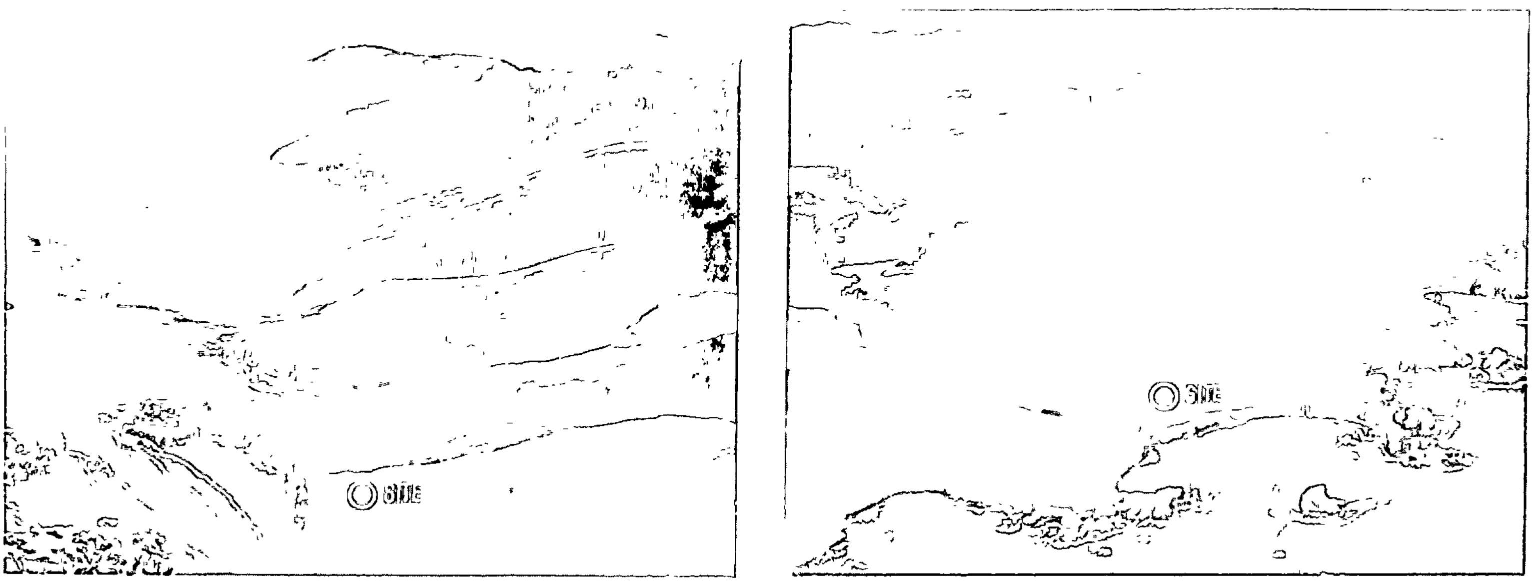
July 1971

Environmental Report

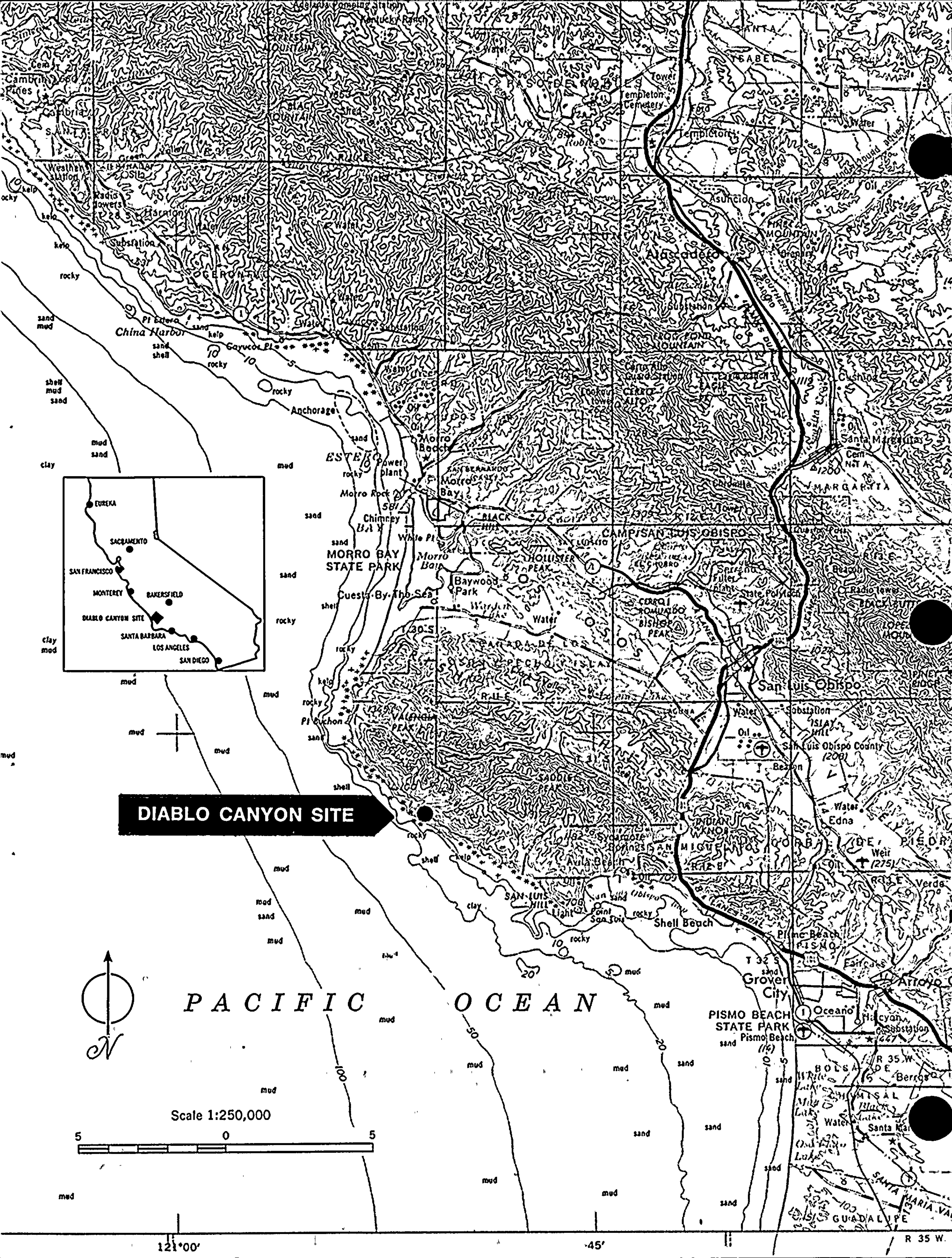
UNITS 1 and 2
DIABLO CANYON SITE

ATOMIC ENERGY COMMISSION DOCKETS 50-275, 50-323



PG and E PACIFIC GAS AND ELECTRIC COMPANY · SAN FRANCISCO · CALIFORNIA

Photographic Montage of Units 1 and 2 — Diablo Canyon Site


DIABLO CANYON SITE
PACIFIC OCEAN
Scale 1:250,000
5
0
5
EUREKA
SACRAMENTO
SAN FRANCISCO
MONTEREY
BAKERSFIELD
DIABLO CANYON SITE
SANTA BARBARA
LOS ANGELES
SAN DIEGO
MORRO BAY STATE PARK
PISMO BEACH STATE PARK
China Harbor
Anchorage
Morro Bay
Morro Rock
Power plant
Cuesta-By-The-Sea
Baywood Park
San Luis Obispo
Atascadero
Templeton
Santa Margarita
Shell Beach
Pismo Beach
Grover City
Oceano
Halcyon
Avila Beach
Edna
CAMP SAN LUIS OBISPO
121°00′
45′
R 35 W.

Contents

Continued following page

Introduction

STATEMENT OF PROJECT

At Diablo Canyon, located midway between San Francisco and Los Angeles on the California coast, the Pacific Gas and Electric Company (PG&E) is building a two-unit nuclear power plant (Units 1 and 2—Diablo Canyon Site).

In December 1966, PG&E applied to the California Public Utilities Commission (CPUC) for authorization to build the first unit. Authorization for the second unit was applied for in 1968. After staff review and extensive public hearings, the CPUC granted the necessary "certificates of public convenience and necessity" for each of the units.

Official approval of the site as compatible with the conservation and prudent use of California's resources was given by the State Resources Agency in 1966. Also in 1966, the Board of Directors of the Sierra Club passed a resolution calling the site a "satisfactory alternative" to one then under consideration by PG&E at Nipomo Dunes on the coast 18 miles south of the Diablo Canyon site.

Applications for licenses to construct Units 1 and 2 were made to the Atomic Energy Commission (AEC) on January 16, 1967 and June 28, 1968 respectively. The AEC regulatory staff and the statutory Advisory Committee on Reactor Safeguards (ACRS) each conducted safety reviews of the plant design. In addition, the AEC appointed Atomic Safety and Licensing Board held separate public hearings on each application. Subsequently, the Board issued favorable decisions for both Units 1 and 2 and the AEC then granted Provisional Construction Permits No. CPPR-39 for Unit 1 on April 23, 1968 and No. CPPR-69 for Unit 2 on December 9, 1970.

Currently both units are under construction with Unit 1 scheduled for initial startup in late 1973 and commercial operation in the spring of 1974, and Unit 2 is scheduled for similar operation one year later. PG&E is acting as its own architect-engineer and construction manager. Consultants in geology, seismology, meteorology, marine biology, quality assurance, architecture, structural engineering and other specialized disciplines have assisted PG&E's own staff.

PURPOSE OF REPORT

PG&E has prepared this Environmental Report in response to the AEC's revised Statement of General Policy (10 CFR, Part 50, Appendix D, effective January 3, 1971) for implementation of the National Environmental Policy Act of 1969 (Public Law 91-190), and in response to a letter to PG&E from the AEC, dated February 9, 1971, which stated:

> *Holders of construction permits must, as soon as practicable, file an Environmental Report with the AEC discussing the environmental considerations enumerated in paragraph 1 of the revised regulations.*

In preparing this report the interim guidelines issued by the AEC, dated February 1971, entitled "Draft Guide to the Preparation of Environmental Reports for Nuclear Power Plants" were followed.

This report demonstrates that the environmental impact of the power plant is minimal when compared to the practical and available alternatives as discussed herein. Units 1 and 2 will provide power needed for the maintenance and improvement of man's total environment.

General

NUCLEAR PLANT LOCATION

The plant site is situated approximately midway between San Francisco and Los Angeles on the California coast and within the County of San Luis Obispo. Although the entire site encompasses 750 acres, the power plant is located on a portion immediately south of Diablo Canyon Creek, near its mouth. See Plate 1.

Approximate straight line distances from the site to other communities are as follows:

San Luis Obispo (county seat)	12 miles northeast
Avila Beach	7 miles southeast
Morro Bay	10 miles north
Pismo Beach	13 miles southeast
Santa Barbara	80 miles southeast
Bakersfield	104 miles east
Los Angeles	165 miles southeast
San Francisco	170 miles north

PHYSICAL CHARACTERISTICS

Nuclear Plant

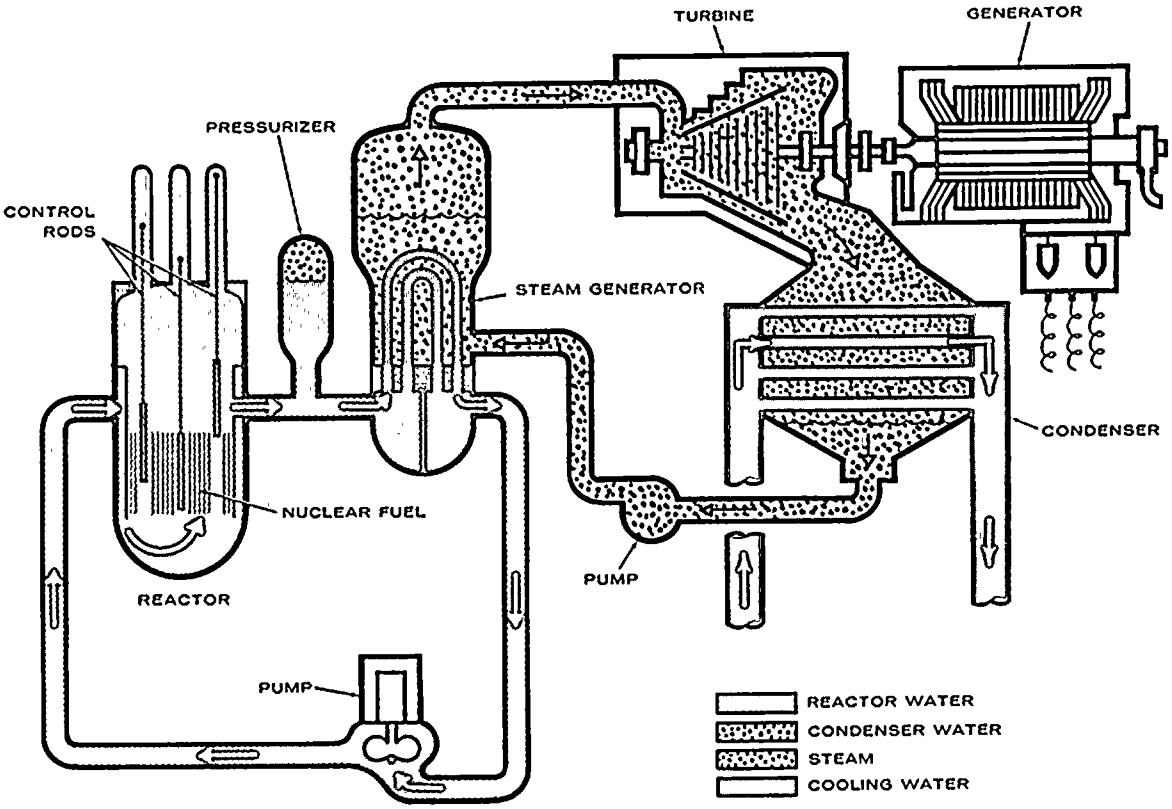
Description

Units 1 and 2 are substantially identical units. Each will use 3,250 megawatt (thermal), four loop, pressurized water nuclear reactors[1] furnished by the Westinghouse Electric Corporation. These steam supply systems are similar in design to those Westinghouse has furnished for several other licensed nuclear plants. Together Units 1 and 2 have a warranted net electrical output of 2,120 megawatts. Ultimately the units are expected to have a net electrical output of 2,287 megawatts.

The major facilities at the site are two reactor containment structures, a common auxiliary and fuel handling building and a turbine building housing the two Westinghouse turbine-generator units.

Other facilities at the site common to the two units include the following: machine shop, laboratories, access control area, warehouse area and administrative office, fire protection systems, diesel fuel oil storage tanks, lubricating oil storage system, makeup water system, auxiliary boiler and two raw water storage reservoirs.

Cooling water for the two units will be pumped through a common intake structure from the Pacific Ocean and circulated through the condensers. The water will then be returned to the ocean via the discharge headworks at Diablo Cove. Two breakwaters will protect the intake structure from wave action during construction and operation.



How the Nuclear Plant Will Work

Within the *reactor,* water kept under pressure to prevent it from boiling (hence the name "pressurized water reactor") flows up through the *fuel* where it is heated by nuclear reaction.

This begins when an atom in the uranium fuel is split by a particle called a neutron. The splitting atom gives up energy in the form of heat. It also gives up two or three neutrons which fly out to split other atoms—which give up more heat and more neutrons to continue the process. The reaction, and thus the output of heat, is regulated by the use of *control rods* which absorb neutrons and by a soluble neutron absorber.

The heated water, kept under constant pressure by the *pressurizer,* passes out of the reactor and through the tubes in the *steam generator* and then is pumped back into the reactor to begin another cycle.

In the *steam generator,* heat from the reactor water is given off through the walls of the tubes and turns water in the steam generator into steam. The steam enters the *turbine,* spinning its blades; an attached shaft turns the *generator* which produces electricity.

Now the exhausted steam is channeled into the *condenser* below the turbine. Cooling water from the ocean flows in tubes through the condenser to cool the steam and turn it back into water. This water, still warm, is pumped back into the steam generator to begin this cycle again. The cooling water, after passing through the condenser, flows back to the ocean.

FIGURE 1

Compared to fossil fueled steam plants, nuclear plants offer definite environmental advantages. This is primarily because they do not emit products of combustion to the atmosphere such as sulfur or nitrogen oxides. Nevertheless, nuclear power plants have an environmental impact. The principal effects associated with such plants are those of warm water discharge and the release of small amounts of low level radioactivity. There are also additional impacts on the environment such as land use, aesthetics, construction effects and sewage disposal. These environmental considerations, most of which are common to any large power plant, and the two principal effects are discussed in Environmental Impact.

Switchyards and Transmission

Power from the generators main stepup transformers will be supplied to a 500 kilovolt (kv) switchyard at the site. Startup and standby power for the plant will be provided from a 230 kv switchyard at the site.

To connect the plant to PG&E's integrated electrical system, the following transmission lines will be constructed (Plate 2):

Two single circuit 500 kv transmission lines, about 84 miles long, to Midway Substation in Kern County; and one single circuit 500 kv line, about 79 miles long, to Gates Substation in Fresno County.

A double circuit 230 kv transmission line to the existing Morro Bay-Mesa 230 kv line, about 10 miles away.

The location and construction of the electric transmission lines from the plant was reviewed and approved by the California Public Utilities Commission (CPUC). PG&E has cooperated with local, state and federal governmental agencies, conservation groups, property owners and other interested parties concerning the location, construction and environmental impact of the transmission lines.

These transmission lines have been certified for construction by the CPUC after public hearings. In its decision dated March 25, 1969, the California Commission required the following:

> ***In designing its plant, switchyard and attendant facilities applicant shall give full consideration to aesthetic values and conservation of the natural resources of the area.***

Public hearings on the transmission lines were again held by the CPUC in March, April and May of 1971 to hear a complaint from several property owners and conservation groups. The CPUC's decision in this matter is pending (July 1971).

AREA ENVIRONMENT

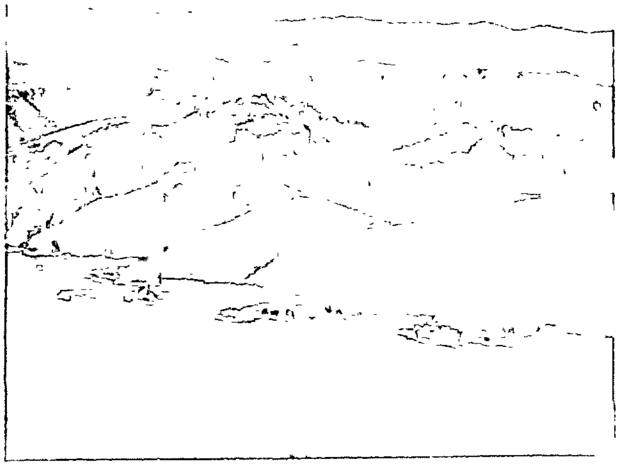
Geography and Topography

San Luis Obispo County is bordered on the north by Monterey County, on the east by Kern County, on the south by Santa Barbara County and on the west by the Pacific Ocean. Of the total county area of 3,316 square miles or 2,122,240 acres, only 233,600 acres are estimated to be under cultivation. Approximately one-seventh of the county is in the Los Padres National Forest (Plate 2).

Geographic features in the area include the Santa Lucia range of mountains which borders the ocean in the northern two-thirds of the county, the Temblor Range which forms the eastern boundary of the county and the Sierra Madre Mountains located in the south central portion. Most of the developed land and the majority of the population are located along the coastal belt, with the exception of the Paso Robles-Templeton areas of agricultural production.

The coastline in the site area is typical for that of central California. It is rugged and rocky with numerous tidal pools and offshore rocks. Cliffs rise in a near vertical plane from the high water line. At the top of the cliffs are sloping marine terraces, with elevations of 50 to 150 feet. The power plant is located on a gently sloping marine terrace approximately 1,000 feet wide. This terrace is backed by the rising slopes of the Irish Hills, part of the San Luis Mountains and by Diablo Canyon, through which Diablo Canyon Creek flows. The canyon is typical of many V-shaped canyons that truncate the San Luis range. The highest elevations near the site are Green Peak (El. 1,414), about a mile and a half to the southeast, and Spooner (El. 1,573) and Pecho (El. 1,493) peaks about a mile to the northeast.

The geographic features of the site area are quite typical of the central California coastal region. Six miles to the north, out of view from the site, these features have been preserved in the 6,000-acre Montana de Oro State Park.



Diablo Canyon and Cove in the foreground. The Irish Hills, part of the San Luis Mountains, rise to about 1,500 feet inland.

The site has a total area of approximately 750 acres. The part south of Diablo Canyon Creek consists of 585 acres and is part of the 8,700-acre Marre Ranch. PG&E has leased this land for a term of 99 years with an option to renew for an additional 99 years. The balance of the site on the north side of the creek is owned by PG&E.

Originally, access to the site was from the town of Avila Beach by a privately-owned unimproved dirt road and from the north by a similar road. The nearest public routes are county roads located in Clark Valley, four miles north, and See Canyon, five miles east. A new private road was built by PG&E from the existing Port San Luis Road at Avila Beach to the site, a distance of nearly eight miles.

History

There is a lack of early recorded history for the Diablo Canyon site area and no indication that early explorers in California visited the site vicinity. The earliest known visits in the area by white traders occurred in 1587 at Morro Bay, 11 miles to the north, and in 1595 at San Luis Bay, about seven miles to the south.

