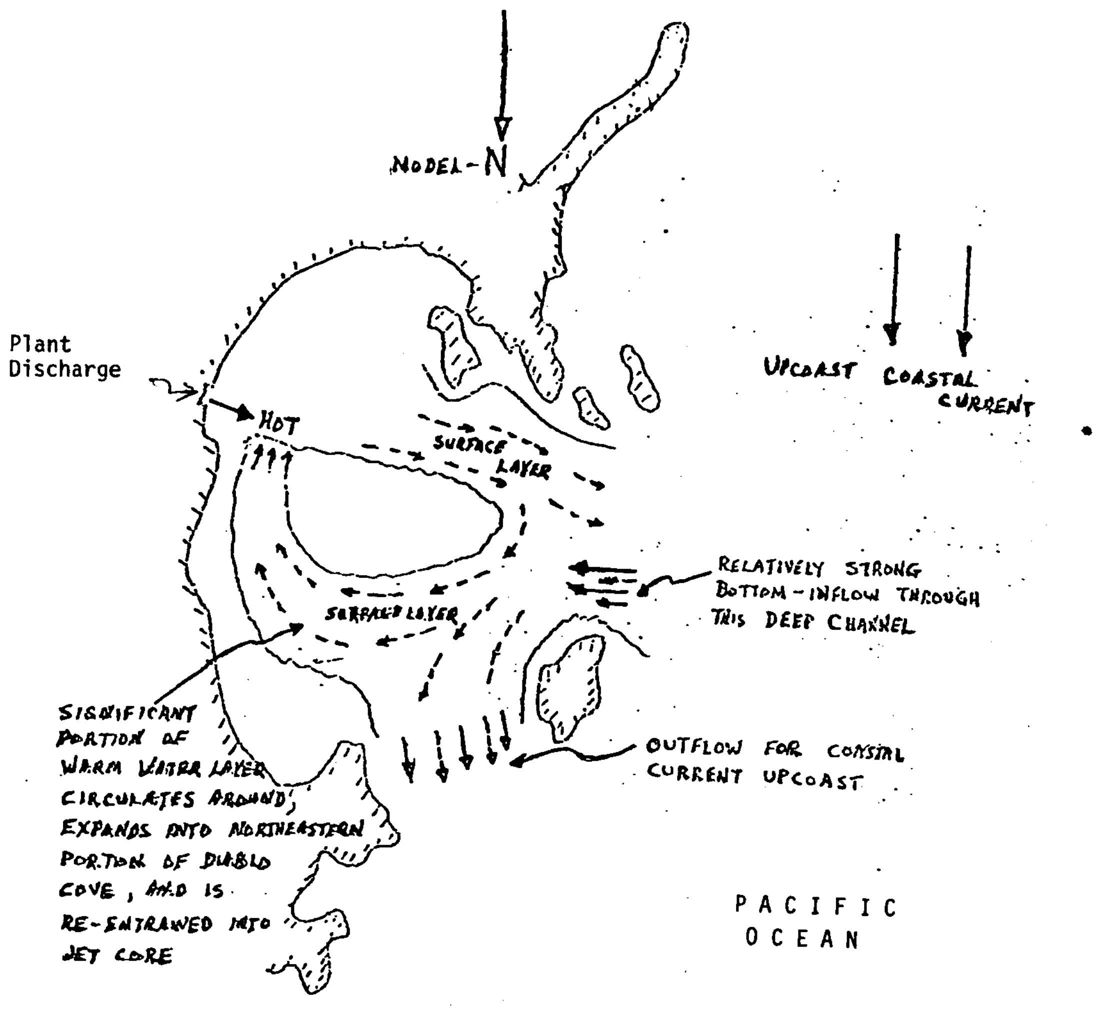


FIGURE 3.4 - Conceptual sketch of flow patterns for upcoast current (unit 1, warm)

5. Once the mixing warm water discharge jet reached the region seaward of Diablo Cove, the warm water was confined within a few feet of the surface with very little change from the ambient temperature occurring more than 10 feet beneath the surface, even when both units were operating simultaneously at full load.

Physical Model Studies - Staff's Evaluation

The applicant did not present drawings showing anticipated isotherm patterns, or tables listing isotherm areas, under various conditions expected at the site. Instead, the results of individual model tests, at specific testing times, were given in graphical and tabular form. The staff has used this information to develop a number of conclusions about thermal plume behavior to supplement the general observations by the applicant presented above. A more quantitative evaluation of the thermal field would require additional analysis and testing, involving both the model and prototype during hot water operation. It is the staff's opinion that the present information, while not exhaustive, can be used for the purpose of estimating the biological impacts of the thermal plume.

(a) General

1. The 10°F surface isotherm never completely filled Diablo Cove under any of the conditions tested. Hence, any suggestion that the Cove may fill with water 19°F above ambient is not plausible.

2. The surface plume was observed to be smaller at low tide than at either mean sea level or high tide. This is in agreement with results obtained from the numerical model which were presented in the FES. However, physical model test results suggest prototype plume areas larger than those presented in the FES.

3 Recirculation into the intake structure is not expected under any of the conditions tested with the model.

4. The plume is expected to be primarily a surface phenomenon upon exiting Diablo Cove, with bottom temperatures considerably less than surface temperatures. In the nearshore water outside the Cove, bottom temperatures beneath the thermal plume are not expected to exceed ambient.

(b) For downcoast currents

5. The area enclosed by the 10°F surface isotherm can cover approximately the southern half of Diablo Cove, although during one-unit operation its extent will usually be less.

6. The 10°F surface isotherm can extend out of the west entrance of the Cove, but during oneunit operation will not usually extend past Diablo Rock.

7. The area enclosed by the 4°F surface isotherm can cover the entire Cove.

8. The 4°F surface isotherm will always emerge from the Cove, sometimes covering an extensive area of hundreds of acres but is not expected to be as large as a square mile (640 acres).

(c) For upcoast currents

9. The area enclosed by the 10°F surface isotherm can cover most of the Cove including the entire southern part.

10. The 10°F surface isotherm can extend well out of the west cove entrance, possibly as much as several thousand feet. This condition was most conspicuous during two-unit operation and during tests with a ΔT of 22°F.

11. The area enclosed by 4°F surface isotherm is expected to cover the entire Cove.

12. The 4°F surface isotherm is expected always to emerge from the cove and cover an extensive area. The maximum extent could not be determined in the model, however, due to the limited extent of the thermistor array and the size of the model.

Figures 3.4 and 3.5 show the surface thermal plumes measured during two separate model tests which simulated two-unit operation, moderate currents and waves. Test 6 (Figure 3.5) simulated a downcoast current while Test 25 (Figure 3.6) simulated an upcoast current. It is emphasized that these figures represent the results of specific model runs and are only qualitative indications of expected prototype behavior. It should also be noted that the data are from the test runs that produced the largest surface plumes.

The above tentative conclusions are based on data obtained from physical model experiments with heated discharges and are predicated on qualitative model/prototype correlations observed from limited tracer dye tests. The extent to which the physical model predicts, quantitatively, the features of the prototype thermal plume cannot be determined more accurately without considerably more comparative testing of the model and prototype. Therefore, the staff believes that the most practical method of obtaining a more quantitative assessment of thermal plume behavior will be the establishment of an extensive current and temperature monitoring program during initial operation of Unit 1. The data so obtained can be used to validate and further calibrate the physical model. It would then be possible to use the model to: 1) better predict the thermal field resulting from two-unit operation, and 2) predict the thermal field resulting from the use of other discharge configurations. The staff believes that additional modeling should await an analysis of the biological impacts caused by the operation of Unit 1.

Thermal Alteration During Defouling

In its earlier review (FES pp. 3-24 and 3-26) the staff expressed concern about the potential heat burden that would be incurred by Diablo Cove during defouling operations, especially when the cooling water system of one unit is inoperative. The applicant has again been made aware of this potential problem in light of the possible time differential between the beginning of operation for Unit 1 and the availability of cooling water from Unit 2. The present schedule indicates that the condenser cooling water system for Unit 2 will be ready for testing by May 1, 1976. The staff believes that the applicant should not plan to defoul Unit 1 until the dilution capability of the cooling water from Unit 2 becomes available and defouling should be conducted for the shortest period necessary for system cleanliness.

3.4 Radioactive Waste Systems

On May 5, 1975 (40 FR 19439), the Commission issued Appendix I to 10 CFR Part 50 to afford "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion 'As Low As Practicable' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents." The guides for limiting conditions for operation set forth in this Appendix shall be met for the Diablo Canyon Plant as follows:

The applicant shall file with the Commission by June 4, 1976:

"(1) Such information as is necessary to evaluate the means employed for keeping levels of radioactivity in effluents to unrestricted areas as low as practicable, including all such information as is required by § 50.34a (b) and (c) not already contained in his application; and

(2) Plans and proposed technical specifications developed for the purpose of keeping releases of radioactive materials to unrestricted areas during normal reactor operations, including expected operational occurrences, as low as practicable."

The staff proposes to review the applicant's submittals in line with the criteria of Appendix I and will insure compliance, if necessary, through the modification of pertinent Technical Specifications that limit the operation of the plant. At this time, the staff has not changed its previous conclusions that both the liquid and gaseous waste treatment systems meet the "low as practicable" guidelines (FES, pp. 3-37, 3-41).

3.5 Chemical and Biocide Systems

3.5.1 Condenser Cooling System Output

The condensers at Diablo Canyon Units 1 and 2 will be cooled by a once-through flow of water from the Pacific Ocean. The flow rate for each unit is 867,000 gpm. As pointed out in Section 3.3.2 of the FES, the condensers are "split"; i.e., a separate circulating pump and conduit supply the coolant water for half the tubes in each condenser. The coolant streams from Units 1 and 2 are not combined until they reach the discharge structure. Therefore, it is possible to chemically treat half a condenser unit at a time.

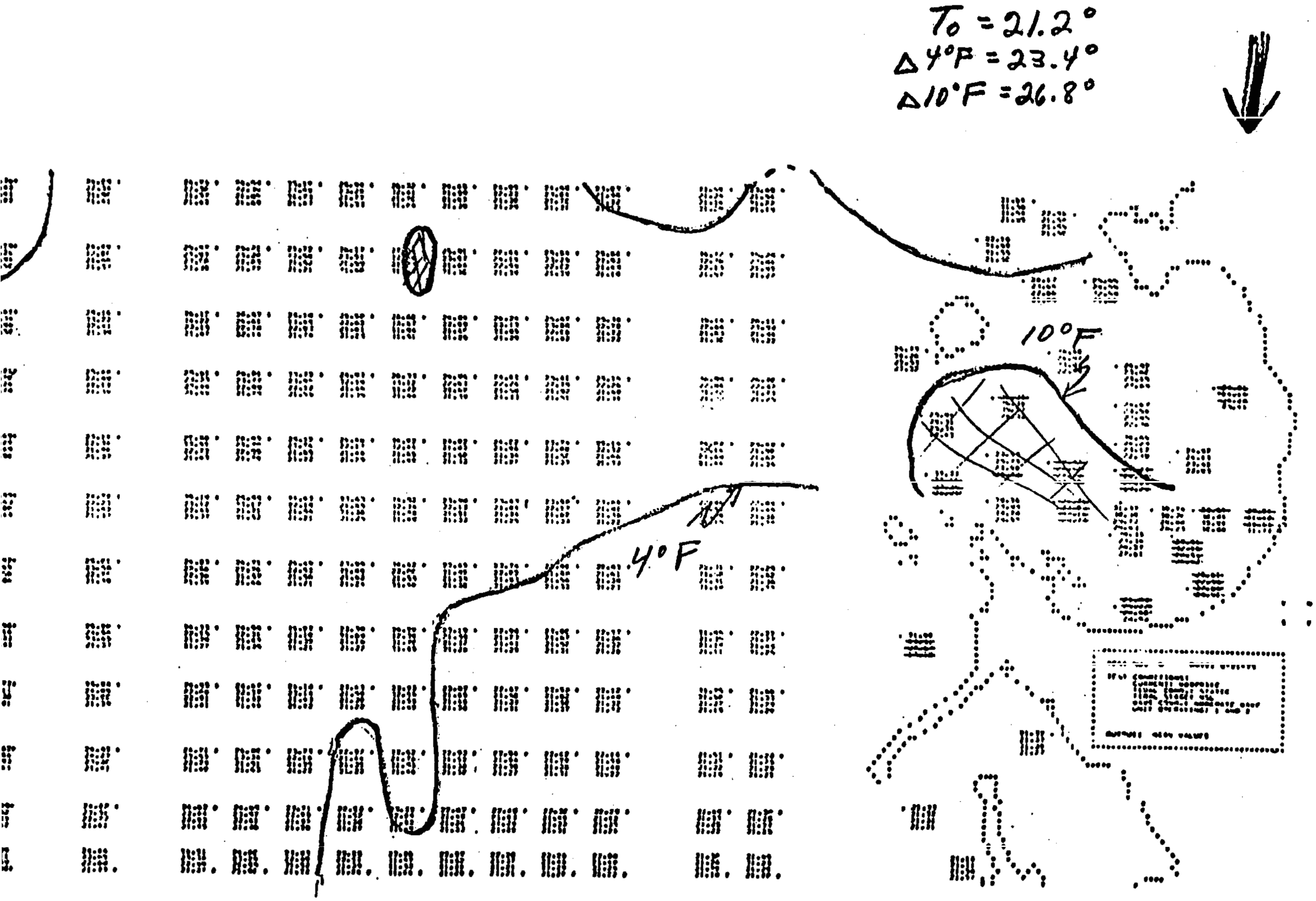


Figure 3.5 Surface isotherms for model test 6

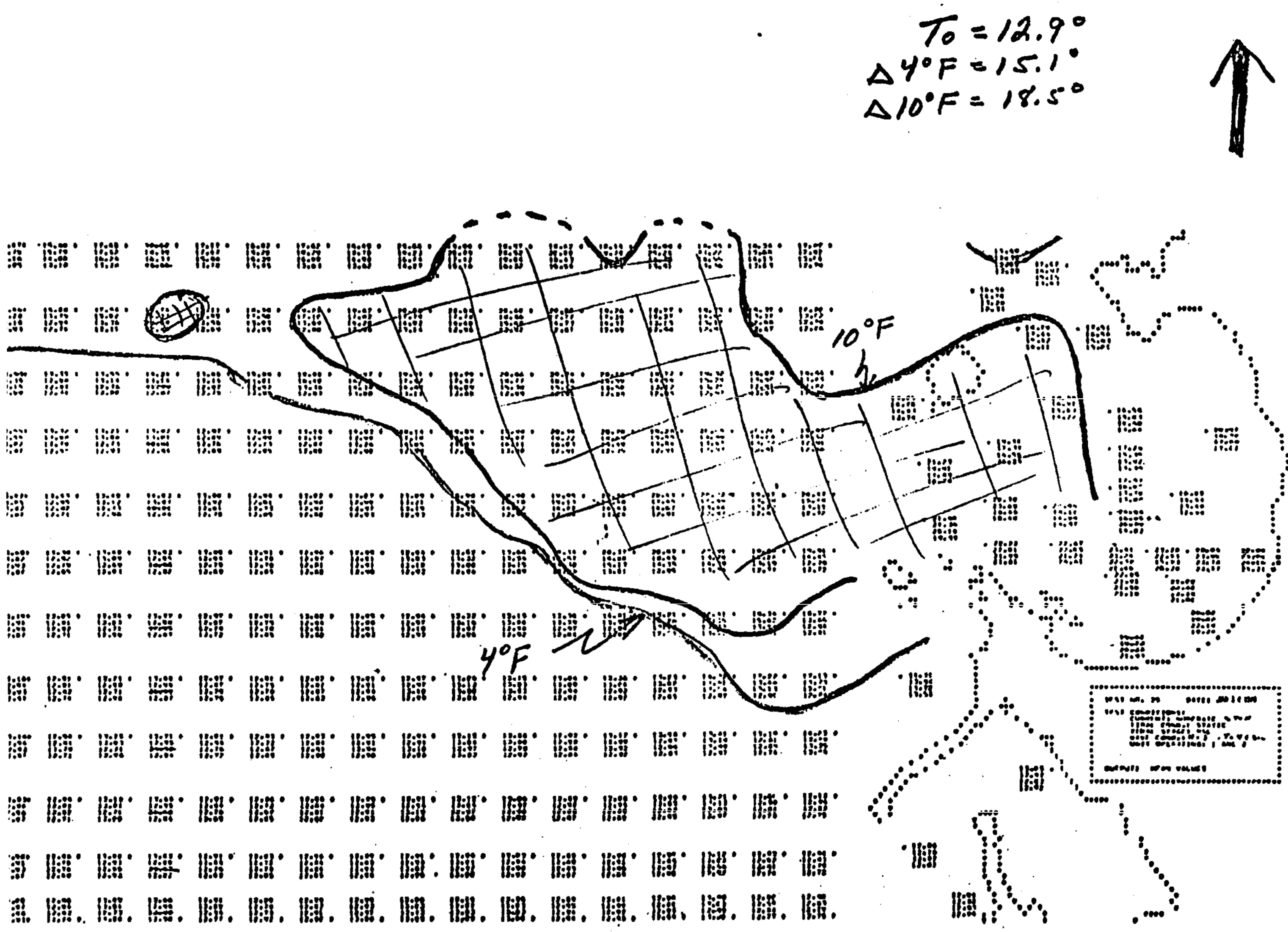


Figure 3.6 Surface isotherms for model test 25

The condenser tubes initially installed were fabricated from 90/10 copper nickel. (The actual composition was 87% copper, 11% nickel, 1.3% iron and 0.7% manganese.[3]) The 58,216 tubes have a waterside surface area of 655,200 square feet. Under normal operating conditions the corrosion rate of the tubes was expected to be less than 25 microns (1 mil.) per year. Based on these values, the staff estimated that corrosion would result in the discharge of 26,411 lbs of copper per year (about 72 lbs/day) and 3,339 lbs of nickel per year (about 9 lbs per day). The average discharge concentration would therefore be less than 7 ppb copper and less than 0.7 ppb nickel (FES p. 3-46).

The schedule for testing the cooling water system for Unit 1 involved several periods of prolonged shutdown of the circulating water pumps. During shutdown, corrosion of the condenser tubes continued, perhaps enhanced by stagnant conditions, although the main condenser was "drained" during shutdown. Consequently, corrosion products accumulated on the inner surfaces of the tubes and for short periods following each startup of the circulating water pumps the discharge of copper greatly exceeded the expected annual average rates. Concentrations of copper in the discharge water were measured to be as high as 1.8 ppm.3 The applicant analyzed water samples to determine the form in which the copper was discharged and found most of it to be insoluble copper trihydroxychloride.