Although the Spanish constructed a mission in nearby San Luis Obispo in 1772, there is no evidence to suggest that the early missionaries frequented the Diablo Canyon area.

During the period of Mexican rule in California, the site was a part of one of the many private land grants made to individuals by the Mexican government. In 1869, after California joined the Union, the grant was patented by the U.S. Government to Juan Wilson. Subsequently, the land had many owners. The portion of the site south of the creek has been in the possession of the family of Luigi Marre, the present owner, since 1892. The predominant use of the lands, from the days of the early land grants, has been for grazing and agriculture.

For more than a century, it has been known that the area contains significant archaeological remains. The archaeological investigations conducted on these remains and the report on the findings are discussed in the Land Use Compatibility section.

One of the sites excavated by archaeologists in the area of the plant.

Climatology and Meteorology

The climate of the site area is typical of that along the central California coast. In the dry season, mainly May through September, the Pacific Anticyclone stays off the California coast and prevents Pacific storms from moving eastward across the state. In the winter or wet season, November through March, the Pacific Anticyclone moves southward, weakening in intensity, and allows Pacific storms to enter. More than 80 percent of the average annual rainfall of 16 inches occurs during this five-month period. April and October are considered transitional months separating the dry and wet seasons.

The average annual temperature of the area around the plant site is about 55°F which reflects the strong maritime influence. Most stations along the coast show only a five to ten degree difference in mean temperature between the coldest winter month and the warmest summer month. However, extreme temperatures may occasionally range from nearly 100°F in the summer to as low as 26°F in the winter. During the dry season, surface winds are generally from the northwest while in the wet season southeast winds are most frequent. Moderate to strong sea breezes are common along most of the California coast in the afternoon during the dry season while, at night, weak offshore drainage winds are prevalent. During the wet season, strong winds are associated with the arrival and passage of storm systems. Middle and high clouds occur mainly with winter storm activity.

During the dry season there is a high frequency of fog or low stratus clouds associated with a strong low-level temperature inversion. The mean height of this inversion base is about 1,100 feet. Severe weather conditions, such as tornadoes and hurricanes, have not been recorded in this area. Thunderstorms are also a rare phenomenon with the average occurrence of lightning being less than three days per year.

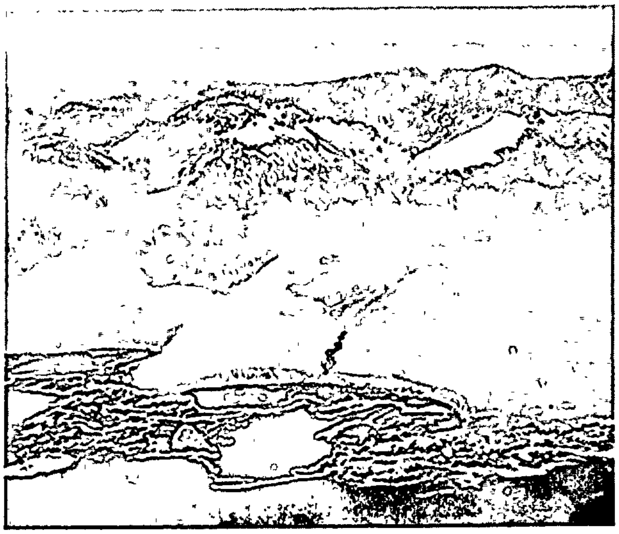
The on-site meteorological measurements program was initiated in July 1967. Data collected during the period July 1967 through October 1969 have been used to establish the baseline meteorological conditions of the site. In addition supplemental data is being collected as part of the Continuing Meteorological Field Measurement Program. This program is described in Appendix A, Continued Studies.

Measurements of wind, temperature and turbulence intensities were recorded at two stations on the coastal plain adjacent to the plant and at two locations on the ridge of hills to the east and south of the plant site. Wind measurements were also recorded at two stations in Diablo Canyon north of the plant site. Twenty-seven diffusion experiments were conducted during the last year of the data collection period.

At the plant site, the most frequent wind flow is from the northwest, and the mean wind speed is about 12 miles per hour. The second most frequent flow is from the southeast with a mean wind speed of six miles per hour. The highest frequency of occurrence of southeasterly flow is during the wet season in advance of winter storm systems. Light and variable wind conditions are common during the night and morning hours in all seasons. There is usually a marked diurnal variation in the wind direction and wind speed with light southeasterly winds typically present during the night and early morning hours and strong northwest winds present during the afternoon and early evening hours.

In Diablo Canyon, the direction of air movement is controlled primarily by the orientation of the canyon. During the wet season, most of the movement is easterly. Westerly flow is predominant in the dry season. Average wind speeds are about seven miles per hour for both flow regimes, with the strongest winds usually associated with wet season easterly flow. There is usually a diurnal variation of the wind flow in the canyon. During the daytime an up-canyon or westerly flow occurs, whereas in the night and morning hours a down-canyon or easterly flow prevails.

Near the top of the ridge east of the plant, the predominant flow is northerly with an easterly



Wet coastal fog and low stratus clouds are common in the area between April and October.

component during the wet season and a westerly component during the dry season. Southerly winds are relatively infrequent except during the wet season. The diurnal variation in the wind direction is not well defined, although usually there is a westerly component in the daytime and an easterly component during night and morning hours.

Hydrology

Diablo Canyon Creek, which reaches the ocean near the plant site, is the only all-year stream in the vicinity. During the dry summer months the flow in this stream is only a few gallons per minute.

The underlying formations in the mountainous regions tend to be relatively impervious, and there are no large underground aquifers. Since the area is relatively arid except for large valleys many miles away, such as the Santa Maria Valley, underground water supplies are difficult to locate. Only minor ground water seepage can be observed at the site. Fresh water requirements for the plant process cycle, sanitary purposes, and for other miscellaneous uses will be met from two small seawater evaporators. The average use will be less than 50 gallons per minute. At times, water from Diablo Canyon Creek may be available although riparian rights for the creek basin have been retained by the adjacent land owners. Water from these sources will be stored in the reservoirs adjacent to the switchyard.

Major flooding in the area is not a problem. Diablo Canyon Creek, with only a small drainage area (about four square miles), is incapable of a flood that would jeopardize the plant.

Oceanography

Condenser cooling water for the plant will be pumped from the Pacific Ocean and returned to the ocean at Diablo Cove through an outfall at the water's edge. Studies of the adjacent ocean waters were conducted to establish design criteria for the plant's once-through cooling system and to assure protection of the marine life.

The Pacific Ocean is turbulent in the area of the plant site. Diablo Cove is elongated across the entrance and not sufficiently indented to form a baylike environment. Wave action tends to be severe, and water circulation and mixing are well developed in all parts of the cove. Circulation is a result of both the tide and an inshore current system and is augmented by the vertical mixing layer normally present to a depth of 100 feet along this section of coast.

The cove area is characterized by an extremely irregular bottom topography. Occasionally, sand and cobbles fill depressions, but in general, sedimentary bottom deposits are scarce. Dense algae growths extend to depths of 50 and 60 feet.

Natural water temperatures in Diablo Cove range from daily lows of 48° F from February to June to recorded peak daily highs of 63° F in the late fall.

Additional information on the baseline physical oceanographic conditions is included in Appendix N, Physical Oceanography.

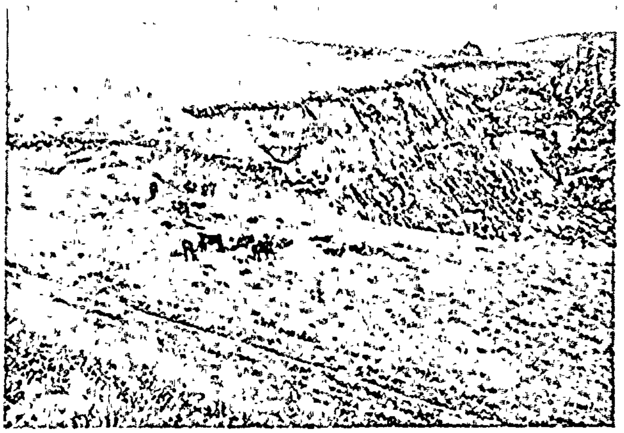
Investigations for the occurrence and maximum size of tsunamis (seismic sea waves) showed that, at high tide and with a storm, a short period wave 18 feet above mean lower low water might be experienced. The plant structures have been designed to withstand a 30-foot high wave.

Ecology

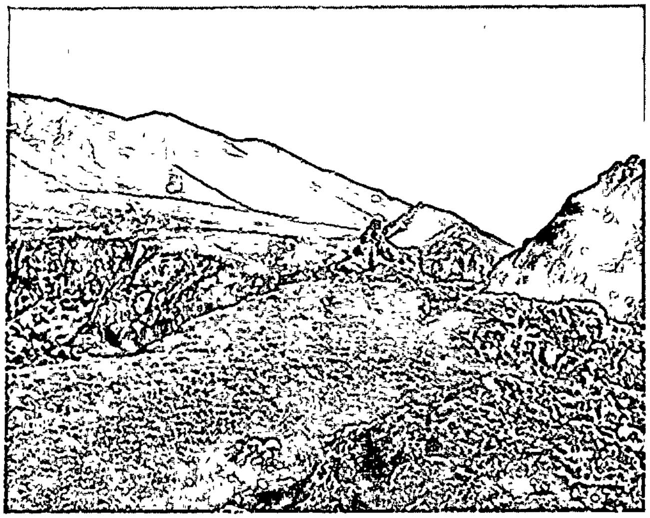
Terrestrial

The flora and fauna of the site and surrounding area are typical of that found along the Central California Coastal Range.

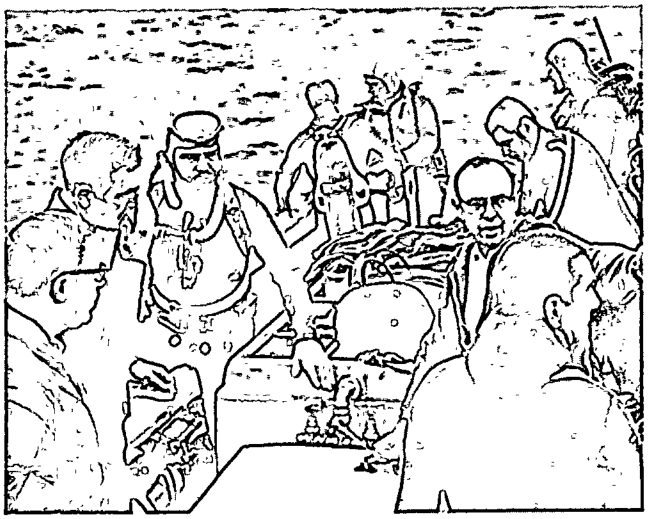
Among the land mammals that have been known to inhabit the area are deer, coyote, fox, bobcat, mountain lion, raccoon, squirrels, gophers, rabbits and mice.



Cattle grazing near Diablo Canyon..



Typical terrain of the Central California Coastal area.



A few of the many SCUBA divers and others from local skin diving clubs, California Polytechnic College, California Department of Fish and Game and PG&E who helped transplant more than 13,000 abalone at the site.

While most of the terrace areas have been denuded by long term cattle grazing, the upper reaches of Diablo Canyon contain a variety of flora including conifers, oak and laurels. Clare B. Hardham and Dr. J. R. Haller, botanists from the University of California, concluded from their studies that

> *. . . Its [Diablo Canyon's] flora is not remarkable, the total number of species which are present is low, and the individual species are all taxa which are adequately represented in the Central Coast Range flora, while most of the species have ranges which extend throughout much of California.*[1]

Aquatic

Extensive studies of the marine ecology in Diablo Cove were made by PG&E's biological consultant, Dr. Wheeler J. North, Professor at the California Institute of Technology, and his colleagues Dr. Barbara North, Einar K. Anderson and Charles T. Mitchell. These studies were conducted in cooperation with the California Department of Fish and Game.

From these studies it was determined that the marine flora and fauna are a diversified mixture of both warm water and cold water plants and animals. This is due to the nearness of the site to Point Conception, California, the nominal dividing line between northern and southern marine forms.

[1] *Page 923 of the transcript of the March 31, 1967 public hearing on Diablo Canyon held by the California Public Utilities Commission in San Luis Obispo, California.*

Intertidally, 31 plant and 35 animal species have been identified as species indigenous to Diablo Cove. Of these 42 percent of the plants and 79 percent of the animals occur in the warmer waters of southern California. Of the subtidal species, 35 percent of the flora and 44 percent of the fauna also occur in warmer water. All organisms are those typical of exposed rocky coasts.

A detailed description of the marine ecology is included in the section, Biological Impact.

Geology

Prior to filing the application for a construction permit for Unit 1, a comprehensive geological investigation of the Diablo Canyon site, including extensive trenching, was made by Dr. Richard H. Jahns, geological consultant for the project. Dr. Jahns' initial report on the site, dated December 5, 1966, together with two supplementary reports dated January 3, 1967 and July 8, 1967, are included in the Preliminary Safety Analysis Report (PSAR) submitted to the AEC for Unit 1. PSAR's are available from the AEC for public review.

Additional investigations were made for Unit 2, including extensive trenching in the vicinity of the proposed unit. Conclusions reached as a result of these investigations substantiate those reached earlier for Unit 1. Dr. Jahns concluded that the Unit 2 site is both feasible and suitable for a nuclear plant. Supplement III to his earlier reports, dated June 19, 1968, which covers the investigations for Unit 2, is included in the Preliminary Safety Analysis Report filed with the AEC for Unit 2.

Bedrock in the site area is Tertiary in age and is comprised of marine shales, sandstones, and fine grained tuffaceous sediments along with a considerable variety of tuffs of volcanic origin. All these rock types are firm and compact, although they represent a wide range in hardness and resistance to erosion.

The bedrock is overlain by marine and nonmarine deposits of Pleistocene age. The base of this terrace section rests on a platform of marine erosion, the age of which is generally recognized to be at least 100,000 years.

The Diablo Canyon site is geologically suitable for a nuclear power plant. Foundations are on firm bedrock. Movements along the few small breaks in the vicinity of the plant site have not occurred for at least 100,000 years and may well have taken place millions of years ago. The probability of surface fault rupture at the site is sufficiently remote that it may be safely disregarded.

Seismology

Seismological investigations were undertaken to determine the potential for earthquakes in the site area and to form a basis for the development of seismic design criteria. Detailed reports of these investigations made by PG&E's consultants, Stewart W. Smith and Dr. Hugo Benioff, are included with the PSARs filed with the Atomic Energy Commission for both Unit 1 and Unit 2.

Past instrumental records indicate that seismic activity within about 20 miles of the Diablo Canyon site has been very low compared to other parts of California. Several small shocks have occurred with Richter magnitudes 4 to 4.4.

The seismically significant fault system nearest the site is the Nacimiento fault located some 20 miles away. The largest earthquake known to have been associated with this fault system occurred on November 22, 1952, at an epicentral distance to the site of about 44 miles. It is listed with a Richter magnitude of 6.0. Activity on the Nacimiento fault system has been very low during the past century and a half.

At its closest point, the San Andreas fault passes some 48 miles from the site. This point is also the approximate northern terminus of the 1857 earthquake break on the San Andreas. This particular 150-mile-long segment of the San Andreas fault, which extends from this point northward to San Juan Bautista, has had no major recorded slip.

A fairly large earthquake, listed by Gutenberg and Richter with a magnitude of 7.3, occurred November 4, 1927, off the coast some 60 miles southwest of the site, presumably on the western extension of the east-west trending fault system which includes the Santa Ynez fault on land.

Land Use

The site and adjacent lands have, since the days of the Mexican ranchos, been idle or used for grazing and agricultural purposes. As these lands have been under private ownership, there are, at present, no residences within 1¾ miles of the site and only 18 inhabitants within a six mile radius.

The San Luis Range dominates the area between the site and U.S. Highway 101 to the east (Plate 2). This upland country is either idle land or used for grazing beef cattle and, to a very minor extent, dairy cattle. The terrain east of U.S. Highway 101, lying in the mostly inaccessible Santa Lucia Mountains, is sparsely populated with little development. A large portion of this area is included in the Los Padres National Forest. Of the total county area of 2,128,640 acres, federal and state owned lands amount to about 18 percent of the total.

Agriculture

San Luis Obispo County has relatively little level land except for a few coastal valleys such as the Santa Maria and San Luis Valleys, and along the county's northern border in the Salinas Valley and Carrizo Plain areas. Farming is the predominant activity in these valleys. Principal crops include vegetables, poultry and grain. The county's leading agricultural product is livestock, constituting over 40 percent of the $58,113,000 gross value of the farm products sold in 1970.

Although agricultural employment has been relatively stable in recent years, a substantial decline has been experienced over the past 30 years. Whereas over one-third of the work force in 1940 was engaged in agriculture, the percentage has dropped to less than 10 percent in 1970. This pattern is expected to continue in the near future as the percentage of land devoted to farming declines.

Industry

About a third of the civilian work force in the county is employed by local, state and federal governmental agencies, with the State of California being the largest single employer. This is due primarily to the state college in San Luis Obispo, a state owned hospital and two state correctional facilities.

Mineral production in the county is on a relatively small scale. Petroleum represents about 40 percent of the total value of production, which in 1967 was $6.5 million. Mercury, sand, gravel and stone make up the remainder. There are no known mineral resources at the Diablo Canyon site or in the immediate vicinity.

Industry in the area is mainly light and serves local needs. The leading manufacturing employer is the printing and publishing industry, followed closely by food processing and petroleum refining. However, less than 5 percent of the county work force is engaged in manufacturing.

The largest industrial complex in the vicinity is Vandenberg Air Force Base, located 55 miles southeast of the plant site in Santa Barbara County. Vandenberg is the National Aeronautics and Space Administration's (NASA) Western Testing Range headquarters. NASA employs over 6,000 people here, and it is estimated that Vandenberg adds $9 million per month to the economy of the Lompoc-Santa Maria area in Santa Barbara County. The economic impact on San Luis Obispo County, however, is relatively small. Vandenberg is one of three sites in major contention for the NASA Space Shuttle Program. This program, if instituted, is expected to provide substantial employment opportunities and expenditures of several billion dollars. The other two major sites being considered are White Plains, New Mexico, and Cape Kennedy, Florida.

The closest U.S. Army installation is the Hunter-Liggett Military Reservation approximately 40 miles north of the site. The California National Guard maintains Camp Roberts, located to the east of the Hunter-Liggett Reservation and Camp San Luis Obispo about eight miles northeast of Diablo Canyon.

Commercial and sport fishing are important in the areas between Morro Bay and Port San Luis. Port facilities are located at both Morro Bay to the north and in San Luis Bay to the south of the site. Further development of port and harbor facilities at both areas is planned.

Transportation

U.S. Highway 101 is the main highway serving the central coastal region. Its nearest point lies about 10 miles to the east of Diablo Canyon, separated from it by the San Luis Mountains. State Highway 1 follows a north-south route near the ocean, passing through San Simeon and Morro Bay where it then heads to the southeast towards San Luis Obispo. Other state highways connect Paso Robles and Atascadero to Fresno and Bakersfield. There are no public roads in the Diablo Canyon area. Prior to PG&E's construction of the site access road, the only vehicle access to Diablo Canyon was via unimproved dirt roads.

Commercial air service is available, although in a limited capacity, to the small airports in San Luis Obispo and Paso Robles. Southern Pacific Transportation Company provides rail service to the county by a route which roughly parallels U.S. Highway 101.

Population Distribution

According to the 1970 census the population of San Luis Obispo County stood at 105,690. Although the gain since 1960, and earlier, has been steady in comparison to other rapidly growing areas in California, it has been unspectacular. During the 1950-60 period the population increased by 57.6 percent but has now slowed to less than 2 percent annually.

Population increases have resulted primarily from immigration, of which a significant portion are retired people. The fastest growing area, and that which appears to have received a large share of the immigration, is in the coastal belt encompassing the communities of San Simeon, Cambria, Cayucos, Morro Bay and Baywood-Los Osos. These communities are 10 to 40 miles north of Diablo Canyon. The population in this northern coastal area is currently increasing at the rate of about 4 percent per year compared to less than 1 percent in the San Luis Obispo Bay area. Growth within this northern area is expected to accelerate in the future because of anticipated development of coastal recreational facilities.

Table 1 shows population trends of San Luis Obispo, Monterey, and Santa Barbara counties and of the entire State of California. Table 2 illustrates the growth of the largest communities within 60 miles of the site between 1960 and 1970. Most of the communities nearby are located adjacent to U.S. Highway 101. The largest cities within 60 miles of the site are San Luis Obispo (28,036), Santa Maria (32,749), and Lompoc (25,284) according to the 1970 federal census.