Three programs, using air and water flushes in conjunction with various types of scouring material, were performed in an effort to remove copper corrosion products from the tubes in the main condenser and have been described at the hearing before the California Regional Water Quality Control Board, Central Coast Region, May 29, 1975. Analyses carried out after the third cleaning program indicated that less than 10 pounds of the copper corrosion compound remained in the condenser tubes. Although this amount represents less than 20% of the normal daily corrosion production (70 lbs per day) predicted by the staff (FES p. 3-46), the applicant considered the cleaning programs to be impractical and made the decision to retube the condensers with titanium tubes. Another factor in this decision was an engineering assessment that titanium tubing would reduce leakage of sea water into the plant's secondary cooling system and thereby reduce expensive plant shutdowns. The copper-nickel alloy tube sheets were retained and coated with epoxy to eliminate bimetallic corrosion and to prevent loss of copper from these surfaces. Retubing of Unit 1 was completed in October 1975 and retubing of Unit 2 is expected to be completed in the spring of 1976.

Through the replacement of the main condenser tubes all but approximately 7% of the original surface area of copper-nickel alloy has been eliminated. The copper-nickel tubes and tube sheets in the component cooling system, the service water heat exchangers, and in the intake constitute the remaining 45,239 square feet of metal surfaces that could contribute copper to the discharge into Diablo Cove. The applicant has activated some of these systems and has found the discharge of copper to be acceptably low. Because these systems are designed to operate continuously even during station outages, they are not expected to produce the slugs of corrosion product that were experienced in the main condensers.

Because of its high resistance to corrosion very little titanium is expected to be released into Diablo Cove. The applicant has estimated a maximum discharge of 1.1 pounds per day or approximately 0.1 parts per billion (E. R. Supplement 6). As a result of its high corrosion resistance and low toxicity, titanium will not form toxic corrosion products such as oxides of copper that help to protect the copper-nickel alloys. Therefore, these new tubes may be more subject to biological fouling and could require additional treatment with chlorine. Experience gained at three of the applicant's power plants with once-through, salt-water cooling has shown that titanium tubes can be treated intermittently, in a normal manner, to control slime without difficulty (E.R. Supplement 6).

References

1. Pacific Gas and Electric Company, "Foam Control at Diablo Canyon - A Report to the California Regional Water Quality Control Board, Central Coast Region," January 15, 1976.

2. Construction Permit CPPR-69, Amendment No. 3, August 14, 1974.

3. Pacific Gas and Electric Company, "Chemical Biological and Corrosion Investigations Related to the Testing of the Diablo Canyon Unit 1 Cooling Water System," May 9, 1975.

4. ENVIRONMENTAL IMPACTS OF SITE PREPARATION, STATION CONSTRUCTION, AND CONSTRUCTION OF TRANSMISSION FACILITIES

4.1 SCHEDULE AND MANPOWER

At the close of 1975 the construction of Unit 1 was nearly complete and the applicant was performing hot functional tests in anticipation of loading fuel in early 1976. The condensers for Unit 2 were retubed with titanium during the first quarter of 1976 and testing of the cooling water system of Unit 2 is planned to start on May 1, 1976. The applicant's plans call for Unit 2 to become operational in 1977.

4.2 IMPACT ON THE TERRESTRIAL ENVIRONMENT

4.2.1 Impacts from Plant and Related Structure Construction

Inasmuch as construction of the plant was well underway when the staff's initial review was performed, most of the major terrestrial modifications had already occurred. During the staff's site visit in July 1975, no serious erosion was observed. The applicant has continued to seed exposed areas of the plant site in an effort to minimize siltation of Intake and Diablo Coves. No schedule has been developed as yet for the removal of "temporary" construction buildings and parking lots; however, the applicant will be expected to protect these areas from erosion when these structures are removed.

4.2.2 Impacts from Construction of Transmission Lines and Access Roads

The Construction Permit for Unit 2 (Condition 2.0 (6)), requires the applicant to implement a program for redress of areas affected by transmission line construction. This program is now in effect and the applicant is maintaining photographic records of the effectiveness of its corrective actions. These records include cut grading, erosion and slide control, and revegetation. When a specific location has been stabilized and vegetation has been established, the recovery of the location is no longer recorded.

The staff has examined photographs of the impacted areas and believes that significant progress has been made in most of them. Several eroded sites will require continued attention, however, because the terrain has made satisfactory restoration difficult.

4.3 Impact on the Aquatic Environment

The serious siltation of Intake Cove that occurred during construction of the breakwater and cofferdam was addressed in the FES. This impact is being repaired and the staff does not expect operation of the plant to cause any further degradation of this cove. This topic is being addressed primarily to describe the applicant's efforts to reverse the damage to the Cove's ecosystem.

As the result of an agreement with the California Department of Fish and Game (CDFBG), the applicant developed a plan to remove the silt by dredging. This plan was approved by the California Water Quality Control Board - Central Coast Region prior to removal of the cofferdam in December 1973 and a site for disposal of the pumped silt was chosen 2000 feet offshore and beyond the 100-ft depth contour. Dredging began in January 1974 and was terminated in November 1975 because the efficiency of silt removal was declining. Dredging was monitored weekly for damage to the ecologically productive regions inshore of the 60-ft contour and no adverse effects were reported.

Immediately prior to the scheduled intake-pump tests in June 1974, the applicant dredged, to hard rock, an area of approximately 2.5 acres in front of the intake structure to minimize silt movement when the pumps were started. Even with this precaution, some sediment, which had accumulated within the intake structure, was pumped through the cooling water system and into Diablo Cove (E.R. Supplement 5) but caused no apparent damage to the ecosystem of the Cove.

During an inspection by CDF&G on May 23, 1974, very few benthic organisms were found in Intake Cove, although, there were indications that a nursery for rockfish was developing and a softbottom community would become established (E. R. Supplement 5). The applicant expects a stable replacement community that is characteristic of sheltered coastal habitats will become established in Intake Cove. The staff is in agreement, but believes it is premature to predict how closely such a community will resemble the one that existed before construction activities began.

During removal of the cofferdam around the discharge structure in Diablo Cove (February 4-14, 1974) the turbidity of the Cove's waters was temporarily increased. A fine layer of silt settled on the rocky substrate offshore of Diablo Creek. No area of heavy sedimentation was found, however, and the adverse impacts on the kelp and benthic community were minimal.

4.4 Transport of Rock

Upon request of the staff, the applicant has supplied current information related to transport of rock to the site (E. R. Supplement 6). The remainder of the construction schedule calls for the delivery of 11,000 tons of rock during the 12 months after September 1975. These deliveries will complete the movement of a total of 504,000 tons of rock for this project. Night hauls will no longer be made. The staff does not anticipate that this activity will cause further problems during the final phase of construction.

5. ENVIRONMENTAL IMPACTS OF STATION OPERATION

The only potential impact associated with the operation of this plant that could be identified during the earlier NEPA review was a probable ecological shift in benthic organisms and fish that will result in an increase in the population of warm-water-tolerant species. Based on its earlier thermal analysis, the staff predicted that as many as 110,000 abalone might be lost because of thermal stress. During the last three years the applicant has been accumulating additional hydrological and biological data that have been made available to the staff (cf. Sections 2.7.2 and 3.3.3). In this section of the Addendum the staff applies this new information to an updated assessment of potential impacts on the marine ecosystem.

The staff's assessment of chemical releases into Diablo Cove was described in the FES. The staff's present analysis considers the unexpected release of copper and the formation of excess foam during initial tests of the intake pumps.

5.2 IMPACTS ON WATER USE

5.2.1 Chemical Discharge -

The discharge of chemicals normally associated with the operation of the Diablo Canyon Plant was evaluated in the FES; however, the release of copper in the concentrations that occurred during startup of the cooling water system for Unit 1 was not anticipated. This phenomenon and its biological consequences have since been investigated thoroughly by the applicant) and by the State of California.3 The State concluded that the release of copper contributed to a significant abalone mortality in Diablo Cove.

The applicant has subsequently substituted titanium for the 90-10 copper-nickel alloy for all of the tubes of the main condensers and has coated the copper-nickel tube sheets of these condensers with epoxy. These measures will effectively eliminate the release of copper from the main condensers. The remaining components of the plant that are made of copper-nickel alloy have been operated continually for several months and daily analyses of the water that has been in contact with these components reveal copper concentrations of 20 ppb or less without dilution from the main cooling system. When at least one unit's pumps are operating, the copper in the discharge water is never expected to exceed 1 ppb.

Based on an analysis similar to that described in the FES, the staff concludes that this very low concentration of copper should have no detrimental effect on the biota of Diablo Cove.

Toxicity data for titanium are sparse and little is known about the effect of this element on the biota native to the plant environs. Generally, titanium has been considered to be much less toxic than copper. The applicant is endeavoring to supplement the information that is now available through corrosion and toxicity studies in its laboratory at the plant site. Based on a prediction that the concentration of titanium in the discharge water will not exceed 0.1 ppb, the staff concludes that the aquatic biota will not be harmed.

The substitution of titanium condenser tubing may require the applicant to chlorinate the cooling water system more frequently to maintain the desired cleanliness; however, the amount of total residual chlorine that will be produced will not be increased over that evaluated for copper-nickel systems. The applicant will still be required to conduct onsite studies to establish the acute and chronic impacts of chlorine on the biota in the entrained and receiving water as described in the FES.

5.2.2 Foaming in Diablo Cove

When the condenser cooling water system for Unit 1 was first started up in June 1974, more foam was produced in Diablo Cove than anticipated or assessed during the staff's earlier review. This phenomenon is thought to be a consequence of the hydraulic performance of the plant's discharge structure combined with the presence of a natural foamant in the water. This foamant, carrageenin, is a mucilage-like material released by algae and seaweeds. The discharge structure returns the cooling water to Diablo Cove, a distance of 80 feet, over a series of three steps. The energy of the falling water is absorbed in the stilling basins at each level to an extent required to achieve the desired velocity of the discharge into the cove. During its fall, the water entrains air and produces a froth, which dissipates relatively quickly in the open waters of the cove. The foam is observed at the edge of the frothy plume, but persists longer than the froth and floats on the surface of the inshore waters until it eventually disintegrates (Figure 3.1).

The applicant observed that the hydraulic performance of the discharge structure was less efficient during the 1974 tests than had been predicted by physical model studies. Consequently, additional model studies were initiated in 1975 with the dual goals of improving the structure's efficiency and controlling the formation of foam. The value of physical models to study foam is very limited, however, because froth and foam cannot be modeled and will be more amenable to study with the operating plant. The applicant has submitted a plan of action to make such studies in the field while performing laboratory investigations related to the efforts of foam on marine life. A copy of this plan is presented in Figure 5.1.

The staff agrees that such a plan of action is required and should address (a) potential biological effects caused by interaction between the foam and aquatic biota, (b) potential effect of reduced light penetration on the benthic organisms of Diablo Cove and inshore waters, (c) aesthetics, and (d) the effect of free and combined chlorine compounds on the stabilization and persistence of foam.

The applicant has proposed various approaches for mitigating the foam problem through modifications to the discharge structure. To date, minor changes have been made to affect the entrainment of air and to improve the dissipation of energy of the water; however, these changes have had no appreciable effect on the foam. The addition of chemicals to the discharge water may not be practical because the volume of water is so large (867,000 gallons per minute per unit) and must be evaluated in terms of substituting one environmental problem for another. The use of sprays to help dissipate foam might give positive results, however, a more complete understanding of the nature of foam is required. Recourse to more extensive and expensive alternatives such as major alteration of the discharge structure does not appear to be required unless the ongoing biological experiments reveal that severe adverse impacts are occurring. Any significant changes in the hydraulic characteristics of the discharge or in the physical and topographical characteristics of Diablo Cove would undoubtedly invalidate the staff's assessment of impacts associated with the thermal discharge and, thus, would require prior permission from the Commission.

The staff will require the applicant to take into consideration the possible adverse impact of foam on the aquatic biota of Diablo Cove as part of the operational monitoring program that will be defined in the Environmental Technical Specifications.

5.3 Biological Impacts

5.3.2 Impact on the Aquatic Environment

The effects on the aquatic environment from operation of the Diablo Power Plant were discussed in the FES. Since that time, extensive changes have occurred in the baseline conditions of Diablo Cove. These changes are described in Section 2.7.2. In addition, a physical model of the site area has been constructed to provide a better description of the dispersion of the thermal plume. The updated isotherms used for the biological effects are presented in Section 3.3.3.

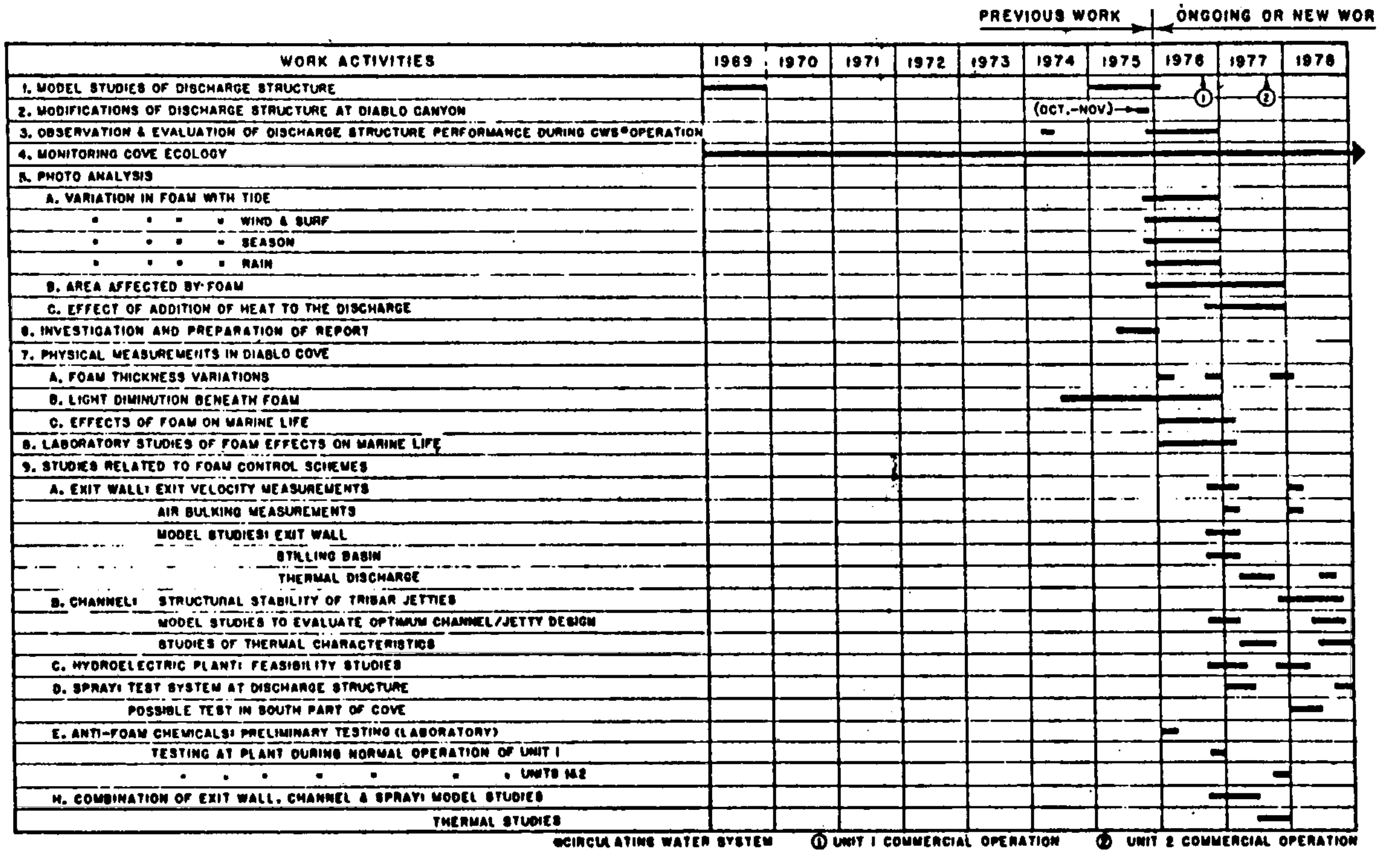
Major potential impacts from plant operation were evaluated in the FES for bull kelp, abalones (both adult and larval stages), the benthic community in the immediate discharge area and fish (eggs, larvae and adults). Entrainment impacts on zooplankton are discussed in Section 2.7.2.

Bull Kelp

In the FES the staff used thermal tolerance data for the giant kelp, Macrocystis pyrifera, because no information was available on the bull kelp. Macrocystis pyrifera beds decline at temperatures in excess of 68°F. Applying this temperature to the bull kelp beds in Diablo Cove, the FES indicated that about 25 acres could be affected by the thermal effluent (4oT°F) for a few hours during high tide when the ambient temperatures are above 64°F. Historical data indicate that an ambient temperature greater than 60°F would be observed only during three weeks of the year.

Since issuance of the FES, no new thermal tolerance data have become available for adult bull kelp. The new thermal plume predictions, however, can be used with previous thermal tolerance data for an updated impact evaluation. The 4°F isotherm at an ambient temperature of 64°F

Fig. 5.1 ACTION PLAN FOR FOAM CONTROL AT DIABLO CANYON



results in the 68°F limit being exceeded in nearly all of Diablo Cove. This is not significantly different from the previous evaluation; however, the present data show the 4°F isotherm extending farther out in the open ocean.

'Bull kelp density is much greater in the northern half of the cove (Figure 2.3). However, the physical model tests conducted with a downcoast coastal current show the northern half of the Cove experiences little temperature rise. For the moderate upcoast coastal current, part of the thermal plume is pushed into the northern part of the cove and out the north entrance. This causes a rise of about 5 to 11°F above ambient at the surface, but only 2°F above ambient near the bottom. The upcoast current typically occurs in the winter months after the kelp has died, so little impact to the kelp will result during this period.

The mathematical model predicted that about 5 acres within Diablo Cove would have a surface temperature of 10°F to 19°F (10°F isotherm) warmer than ambient. The results of the physical model indicate that the 10°F isotherm may encompass three times the area previously predicted. The kelp canopy within this area will be subjected to temperatures above 68°F for approximately 2 months of the year (September and October). A limited kelp canopy may form within these parts of the cove during spring and early summer but will decline rapidly when ambient water temperatures exceed 58°F. Some kelp canopy immediately outside the mouth of the cove may be affected by the heated plume; however, kelp is not abundant outside the Cove because of excessive water depth.