Table 1

Population Trends of the State of California and the Counties Surrounding the Diablo Canyon Site

Year	Monterey	Counties San Luis Obispo	Santa Barbara	State of California	
1940	73,032	33,246	70,555	6,907,387	Note 1
1950	130,498	51,417	98,220	10,586,223	Note 1
1955	161,400	63,100	110,200	13,004,000	Note 2
1960	198,351	81,044	168,962	15,717,204	Note 1
1965	214,800	94,900	245,500	18,516,000	Note 2
1970	250,071	105,690	264,324	19,953,134	Note 1
1975	273,000	120,000	286,000	21,983,000	Notes 3 and 4
1980	313,000	133,000	311,000	24,154,000	Notes 3 and 4
1985	353,000	147,000	335,000	26,557,000	Notes 3 and 4

Note 1: U.S. Bureau of the Census figures
Note 2: State of California Department of Finance estimates
Note 3: State of California Department of Finance projections, special report of January 15, 1970 (for State of California only)
Note 4: PG&E estimates of April 1971 (except for State of California)

Table 2

Growth of Communities Over 1,000 Population Within 60 Miles of the Diablo Canyon Site

Community	Population 1960[1]	1970[2]	Percent Change
Arroyo Grande	3,291	7,454	126.5
Atascadero	5,983	10,290	72.0
Cambria	not available	1,716	-
Cayucos	not available	1,772	-
Grover City	5,210	5,939	14.0
Guadalupe	2,614	3,145	20.3
Lompoc	14,415	25,284	75.4
Morro Bay	3,692	7,109	90.0
Oceano	1,317	2,564	94.7
Orcutt	1,414	8,500	501.1
Paso Robles	6,677	7,168	7.4
Pismo Beach	1,762	4,043	129.5
San Luis Obispo	20,437	28,036	37.2
Santa Maria	20,027	32,749	63.5
Shell Beach	1,820	included in Pismo Beach above	-
Solvang	1,325	2,004	51.2

[1] 1960 population figures from U.S. Bureau of the Census
[2] 1970 population figures from U.S. Bureau of the Census, 1970 Final Population Counts

Tourism and Recreation

There are numerous tourist attractions in San Luis Obispo County. These include Hearst Castle at San Simeon which attracts 400,000 or more persons per year, Mission San Luis Obispo and Mission San Miguel, Morro Bay and Morro Rock (PG&E's power plant at Morro Bay itself registers over 15,000 visitors per year), Port San Luis Obispo at Avila, the beaches and dunes of Pismo Beach and other coastal areas, several state parks, which alone attract more than 3,000,000 visitors per year, and several lakes and reservoirs.

It should be noted that, although San Luis Obispo County is blessed with an abundance of ocean shoreline, its use is substantially less extensive than in most other southern California counties. This minimal beach use appears to result from a combination of factors including a small local population and the long travel distances to metropolitan areas. Because of lack of any public access by land and very limited beach areas, Diablo Canyon has never been used as a recreational area.

Unquantified Values

Although Diablo Canyon does not contain any unique flora or fauna or outstanding scenic values, some dedicated conservationists continue to oppose development of this site on the basis that it should be retained as untouched, natural coastline. It is PG&E's belief, however, that, when all aspects of the public interest are considered, construction and operation of nuclear units at the Diablo Canyon site are reasonable accommodations of society's need for power and consideration of the environment. Every effort has been made to design the plant in a manner compatible with the coastal site.

POWER NEEDS

Present and Proposed PG&E Area Capacity

As of December 31, 1970, the firm electrical capacity available to the Pacific Gas and Electric Company area system under minimum water supply conditions at the time of the summer peak was 12,560.8 megawatts. These capacity resources, which are either owned by PG&E or available under firm contracts for delivery and use by the area system, are shown in Table 3.

Table 3

Pacific Gas and Electric Company Area System Capacity Resources as of December 31, 1970

	Megawatts (MW)
Hydroelectric	5,618.4
Thermal electric	
Gas and oil-fueled	6,800.2
Geothermal[1]	79.0
Nuclear-fueled	63.2
Total Capacity Resources	12,560.8

[1] PG&E's geothermal units are located at a naturally active steam field approximately 70 miles north of San Francisco. They are the only commercially operating geothermal units in the United States.

Additions to these capacity resources for each of the years 1971 through 1975 are listed in Table 4. With the exception of geothermal units planned for the latter part of this period, all additions are either in service or under construction. By 1974 and 1975, when Units 1 and 2 at Diablo Canyon are scheduled for commercial operation, PG&E area system capacity requirements will be nearly 16,100 megawatts and 17,000 megawatts, respectively.

Relationships of Proposed Facilities to Demand

The electrical demand and energy requirements in the PG&E area historically have doubled about every 10 years as has been the general case throughout the United States. From about 1,100 megawatts in 1940, the area electrical demand has increased nearly tenfold to almost 10,100 megawatts in 1970. Energy load of the area in 1970 was 56.0 billion kilowatt-hours (kwh). Although it is predicted that this growth will decrease somewhat during the 1970's, it is still expected to compound annually at an average rate of about 6½ percent. When Unit 1 is scheduled to be operational in 1974, the annual peak demand is estimated to be 13,100 megawatts. By 1975, when Unit 2 will be operational, the annual peak demand and annual energy loads of the PG&E area system are expected to be about 14,000 megawatts and 80 billion kwh respectively.

Both units at Diablo Canyon are required for the PG&E area system in order to have capacity reserve margins adequate to maintain reliable service in northern and central California. If only one of these units is not available as scheduled, reserve margins in northern California could be reduced nearly 40 percent, thus seriously impairing the reliability of electric service in the PG&E area. A substantial delay in both units could make it impossible for PG&E to fulfill its public service obligation of providing reliable electric service to its customers.

PG&E is a member of the Western Systems Coordinating Council which consists of 38 major interconnected public and investor-owned power systems in the 13 western states and western Canada. Its purpose is to increase reliability by coordinating electric operations. This regional council, one of nine such councils in the United States, annually reports information relating to the Council's area reliability to the Federal Power Commission. Because PG&E is interconnected with utilities in the Pacific Northwest and in southern California through the Pacific Northwest-Southwest EHV Intertie, reduced reliability of the PG&E area system resulting from the delay of Units 1 and 2 at Diablo Canyon would also affect the reliability of these interconnected utilities and the other utilities of the western interconnected systems.

When Units 1 and 2 at Diablo Canyon commence operation, they will be operated as base load generation. The effect will be to permit some of PG&E's existing fossil-fueled generating units to be operated for peaking service. By lowering the generation requirements on these units, the need for scarce fossil fuels will be lessened and the resultant emissions of combustion products will be reduced.

Table 4

Pacific Gas and Electric Company Area System Generating Plants—Scheduled and Planned (As of May 1, 1971)

Station or Unit	Type	Capacity (MW)	Planned Commercial Operating Date	Owner
Loon Lake	Hydro	78.0	Spring, 1971	SMUD[2]
Geysers Unit 5	Geothermal	53.0	Fall, 1971	PG&E
Geysers Unit 6	Geothermal	53.0	Fall, 1971	PG&E
Geysers Unit 7	Geothermal	53.0	Summer, 1972	PG&E
Geysers Unit 8	Geothermal	53.0	Fall, 1972	PG&E
Pittsburg Unit 7	Gas and Oil	735.0	Fall, 1972	PG&E
Rancho Seco Unit 1	Nuclear	830.0	Spring, 1973	SMUD
Geysers Unit 9	Geothermal	53.0	Summer, 1973	PG&E
Geysers Unit 10	Geothermal	53.0	Fall, 1973	PG&E
Melones	Hydro	-13.3[1]	Fall, 1973	PG&E
Unit 1-Diablo Canyon Site	Nuclear	1,060.0	Spring, 1974	PG&E
Geysers Unit 11	Geothermal	53.0	Summer, 1974	PG&E
Geysers Unit 12	Geothermal	53.0	Fall, 1974	PG&E
Unit 2-Diablo Canyon Site	Nuclear	1,060.0	Spring, 1975	PG&E
Geysers Unit 13	Geothermal	53.0	Summer, 1975	PG&E
Geysers Unit 14	Geothermal	53.0	Fall, 1975	PG&E

[1] Removed from service
[2] Sacramento Municipal Utility District, Sacramento, California

Approvals and Consultations

Selection of the Diablo Canyon site, site investigation, preoperational studies and construction of the units have required many approvals, permits, and licenses.

The following tables (Nos. 5, 6 and 7) list those necessary federal, state and local approvals, the statutory authority under which they were obtained, their status as to issuance, and the public hearings, if any, conducted in each instance. Copies of those permits which may be of interest to the reader are included in the Appendices.

Obtaining these approvals was preceded in most cases by extensive consultations, site visits, and informal meetings with the various agency representatives. These activities are summarized in Table 8.

UNITS 1 AND 2
DIABLO CANYON SITE
FEDERAL
LICENSES, PERMITS AND APPROVALS

Table 5

Agency	Licenses, Permits, Approvals	Statutory or Other Authority	Status
Atomic Energy Commission	*Construction permit for Unit 1	Section 104(b) (now Section 103) of Atomic Energy Act of 1954 (42 U.S.C. 2134) and Part 50 of Title 10 of the Code of Federal Regulations	Issued April 1968 after public hearing
	*Construction permit for Unit 2	Section 104(b) (now Section 103) of Atomic Energy Act of 1954 (42 U.S.C. 2134) and Part 50 of Title 10 of the Code of Federal Regulations	Issued December 1970 after public hearing
	Reactor operators licenses	Section 107 of Atomic Energy Act of 1954 (42 U.S.C. 2137) and Part 55 of Title 10 of the Code of Federal Regulations	Scheduled to be obtained by August 1973
	Operating license for Unit 1	Section 104(b) (now Section 103) of Atomic Energy Act of 1954 (42 U.S.C. 2134) and Part 50 of Title 10 of the Code of Federal Regulations	Scheduled to be obtained by September 1973
	Operating license for Unit 2	Section 104(b) (now Section 103) of Atomic Energy Act of 1954 (42 U.S.C. 2134) and Part 50 of Title 10 of the Code of Federal Regulations	Scheduled to be obtained by September 1974
	Special nuclear materials license	Section 161 of Atomic Energy Act of 1954 (42 U.S.C. 2201) and Part 70 of Title 10 of the Code of Federal Regulations	To be issued along with operating license
Corps of Engineers (U.S. Army)	Permit to install wave recorder	Section 10 of the Rivers and Harbors Appropriation Act of 1899, Sections 403 and 404 of Title 33 of the United States Code	Issued October 1968
	*Permit to construct breakwater and intake	Section 10 of the Rivers and Harbors Appropriation Act of 1899, Sections 403 and 404 of Title 33 of the United States Code	Issued June 1969
	Permit for barge landing	Section 10 of the Rivers and Harbors Appropriation Act of 1899, Sections 403 and 404 of Title 33 of the United States Code	Issued April 1970
	*Permit for cofferdam, roads, soil removal for discharge	Section 10 of the Rivers and Harbors Appropriation Act of 1899, Sections 403 and 404 of Title 33 of the United States Code	Issued April 1970
	Permit for discharge — Units 1 and 2	Section 13 of the Rivers and Harbors Appropriation Act of 1899, otherwise known as the Refuse Act of 1899 (33 U.S.C. 407)	To be applied for by July 1, 1971
Bureau of Land Management	Right of way for breakwater and filled areas	Acts of February 15, 1901 (16 U.S.C. 522) and March 4, 1911 (16 U.S.C. 523), and Section 2234.4 — 1 of Title 43 of the Code of Federal Regulations	Issued August 1969
Federal Aviation	Determination of no hazard for meteorological mast	Section 1101 of the Federal Aviation Act of 1958 (49 U.S.C. 1501), and Part 77 of Title 14 of Code of Federal Regulations	Issued December 1966
	Amendment to "determination," resulting from height change of meteorological mast	Section 1101 of the Federal Aviation Act of 1958 (49 U.S.C. 1501), and Part 77 of Title 14 of Code of Federal Regulations	Approved January 1967
	Determination of no hazard for containment structures	Section 1101 of the Federal Aviation Act of 1958 (49 U.S.C. 1501), and Part 77 of Title 14 of Code of Federal Regulations	Issued October 1969
	Determination of no hazard for tower crane	Section 1101 of the Federal Aviation Act of 1958 (49 U.S.C. 1501), and Part 77 of Title 14 of Code of Federal Regulations	Issued December 1969
	Amendment to "determination," resulting from removal of lighting from meteorological mast	Section 1101 of the Federal Aviation Act of 1958 (49 U.S.C. 1501), and Part 77 of Title 14 of Code of Federal Regulations	Approved December 1969

*Included in Appendix.

UNITS 1 AND 2
DIABLO CANYON SITE
STATE OF CALIFORNIA
LICENSES, PERMITS AND APPROVALS

Table 6

Agency	Licenses, Permits, Approvals	Statutory or Other Authority	Status
Department of Fish and Game	Approval for culvert and fill	Sections 1601 and 1602 of the California Fish and Game Code	Approved July 1968
State Lands Commission	Lease of submerged lands for wave height transducer	Division 6 of California Public Resources Code	Issued November 1968 after public hearing
	Boundary line agreement	Section 6357 of the California Public Resources Code	Issued August 1969
	Lease for intake basin	Division 6 of California Public Resources Code	Issued August 1969 after public hearing
	Extension of lease for wave height transducer	Division 6 of California Public Resources Code	Issued February 1970 after public hearing
	Right of way for discharge channel	Division 6 of California Public Resources Code	Issued June 1970 after public hearing
	Industrial lease right of way for road and cofferdam	Division 6 of California Public Resources Code	Issued June 1970 after public hearing
Resources Agency Departments of: Conservation Water Resources Parks and Recreation Fish and Game Harbors and Watercraft	*Agreement	No statutory requirements. Agreement sets forth certain commitments by PG&E which will assist in the protection of the natural resources of California	Issued December 1966
Public Utilities Commission	*Certificate of public convenience and necessity for Unit 1	California Public Utilities Code Section 1001 and the Rules of Practice and Procedures of the California Public Utilities Commission	Issued November 1967 after public hearings.
	*Certificate of public convenience and necessity for Unit 2	California Public Utilities Code Section 1101 and the Rules of Practice and Procedures of the California Public Utilities Commission	Issued March 1969 after public hearings.
Central Coast Regional Water Quality Control Board, the Resources Agency	Waste discharge requirements	Section 13263 of California Water Code (Stats. 1969, Ch. 482)	Issued May 1969 after public hearings
State Water Resources Control Board, the Resources Agency	Water quality certification	Section 21(b) of the Federal Water Pollution Control Act and Title 23, Chapter 3, Subchapter 11, of the California Administrative Code	Scheduled to be obtained by December 1971
Department of Public Health	*Program of radiological monitoring	Section 25607 of California Health and Safety Code	Continuing program
Division of Industrial Safety	Miscellaneous reviews of construction safety, pressure vessels, elevator permits, etc.		
Port San Luis Harbor District	Lease	Section 6074 of the California Harbors and Navigation Code — Port San Luis Harbor District	Issued December 1969. Became final with approval of Department of Navigation and Ocean Development, July 1970

* Included in Appendix

UNITS 1 AND 2
DIABLO CANYON SITE
LOCAL
LICENSES, PERMITS AND APPROVALS

Table 7

Agency	Licenses, Permits, Approvals	Statutory or Other Authority	Status
County of San Luis Obispo	Use permit for plant site	* None. County Ordinance Code Section 11-481(3) as amended by County Ordinance 875 states that the plant is a permitted use at its location provided it is constructed with the approval of the California Public Utilities Commission	
	Excavation and grading permit for access road	San Luis Obispo County Ordinance 756 and by reference portions of the Uniform Building Code (specifically Section 7003 of Chapter 70)	Issued April 1968
	Excavation and grading permit for borrow area	San Luis Obispo County Ordinance 756 and by reference portions of the Uniform Building Code (specifically Section 7003 of Chapter 70)	Issued June 1968
	Excavation and grading permit for Point Patton to Elevation 85′	San Luis Obispo County Ordinance 756 and by reference portions of the Uniform Building Code (specifically Section 7003 of Chapter 70)	Issued March 1970
	Excavation and grading permit for Point Patton — Elevation 85′ to 75′	San Luis Obispo County Ordinance 756 and by reference portions of the Uniform Building Code (specifically Section 7003 of Chapter 70)	Issued July 1970
	Excavation and grading permit for Unit 2	San Luis Obispo County Ordinance 756 and by reference portions of the Uniform Building Code (specifically Section 7003 of Chapter 70)	Issued May 1970
	Excavation and grading permit for barge landing	San Luis Obispo County Ordinance 756 and by reference portions of the Uniform Building Code (specifically Section 7003 of Chapter 70)	Issued June 1970
	Excavation and grading permit for temporary laydown area	San Luis Obispo County Ordinance 756 and by reference portions of the Uniform Building Code (specifically Section 7003 of Chapter 70)	Issued April 1971
	Conditional use permit for trailer housing	Division 5, Chapter 11, Section 451.2, San Luis Obispo County Ordinance Code	Issued July 1968
	Building permit for Unit 1 — below Elevation 85′	Title 19.04.030 of San Luis Obispo County Ordinance	Issued October 1969
	Building permit for Unit 1 — above Elevation 85′	Title 19.04.030 of San Luis Obispo County Ordinance	Issued June 1970
	Building permit for meteorological towers	Title 19.04.030 of San Luis Obispo County Ordinance	Issued January 1967
	Building permit for barge landing	Title 19.04.030 of San Luis Obispo County Ordinance	Issued June 1970
	Building permit for gate house	Title 19.04.030 of San Luis Obispo County Ordinance	Issued September 1970
	Building permit for conference and construction office	Title 19.04.030 of San Luis Obispo County Ordinance	Issued July 1969
	Building permit for warehouse	Title 19.04.030 of San Luis Obispo County Ordinance	Issued June 1969
	Building permit for compressor building	Title 19.04.030 of San Luis Obispo County Ordinance	Issued June 1969
	Building permit for quality assurance laboratory and office	Title 19.04.030 of San Luis Obispo County Ordinance	Issued June 1969
	Building permit for concrete batch plant	Title 19.04.030 of San Luis Obispo County Ordinance	Issued April 1969
	Building permit for 230 kv switchyard control building	Title 19.04.030 of San Luis Obispo County Ordinance	Issued April 1971
	Building permit for 500 kv switchyard control building	Title 19.04.030 of San Luis Obispo County Ordinance	Issued May 1971
	Building permit for Unit 2	Title 19.04.030 of San Luis Obispo County Ordinance	Scheduled to be obtained by July 1971

* Included In Appendix

CONSULTATIONS

Table 8

Atomic Energy Commission

Between the presentation of Unit 1 to the Atomic Energy Commission in May 1966 and the issuance of the construction permit for Unit 2 in December 1970, a continual review of the project has been conducted by the Atomic Energy Commission in conjunction with other government agencies such as the U.S. Geological Survey, Department of Interior, and the U.S. Coast and Geodetic Survey Department of Commerce. The review, which culminated in the issuance of the construction permits for Unit 1 (April 1968) and Unit 2 (December 1970), consisted of numerous formal and informal meetings, consultations and site visits with PG&E representatives. The subjects discussed dealt with geology, seismology and seismic design, tsunami potential, plant layout and design of major structures, design stress levels, instrumentation and control systems, engineered safety features and accident analyses.

U.S. Corps of Engineers

The U.S. Army Corps of Engineers was first consulted in August 1965 on PG&E's investigation of a harbor at the plant site. Following this initial contact and until December 1970, the subjects of harbor location and feasibility, breakwater construction methods, permit procedures and thermal effects of the circulating water system were discussed at numerous meetings and site visits. The State Lands Commission participated in two of the meetings.

California Regional Water Quality Control Board—Central Coast Region

Although PG&E submitted the waste discharge report on Units 1 and 2 on May 7, 1969, informal consultation with the Central Coast Water Quality Control Board had begun in March 1968. During the interim period, the Board visited the plant and a joint meeting was held later on with representatives of the State Departments of Fish and Game, Water Resources and Public Health, the administrator of the Resources Agency, a hydrological engineer from San Luis Obispo County and two county supervisors. Prior to the formal adoption of waste discharge requirements on October 17, 1969, the Board and PG&E met with the Department of Fish and Game and the Department of Public Health to establish a postoperational monitoring system.

California Public Utilities Commission

Initial contact with the CPUC was made in July 1966, and related to the lease of the plant site. CPUC staff visited the site shortly afterwards. PG&E filed an application for a certificate to construct Unit 1 in December 1966. Public hearings were held from February through May 1967. Construction was authorized in November, subject to AEC approval. In February 1968 PG&E filed an application to construct Unit 2. Public hearings were held in December, and construction was authorized in March 1969, again subject to obtaining AEC approval. Interspersed were many discussions relating to construction of the breakwater and architectural renditions of the plant.

Resources Agency

PG&E's involvement with the Resources Agency traces back to as early as August 1964 and has continued to present. Alternative sites had been visited and evaluated by the Agency before PG&E reached a decision on the Diablo Canyon site in April 1966. Since then an agreement has been developed and formalized with the Task Force which included the Department of Fish and Game, the Central Coast Water Quality Control Board, the State Water Resources Control Board and the Division of Mines and Geology. Meetings were held with the Department of Harbors and Watercraft and Department of Fish and Game to discuss the construction of the breakwaters and circulating water system in conjunction with oceanographic surveys and ecological studies. Pre- and postoperational radiological monitoring programs were also established during the period of May 1968 to August 1969. Representatives of the Resources Agency gave testimony during the AEC and CPUC hearings.

State Lands Commission

The initial meeting with the State Lands Commission was held in March 1967 concerning the circulating water system and the jurisdiction of the breakwaters. Two more meetings were held jointly with the Corps of Engineers and PG&E representatives to discuss permit requirements for the discharge structure, boundary line agreement, dredging and filling, and installation of the breakwaters. The latest meeting, which pertained to the construction road from Diablo Creek to the cofferdam, was held in January 1970.