Investigations of the thermal response of juvenile sporophytes of bull kelp were conducted in tanks at the Morro Bay Power Plant north of Diablo Canyon (E.R. Supplement 8).1 The preliminary results found tissue decline in the young plants at temperatures about 62°F. Young sporophytes are typically found in Diablo Cove from March to May and would be subjected only to bottom temperatures until the stipe reaches the surface. Ambient temperatures are lowest at this time of the year and temperatures outside the 10°F isotherm will be below 62°F. More importantly, the 10°F isotherm will cover little of the bottom area.

Diablo Cove now contains much more bull kelp than when the FES was issued. This proliferation is a direct result of the removal of the primary kelp grazers, the abalone and the urchins, by sea otters and commercial divers. Much of the new, more dense growth of kelp is in the northern part of the Cove. This area should be least affected by the thermal plume according to the physical model studies. The southern two-thirds of the Cove will become less productive for bull kelp. This loss is regionally offset, however, because the return of the sea otter to the region below Montery and its subsequent predation of abalone and urchins, has substantially increased bull kelp densities. Therefore, removal of up to 10 or 20 acres of bull kelp production in this region will not be a serious impact to those aquatic species that depend on kelp for food or habitat.

<u>Benthic Communities</u>

In the FES the staff predicted that a replacement community would develop in the area bounded by the 10°F and ambient bottom isotherms and this area was estimated to be no more than 10 acres. Warm-water-tolerant and eurythermal organisms would become more abundant in the heated areas, replacing cold-tolerant stenothermic species. This kind of replacement community has become established near the discharge of the applicant's Morro Bay Plant. The staff's current assessment indicates that the area subject to ecological replacement will be 10 to 15 acres.

<u>Abalone</u>

The principal benthic species of concern in the vicinity of Diablo Cove is the abalone. This species grows and survives best in cool water and thus will be subject to direct impact. In addition, an indirect impact may occur because of the close trophic relationship between the abalone and kelp. There is concern that a reduction in the abundance of kelp could affect the abundance of the abalone.

New thermal tolerance data for red abalone are discussed in Section 2.7.2. These data indicate that abalone should survive long-term exposure to temperatures of 70°F, which is about 7°F above the maximum temperature recorded for Diablo Cove. Using the percent frequency of ambient temperatures for Diablo Cove (E.R. Supplement 5), red abalone may find unfavorable thermal conditions within the 10°F bottom isotherm when the ambient intake temperature is 60°F or warmer. This condition occurs for about 3 weeks during the year. An ambient intake temperature of 62°F, which occurs for about 1 week per year, will result in unfavorable conditions within the 8°F (4.4°C) isotherm on the bottom. In addition, the abalone can tolerate exposures to 71.6°F (22°C) for 24 hours, and to even higher temperatures for shorter periods. As the maximum temperatures recorded at Diablo have occurred for only a few hours each day, the red abalone population should not be adversely influenced by the temperature increase outside of the 10°F isotherm on the bottom of the Cove.

A potential loss of 110,000 abalone as a result of station operation was predicted by the staff in the FES. This estimate was based on the 1970-1971 abalone surveys by the COF&G. As indicated in Section 2.7.2, the population of red abalone has declined 95% at subtidal stations. Based on the current abalone densities for Diablo Cove, the total number that could be killed will be small; however, the Cove will not afford a viable habitat in those areas where the thermal plume remains in constant contact with the bottom.

The effects of pumping abalone eggs and larvae through the condensers was discussed in Section 2.7.2. Insignificant mortality to eggs and larvae occurred when they were subjected to the temperature-decay regime simulating that of the plant. This study did not duplicate the effects of mechanical abrasion and pressure, but field studies made by PG&E on its operating plants have not revealed significant mechanical or pressure related effects to entrained organisms.

Entrainment - Fish Eggs and Larvae

In its earlier review, the staff used data from offshore sampling that indicated that the density of larvae near the plant would be approximately 1.1/m3. More recent data indicates that the average yearly density is probably less that this value. Peaks of over 1.0/ma have been observed, however, and these periods of peak abundance are critical for recruitment of the species.

The significance of the potential loss of fish eggs and larvae to the coastal fisheries is difficult to estimate. This assessment is complicated by not knowing which species comprise the high densities. Nevertheless, the staff believes that the effect on pelagic larval fishes drawn in from areas outside the Cove will be negligible. At the most, some slight reductions might occur in the populations within Intake Cove (most likely Sebastes spp), but this would only happen if these communities could not be sustained by recruitment of juveniles and adults from outside the Cove.

Impingement

Operation of the condenser cooling water system has the potential for entrapping fish in Intake Cove and eventually impinging these fish on the intake screens. Typically, fish that have been impinged, washed off the screens, and returned to a "safe" environment, suffer significant mortality. The applicant's Morro Bay Plant has a type of shoreline intake design similar to that for Diablo Canyon and apparently this design has not caused impingement problems. However, no study has been made of the material in the screenwash baskets and, therefore, no data are available to support this conclusion.

On February 4, 1976, the applicant submitted preliminary data on fish impingement at Diablo Canyon (E.R. Supplement 8). These data were collected during "pump testing" of only Unit 1 over the period December 10-19, 1975. The traveling screens were operated for 15 minutes every two hours. High pressure screen wash water is sprayed on the screens and carried the accumulated fish and debris to a sump lined with a small mesh basket. This basket was lifted once a day for removal of fish and debris.

A total of 53 fish representing 23 species was collected. An average of 2.3 fish per day were picked up on the traveling screens of Unit 1, which was operating with a full circulating water flow of 3283 m3/minute. However, the low numbers of fish collected during the winter may not be representative of the entire year.

Based on these preliminary results and on the applicant's operating experience at other coastal plants, the staff does not believe that impingement will have significant adverse effects on nearby finfish populations. However, the cul-de-sac configuration of Intake Cove may encourage fish congregation when the intake pumps of both units are operating. The strong intake flow between the breakwaters may prevent the escape of juvenile and weakly swimming fish out of the Intake Cove. This aspect of the intake design and the uncertainty of the "state-of-the-art" for impingement prediction necessitates routine impingement monitoring during operation.

Summary

The staff's prediction of the potential major impacts on the aquatic ecosystem during operation of the Diablo Canyon Plant has been modified since issuance of the FES. Extensive changes have occurred in the baseline conditions on which the FES impacts were based. These changes were brought about mainly by the southward migration of the sea otter, increased commercial harvesting in the Diablo Canyon region, red tides, and to a lesser extent by toxicity problems associated with the testing of the plant's cooling water system.

The major changes have been the decline of the abalone and sea urchin populations. The abalone has declined in numbers to the extent that it is no longer a major component of the Diablo Cove subtidal community. However, if the abalone can acclimate to the higher temperature in the cove after the plant becomes operational, the CDF&G predicts a harvestable red abalone population could return to its former abundance in 5 to 10 years. This would be contingent on the absence of otter foraging in Diablo Cove, a situation considered unlikely.

Other potential concerns have been resolved by acquisition of new data as requested in the FES. Impingement and entrainment (of fish eggs and larvae and abalone eggs and larvae) are two areas where the predicted impacts have been downgraded after assessment of additonal information. Monitoring will still be required, however, to document the magnitude of these impacts.

The physical model studies show that the thermal plume will probably require a larger area for dissipation of heat than previously assessed. More of Diablo Cove will be heated and some parts to a greater degree than indicated by the mathematical models in the FES. A much larger area of the open ocean will be heated than was previously predicted.

The larger thermal plume area will not substantially increase the thermal impact on Diablo Cove because much of the heat will be dissipated outside of the cove. Some additional kelp beds may be affected outside Diablo Cove but the impact will be minimal because of the low abundance of kelp in this deeper offshore water. The effect of the surface plume on other biota in the nearshore waters ?s expected to be minimal.

5.5 Compliance With California Water Criteria and the Federal Water Pollution Control Act

The staff's earlier review of water quality concerns was made under the guidelines of the Commission's (AEC) Interim Policy Statement implementing the FWPCA. In general, this Statement provided the continuation of the Commission's authority and responsibility, pursuant to NEPA, to impose limitations on the discharge of pollutants from nuclear power plants. This position was also based on a Memorandum of Understanding between the Commission and the Environmental Protection Agency (EPA) dated January 29, 1973 (38 FR 2713).

In October 1974, the EPA published (39 FR 36176 and 36186) Parts 122 (Thermal Discharges) and 423 (Steam Electric Power Generating Point Source Category) to 40 CFR that provided regulations implementing section 316(a) of the FWPCA and established effluent limitations and guidelines. The promulgation of these regulations effectively transferred authority over water quality matters back to EPA. The First Memorandum of Understanding has been rescinded as part of a Second Memorandum signed by EPA and NRC on December 17, 1975.

The current status of the applicant's compliance with existing quality regulations is given below:

(a) Possession of a water quality certification under § 21(b) of the FWPCA dated October 19, 1971. This certification sufficed for the Commission's requirements.

(b) A filing has been made (October 26, 1973) for a § 401 certification to update the 21(b) certificate previously issued by the State of California.