Table 8 (Cont'd)

San Luis Obispo County

The involvement of the County Board of Supervisors and Planning Commission with PG&E in locating and constructing the power plant began in mid-1963 when the Nipomo Dunes property had been designated as the proposed site. However, when strong public opposition was made to using the Nipomo Dunes site, the County representatives worked closely with conservation groups and the Company in conducting further site studies, which resulted in the selection of Diablo Canyon as the acceptable alternative. County participation in project activities has continued to date and has involved every aspect of the plant facility, including extensive planning in locating the access road to the site. They have also taken part in the approval procedures of other agencies by such actions as their attendance at public hearings held by the AEC and CPUC.

Port San Luis Harbor Commission

Initial contact with the Port San Luis Harbor Commission was made in January 1968 relating to the location of the parcel to be leased for a barge landing. The barge landing area, amount of use, type of fill and fee were discussed prior to the drawing-up of a lease agreement. The proposed barge unloading facility was accepted in December 1969, and the lease agreement was signed on August 6, 1970.

Sierra Club

Discussions began between the Sierra Club and PG&E in mid-1964 as a result of the selection of Nipomo Dunes as the proposed plant site. The Nipomo Dunes site was not considered suitable for industrial development by the Sierra Club and other conservation organizations, and through their involvement with PG&E in further site investigation studies, Diablo Canyon was chosen as the acceptable alternative. PG&E and the Sierra Club have maintained an on-going dialogue through informal meetings, site visits, and participation in hearings before governmental agencies.

Land Use Compatibility

Impact on Present and Future Uses

The power plant at Diablo Canyon is fully compatible with present and future land use. The site received the approval of county government (San Luis Obispo County Board of Supervisors and County Planning Commission), the State Resources Agency, numerous local civic organizations, and conservation groups such as Conservation Associates, Sportsman Council of Central California and the California Wildlife Federation. The site was also in accord with the pre-existing County Master Plan for the Diablo Canyon area, and the use of the site conforms with local zoning ordinances.

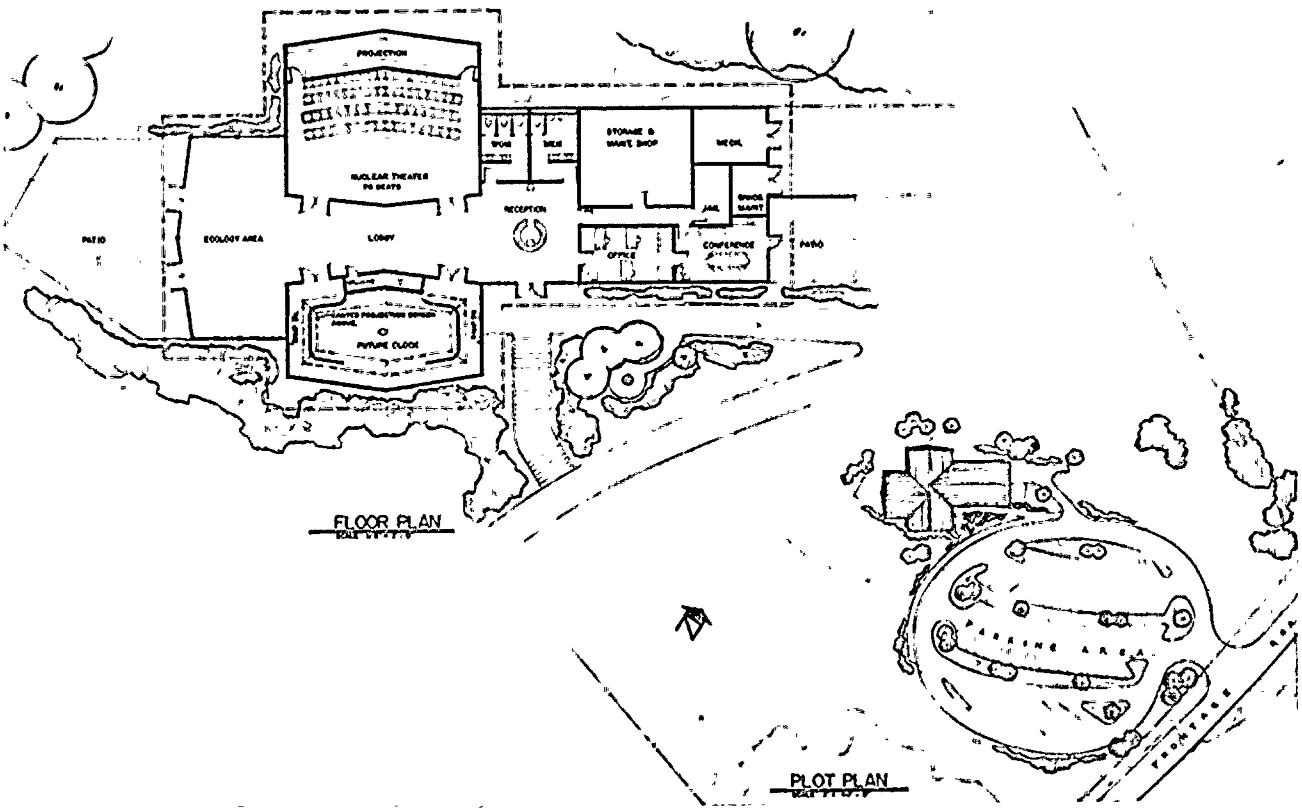
San Luis Obispo County is approximately midway between the large marketing and manufacturing areas of Los Angeles and San Francisco, and as a result of the distances to these urban areas, it has not yet experienced the industrial "spill-over" characteristic of adjacent Santa Barbara County. The majority of the industries operating in San Luis Obispo County are based upon local resources (agricultural, petroleum, and mining) with small employment requirements.

The principal factor minimizing population growth and consequently any rapid changes of land use in the area is lack of significant increases in employment opportunities. Unless some major economic development occurs, such as the possible NASA project at Vandenberg, rapid changes are unlikely. At present, the county population is projected to increase about 3 percent per year between 1970 and 1985.

Since Units 1 and 2 will require about 70 persons for operation, employment patterns in the area will be virtually unaffected by the operation of the power plant. Nevertheless, the additions of Units 1 and 2 would create a significant tax revenue benefit for local tax districts and San Luis Obispo County without any substantial need for new services such as sewage treatment, schools, roads and transportation. The effects of any substantial increase in these tax bases, however, has not been measured at this time.

As a result of the large work force required to construct Units 1 and 2, there has been an immediate impact on the area's economy. With a peak work force of an estimated 1,100 workers, most of the construction payroll finds its way into the local economy. Although some additional services have been required to accommodate this work force, expenditures for these services have not created any undue financial strain. The power plant already has been a favorable addition to the local economy which, prior to start of construction, had been in a depressed condition with relatively high unemployment.

The addition of the power plant will have a minimal effect on the land use of the surrounding area. Some grazing land has been eliminated by the project, but this is an insignificant amount compared to the total area available for grazing in the county.



PROPOSED DIABLO CANYON INFORMATION CENTER FIGURE 2

In order to protect the prehistoric significance of the power plant area, seven archaeological sites were investigated by archaeologists working under an agreement between PG&E and the Central California Archaeological Foundation. The sites excavated were those that might be disturbed by construction of the power plant, switchyards, and access road. Excavation work by the Foundation, completed in June 1968, was funded entirely by PG&E.

The manuscript of the archaeologists' report is on file with the Central California Archaeological Foundation, Sacramento, California.

The Diablo Canyon area does not include any historic landmarks registered in accordance with Public Law 89-665, the National Historic Preservation Act of 1966. The nearest place which may have historic significance is the ruins of an adobe about five miles southeast of the plant site. The State of California, Department of Parks and Recreation, has stipulated that, although these adobe ruins are not presently under consideration as a national historic site, they do have local historic importance. In any event, construction and operation of the power plant will not affect this historic site.

An information center will be constructed adjacent to the offramp at San Luis Bay Drive interchange on U.S. Highway 101. Location of this facility is approximately 6½ miles south of San Luis Obispo. The information center is scheduled to be opened to the public in the summer of 1972.

The distance from the information center to the power plant is 10.2 miles. The center, designed to accommodate 150 visitors per hour, will have an architectural appearance in character with the traditions of early California. Currently being investigated is possible development of a day-use recreational facility adjacent to the information center and a viewing facility located at the power plant site which would serve as the site terminus for visitor bus tours conducted from the information center. The site plan for the information center is shown on Figure 2.

Future Uses

By locating a nuclear power plant on the coast, an opportunity is established for combining the plant with a seawater desalination facility. PG&E is cooperating in a feasibility study toward this end at the Diablo Canyon site. This facility, if constructed, will be financed by the State of California and federal government. The study, sponsored by the California Department of Water Resources and the Federal Office of Saline Water, will evaluate the feasibility of siting the prototype plant at Diablo Canyon and of supplying desalted water in San Luis Obispo and Santa Barbara counties. The power plant would serve as an energy source for the desalination plant, supplying both steam and electrical energy. The feasibility study will consider environmental factors related to the desalting plant and its operation. It is anticipated that the study will be completed and a report prepared in the spring of 1972.

The second amendment to the PSAR for Unit 2 mentions plans for a new community to be located several miles from the site in the Los Osos Valley. It is PG&E's understanding that this project is no longer actively being considered. However, the owner of the land southeast of the site still intends to develop low density residential housing and recreational areas. PG&E has cooperated with the owner on these plans, and it is expected that the power plant will be fully compatible with the development.

PG&E ultimately plans to have six units installed at the site. However, no definite dates have been established at this time for installation of any units beyond Units 1 and 2.

Summary

For the last decade, the area has been dependent upon its own resources for its economic well being. Gains in population and economic development have generally been steady but not spectacular in comparison with nearby counties. San Luis Obispo County has received little or no "spill-over" of population or industry from the large metropolitan areas due to the travel distances involved. Consequently, large amounts of land remain vacant or are used for cattle grazing. Units 1 and 2 at Diablo Canyon will not substantially alter the existing local economic and social trends in the near future. At the same time the power plant will have a positive economic impact in that the county will gain tax revenues without any substantial need for new services. Precluding a major development, such as the possible NASA project at Vandenberg AFB, it appears probable that the population of San Luis Obispo County will continue to increase at a gradual pace for the next one or two decades.

Water Use Compatibility

General

Because of its coastal setting and its use of ocean water for cooling, considerable attention has been focused on the compatibility of the power plant with the ocean water resource. The Diablo site is many miles away from any significant fresh water resources and, consequently, has no impact on these resources.

Fresh Water

Diablo Canyon Creek

The power plant is situated on the coastal terrace immediately south of the mouth of Diablo Canyon Creek. The creek has a watershed of about four square miles and a flow of only a few gallons per minute during the summer. No water is available from the creek for power plant use on a permanent basis since the property owners adjacent to the creek have reserved all the available supply for their own use. However, PG&E is entitled to use the creek water during construction of Units 1 and 2.

Ground Water

There are no known significant ground water sources at or near the site. The only evidence of underground water is the minor seepage that occurs from some of the rock terraces. Construction and operation of the plant is not expected to have any affect on these minor underground sources.

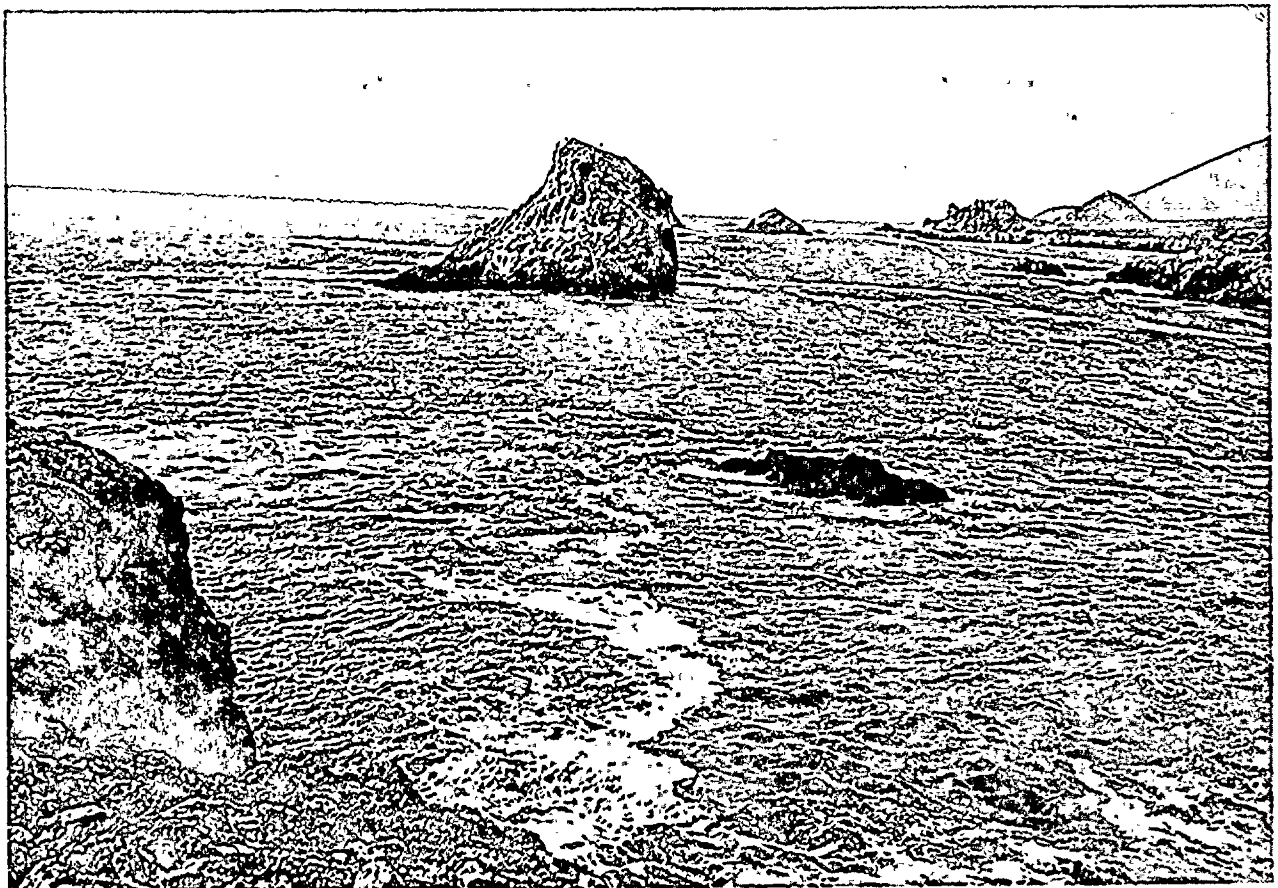
Domestic Water Supplies in Area

There are no domestic water supplies in the immediate vicinity of the site; consequently, construction and operation of the plant will not affect any present domestic supplies. Water supply for the City of San Luis Obispo is derived principally from Santa Margarita Lake, a reservoir about 23 miles northeast of the plant site. The major source of water for the coastal towns from Arroyo Grande to Avila Beach is Lopez Reservoir, located about 20 miles east of the plant site on a tributary to the Arroyo Grande Creek. Whale Rock Reservoir on Old Creek, 17 miles north of the site, and Chorro Reservoir, about 13 miles northeast, are also used for municipal water supply. There are, in addition, some small reservoirs about 18 miles northeast of the plant site used in connection with the San Luis Obispo Water System. Small communities in the area around San Luis Obispo depend on wells for their domestic water supplies.

As the county's surface and subsurface water resources have been almost fully developed, future supplies must be obtained from other sources. Therefore, beginning in 1980, the county plans to receive its additional water supply, in amounts gradually increasing to 25,000 acre-feet annually, from the State Water Project. However, the prototype desalination facility at the power plant site which is presently being considered by federal and state agencies could be a potential means of supplying a portion of the future water needs of the region. The feasibility study on this project has just been started; therefore, it cannot be determined at this time in what manner the desalination plant will be integrated with the nuclear plant and, if so, to what extent it will replace deliveries from the State Water Project in meeting the future water needs of the surrounding area.

Ocean Water

Diablo Cove, located along the rocky coast between Point Buchon and Point San Luis, is relatively isolated from fishing ports and not subject to heavy fishing. Morro Bay, to the north, and Avila, to the south, are the nearest ports. Both commercial and sport fishing boats operate out of these harbors, and their fishing range occasionally extends to Diablo Cove. The estimated average annual catch between Point Buchon and Point San Luis from this commercial and sport fishery is about 621,000 pounds of abalone, 81,000 pounds of rockfish and 22,000 pounds of ling cod, sole and cabezon. The area near Diablo Cove contributes a relatively small amount to this total since other areas have abalone in greater abundance and are more accessible. Estimates have been made that the annual harvest of abalone from Diablo Cove is only one percent of the total catch in this fishery. The contribution of the cove to the catch of other species is similar to the low magnitude of abalone. Little sport fishing takes place near Diablo Cove, primarily because of the distance from Morro Bay and Avila and also because of more productive areas such as Pecho Rock and other offshore rocks. As more fully explained in the Biological Impact section, construction and operation of the power plant is not expected to have any noticeable impact on the commercial or sport fishery in the area.

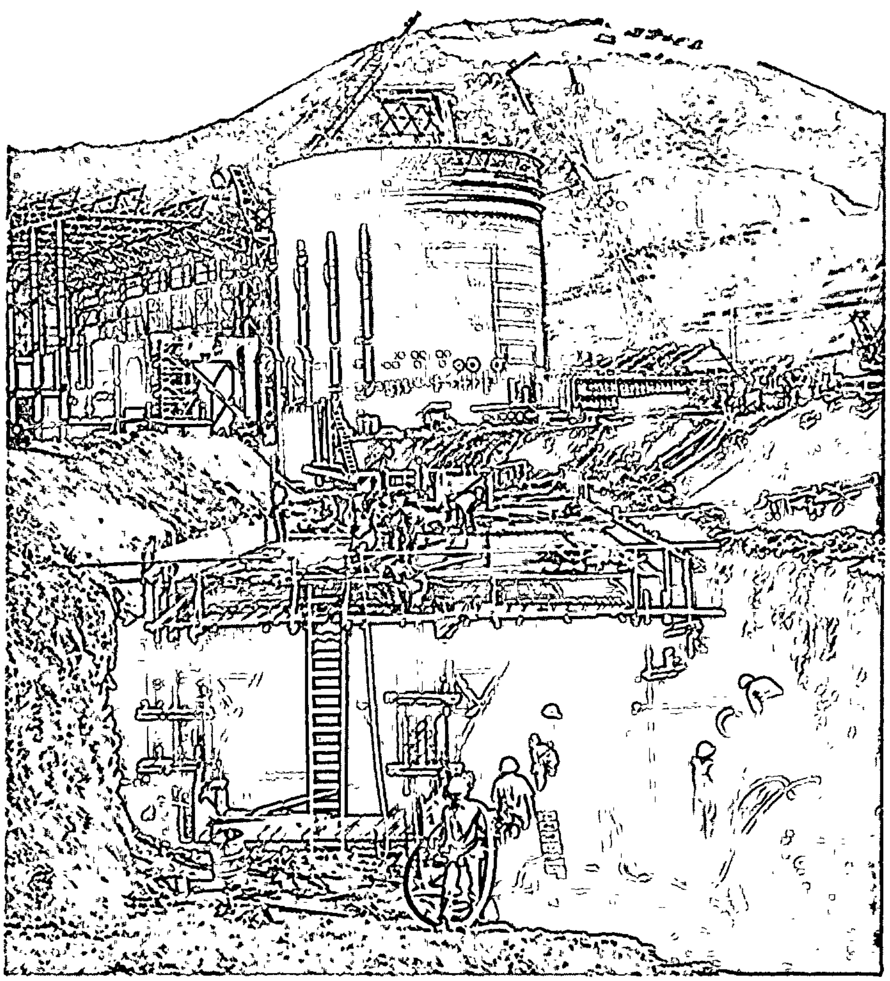


A typical cove of the Central California Coast. This one is about a mile south of Diablo Cove.

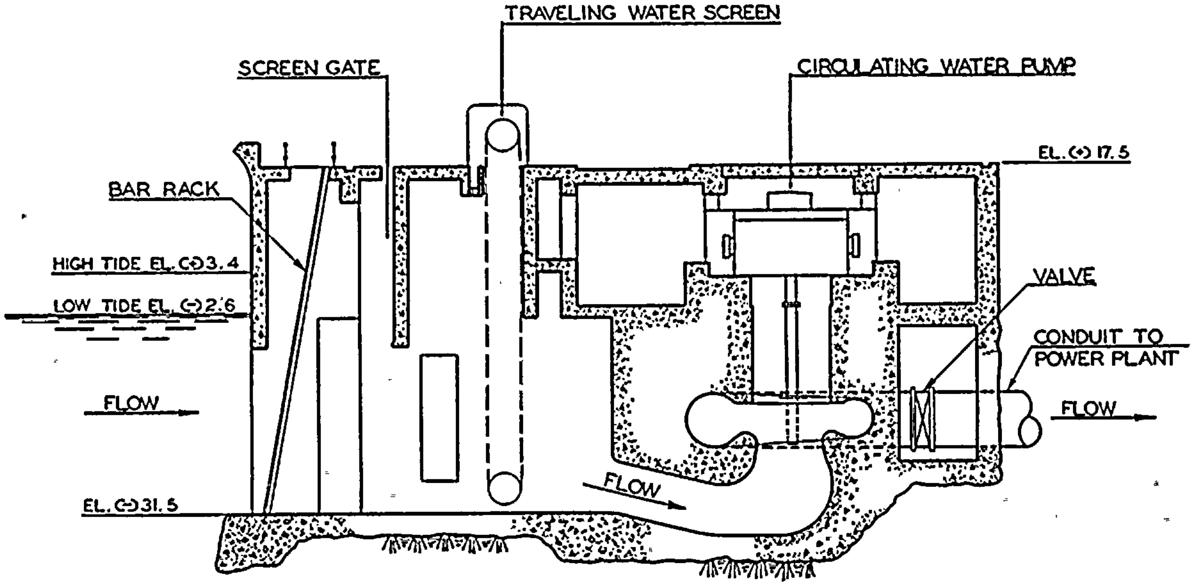
Heat Dissipation

Cooling Method

Nuclear plants such as Units 1 and 2 will operate with a thermal efficiency of about 32 percent, meaning that about one-third of the energy released by the fission process in the reactor core is converted to electricity. The rest of the energy must be dissipated in the form of heat. Several methods of dissipating this heat are available. After considering these methods, a once-through cooling system was selected for Units 1 and 2. Other cooling methods considered and the reasons they were not selected are discussed in the section, Alternatives.