(c) Possession of Provisional NPDES Permit No. CA0003751, adopted October 11, 1974 with an expiration date of May 1, 1976. This permit was modified on December 31, 1974 to include revised monitoring and reporting programs to be initiated on January 17, 1975. Under the "Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California (May 18, 1972)," the Diablo Canyon Units 1 and 2 are defined as "Existing Discharges." The California Regional Water Quality Control Board - Control Coast Region, on January 15, 1976, issued a Proposed Tentative NPDES Permit for the Diablo Canyon Plant. This 5-year permit was adopted on April 9, 1976 and thereby replaces the provisional permit.

(d) The applicant petitioned on November 26, 1974, for imposition of alternate effluent limitations pursuant to § 316(a) of FWPCA.

(e) In compliance with its NPDES permit, the applicant has submitted, in October 1975, a 316(a) Demonstration Program to the California Regional Water Quality Control Board - Central Coast Region.

(f) The EPA has issued a 'Finding of Violation' of conditions in the NPES permit based on the alleged mortality of marine life caused by the discharge of copper into Diablo Cove during the pump tests in 1974.

(g) The applicant is under Cease and Desist Order 75-1, issued on July 13, 1975 by the California Regional Water Quality Control Board - Central Coast Region, to desist from discharging wastes contrary to certain requirements imposed in the State of California's Waste Discharge Requirements of 1969 and in the NPDES Permit. A report entitled "Foam Control at Diablo Canyon" was submitted on January 15, 1976 to the Water Quality Control Board in partial response to this Order.

Regulatory agencies responsible for the implementation of the FWPCA have shown an awareness of and concern over the same water quality problems that have been evaluated by the NRC staff and are pursuing resolution of these problems in accordance with FWPCA.

References

1. Pacific Gas and Electric Company, "Chemical, Biological, and Corrosion Investigations Related to the Testing of Diablo Canyon Unit 1 Cooling Water System," May 9, 1975.

2. M. Martin, "A Summary of the Cause and Impact of an Abalone Mortality - Diablo Canyon, San Luis Obispo County, California," State of California Department of Fish and Game, December 12, 1974.

6. EFFLUENT AND ENVIRONMENTAL MEASUREMENT AND MONITORING PROGRAMS

6.1 PREOPERATIONAL SURVEYS

The applicant has issued the data acquired from various oceanographic, biological, radiological, ecological, and hydrological programs in the following documents:

(a) Environmental Investigations at Diablo Canyon 1972-1973, Supplement #4 to the Environmental Report, May 16, 1975.

(b) Environmental Investigations at Diablo Canyon 1974, Supplement #5 to the Environmental Report, August 1, 1975.

(c) Supplement #6 to the Environmental Report, August 18, 1975.

(d) Environmental Investigations at Diablo Canyon July 1974 thru June 30, 1975 (Preliminary Report), Supplement W8 to the Environmental Report, February 6, 1976.

(e) Preliminary Report on Fish Impingement Study at Diablo Canyon, Supplement 8 to the Environmental Report, February 6, 1976.

(f) Environmental Report, Diablo-Gates Transmission Access Road Survey, May 1975.

(g) Environmental Report, Diablo-Midway Transmission Access Road Survey, May 1975.

(h) Diablo Canyon Unit 1 Power Plant Survey using Aerial Tracer Dye Imaging Techniques, April 1975.

(i) Report on Model Study of Cooling Water System of Pacific Gas and Electric Company Nuclear Power Plant Located at Diablo Canyon, California, Supplement #8 to the Environmental Report, February 6, 1976.

By means of these programs, the applicant has complied with the requirements of Regulatory Guide 4.2 (Preparation of Environmental Reports) and in the licensing conditions in the construction permit for Unit 2.

6.2 OPERATIONAL BIOLOGICAL AND THERMAL MONITORING PROGRAMS

The assessments of potential impacts to the marine ecosystem that were presented in the FES and in Section 5 of this Addendum have been based principally on the surveys and experiments listed in Section 6.1 and on the applicant's and staff's evaluation of the thermal discharge. The staff believes that these assessments should be confirmed by monitoring the thermal plumes and the indigenous biota after Unit 1 has begun operation. To a large degree, the biological program will be a continuation of the preoperational surveys and tests. The thermal monitoring program described in the FES (p. 6-7) is no longer considered adequate. Updated biological and thermal programs will be defined by the Environmental Technical Specifications that are currently being developed by the applicant and staff and which will become Appendix B to the Operating License.

For biological purposes, thermal plume measurements need only be conducted within Diablo Cove as this area is predicted to be affected to a much greater extent than offshore. The northern part of the cove, especially the northern entrance, should be extensively monitored, and an assessment of changes to the kelp and other biota must be corroborated with the history of thermal exposure of these species.

As long as the biological impacts do not significantly exceed those predicted in Section 5.3.2 of this Addendum, the staff does not consider it necessary for the applicant to provide additional information relative to an alternative discharge system. The need for additional designs, thermal plume models, and biological assessments could arise, however, if the currently designed discharge system results in one of the following situations:

(1) The impact on the aquatic ecosystem, as established by the monitoring programs, is found to be excessively adverse.

(2) The plant fails to meet the criteria of the State of California's 316(a) exemption.

(3) The currently designed discharge system continues to produce an amount of foam that is unacceptable to the State of California.

6.4 RADIOLOGICAL MONITORING

The program that will be continued after Unit 1 becomes operational will conform to the one defined in Regulatory Guide 4.8 and will be described in detail in the Environmental Technical Specifications.

8. ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

At this stage of the licensing process, the staff is able to assess the correctness of some of its predictions that were made in 1973 and also to predict more accurately the environmental impacts that will be associated with the operation of the plant.

A significant impact on the land resulted from the construction of transmission corridors and associated access roads. As reported in Section 4.2.2 of this Addendum, considerable progress has already been made toward restoration of these areas and the redress program is continuing satisfactorily.

The overall aquatic ecosystem of Inlet Cove was severely damaged when portions of the cofferdam collapsed during construction of the intake structure. The applicant has subsequently carried out an extensive dredging operation in an attempt to restore the floor of this cove to a siltfree condition. The staff believes a new ecosystem is presently developing which will be influenced by both the "reef" habitats afforded by the breakwaters as well as by the relatively virgin characteristics of the floor of the cove.

The staff's original assessment of the potential shift of the ecosystem of Diablo Cove to more warm water species appears to remain valid. The extent of this change will become known accurately only after the plant has become operational; however, the plant's impact on fish will not be significant and the impact on benthic organisms will occur principally in the southern 10 to 15 acres of the cove.

The staff has acquired additional information from the applicant related to the types and habits of the aquatic species in the marine environs of the plant and now predicts, with increased assurance, that the probable losses due to entrainment and to impingement at the intake structure will neither be extensive nor have a measurable impact on the marine ecosystem.

The unexpectedly large concentrations of copper that were discharged during the initial tests of the Unit 1 intake water pumps is considered to be somewhat of an enigma because of the abundance of previous reports of satisfactory experience acquired with 90-10 copper-nickel alloy for condenser tubing. Recurrence of this, or similar chemical problems, has been made highly improbable through the substitution of titanium tubing in the main condensers of the Diablo Canyon units.

The formation of foam in Diablo Cove when condenser cooling water is discharged will be aesthetically detrimental only to a limited area of the cove. The effect of this additional foam on the aquatic biota of this cove will also be restricted in extent and to a degree that is controlled by the NPDES permit of the State of California.

11. NEED FOR POWER

Recognition of the applicant's need for the Diablo Canyon Plant was implicit in the issuance of construction permits for Units 1 and 2. The Commission reviewed its earlier assessment as part of the NEPA review and hearings for Unit 2, and determined that the plant was still required to help the applicant meet its future demands.

Even though the construction phase is nearly completed, the staff has updated its previous assessments so as to establish the impact of the recent nationwide changes in energy demand and production. The applicant's operating experience during the period 1968 to 1974 (E. R. Supplement 5) showed an average growth rate in peak demand and annual energy requirements of 6.2% and 4.4%, respectively (Table 11-1). Using the applicant's forecasts, the staff calculates that the projected growth rates for these two loads will be 5.6% and 5.9% per year. These data also show that the applicant's reserve capacity during the years 1976, 1977, and 1978 will be 22.6%, 23.2%, and 18.2% with the Diablo Canyon Plant on line and 15.2%, 9.2%, and 4.4% if this plant is not commercially available (Table 11-2).

The staff recognizes that the recent perturbations in the nation's economy and energy resources increases the difficulty of making long-range load forecasts. Consequently, the possibility exists that the applicant's annual growth rate for total output will continue to be as depressed as it has been since 1973. The two Diablo Canyon Units are nearly completed, however, and the staff believes that prompt issuance of their operating licenses is justified by the improvements in reliability and economy that these units will afford the applicant's baseload resources. As shown in Table 11-3, the applicant extends the justification further by predicting the potential savings in natural gas and oil that will accrue from the use of these nuclear units during the 1976-1978 period. The staff agrees that this assumption is valid.

Table 11-1

PG&E AREA SYSTEM LOADS

			August Peak Demand (Megawatts)		
			Estimated		
Year	Actual	(Growth, %)	Average	(Growth, %)	Adverse
1968	9117	-			
1969	9337	2.4			
1970	9933	6.4			
1971	10965	10.4			
1972	11867	8.2			
1973	12262	3.3			
1974	13071	6.6			
1975			13460	3.0	13530
1976			14310	6.3	14390
1977			15200	6.2	15270
1978			16150	6.3	16220
1979			17080	5.8	17150
1980			18060	5.7	18120
1981			19070	5.6	19120
1982			20140	5.6	20200
1983			21340	6.0	21400

			Annual Energy (Million kWh)		
			Estimated		
Year	Actual	(Growth, %)	Average	(Growth, %)	Adverse
1968	51272	-			
1969	53327	4.0			
1970	55962	4.9			
1971	59645	6.6			
1972	64619	8.3			
1973	66261	2.5			
1974	66420	0.2			
1975	(6 mos. 33189	-0.1)	70300	5.8	71210
1976			74790	6.4	75710
1977			79340	6.1	80300
1978			84370	6.3	85330
1979			89030	5.5	89970
1980			94310	5.9	95240
1981			99710	5.7	100610
1982			105150	5.5	106030
1983			111030	5.6	111900

Table 11-2

PACIFIC GAS AND ELECTRIC COMPANY
ESTIMATED AREA SYSTEM LOADS AND RESOURCES
(MEGAWATTS EXCEPT WERE NOTED) Adverse Water Conditions

Line		WITH DIABLO CANYON UNITS		
		YEAR 1976 AUGUST	YEAR 1977 AUGUST	YEAR 1978 AUGUST
1.	Area Load	14390	15270	16220
2.	Less External Pumping Resources	107	124	123
3.	Less Interruptible Load	65	65	65
4.	Planning Load	14218	15081	16032
5.	Estimated Resources			
6.	Existing as of 12/74	13518	13518	13518
7.	Imports from Pacific Northwest	1542	1500	1400
8.	Planned Additions:			
9.	Unit 1-Diablo Canyon	1060	1060	1100
10.	Unit 2-Diablo Canyon	0	1060	1100
11.	Other	1318	1443	1825
12.	Total Additions	2378	3563	4025
13.	Total Existing, Planned, & Imports	17438	18581	18945
14.	Estimated Maintenance Outage	0	0	0
15.	Net Reserve Capacity			
16.	Megawatts	3220	3500	2913
17.	Percent of Planning Load	22.6	23.2	18.2
18.	Reliability Index			
19.	Without Emergency Support	210.6	99.2	14.0
20.	With Emergency Support	2997.9	939.2	105.7
		WITHOUT DIABLO CANYON UNITS		
21.	Estimated Resources	16378	16461	16745
22.	Estimated Maintenance Outage	0	0	0
23.	Net Reserve Capacity			
24.	Megawatts	2160	1380	713
25.	Percent of Planning Load	15.2	9.2	4.4
26.	Reliability Index			
27.	Without Emergency Support	22.3	1.3	0.2
28.	With Emergency Support	305.6	10.7	1.4

Table 11-3

SOURCES OF ENERGY

Millions of Kilowatt Hours

	1976	1977	1978
Average Year Annual Energy	74790	79340	84370
State Water Project by Others	-704	-723	-688
Planning Energy Load	74086	78617	83682
Hydro and Imports	28133	27838	27377
Geothermal	3796	4736	6360
Refinery Plant Generation	561	562	562
Other Nuclear	5624	6522	6893
Units 1 & 2 at Diablo Canyon[(1)]	4314	11632	13102
Fossil - Gas and Oil	31658	27327	29388

FOSSIL FUEL REQUIREMENTS

Millions of Equivalent Oil Barrels

	1976	1977	1978
Natural Gas (Oil Basis)	7.1	3.0	0.8
Fuel Oil with Units 1 and 2	40.2	41.0	44.7
Fuel Oil without Units 1 and 2	46.6	58.4	64.6
Estimated Fuel Oil Saving with Units 1 & 2	6.4	17.4	19.9

(1) Includes an estimated 1550 million kWh of pre-commercial energy for each unit.

NUMBER T- 2071 ANALYTICAL DATA

VE INGREDIENT ORTHENE CROP Cotton CHEMICAL SPECIES ANALYZED FOR ORTHO 9006

SAMPLES RECEIVED 10/5 - 10/26/71 SAMPLE STORAGE TEMPERATURE -20° C EXTRACT STORAGE TEMPERATURE 4° C

ACTION SOLVENT Ethyl acetate EXTRACTION NOTEBOOK REFERENCE: BOOK 4375 PAGES 48, 49, 50

YTICAL METHOD: RM- 12 A ANALYSIS NOTEBOOK REFERENCE: BOOK 4375 PAGES 48, 49, 50

YTICAL METHOD MODIFICATIONS

MPLE ODE	CROP PART ANALYZED	EXTRAC-TION DATE	WEIGHT EXT'D GMS.	VOL. SOLVENT MLS.	ANALYSIS DATE	VOLUME EXTRACT TAKEN ml	FINAL VOLUME ml	DILUTION FACTOR	VOLUME ANAL'D µl	WT. SAMPLE IN FINAL ALIQUOT mg	DATA cm pk ht	AMOUNT FOUND ng	P.P.M. FOUND	P.P.M. CORR.*	FORT. REC. %
1-46A	wiped leaves	10-8-71	12.7	300	10-21	300	80	1	1	0.16	14.1	1.13	7.06	7.68	
-47A	" "	"	13.1	"	"	"	"	"	"	0.16	7.9	0.63	3.94	4.28	
-48A	" "	"	13.7	"	"	"	"	"	"	0.17	13.1	1.05	6.18	6.72	
-49	wipe	10-12	6.9	"	10-19	"	10	"	"	0.69	2.8	0.24	0.406	0.37	
-50	"	"	7.9	"	"	"	"	"	"	0.79	2.6	0.22	0.279	0.24	
-51	"	"	10.4	"	"	"	"	"	"	1.04	2.6	0.22	0.212	0.17	
-49A	wiped leaves	10-8	6.9	"	10-21	"	200	"	"	0.035	4.7	0.38	10.9	11.9	
-50A	" "	"	7.9	"	"	"	150	"	"	0.053	9.5	0.076	14.3	15.6	
-51A	" "	"	10.4	"	"	"	"	"	"	0.069	8.4	0.67	9.72	10.6	
	FORTIFIED AT			P.P.M.										‡	
	FORTIFIED AT			P.P.M.										‡	

.= CORRECTED FOR CHECK, RECOVERY AND LIMIT OF DETECTABILITY. ‡ FORTIFIED SAMPLES CORRECTED FOR CHECK ONLY.

OF DETECTABILITY ______ P.P.M. STANDARDS: QUANTITY OR CONCENTRATION 1.0 µg/ml DATA 11.9 cm pk ht(10-19) 12.5 cm pk ht(10-21)

IKS See page 17

12/3/71 SIGNATURE B.V. Tucker ORGANIZATION CHEVRON CHEMICAL COMPANY

TEST NUMBER T- 2071

IVE INGREDIENT ORTHENE CROP Cotton CHEMICAL SPECIES ANALYZED FOR ORTHO 9006

E SAMPLES RECEIVED 10/5 - 10/26/71 SAMPLE STORAGE TEMPERATURE -20° C EXTRACT STORAGE TEMPERATURE 4° C

RACTION SOLVENT Ethyl Acetate EXTRACTION NOTEBOOK REFERENCE: BOOK 4375 PAGES 48, 49, 50

LYTICAL METHOD: RM- 12 A ANALYSIS NOTEBOOK REFERENCE: BOOK 4375 PAGES 48, 49, 50

LYTICAL METHOD MODIFICATIONS

AMPLE CODE	CROP PART ANALYZED	EXTRACTION DATE	WEIGHT EXT'D GMS.	VOL. SOLVENT MLS.	ANALYSIS DATE	VOLUME EXTRACT TAKEN ml	FINAL VOLUME ml	DILUTION FACTOR	VOLUME ANAL'D µl	WT. SAMPLE IN FINAL ALIQUOT mg	DATA cm pk ht	AMOUNT FOUND ng	µg FOUND	µg CORR.*	FORT. REC. %
1-152	shirt sleeve	11-1-71	---	500	11-4	500	10	1	1	---	4.2	0.51	5.10	5.9	
-153	" "	"	---	"	"	"	5	"	"	---	2.7	0.33	1.65	1.8	
-154	" "	"	---	"	"	"	2	"	"	---	4.5	0.55	1.10	1.2	
-155	" "	"	---	"	"	"	"	"	"	---	0.5	0.06	0.12	---	
-156	respirator filter	10-27	---	700	11-8	700	1	"	"	---	1.8	0.16	0.16	0.2	
-157	" "	"	---	"	"	"	"	"	"	---	1.2	0.10	0.10	0.1	
-158	" "	"	---	"	"	"	"	"	"	---	0.0	0.00	0.00	---	
	FORTIFIED AT 1.0 µg														
-155	shirt sleeve	11-1	---	500	11-4	500	2	1	1	---	3.9	0.48	0.96	0.84‡	84
	FORTIFIED AT 2.0 µg														
-158	resp. filter	10-27	---	700	11-8	700	2	1	1	---	11.1	0.96	1.92	1.92‡	96

R.= CORRECTED FOR CHECK, RECOVERY AND LIMIT OF DETECTABILITY. ‡ FORTIFIED SAMPLES CORRECTED FOR CHECK ONLY.