Condenser cooling water for the plant will be pumped through these square reinforced concrete underground intake tunnels.



TYPICAL SECTION

COOLING WATER INTAKE STRUCTURE

SCALE IN FEET

FIGURE 3

Ocean water for cooling will be pumped through the intake structure from the cove located to the south of Diablo Cove (see Figure 3 and Plate 3). Each unit has two circulating water pumps capable of pumping 867,000 gallons per minute of seawater from the intake structure through the two intake conduits to the condensers. As the water passes through the condenser, its temperature is raised about 18°F with the plant operating at full load. At reduced plant loadings, circulating water flow usually will remain the same, but since there will be less heat to dispose of, the temperature increase will be less.

After leaving the condensers, the cooling water flows by gravity through the two discharge conduits to the discharge structure located on the shoreline of Diablo Cove. A typical cross section of the discharge structure is shown on Figure 4. Total travel time for the circulating water from the intake to the discharge is approximately 4½ minutes.

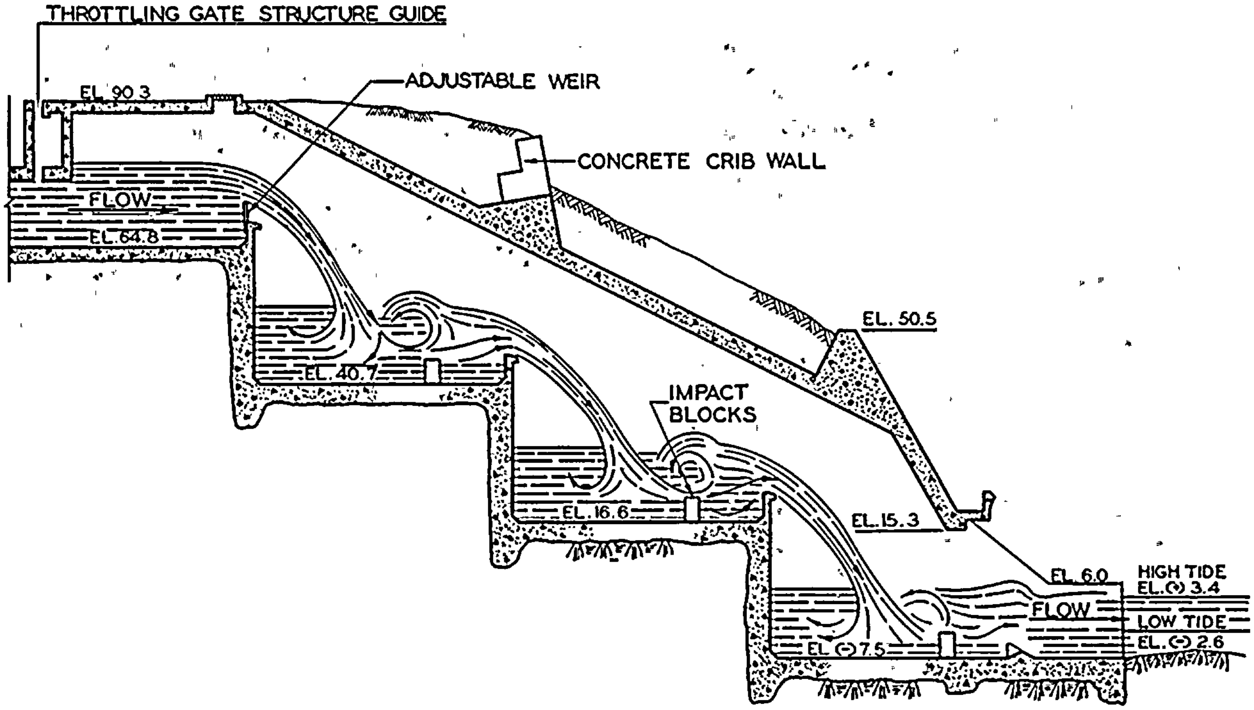
Facilities installed in the intake for the protection of fish are discussed in the section, Biological Impact.

The intake cove water temperatures from February to June reach daily lows of 48°F and, in the late fall period, peak daily highs of 63°F. Therefore, with an 18°F rise through the condensers, the temperature of the circulating water discharged into Diablo Cove will range from 66°F in the late winter and spring season to 81°F in the late fall.

Environmental Impact

The effect of the construction and operation of the breakwaters and discharge structure on the marine habitat has been reviewed and approved by the California Department of Fish and Game. To protect the abalone population during construction of the intake breakwater and discharge structures, about 13,000 abalone were removed and transplanted to areas that would remain undisturbed by construction activities.

Periodic thermal treatment of the cooling water system will be carried out to minimize growth of



TYPICAL SECTION
COOLING WATER DISCHARGE STRUCTURE

FIGURE 4

marine organisms, chiefly mussels and barnacles, in the system piping and heat exchangers. The required frequency of this operation varies with the season but normally will have a duration of no more than a few hours per month. During this cleaning operation, total heat discharged to the ocean will be substantially less than the heat output when the plant is operating continuously at full capacity.

The Biological Impact section discusses in detail the anticipated ecological effects of the heated water discharge.

Mixing Zone

PG&E has predicted the influence of the thermal discharge on the surface water temperature of Diablo Cove and surrounding area. This prediction is based on mathematical models, tank model studies at PG&E's research laboratory, model verification studies at PG&E's Pittsburg Power Plant, and empirical derivation of temperature distribution from numerous field studies conducted at the Morro Bay Power Plant.

Based on the investigations and analyses the cooling water discharge from Units 1 and 2 at Diablo Canyon can be expected to raise the surface water temperature 10°F above ambient over an area of 2.0 acres 50 percent of the time and 4.2 acres 20 percent of the time. The temperature isotherm of 4°F above ambient is predicted to enclose surface area of 15 acres 80 percent of the time, 32 acres 50 percent of the time and 82 acres 20 percent of the time. At low tide Diablo Cove has a total surface area of about 40 acres.

The Pacific Ocean is turbulent in the Diablo Cove area and has a great capacity for dilution and dispersion. Circulation, by both the tide and an inshore current system, is augmented by the vertical mixing layer normally present to a depth of about 100 feet along this part of the Pacific Coast. Experience at the Morro Bay Power Plant on the coast 12 miles north, shows rapid diffusion of the thermal discharge under ocean conditions less favorable than those at Diablo Cove. To help confirm the estimate of an adequate dilution capacity of Diablo Cove, field tests were performed. Rhodamine dye was released in the cove and the concentrations were measured over a period of two and one-half tidal cycles in the cove and adjacent waters. Test results confirmed that the cove is flushed rapidly and dilution is similar to that experienced in other turbulent coastal locations.

Thermal Standards

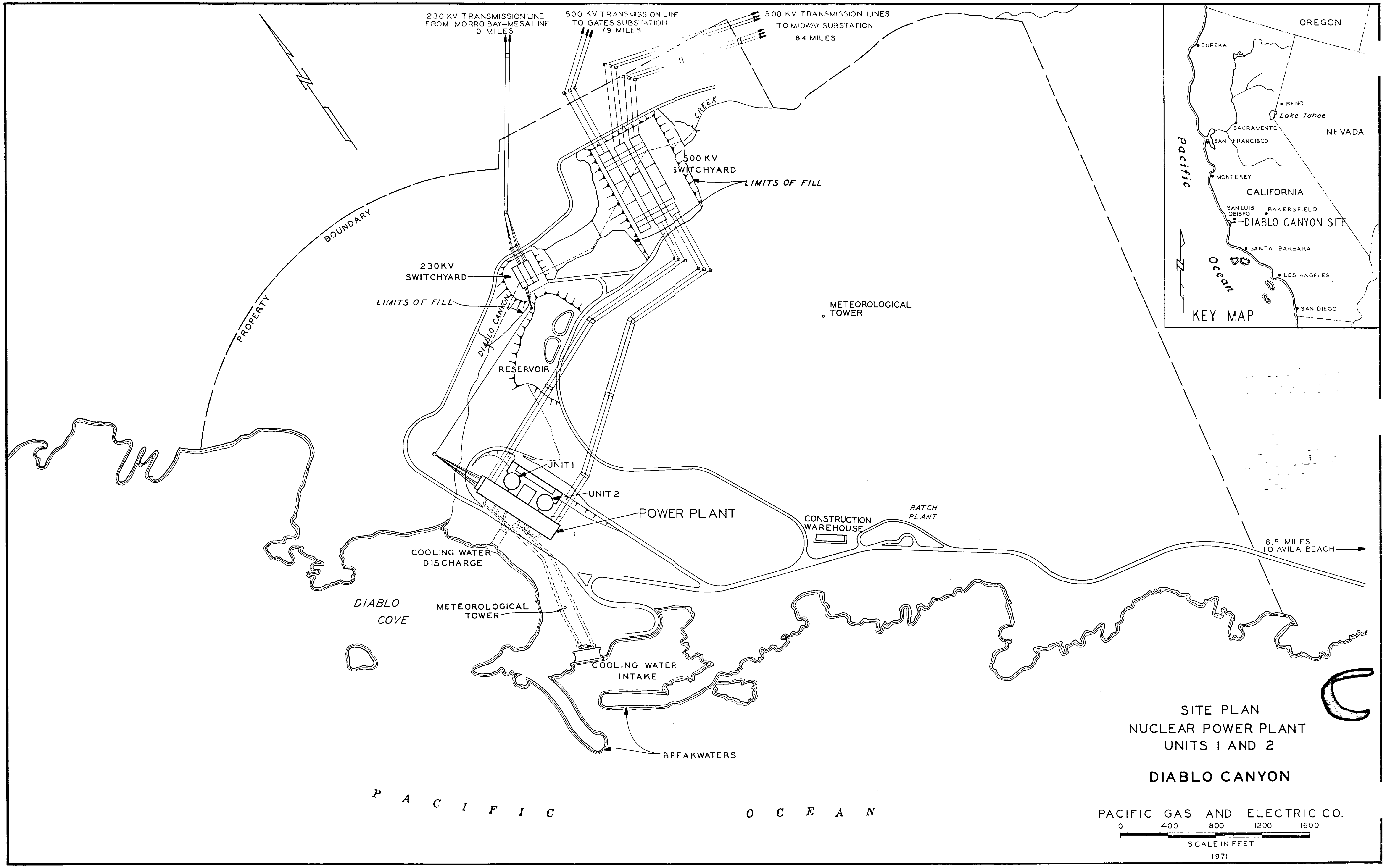
The statutory requirement establishing water quality objectives in California, including thermal discharge requirements, is found in the Porter-Cologne Act, Section 13241 of the Water Code.

On January 7, 1971 the California State Water Resources Control Board adopted the following "Policy Regarding the Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California". It applies to ocean waters such as at Diablo Canyon:

> *Coastal Waters*
>
> *A. Existing discharges:*
>
> *(1) Elevated temperature wastes shall comply with specific temperature limitations and other restrictions necessary to assure protection of the beneficial uses including areas of special biological significance.*
>
> *B. New discharges:*
>
> *(1) Elevated temperature wastes shall be discharged a sufficient distance from areas of special biological significance to assure the maintenance of ambient temperature in these areas.*
> *(2) The maximum temperature of thermal waste discharges shall not exceed the ambient temperature of receiving waters by more than 20°F.*
> *(3) Additional limitations shall be imposed when necessary to assure protection of beneficial uses.*

Diablo Units 1 and 2 are defined as existing discharges in the adopted policy. The state has sent this policy to the Environmental Protection Agency for approval in accordance with the Federal Water Pollution Control Act, as amended in 1970. As of July 1971 the state policy has not yet been approved by the Environmental Protection Agency.

Application for a certificate of conformance with water quality standards was made on April 30, 1971, to the California Regional Water Quality Control Board, Central Coast Region. This application is required by Section 21(b) of the Federal Water Pollution Control Act, and is made in accordance with Title 23, Chapter 3, Subchapter 11, of the California Administrative Code. The application is being reviewed by state agencies.



SITE PLAN
NUCLEAR POWER PLANT
UNITS 1 AND 2

DIABLO CANYON

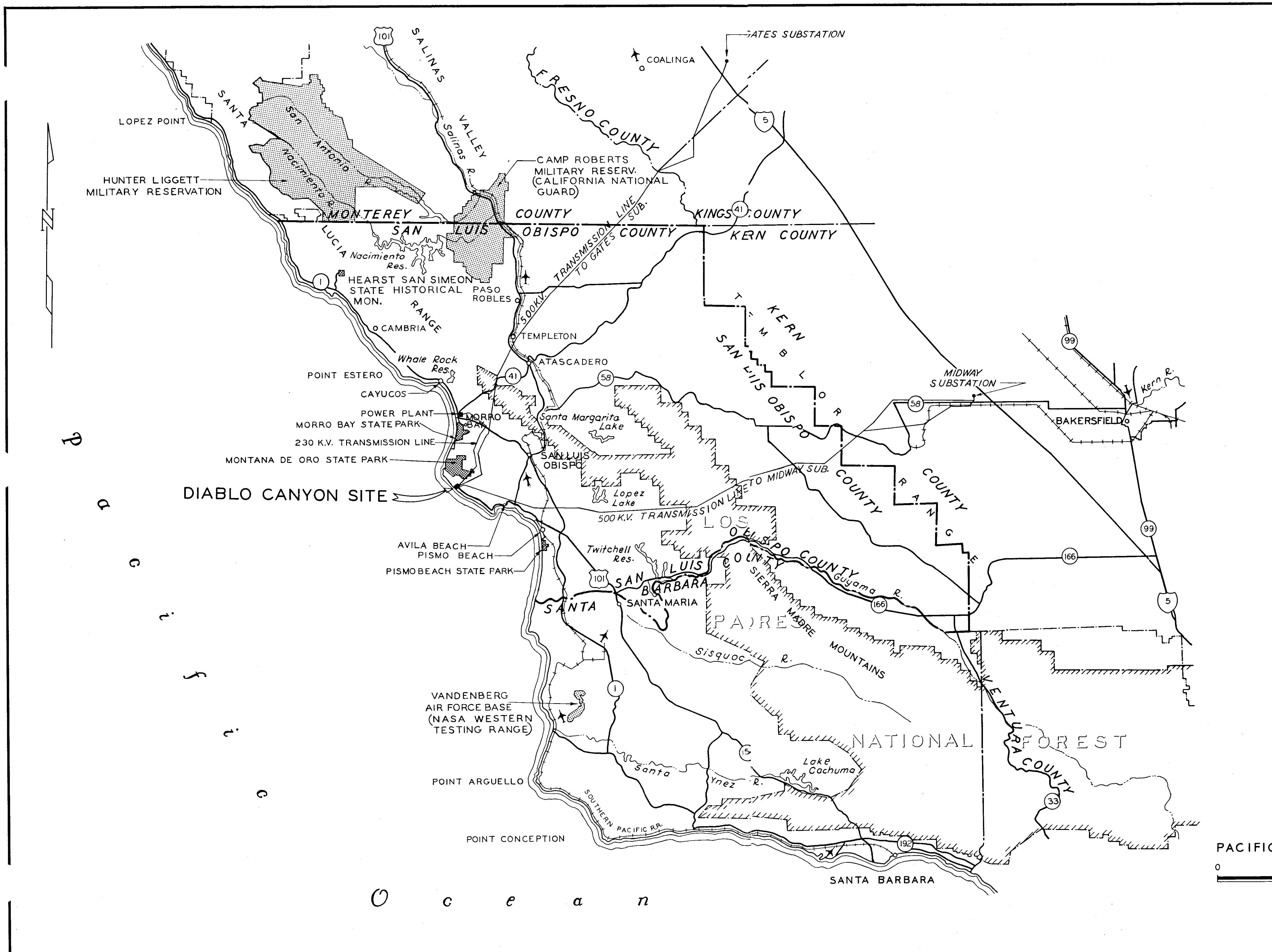
PACIFIC GAS AND ELECTRIC CO.

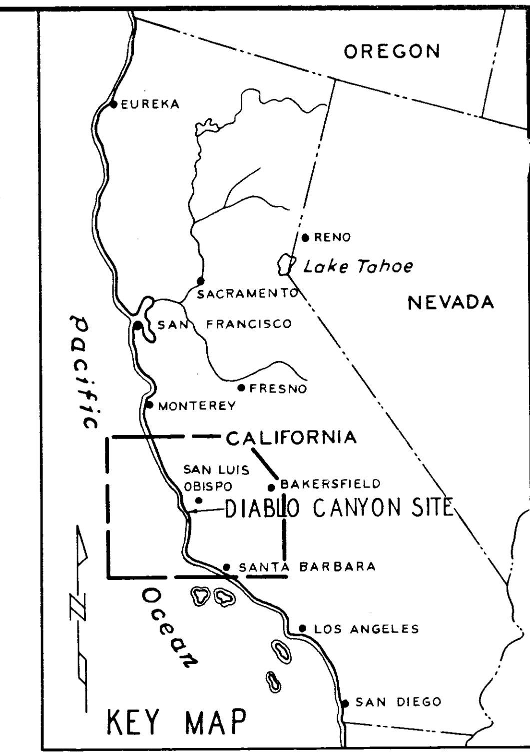
1971

C

8506030233 - 01

PLATE 2





C

REGIONAL MAP

DIABLO CANYON

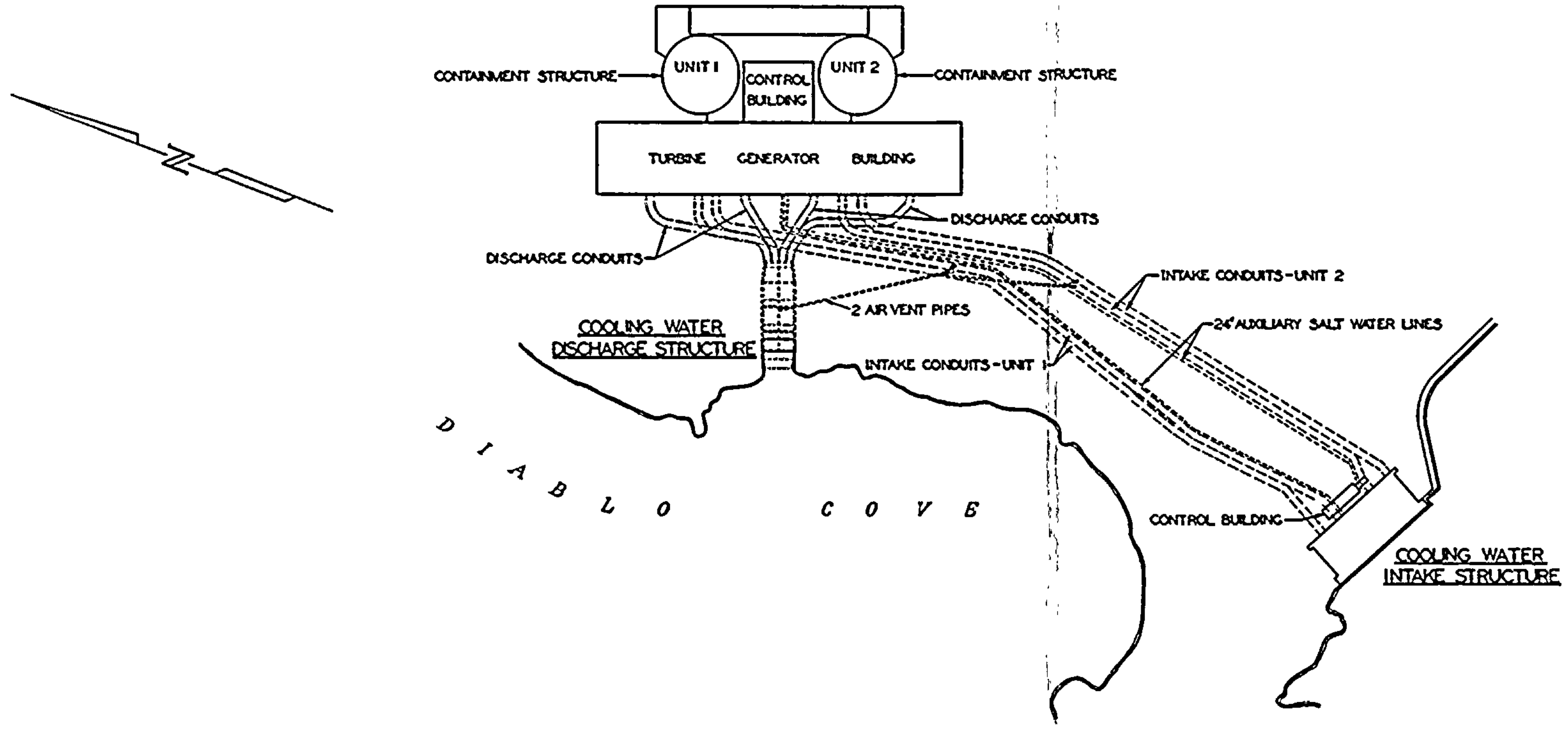
PACIFIC GAS AND ELECTRIC CO.

0 10 20 30 40

SCALE IN MILES

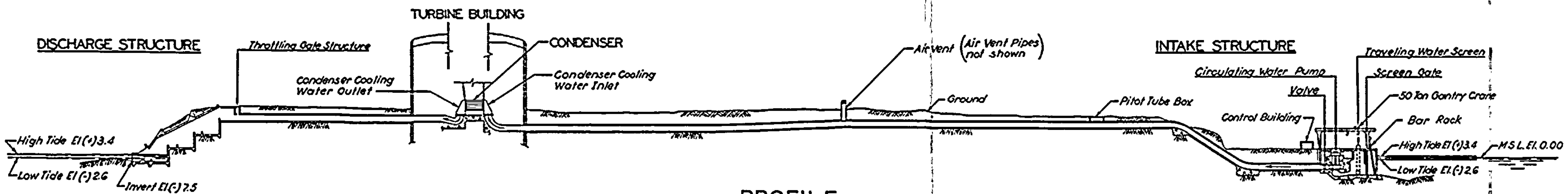
1971

8506030233 -02



PLAN

0 200 400 600
SCALE IN FEET



PROFILE

0 100 200 300 400
SCALE IN FEET

Elevations are on U.S.O.S. datum.

Also Available On Aperture Card

TI APERTURE CARD

PLAN AND PROFILE
CONDENSER COOLING WATER SYSTEM
UNITS 1 & 2

DIABLO CANYON

PACIFIC GAS AND ELECTRIC CO.

1971

8506030233-03

Chemical Discharges and Sanitary Wastes

Chemical Discharges

Various chemicals will be used during the operation of Diablo Units 1 and 2. In designing the units, PG&E has provided adequate waste handling facilities to ensure that chemical discharges will be in conformance at all times with the strict waste discharge requirements of the California Regional Water Quality Control Board, Central Coast Region (a copy of the waste discharge requirements which includes a description of the plant's discharge is in Appendix I). Among other provisions, these requirements specifically require that there shall be no acute toxicity to the marine biota due to waste discharge.

Chemical discharges from the units will include the following:

Small amounts of chlorine will be used in the condenser cooling water for slime and algae control. Chlorination will be carried out periodically in such a way that the residual chlorine concentration at the condenser outlet will generally be less than 0.5 parts per million (ppm) but in no case more than 1 ppm. Chlorination will be for periods of up to one hour once or twice a day during the times when control is required. By the time the circulating cooling water passes through the discharge conduits and into Diablo Cove, the residual chlorine will be significantly diluted below the upper limit of 1 ppm and usually will be below measurable concentrations.

Drainage from plant equipment areas susceptible to possible oil spillage will be processed in an air flotation type separator. Effluent from the power plant oil separator will contain less than 20 ppm oil. After mixing with the circulating cooling water, oil concentration in the discharge will be less than 0.01 ppm.

Miscellaneous chemical wastes, typical of pressurized water reactors will be released from each unit. These wastes are described in detail in paragraph 5b. of the Waste Discharge Requirements (see Appendix I, page 3). After dilution of these wastes with the circulating water, chemical concentrations will be less than 1 ppm.

Fresh water for use in the power plant will be supplied by two 150 gallon per minute seawater flash evaporators. Evaporator blowdown with salinity twice that of seawater will be discharged into the circulating water. After dilution, salinity increase of the circulating water will be insignificant.

Sanitary Discharges

For construction purposes, separate septic tanks and leaching fields have been installed for the main construction office building and the construction camp. These were designed and installed according to applicable regulations and do not create any adverse environmental effects.

Sanitary wastes from the power plant will receive primary treatment in a septic tank prior to discharge to the circulating cooling water. Treatment facilities will be sufficient to handle the permanent staff at the plant of about 70 employees. Provisions for chlorinating this effluent are included in the power plant design and will be installed if a need for such treatment is deemed necessary by the Regional Water Quality Control Board. Separate sanitary treatment facilities will be provided for the control building located at each switchyard. Treatment facilities at each location will consist of a septic tank and leaching field system. These will be installed in accordance with applicable regulations. Use of these facilities will be light as the switchyards will normally operate as unattended facilities with only periodic operation maintenance and inspection required.

Environmental Impact

Because of the very low concentration levels, chemical and sanitary waste discharges from the units will have no adverse environmental effects. In the unlikely event that there are indications of acute toxicity to the marine biota from the waste discharges, PG&E will take whatever steps necessary to mitigate such adverse effects.

Biological Impact

Marine Ecological Studies

The primary objective of the ecological studies has been to establish the background conditions in Diablo Cove and surrounding waters. Biological studies were conducted by PG&E's consultant, Dr. Wheeler J. North of the California Institute of Technology and his colleagues. In addition, under the terms of the agreement between the State of California Resources Agency and PG&E (Appendix F), the California Department of Fish and Game is conducting a quantitative analysis of certain species in the cove area and at control areas to the north and south. The results of the Department of Fish and Game's analysis will be used also as a basis for evaluating post-operational observations.

Description of Studies

Studies were largely confined to Diablo Cove at the mouth of Diablo Creek and to control areas located north of Diablo Cove. Observations and studies of the effects of existing plants indicate that biological changes caused by plant operation will not extend significantly beyond the cove. The results of surveys conducted in the vicinity of the discharge canal at PG&E's Morro Bay Power Plant, a gas and oil fired facility of 1,030 megawatts located 12 miles north on the coast, have been used to supplement data collected at the Diablo site. Because of the similarity of the environment and species composition, changes observed at Morro Bay have been useful in predicting the operational effects of the units at Diablo Canyon.

Physical Oceanography

Physical oceanographic surveys conducted at Diablo Canyon are outlined in Table 9. The procedure for these surveys required the outfitting of a commercial fishing boat with standard oceanographic instruments. These surveys were designed to:

1. Develop a map showing the bottom topography of the area within one quarter mile of the plant site.
2. Record tide levels to establish a correlation with published data.
3. Determine vertical temperature and salinity profiles at various times of the year and evaluate changes in stability.
4. Continuously measure surface water temperature and correlate the measurements with long time temperature records.
5. Measure currents to establish seasonal and other variations.
6. Study dye dispersion and dilution rates.

Detailed information obtained from the physical oceanographic surveys is included in Appendix N

TABLE 9 **Chronology of Physical Oceanography Surveys**

Date	Nature of Survey
3/25/67	Oceanographic stations
3/27/67	Current measurements
3/28/67	Current measurements
4/4/67	Dye study
4/5/67	Dye study
6/22/67	Current measurements
6/23/67	Current measurements
6/24/67	Current measurements
6/25/67	Oceanographic stations
6/26/67	Underwater topographic surveys
6/27/67	Underwater topographic surveys
6/27/67	Current measurements
6/28/67	Underwater topographic surveys
6/29/67	Underwater topographic surveys
6/30/67	Underwater topographic surveys
9/25/67	Current measurements
9/26/67	Current measurements
9/27/67	Dye study
9/28/67	Oceanographic stations
9/29/67	Current measurements
9/30/67	Current measurements
10/1/67	Current measurements
12/3/67	Current measurements
12/4/67	Current measurements
12/6/67	Oceanographic stations
12/7/67	Current measurements
12/8/67	Current measurements
12/9/67	Current measurements
12/10/67	Current measurements

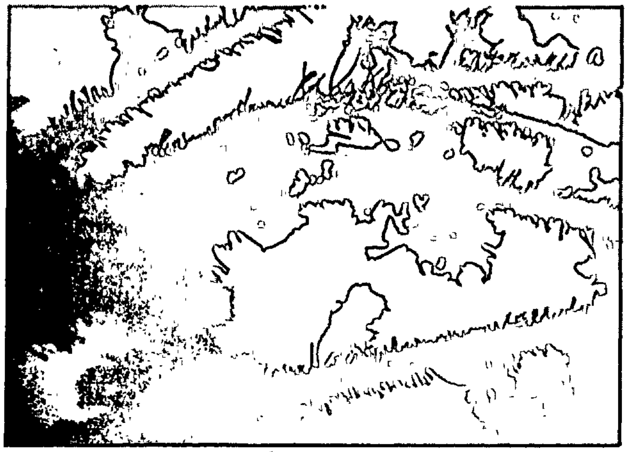
Biological Surveys

Dr. North and his colleagues, with the assistance of PG&E researchers, surveyed the nearshore waters and the intertidal areas in the vicinity of the proposed discharge to assess the resident marine biota and identify oceanographic features of biological importance. Underwater transects were inspected using SCUBA. Various physical parameters such as water temperature, ambient light and underwater visibility were measured or estimated during the transects. Plant and animal species were recorded and population densities of certain organisms were measured. A schedule of Dr. North's expeditions to Diablo and at Morro Bay is shown in Table 10.

Surveys of the populations of the area also were conducted by the California Department of Fish and Game and PG&E researchers. Permanent intertidal and subtidal stations were established. These stations established a baseline to determine annual and seasonal biotic variations inherent to this specific marine system. Ecological surveys included counting the dominant and important species and noting their food-web associations. Samples of the flora and fauna were transported to the laboratory for identification and establishment of a reference collection of the area.

TABLE 10 **Schedule of Field Operations for Ecological Work at the Diablo Canyon and Morro Bay Power Plant Sites**

Date	Location	Nature of Operation
11/5/66	Diablo Cove	Subtidal surveying
11/6/66	Diablo Cove	Subtidal surveying
11/12/66	Diablo Cove	Subtidal surveying
3/1/67	Morro Bay	Subtidal inspection, discharge canal
3/25/67	South Diablo	Intertidal survey
4/3/67	South Diablo	Subtidal survey
5/12/67	Morro Bay	Subtidal inspection
12/2/67	Diablo Cove	Intertidal survey
12/3/67	Diablo Cove	Subtidal survey
12/3/67	Morro Bay	Subtidal survey
1/6/68	Diablo Cove	Subtidal survey
1/7/68	Morro Bay	Subtidal survey
8/19/68	Diablo Cove	Subtidal survey
8/19/68	Morro Bay	Subtidal survey
1/18/69	Diablo Cove	Intertidal survey



A thicket of feather boa kelp (Egregia) in the Shallow Subtidal Zone. The straplike blades are covered with clusters of an epiphytic green alga, sea lettuce (Ulva).

A total of more than 687 man days and 47 boat days were expended during the initial phase of the investigations by the California Department of Fish and Game including:

382 man days–PG&E-Diablo Canyon contract studies
6 man days–South cove jetty habitat and abalone population survey
20 man days–Installation of permanent subtidal transects
32 man days–Surveying subtidal transects
48 man days–Surveying subtidal transects
80 man days–Planning and laboratory analysis
47 boat days–Conducting subtidal research
6 man days–Installation of permanent intertidal transects
22 man days–Assisting and observing abalone transplants
5 man days–Station construction and thermograph installation and changes
84 man days–Preparing and conducting fish collection
2 man days–Conducting kelp counts

View along the boundary between the Shallow Subtidal Zone (background and lower left corner) and the Shallow Barren Zone (center and lower right). Note dense swarm of urchins, characteristic of the Shallow Barren Zone.

Observations

Identification of Species

The biota for Diablo Cove comprised an extremely diversified assemblage of plant and animals. This diversity was explained by the ecotonal character of Diablo Cove. (An ecotone is the region where two different habitats or environments overlap and species characteristic of each coexist together.) Diablo Cove is approximately 55 miles north of Point Conception, the generally accepted transition region between the colder water organisms common to northern California and the warmer water forms of southern California. Sixty-three intertidal plant and 87 intertidal animal species have been recorded (Tables 11 and 12). In the same region, 82 subtidal plant and 198 subtidal animal species were noted (Tables 13 and 14). Organisms were classified as warm or cold water types, depending on whether they occurred in warm water areas in southern California. Those species designated as warm water forms are denoted by an asterisk in the tables.

Vertical surface of boulder at boundary between the Shallow Subtidal Zone and the Shallow Barren Zone with red abalone exposed at top center. Abalone usually inhabit crevices during the day unless there is intense competition for food. Competitors in this case were giant urchins at bottom center. Stalk and holdfast of a palm kelp are in center, near abalone.

TABLE 11

Intertidal Plants

CHLOROPHYTA
*Cladophora trichotoma**
*Codium fragile**
C. setchellii
*Enteromorpha sp.**
Spongomorpha coalita
Ulva sp.

PHAEOPHYTA
*Colpomenia sinuosa**
*Cystoseira osmundacea**
Dictyoneurum californicum
Egregia menziesii
Fucus furcatus
*Hesperophycus harveyanus**
Laminaria setchellii
Nereocystis leutkeana
*Pelvetia fastigiata**
*Ralfsia pacifica**
Scytosiphon lomentaria

RHODOPHYTA
*Agardhiella coulteri**
*Bossiella orbigniana**
Botryoglossum farlowianum
*Calliarthron setchelliae**
Callophyllis crenulata
*Centroceras clavulatum**
*Corallina gracilis**
*C. chilensis**
Cryptopleura violacea
Cryptosiphonia woodii
Cumagloia andersonii
*Endocladia muricata**
Farlowia sp.
Gastroclonium coulteri
*Gelidium robustum**
*Gigartina binghamiae**
G. californica
*G. canaliculata**
G. corymbifera
G. cristata
*G. leptorhyncus**
Gigartina papillata
*G. volans**
*Gracilariopsis sjoestedtii**
Gymnogongrus linearis
Halosaccion glandiforme
Hymenena flabelligera
Iridaea flaccida
I. heterocarpa
Laurencia spectabilis
*Lithothamnium sp.**
Melobesia marginata
Microcladia coulteri
*Peyssonelia pacifica**
*Plocamium coccineum**
Polysiphonia californica
Porphyra perforata
Prionitis andersonii
P. lanceolata
*P. linearis**
Rhodocorton sp.
*Rhodoglossum affine**
Rhodomela floccosa
Schizymenia pacifica
*Smithora naiadum**

SPERMATOPHYTA
*Phyllospadix scouleri**

*Occurs in warm water

TABLE 12 Intertidal Animals

PROTOZOA
*Gromia oviformis**

PORIFERA
Cliona celata
*Haliclona permollis**
*Plocamia karykina**
*Verongia thiona**

COELENTERATA
*Anthopleura elegantissima**
*A. xanthogrammica**
Corynactis californica
*Diadumene sp.**
*Epiactis prolifera**

PLATYHELMINTHES
*Leptoplana chloranota**
Unident.

BRYOZOA
Hippothoa hyalina
Lyrula hippocrepis
*Membranipora membranacea**
M. villosa
Microporella sp.
*Rhyncozoon rostratum**

ANNELIDA
*Dexiospira spirillum**
*Eupomatus gracilis**
Platynereis bicanaliculata
Sabellariidae
Salmacina tribranchata
*Serpula columbiana**
Spionidae
Terebellidae

MOLLUSCA (Amphineura)
*Mopalia muscosa**
Unident.

MOLLUSCA (Gastropoda)
Acanthina spirata
*Acmaea limatula**
A. mitra
*A. pelta**
*A. persona**
*A. scabra**
Astraea inequalis
Calliostoma annulata
*Fissurella volcano**
*Haliotis cracherodii**
*H. fulgens**
H. rufescens
*Hopkinsia rosacea**
Lacuna porrecta
*Littorina planaxis**
*L. scutulata**
*Lottia gigantea**
Mitrella aurantiaca
Spiroglyphis lituellis
*Tegula aureotincta**
T. brunnea
*T. funebralis**
Thais emarginata

MOLLUSCA (Pelecypoda)
*Chama pellucida**
*Mytilus californianus**

ARTHROPODA (Crustacea)
Balanus glandula
Cancer sp.
*Chthamalus fissus**
*Cirolana harfordi**
*Hemigrapsus oregonensis**
Idothea sp.
*Lygia occidentalis**
*Mimulus foliatus**
*Mitella polymerus**
*Pachycheles pubescens**
*P. rudis**
*Pachygrapsus crassipes**
*Pagurus granosimanus**
*P. hirsutiusculus**
*Petrolisthes eriomerus**
*Pugettia productus**
P. richii
*Tetraclita squamosa**

ECHINODERMATA
Leptasterias aequalis
L. pusilla
*Linckia columbiana**
*Pateria miniata**
*Pisaster giganteus**
*P. ochraceous**
Pycnopodia helianthoides
*Strongylocentrotus purpuratus**

HEMICHORDATA
Unident. balanoglossid

CHORDATA (Tunicata)
*Boltenia villosa**
Clavelina huntsmani
Cystodites sp.
Metandrocarpa taylori

CHORDATA (Pisces)
Xerepes fucorum

CHORDATA (Aves)
*Larus sp.**

CHORDATA (Mammalia)
Zalophus californianus

*Occurs in warm water

TABLE 13

Subtidal Plants

CHLOROPHYTA
Bryopsis corticulans
*Cladophora sp.**
Codium setchellii
*Enteromorpha sp.**
Halicystis ovalis
Ulva lobata

PHAEOPHYTA
*Cystoseira osmundacea**
Dictyoneurum californica
*Dictyota binghamiae**
Desmarestia herbacea
D. munda
D. tabacoides
*Ectocarpus sp.**
Egregia laevigata
E. menziesii
Laminaria setchellii
L. sinclairii
Leathesia difformis
Nereocystis leutkeana
Pterygophora californica

RHODOPHYTA
*Acrosorium uncinatum**
Aeodes gardneri
Agardhiella coulteri
Ahnfeltia plicata
Amplisiphonia sp.
Botryoglossum farlowianum
Bossiella corymbifera
B. gardneri
Calliarthron cheilosporiodes
C. regenerans
Callophyllis firma
C. flabellulata
C. heanophylla
C. pinnata
C. violacea
Ceramium sp.
*Corallina gracilis**
Cryptopleura violacea
Cryptosiphonia woodii
*Endocladia muricata**
Fryeela gardneri

TABLE 13

Subtidal Plants

Gastroclonium coulteri
*Gelidium robustum**
G. coulteri
*Gigartina binghamiae**
*G. canaliculata**
*G. corymbifera**
*G. leptorhyncus**
G. papillata
*G. volans**
*Gracilariopsis sjoestedtii**
Grateloupia schizophylla
Griffithsia pacifica
Gymnogonorus leptophyllus
G. platyphyllus
Hildenbrandia prototypus
Hymenena flabelligera
Iridaea flaccida
I. heterocarpa
I. lineare
I. splendens
Laurencia gardneri
L. spectabilis
*Lithothamnium sp.**
Melobesia marginata
Opuntiella californica
*Peyssonelia pacifica**
*Plocamium coccineum**
Polyneura latissima
Polysiphonia brodiaei
Prionitis andersonii
P. lanceolata
*P. linearis**
Pterosiphonia dendroidea
P. gracilis
Ptilota densa
*Rhodoglossum affine**
*Rhodymenia pacifica**
Schizymenia epiphytica
Weeksia reticulata

CHRYSOPHYTA
*Licmophora sp.**

SPERMATOPHYTA
*Phyllospadix scouleri**

*Occurs in warm water

TABLE 14 Subtidal Animals

PROTOZOA
*Gromia oviformis**

PORIFERA
Acarnus ericthacus
Cliona celata
Esperiopsis originalis
Ficulina suberea
*Haliclona permollis**
Hymenamphiastra cyanocrypta
*Leuconia heathii**
Leucosolenia eleanor
Lissodendoryx firma
L. rex
Paresperella psila
*Plocamia karykina**
Prosuberites sisyrnus
*Rhabdodermella nuttingi**
*Spheciosoongia confederata**
Stelleta clarella
Tethya aurantia
Tetilla arb

COELENTERATA (Hydrozoa)
Abietinaria sp.
Aglaophenia sp.
Allopora porphyra
Campanularia sp.
Halecium sp.
Obelia sp.
Plumularia sp.
Sertularella
Sertularia

COELENTERATA (Scyphozoa)
Haliclystus sp.

COELENTERATA (Anthozoa)
Anthopleura artemesia
*A. elegantissima**
*A. xanthogrammica**
Balanophyllia elegans
Corynactis californica
*Diadumene sp.**
*Epicatis prolifera**
*Harenactis attenuata**
Tealia sp.

BRYOZOA
Cauloramphus spiniferum
*Costazia robertsoni**
*Crisia occidentalis**
*Diaporecia californica**
Diasporella sp.
Flustrella corniculata
Hippothoa hyalina
Holoporella sp.
Lagenipora punctulata
Lyrula hippocrepis
Membranipora fusca
*M. membranacea**
Microporella sp.
Mucronella sp.
Parasmittina sp.
Pherusella brevituba
*Phidolopora pacifica**
*Rhyncozoon rostratum**
Scrupocellaria sp.
Thalamoporella californica
Tricellaria occidentalis
Tubulipora sp.

NEMERTEA (Unident.)

SIPUNCULOIDEA (Unident.)