T OF DETECTABILITY 0.1 µg respirator filters; 0.2 µg shirt sleeves STANDARDS: QUANTITY OR CONCENTRATION 1.0 µg/ml DATA 8.2 cm pk ht(11-4) 11.6 cm pk ht(11-8)

RKS Respirator filters and shirt sleeves reported as total µg/sample.

See page 17

12/3/71 SIGNATURE B. V. Tucker ORGANIZATION CHEVRON CHEMICAL COMPANY

TEST NUMBER T- 2071

13. BENEFIT-COST ANALYSIS

All of the problems and environmental costs identified in the FES pertained to ecological damage that would result either from construction impacts on the terrestrial environs or from operational impacts on the marine environs of Intake and Diablo Coves. In general, the staff believes the applicant has made sincere and successful efforts to minimize environmental, aesthetic, and societal costs and to redress those impacts that did occur, e.g., erosion in the transmission line corridors, siltation of Intake Cove, and pollution of Diablo Cove with heavy metals.

All land alterations at the plant site and in the transmission line corridors have been completed and successful redress is in progress; therefore, these impacts have not been assessed further. The applicant is expected to continue its program to reduce erosion at the site and in the transmission rights-of-way and to minimize siltation of Intake and Diablo Coves.

In its earlier review, the staff concluded that a real, but acceptable, cost would be borne by the benthic organisms of Diablo Cove once the plant became operational. Although our ability to predict the conditions that will exist in this cove has been enhanced by additional biological data and from the results of experiments performed with a physical model of the discharge system, the costs that will result from alteration of the existing ecosystem cannot be quantitized with much greater certainty than was presented in the FES. The staff believes the changes in abalone and urchin population will become known with accuracy only through the monitoring program to be defined in the Environmental Technical Specifications. Because the value of Diablo Cove as a viable abalone fishery has decreased significantly in the last few years, the overall importance of this Cove to the regional ecosystem has become so small that the loss of the current communities of kelp, abalone, and urchins cannot logically be balanced against the availability of this plant to the applicant and the people of its service area. On the other hand, the staff does not conclude that the benefits to be derived from this plant would outweigh severe and irreversible changes in the oceanic ecosystem. The staff has not identified any impacts outside Intake and Diablo Coves; however, the intake and discharge systems must be monitored carefully, and, if measurable indications of major impacts to the coastal waters are observed, the applicant must take immediate and sufficient measures to control this trend to the satisfaction of the Commission.

The staff, therefore, takes the position that this plant is needed by the applicant to fulfill its needs in 1976 and thereafter and that licenses to operate the two units should be issued.

14. RESPONSES TO AGENCY COMMENTS

When preparing the FES, the staff used Chapter 14 to make certain modifications and extensions of its assessments in response to comments of reviewers of the Draft Environmental Statement. In light of new information that has been acquired since the FES was issued, the following revisions must be made to the subsections of this Chapter.

14.4 THERMAL DISSIPATION

This subject is treated in Section 3.3 of this Addendum.

14.5 EFFECT OF OCEAN CURRENTS

This subject is also treated in Section 3.3 of this Addendum.

14.6 LIQUID RADIOACTIVE WASTE

This subject is updated in Section 3.4 of this Addendum.

14.8 CHEMICALS

The subjects of copper and chlorine are discussed in Sections 3.5.1, and 5.2.1 of this Addendum.

14.13.7 Occupational Radiation Exposure

Based on a review of the applicant's safety analysis report, the staff has determined that individual occupational radiation doses can be maintained within the limits of 10 CFR 20. Radiation dose limits of 10 CFR 20 are based on a thorough consideration of the biological risk of exposure to ionizing radiation. Maintaining radiation doses of plant personnel within these limits ensures that the risk associated with radiation exposure is no greater than those risks normally accepted by workers in other present-day industries.* Using information complied by the Commission** of past experience from operating nuclear reactor plants, it is estimated that the average collective dose to all onsite personnel at large operating nuclear plants will be approximately 450 man-rems per year per unit. The total dose for this plant will be influenced by several factors for which definitive numerical values are not available. These factors are expected to lead to doses to onsite personnel lower than estimated above. Improvements to the radioactive waste effluent treatment system to maintain offsite population doses as low as practicable may cause an increase in onsite personnel doses, if all other factors remain unchanged. However, the applicant's implementation of Regulatory Guide 8.8 and other guidance provided through the staff radiation protection review process is expected to result in an overall reduction of total doses from those currently experienced. Because of the uncertainty in the factors modifying the above estimate, a value of 900 man-rems will be used for the occupational radiation exposure for the two-unit station.

14.9 LOAD FORECASTS

This subject is updated in Section 11 of this Addendum.

Appendix 1-1 Applications and Approvals

This Appendix is updated in Sections 1.1 and 5.5 of this Addendum.

*Implications of Commission Recommendations That Doses Be Kept As Low As Readily Achievable, ICRP Publication 22 (1973).

**I.D. Murphy, "A Compilation of Occupational Radiation Exposure from Light Water Cooled Nuclear Power Plants:1969-1973," WASH-1311, USAEC (May 1974).

A P P E N D I X   A

LETTER TO GORDON K. DICKER OF NRC FROM E. C. FULLERTON, DIRECTOR OF THE CALIFORNIA DEPARTMENT OF FISH AND GAME

STATE OF CALIFORNIA—RESOURCES AGENCY   EDMUND G. BROWN JR., Governor

DEPARTMENT OF FISH AND GAME
1416 Ninth Street
Sacramento, California 95814
Phone (916) 445 3531

RECEIVED OCT 15 1975

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October 7, 1975

Mr. Gordon K. Dicker, Chief
Environmental Projects Branch 2
Division of Reactor Licensing
United States Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Dicker:

Thank you for your request to provide data and information concerning the potential impacts of the Diablo Canyon Nuclear Plant (DCNP) on the aquatic ecosystem of Diablo and South Coves and adjacent coastal regions. Our Department has been conducting ecological baseline studies and water quality investigations during the construction phase at DCNP. We intend to continue those studies after the plant becomes fully operational in order to determine the effects of its discharge upon Diablo Cove and adjacent areas of the coast.

As you noted, we have observed certain definite changes in benthic communities near the plant site. The effects of siltation on South Cove and the abalone mortality in Diablo Cove were, of course, caused by separate events and have resulted in different degrees of damage to the marine environment.

In 1970 and 1971, the Department documented construction impacts to South Cove as a result of the intake structure cofferdam construction. Major environmental degradation to the entire biotic community of approximately 10 acres occurred when muds and silts from the cofferdam were released into the cove.

Pacific Gas and Electric Company (PG&E) commenced cleanup dredging within South Cove in January 1974 and has proceeded, more or less continuously, since that date. The dredge had purportedly made one pass over the entire basin by early spring of 1975, with intensive silt removal activities conducted immediately in front of the intake structure. At this time, considerable amounts of silt are still present over most of the cove. Our Department, in cooperation with the Office of the Attorney General of California, has requested PG&E to explore alternative methods of silt removal, including re-establishment of the natural circulation pattern of South Cove as well as methods to reduce cove siltation from land-runoff. A number of actions have been taken by PG&E to reduce the land-runoff impacts but we are unaware of any planning by the company with regard to the circulation problem.

There is presently no recreational or commercial abalone or sea urchin fishery in South Cove. We have prepared a comprehensive inventory of the plants and animals estimated to have been lost from the South Cove as a result of the silt deposition. Except for peripheral areas, most of the formerly diverse benthic

communities have not recovered. The Department is continuing to seek restoration of the South Cove to as near original condition as possible.

During certain pump tests at DCNP in 1974 and 1975, the Department collected evidence that toxic concentrations of copper had been released to Diablo Cove. Those concentrations, identified by standard bioassay testing and heavy metal analysis, were recorded on several occasions during circulating pump testing in July 1975 and during start-up of the internal cooling water pump systems. Tissues from numerous plants and animals collected from Diablo Cove showed significantly elevated concentrations of copper in comparison with areas not affected by the discharge. Department staff established that abalone mortality and accumulation of copper resulted from the discharge of copper to Diablo Cove, which led, in part, to the decision by PG&E to replace the copper systems with titanium.

In Diablo Cove, however, assignment of losses has been complicated by other possibly interactive events. Populations of red abalone and sea urchins in Diablo Cove and control areas to the north have declined dramatically since the initial 1970-1971 surveys by the Department and several factors may have been responsible for those declines: sea otter predation (documented elsewhere in central California), increased commercial abalone take, red tide conditions in the fall of 1974, and the release of toxic concentrations of copper during pump testing in 1974 and 1975. The following percentage decreases of red abalone and sea urchins in Diablo Cove and control areas have been reported. In subtidal permanent stations for red abalone, Diablo Cove showed a 95 percent decrease in abundance while control areas showed an 80 percent decrease (1975 vs. 1970). In stratified random surveys, red abalone declines were 85 percent in Diablo Cove and 75 percent at control areas (1975 vs. 1974). Red sea urchin populations declined at similar rates in Diablo Cove and the control areas. The difficulties in identifying and differentiating between the causes of sea urchin and abalone reductions in Diablo Cove, reemphasizes the need for extremely comprehensive and intensive monitoring of all potential factors which influence the marine biota of that area.

I hope the above information will meet your needs. Please advise me if you would like further specific information and data regarding any phase of the investigations at Diablo Canyon by the California Department of Fish and Game.

Sincerely,

E C Fullerton

Director