ANNELIDA
*Chaetopterus variopedatus**
*Dexiospira spirillum**
*Diopatra ornata**
Dodecaceria sp.
*Eudistyla polymorpha**
*Phragmatopoma californica**
Platynereis bicanaliculata
Polynoidae
Sabella sp.
Sabellaria sp.
Salmacina tribranchiata
*Serpula columbiana**
*Spirabranchis spinosus**

BRACHIOPODA
Terebratalia transversa

MOLLUSCA (Amphineura)
Cryptochiton stelleri
Ischnochiton mertensii
I. radians
Katherina tunicata
Tonicella lineata
T. marmorea
Unident. chiton

MOLLUSCA (Gastropoda)
*Acmaea incessa**
A. mitra
*A. paleacea**
*A. persona**
*Aletes squamigerous**
Anisodoris nobilis
*Aplysia californica**
Archidoris monteryensis
Astraea inequalis
Cadlina flavomaculata
C. luteomarginata
Calliostoma annulata
C. canaliculatum
C. costatum
*Crepidula sp.**
Dendrodoris albopunctata
D. Fulva
Diodora sp.
*Fissurella volcano**
*Haliotis cracherodii**
*H. fulgens**
H. rufescens
*Hermissenda crassicornis**
*Hopkinsia rosacea**
*Jaton festivus**
Margarites sp.
Mitra ida
Mitrella aurantica
Nassarius sp.
*Norrisia norrisii**
*Olivella biplicata**
Phidiana niger
Pteropurpura trialatus
Rostangia pulchra
Tegula brunnea
*T. funebralis**
T. montereyi
T. pulligo
Triopha carpenteri

MOLLUSCA (Pelecypoda)
*Hinnites giganteus**
*Mytilus californianus**
Pododesmus macroschisma
Saxicava sp.

MOLLUSCA (Cephalopoda)
Octopus sp.

ARTHROPODA
Balanus crenatus
B. nubilis
*B. tintinnabulum**
Cancer sp.
Caprella sp.
Cirolana sp.
*Cragon dentipes**
Gammarid unident.
*Idothea resecata**
Loxorhyncus sp.
*Mimulus foliatus**
Pagurus sp.
Pandalus danae
Petrolisthes sp.
*Pugettia producta**
Spirontocaris sp.
Tanystalum occidentalis

ECHINODERMATA
*Astrometis sertulifera**
Cucumaria miniata
Henricia leviscula
Leptasterias aequalis
Ophioncus granulosus
*Ophipteris papillosa**
*Ophiothrix spiculata**
*Pateria miniata**
*Pisaster brevispinus**
*P. giganteus**
*P. ochraceous**
Pycnopodia helianthoides
Stichopus sp.
Strongylocentrotus franciscanus
*S. purpuratus**

CHORDATA (Tunicata)
Amaroucium sp.
Ascidia ceratodes
Boltenia villosa
Botryllus sp.
Clavelina huntsmani
Cnemidocarpa finmarkiensis
Didemnum carnulentum
Euherdmania claviformis
Metandrocarpa taylori
Perophora annectans
Polyclinum planum
Pycnoclavella stanleyi
Sigillinaria sp.
Styela montereyensis

CHORDATA (Pisces)
*Amphisticus argenteus**
*Anisotremus davidsoni**
*Arbaciosa rhessodon**
*Atherinops affinis**
Clinocottus analis
Coryphopterus nicholsi
*Embiotoca jacksoni**
E. lateralis
*Girella nigricans**
*Heterostichus rostratus**
Hexagrammos decagrammus
Hypsurus caryi
*Leiocottus hirundo**
Ophiodon elongatus
Oxyjulis californica
*Paralabrax clathratus**
*Phanerodon furcatus**
*Platyrhinoides triseriatus**
*Rhacochilus vacca**
*Scorpaena guttata**
Scorpaenichthys marmoratus
*Sebastes chrysomelas**
S. mystinus
S. spp.

CHORDATA (Mammalia)
*Zalophus californianus**

*Occurs in warm water

Studies were conducted for a sufficient period to determine whether a species could be considered "indigenous", that is, a permanent resident of the study area. The criteria used for this purpose included frequency of observation, extent of distribution in the Diablo area and abundance of organisms. Intertidally, 37 plant and 35 animal species (Tables 15, 16, 17, 18) qualified as indigenous species. Of the indigenous intertidal species, 42 percent of the plants and 79 percent of the animals occur in the warmer areas of southern California. Thirty-five percent of the subtidal flora are heat tolerant as are 44 percent of the subtidal fauna.

TABLE 15

Intertidal Plant Species of the Diablo Cove Region Classified as "Indigenous" on the Basis of Two Years of Observations

CHLOROPHYTA
*Cladophora trichotoma**
*Ulva sp.**

PHAEOPHYTA
Dictyoneurum californicum
Egregia menziesii
Fucus furcatus
*Hesperophycus harveyanus**
Laminaria setchellii
*Pelvetia fastigiata**
*Ralfsia pacifica**

RHODOPHYTA
*Agardhiella coulteri**
Botryoglossum farlowianum
Calliarthron setchelliae
Callophyllis crenulata
*Corallina chilensis**
Cryptosiphonia woodii
*Endocladia muricata**
Gastroclonium coulteri
*Gelidium robustum**
*Gigartina canaliculata**
G. cristata
*G. leptorhnycus**
G. papillata
Halosaccion glandiforme
Hymenena flabelligera
Iridaea flaccida
I. heterocarpa
Laurencia spectabilis
Lithothamnium sp.
*Plocamium coccineum**
Polysiphonia californica
Porphyra perforata
Prionitis andersonii
*P. linearis**
*Rhodoglossum affine**
Smithora naiadum

SPERMATOPHYTA
*Phyllospadix scouleri**

*Occurs in warm water

TABLE 16

Intertidal Animal Species of the Diablo Cove Region Classified as "Indigenous" on the Basis of Two Years of Observation

PORIFERA
Plocamia karykina

COELENTERATA
*Anthopleura elegantissima**
*A. xanthogrammica**
*Diadumene sp.**

PLATYHELMINTHES
*Leptoplana chloranota**

ANNELIDA
*Dexiospira spirillum**

CHORDATA (Pisces)
Xerepes fucorum

MOLLUSCA
*Acmaea limatula**
*A. pelta**
*A. persona**
*A. scabra**
*Haliotis cracherodii**
H. rufescens
*Littorina planaxis**
*L. scutulata**
*Mopalia muscosa**
*Mytilus californianus**
Tegula brunnea
*T. funebralis**

CHORDATA (Tunicata)
*Boltenia villosa**
Clavelina huntsmani

ARTHROPODA
*Balanus glandula**
Cancer sp.
*Chthamalus fissus**
*Cirolana harfordi**
*Lygia occidentalis**
*Pachygrapsus crassipes**
Petrolisthes cinctipes
Pugettia productus
*Tetraclita squamosa**

ECHINODERMATA
*Pateria miniata**
*Pisaster ochraceous**
Pycnopodia helianthoides
*Strongylocentrotus purpuratus**

*Occurs in warm water

TABLE 17

Subtidal Plant Species of the Diablo Cove Region Classified as "Indigenous" on the Basis of Two Years of Observation

CHLOROPHYTA
Ulva lobata

PHAEOPHYTA
*Cystoseira osmundacea**
Dictyoneurum californica
*Egregia laevigata**
E. menziesii
Laminaria setchellii
Nereocystis leutkeana
Pterygophora californica

RHODOPHYTA
Botryoglossum farlowianum
B. gardneri
Calliarthron cheilosporioides
C. regenerans
C. flabellulata
C. violacea
*Gelidium robustum**
*Gigartina corymbifera**
Iridaea flaccida
I. heterocarpa
*Lithothamnium sp.**
Opuntiella californica
*Peyssonelia pacifica**
*Plocamium coccineum**
Polyneura latissima
*Prionitis linearis**
Ptilota densa

SPERMATOPHYTA
*Phyllospadix scouleri**

*Occurs in warm water

TABLE 18

Subtidal Animal Species of the Diablo Cove Region Classified as "Indigenous" on the Basis of Two Years of Observation

PORIFERA
Hymenamphiastra cyanocrypta
Tethya aurantia

COELENTERATA
Allopora porphyra
*Anthopleura elegantissima**
*A. xanthogrammica**
Balanophyllia elegans
Corynactis californica
*Diadumene sp.**
Tealia sp.

BRYOZOA
*Costazia robertsoni**
*Phidolopora pacifica**

ANNELIDA
Dodecaceria sp.
*Eudistyla polymorpha**
*Serpula columbiana**

MOLLUSCA
Acmaea mitra
*Aletes squamigerous**
Anisodoris nobilis
Astraea inequalis
Cryptochiton stelleri
Haliotis rufescens
*Hinnites giganteus**
Mitra ida
Tegula brunnea
T. montereyi

ARTHROPODA
Balanus nubilis
*Pugettia productus**

ECHINODERMATA
*Astrometis serulifera**
Leptasterias aequalis
*Pateria miniata**
*Pisaster ochraceus**
Pycnopodia helianthoides
Stichopus sp.
*Strongylocentrotus franciscanus**
*S. purpuratus**

CHORDATA (Tunicata)
Clavelina huntsmani
Didemnum carnulentum

CHORDATA (Pisces)
Coryphopterus nicholsii
*Embiotoca jacksoni**
E. lateralis
*Heterostichus rostratus**
*Paralabrax clathratus**
Scorpaenicthys marmoratus
Sebastes mystinus

CHORDATA (Mammalia)
*Zalophus californianus**

*Occurs in warm water

Distribution of Organisms

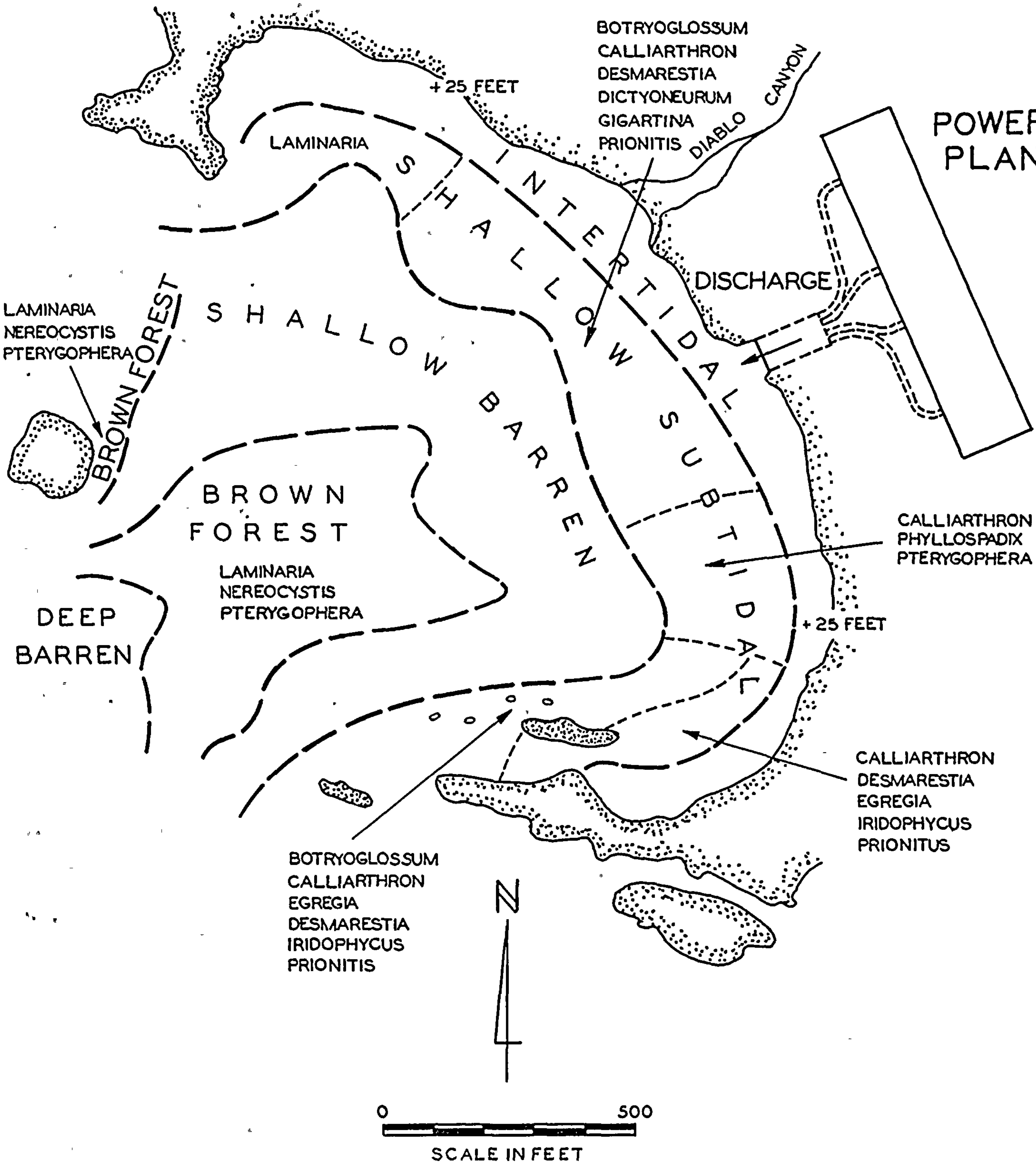
A relatively consistent intertidal distribution pattern existed throughout most of the area within Diablo Cove and in the inlet cove to the south. Some differences occurred in the intertidal zones around the headlands and offshore rocks. One unusual feature that appears to influence the distribution of the biota in a minor way is the discharge of fresh water from Diablo Canyon Creek. This results in the initial disappearance of all but four marine animal and seaweed species *(Grateloupia, Prionitis, Cladophora and Gigartina)* from the intertidal area.

Zonation was well developed intertidally and present, although somewhat subdued, subtidally (Fig. 5). The area was subdivided into five zones classified according to the dominant seaweed species present. Because of the importance of attached algae to the economy of the cove, the seaweed distribution is probably the most useful indicator of changes which might occur during plant operation. Attached plant communities are generally good indicators of environmental conditions, both static and changing. Also, these organisms are closely related to the nutritional and systematic relationships of a specific environment. On this basis, characterization of the zonation patterns has been invaluable in assessing the magnitude and extent of change anticipated as a result of plant operation.

Subtidally, swarms of giant red urchins dominated the bottom, below 50 feet and between the 25 and 10 foot deep contours. These urchin-dominated territories have been designated as Deep Barren and Shallow Barren (Figure 5). Urchin concentrations were highest at the border of the Shallow Barren Zone, apparently attracted by the plant food occurring above and below the zones. Some abalone occurred in the open at these borders, mingling with the urchins, but within the seaweed forests, the abalone remained hidden in crevices and under rocks.

Plant cover within the Deep Barren Zone was limited to encrusting forms except for the peaks of large pinnacles. A sparse scattering of giant urchins probably removed all other plants as they appeared. This zone is a minor area compared to other zones of Diablo Cove.

Between the urchin zones, a lush cover of brown algae dominated the bottom (Brown Forest Zone). This zone displays lower limits at about 50 to 60 feet and upper limits at about 25 feet. It is characterized primarily by dense growths of



ZONES AND PRINCIPAL PLANT SPECIES OBSERVED NEAR THE COOLING WATER DISCHARGE AT DIABLO COVE

FIGURE 5

two brown algae kelps (*Pterygophora* and *Laminaria*). Some patches of the bull kelp (*Nereocystis leutkeana*) provide a midwater biotope that attracted benthic fishes. Many herbivorous animals achieve substantial concentrations in this zone. High abalone counts are recorded in the deeper portion of this zone. Juvenile red abalone also are found in this zone.

The lower limits of the Shallow Subtidal Zone occur between 10 and 15 feet, while the upper border has arbitrarily been considered the Intertidal Zone. Dense plant growths of the Shallow Subtidal Zones offer abundant food and shelter for animals, and the highly irregular bottom provides a maximal surface for attachment. Large boulder piles occur near the southern border of the cove in this zone and provide some deep crevice environments for abalone and urchins. Most of the Intertidal Zone is completely covered by vegetation. The thickness of this algal cover is considerably less than that found in the Shallow Subtidal, probably due to pruning action by the surf.

Nutritional Relationships

The biological economy of Diablo Cove apparently depends heavily on productivity by attached algae. Except in regions where urchins dominate the bottom, luxuriant stands of seaweed proliferate and support hosts of grazing animals. Filter feeding animals are present but rarely dominate, suggesting that productivity by phytoplankton is secondary in importance.

Of major concern regarding the economy of the cove has been the evaluation of the subtidal productivity. The intertidal plant communities are complex and difficult to evaluate in terms of plant productivity. This area is small, however, compared to the total area of subtidal productivity. A total of 67 plant species were recorded subtidally; however, only 12 appeared to be considered significant to subtidal productivity (*Desmarestia herbacea, Dictyoneurum, Egregia, Laminaria, Nereocystis,* and *Pterygophora* among the brown algae; *Botryoglassum, Calliarthron, Gigartina binghamiae, Iridopycus flaccidum,* and *Prionitis lanceolata* among the red algae; *Phyllospadix,* a flowering plant).

Of particular interest are the barren belts of territory found throughout the cove (Shallow Barren and Deep Barren Zones). This territory invariably displays dense concentrations of urchins (primarily the giant urchin, *Stronglyocentrotus franciscanus*). Urchins graze plants, and the dense populations of these animals undoubtedly account for the barren condition of the bottom. Other herbivorous animals, including abalone, are scarce in the urchin territories.

Seasonal and Long-Term Changes

At present, available data are insufficient to conclusively characterize the temporal changes which occur in the cove. Short-term observations, however, do allow some speculation on the magnitude and types of seasonal and long-term changes to be effected. Seasonal investigations along a transect line in the lee of Diablo Rock lying across the cove entrance indicate that few, if any, significant changes of any kind should be expected either in species present or in species distribution.

Within the cove proper, canopies formed by the bull kelp, *Nereocystis leutkeana*, appeared better developed qualitatively and more extensive during summer surveys than in other seasons. Possibly this change in canopy represents a seasonal effect.

Some assessment of long-term changes in the cove was possible through resurvey of various transects evaluated during initial studies.

Minor changes in the presence and distribution of floral species were observed to a limited extent in a few groups which apparently contribute little to the overall productivity of the area. These changes are probably of little significance ecologically. The animal population showed a general increase in diversity. Although not quantified, this increase in species diversity is not considered to be ecologically significant.

Results of continuing studies will be used to further assess the seasonal and temporal characteristics in this area.

Impact on Species

Changes in Dominant and Important Species

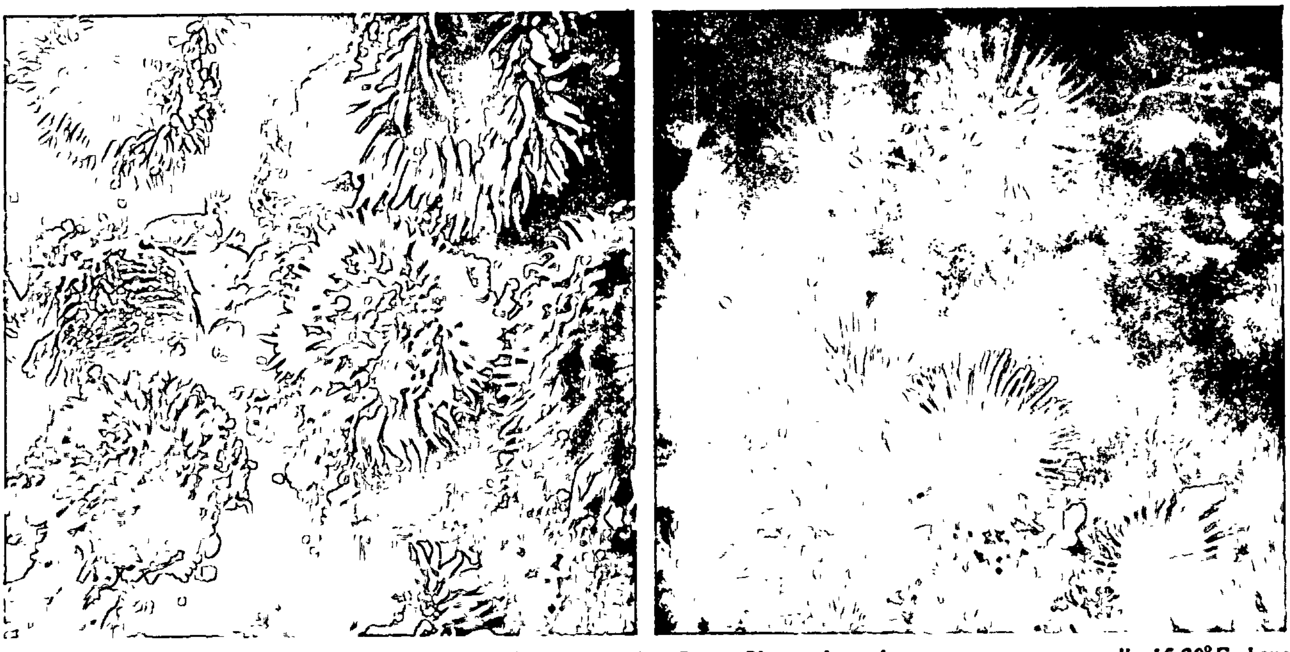
Due to the commercial importance of abalone in this area, PG&E has given considerable attention to assessing the impact of the thermal discharge on abalone survival. The cooling water discharge may create unfavorable thermal conditions for abalone to depths of 15 feet within 300 feet of the discharge and to depths of 10 feet over an area of 30 acres within the confines of the embayment. Since abalone cannot be legally gathered for commercial purposes shallower than 20 feet, no area is expected to be permanently removed as potential fishing territory for abalone divers. However, some reduction in red abalone is expected to occur within Diablo Cove as a result of plant operation. At the present time, at least two factors unrelated to the Diablo power plant are currently affecting the abalone population within Diablo Cove. These are: (1) the population of the large urchin, *Strongylocentrotus franciscanus*, which is a successful competitor for the existing food supply and (2) commercial harvesting.

Changes in Food-Web Associations

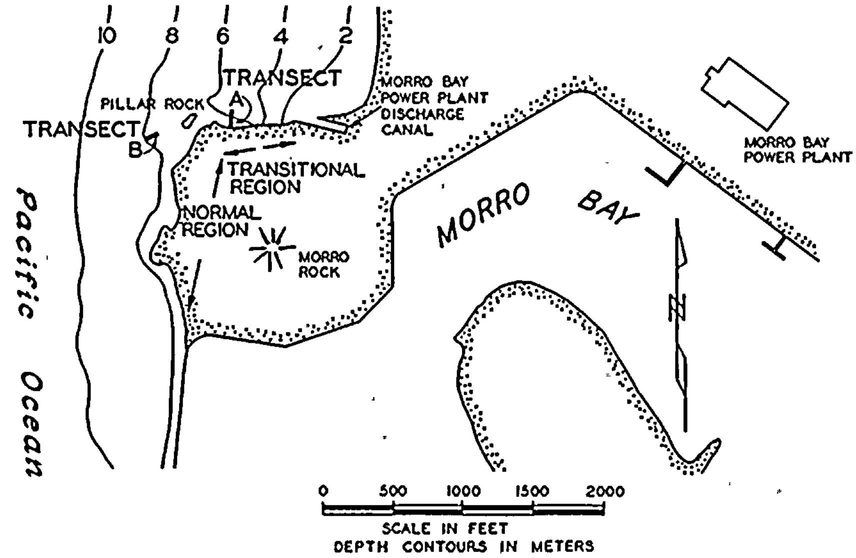
Investigations and experience at other power plants provide reasonable certainty that the operations of Units 1 and 2 will cause a change in species composition in the area by increasing the percentage of warm water species within the shallow parts of the cove. When considering biological changes that may occur in a situation such as Diablo Cove, however, it is important to realize that the end result could be a richer, more dense association of organisms than now present. Changes in species composition do not imply that a barren area will develop or that standing crops will decrease significantly. The relative nearness of Diablo Cove to Point Conception will insure a plentiful supply of organisms to provide for the establishment of a community of rich flora and fauna.

Many marine organisms can tolerate wide temperature fluctuations, and many survive continuous exposure to temperatures well above average values in their natural environments. It is reasonable to predict that species sensitive to warmer water will diminish and be replaced by species now present that can tolerate the change; i.e., other warm water species, currently absent, may appear as larvae or eggs and be brought into the area by ocean currents. In general an initial decrease in species diversity and standing crop is predicted, followed by a recovery of standing crop and a gradual recovery of species diversity.

Another factor considered is whether appreciable ecological imbalances may arise during the initial period of plant operation while the biota is adjusting to the presence of the warm water discharge. If an imbalance develops among the various trophic levels (plant producers, herbiv-



*Some common marine life in the discharge canal of the Morro Bay Power Plant, where the temperatures are usually 15-20°F above normal ocean temperatures. (Left): Lined shore crab (*Pachygrapsus crassipes*) and giant green anemone (*Anthopleura xanthogrammica*). (Right): Small anemone (*Diadumene sp.*)*



LOCATIONS OF ECOLOGICAL SURVEYS NEAR MORRO BAY

FIGURE 6

ores, lower carnivores, higher carnivores, decomposers, etc.), deterioration could be much more serious and extend beyond the area exposed to the warm water discharge. On a short-term basis, abalone fishing might be affected if such an imbalance develops temporarily in the ecological food chains supporting the abalone populations. Conceivably, this could affect abalone fishing in areas beyond Diablo Cove.

Mitigation of any ecological imbalance in the abalone food chain is believed feasible by the control of competetive grazers. The principal cause for concern lies in the presence of the large population of giant urchins in the Shallow Barren Zone of Diablo Cove. Urchins are not utilized to any extent commercially, and they can be eliminated by techniques developed by the Kelp Habitat Improvement Project at the California Institute of Technology. It is believed that the population in the Shallow Barren Zone easily would be reduced to concentrations that would not create ecological problems in the barren areas. An excellent algal cover would require six months to one year for development.

The possibility of creating a widespread ecological imbalance is highly unlikely, as evidenced by observations at other PG&E power plants. Therefore, predictions are that ecological effects will not extend significantly beyond Diablo Cove. PG&E has developed substantial justification for this view by examining the effects of the heated effluent discharged from the Morro Bay plant.

Cooling water at the Morro Bay plant is drawn from Morro Bay and discharged through a canal just northeast of Morro Rock. Surveys which were started in 1965 have identified a total of 100 animal and eight plant species (Table 19). The survey identified as survey Number 3 in Table 20 resulted in the identification of three regions that appear fairly distinct in the vicinity of the discharge: (1) the discharge canal, (2) a transitional region along the northeast face of Morro Rock and (3) a normal region beginning about 500 feet from the discharge canal. These regions are shown in Figure 6. Plant and animal species observed are listed in Tables 21 and 22 respectively.

Effects within the Morro Bay canal and the transitional region are much more pronounced on the flora than on the fauna. Within the discharge canal and the transitional region, vegetation is low, both in the numbers of species present and in the total biomass. The fauna, however, is much less influenced because there is a luxuriant cover of benthic invertebrates on the riprap that lines the discharge canal. Fauna species composition changes markedly when passing from the canal through the transitional region to the normal region. The total number of animal and plant species noted in the Morro Bay canal by all observers is 108. It is significant that such a large number of species apparently flourish under these circumstances. It is, perhaps, even more significant that ecological effects can be unequivocally demonstrated for a distance of only about 500 feet from the canal.

The Morro Rock area and Diablo Cove have in common 33 animal and 23 plant species. This represents 68 percent of all the animal and 66 percent of the flora thus far observed at Morro Bay. (Diablo Cove is a much more varied environment with a very large species diversity, and the reverse percentages are therefore smaller: 19 percent of the Diablo fauna and 34 percent of the Diablo flora occur at Morro Rock.) The Morro Rock biota tends to have a slightly higher component of northern (presumably psychrophilic) organisms. Therefore, it is concluded that, biologically, Morro Rock resembles Diablo fairly closely, and any differences involve a slight preference by cold water forms at Morro Rock. It seems entirely justifiable to assume that conditions in the vicinity of the Morro Bay discharge canal are either representative of or more severe than changes that may occur in Diablo Cove. Changes observed at Morro Rock are in general a substitution of warm water species for cold water forms in areas where temperatures are most elevated, a transitional zone about 500 feet long where species and biomass are diminished and then a normal region. Transposed to Diablo Cove, it is expected that most of the ecological alterations will be along the shoreline within the cove, but as the headlands to the northwest and southwest are approached, normal conditions should persist.

TABLE 19 Summary of Organisms Observed in the Morro Bay Power Plant Discharge Canal

Species	Survey Number 1	2	3	4	5
Rhodophyta					
Corallina chiliensis, Erect Coralline Red Algae		X			
Gigartina sp.				X	
Gracilariopsis sjoestedtii	X				
Grateloupia setchellii				X	X
Iridaea cordata var. *splendens*		X		X	
Microcladia coulteri	X				
Polysiphonia pacifica				X	X
Schizymenia pacifica				X	
Porifera					
Aplysilla glacialis	X				
Haliclona sp., Encrusting Sponge		X		X	X
Leucetta los angelensis, Turquoise Sponge				X	
Leucosolenia sp.				X	X
Rhabdodermella nuttingi	X			X	
Coelenterata (Hydrozoa)					
Tubularia crocea, Pink Mouthed Hydrozoa				X	X
Coelenterata (Anthozoa)					
Anthopleura artemesia, Burrowing Anemone	X	X	X		X
A. elegantissima, Aggregated Anemone			X	X	X
A. xanthogrammica, Giant Green Anemone		X	X	X	X
Haliplanella luciae (=Diadumene sp.)(tan anemone)				X	X
Epiactis prolifera, Proliferating Anemone				X	
Harenactis attenuata				X	
Bryozoa					
Bugula sp.			X		
Membranipora membranacea, Encrusting Bryozoan					X
Phidolopora pacifica, Coralline Bryozoan	X				
Annelida					
Cirriformia spirabranchia, Hairy Gilled Worm	X				
Lumbrinereis zonata	X				
Nephtys caecoides	X				
Phyllochaetopterus prolifica				X	
Sabellaria sp.		X			
Mollusca (Amphineura)					
Chaetopleura gemma	X				
Mopalia muscosa, Mossy Chiton	X				
Mollusca (Gastropoda)					
Acanthina spirata, Thorn Shell				X	
Acmaea digitalis, Rough Limpet	X			X	
A. limatula, File Limpet			X	X	
A. pelta (limpet)			X	X	
A. scabra, Ribbed Limpet			X	X	
A. scutum, Plate Limpet	X			X	
Aeolidia papillosa (eolid nudibranch)	X				
Aletes squamigerus, Fixed Snail				X	
Amphissa versicolor				X	
Chromodoris californiensis (dorid nudibranch)				X	
Diaulula sandiegensis (dorid nudibranch)			X	X	X
Hermissenda crassicornis (eolid nudibranch)			X	X	X
Jaton festivus, Festive Rock Shell					X
Littorina scutulata, Checkered Periwinkle				X	
Mitrella carinata		X			
Olivella biplicata, Purple Olive	X			X	
Pusula californiana	X				
Tegula funebralis, Black Turban Snail	X			X	

TABLE 19 (Cont'd) **Summary of Organisms Observed in the Morro Bay Power Plant Discharge Canal**

Species	Survey Number 1	2	3	4	5
Mollusca (Pelecypoda)					
Chama pellucida, Rock Oyster	X		X	X	X
Clinocardium nuttallii, Basket Cockle	X				
Kellia suborbicularis	X				
Mytilus californianus, California Mussel	X	X			
M. edulis, Bay Mussel	X			X	X
Ostrea lurida, Native Oyster		X			
Pododesmus macroschisma, Jingle			X		
Protothaca laciniata, Rough Sided Littleneck Clam				X	X
P. staminea, Common Littleneck Clam	X				
Saxicava pholadis	X				
Saxidomus nuttalli, Washington Clam	X				
Tivela stultorum, Pismo Clam (shell only)				X	
Tresus nutalli, Gaper Clam (shell only)				X	
Volsella modiolus, Giant Horse Mussel	X			X	X
Arthropoda					
Balanus cariosus, Thatched Barnacle	X	X			
B. glandula, Acorn Barnacle	X		X	X	X
B. nubilis, Giant Barnacle				X	
B. tintinnabulum, Red and White Barnacle	X	X	X	X	X
Cancer attennarius, Rock Crab	X	X	X	X	X
C. jordani (crab)	X				
Caprella equilibra, Skeleton Shrimp	X			X	X
Cthamalus dalli (barnacle cthamalus)				X	X
C. fissus (barnacle)			X		
Corophium acherusicum (amphipod)	X	X		X	
Hapalogaster cavicauda, Hairy Crab				X	
Hemigrapsus nudus, Purple Shore Crab		X			
H. oregonensis, Hairy Shore Crab	X				
Neosphaeroma oregonensis (isopod)	X				X
Pachycheles rudis, Porcelin Crab				X	
Pachygrapsus crassipes, Lined Shore Crab	X		X	X	X
Pagurus samuelis, Hermit Crab	X			X	
Polycheria antarctica (commensal amphipod)					X
Pugettia producta, Kelp Crab		X		X	
Tetraclita squamosa rubescens, Red Barnacle				X	
Phoronida					
Phoronis sp. (phoronid)	X				
Echinodermata					
Amphiodea occidentalis, Brittle Star	X			X	X
Pateria miniata, Bat Star Pateria				X	
Pisaster Brevispinus, Shortspined Star				X	
P. ochraceous, Ochre Star				X	
Chordata (Urochordata)					
Amaroucium californicum, Sea Pork	X				
Botrylloides diegensis (compound ascidian)				X	
Botryllus sp. (compound ascidian)					X
Distaplia occidentalis (compound ascidian)		X			
Pisces					
Amphistichus argenteus, Barred Surfperch		X		X	
Atherinops affinis, Topsmelt		X		X	
Atherinopsis californiensis, Jacksmelt		X			
Embiotoca jacksoni, Black Perch		X	X		
E. lateralis, Striped Seaperch		X		X	
Engraulis mordax, Northern Anchovy		X			
Girella nigricans, Opaleye		X	X	X	X
Hermosilla azurea, Zebra Perch		X			
Hyperprosopon argenteum, Walleye Surfperch		X			
Medialuna californiensis, Halfmoon		X			
Paralabrax clathratus, Kelp Bass		X			
P. nebulifer, Sand Bass		X			
Paralichthys californicus, California Halibut				X	
Raja inornata, California Skate		X		X	X
Roccus saxatilis, Striped Bass	X	X		X	
Rhacochilus vacca, Pile Perch		X			
R. toxotes, Rubberlip Perch		X			
Sebastes rastrelliger, Grass Rockfish				X	
Urolophus halleri, Round Sting Ray				X	X

TABLE 20 **Summary of Plant and Animal Species Observed in the Vicinity of the Morro Bay Discharge Canal During Survey Number 3**

Region	Plant Species	Animal Species
Discharge canal	0	27
Transitional region	10	23
Normal region	30	44

TABLE 21 **Seaweed Species Observed In and Near the Discharge Canal During Survey Number 3**

Species	Discharge Canal	Transitional Region	Normal Region
Chlorophyta			
Codium setchellii			X*
Ulva sp.			X*
Phaeophyta			
Laminaria setchellii		X**	X*
L. sinclairii			
Rhodophyta			
Aeodes gardneri			X
Agardhiella coulteri			X*
Ahnfeltia plicata			X
Calliarthron cheilosporiodes			X*
Callophyllis flabellulata		X**	X*
C. heanophylla			X*
Cryptopleura violacea			X
Gelidium robustum			X*
G. coulteri			X
Gigartina volans			X*
Gracilariopsis sjoestedtii		X	X*
Gymnogongrus leptophyllus			X
Hymenena flabelligera			X
Iridaea flaccida			X*
I. lineare		X	X
I. splendens			X
Laurencia gardneri			X
Melobesia marginata		X	
Peyssonelia pacifica		X**	X
Plocamium coccineum			X*
Polyneura latissima			X*
Polysiphonia brodiaei			X
Prionitis lanceolata		X**	X*
P. linearis			X*
Pterosiphonia dendroidea		X**	X*
Ptilota densa			X
Rhodymenia pacifica		X**	X*
Schizymenia epiphytica			X*
Spermatophyta			
Phyllospadix torreyi		X	X

*Noted along Transect B
**Noted along Transect A

TABLE 22 ANIMAL SPECIES OBSERVED IN AND NEAR THE MORRO BAY DISCHARGE CANAL DURING SURVEY NUMBER 3

Species	Discharge Canal	Transitional Region	Normal Region
Porifera			
Acarnus ericthacus			X
Ficulina suberea		X	X
Haliclona permollis		X	X
Lissodendoryx firma		X	X
Plocamia karykina			X
Rhabdodermella nuttingi		X	X
Coelenterata (Hydrozoa)			
Sertularia sp.		X	
Tubularia sp.	X		
Coelenterata (Anthozoa)			
Anthopleura artemesia		X	X
A. elegantissima	X	X	X
A. xanthogrammica	X	X	X
Corynactis californica			X
Epiactis prolifera	X		
Tealia sp.			X
Bryozoa			
Bugula sp.	X		
Rhyncozoon rostratum		X	X
Annelida			
Diopatra ornata			X
Eudistyla polymorpha			X
Phragmatopoma californica			X
Phyllochaetopterus prolifica	X		
Spirabranchis spinosus			X
Mollusca (Gastropoda)			
Acmaea limatula	X		
A. mitra			X
A. pelta	X		
A. scabra	X		
Aeolidia papillosa	X		
Anisodoris nobilis			X
Archidoris monteryensis			X
Diaulula sandierensis	X		
Hermissenda crassicornis	X	X	X
Mitrella sp.			X
Olivella biplicata			X
Phidiana niger			X
Rostangia pulchra			X
Tegula funebralis	X		
Mollusca (Pelecypoda)			
Chama pellucida	X		
Mytilus californianus			X
M. edulis	X		
Pododesmus macroschisma	X	X	X
Arthropoda			
Balanus glandula	X		
B. tintinnabulum	X		
Cancer sp.	X		
Chthamalus fissus	X		X
Pollicipes polymerus			X
Pachygrapsus crassipes	X		
Echinodermata			
Leptasterias aequalis		X	
Pisaster brevispinus			X
P. giganteus			X
P. ochraceous	X	X	X

TABLE 22 (Cont'd) ANIMAL SPECIES OBSERVED IN AND NEAR THE MORRO BAY DISCHARGE CANAL DURING SURVEY NUMBER 3

Species	Discharge Canal	Transitional Region	Normal Region
Chordata (Tunicata)			
Amaroucium sp.		X	
Botrylloides diegensis	X		
Didemnum carnulentum			X
Euherdmania claviformis			X
Perophora annectans		X	
Polyclinum planum		X	X
Sigillinaria pulchra			X
Styela montereyensis			X
Chordata (Pisces)			
Unident. Atherinid	X	X	
Embiotoca jacksoni	X		
E. lateralis		X	X
Cirella nigricans	X	X	
Hexagrammos decagrammus		X	X
Hypsurus caryi			X
Ophiodon elongatus		X	X
Paralabrax clathratus (juveniles)	X		
Phanerodon furcatus		X	
Platyrhinoides triseriatus			X
Rhacochilus vacca		X	X
Scorpaena guttata			X
Scorpaenicthys marmoratus			

Fish Protection Facilities

Intake design for Units 1 and 2 evolved from environmental considerations and the present and potential commercial and recreational usages of the area. Seawater entering the intake structure passes first through trash racks consisting of 3/8 inch by 3 inch bars at 3-3/8 inch center spacing. These inclined bar racks retain floating debris of moderate size which can be raked from the bars if necessary. A typical section through the intake structure is illustrated in Figure 3 on Page 28.

After passing through the trash racks, water flows through traveling water screens which have 3/8 inch square openings and physically remove objects or organisms that might clog the condenser tubes. The traveling water screens of the cooling system are located to minimize the possibility of fish being trapped against the screens. The trash racks form a cage out in the water, keeping debris from the screens but allowing free passage of fish with no traps or pockets. Approach velocities are less than 1 foot per second, and maximum velocities through the traveling screens are less than 2 feet per second. Tests conducted at PG&E's Contra Costa Steam Plant have shown that large fish can swim away from these approach velocities, and smaller fish can pass through the traveling screens without harm.

Effects on Pelagic Communities

Phytoplankton

The effects of the cooling water discharge on pelagic communities can be considered primarily in terms of freely-drifting forms such as phytoplankton and zooplankton. Since the intake screens will be 3/8-inch mesh, only these smaller organisms which pass through the screens will be exposed to the full temperature rise across the condensers.

The survival of phytoplankton passing through condenser cooling water systems has been studied by several investigators (Coutant, 1970; Johns Hopkins University, 1970; Hirayama and Hirano, 1970–see Appendix M). Differences in the thermal and chlorine tolerance of several phytoplankton species have been found. The studies indicate that heated effluents from a power plant will not biologically damage marine phytoplankton, even within the immediate area of the discharge, because neither the temperature experienced nor the chlorine levels at operating power plants reach the lethal levels determined from laboratory experiments. The effects of passage of phytoplankton through a condenser have been studied at the San Onofre Generating Station in southern California at intake temperatures ranging from 60.8°F to 65.3°F and discharge temperatures ranging from 79.7°F to 82.4°F. (See Appendix M) Analysis of carbon-14 and chlorophyll studies indicate little, if any, negative effect on the productivity of the phytoplankton.

The average monthly temperatures at Diablo Cove show about a 15°F range, from 48°F to 63°F. This low seasonal temperature spread, combined with the character of the phytoplankton populations in the area, should limit any potential adverse effects to a very restricted time period. Even if certain cold-water forms of plankton are damaged during some unusually warm spells, the presence of warm water forms and the rapid turn-over time of plankton populations themselves (in the order of a few days) should make the effects extremely localized, and insignificant to other forms dependent upon phytoplankton for food.

Zooplankton

Samples of the zooplankton populations offshore of Diablo Cove have been collected as part of the oceanographic studies. Many different investigators have studied the effects of passing zooplankton through the cooling water system of thermal power plants (Heinle, 1969; Barnett and Hardy, 1969; Johns Hopkins University, 1970; Hair, 1971—see Appendix M). In general, the results show that each species has an upper thermal limit which cannot be exceeded even for short term exposures. This upper thermal limit for the oppossum shrimp, *Neomysis awatschensis,* was shown by Hair to be 87°F at a 6-minute exposure and 97°F for the mollusc larvae *Tellina sp.*

Zooplankton were sampled from the intake and discharge of the San Onofre Nuclear Generating Station on five different periods in December 1970, when intake temperatures ranged from 60.8°F to 65.3°F, and discharge temperatures varied from 79.7°F to 82.4°F. The average mortality for the zooplankton was 12.7%, with copepods and mysids representing nearly all the mortality. Soft-bodied animals and protozoans showed little, if any, effect from their passage. Both veliger and post-larval stages of gastropods (snails) and pelecypods (clams) had no observed mortality when recovered in the discharge water.

The same general conclusions about the effects of the cooling water discharge from Units 1 and 2 on phytoplankton can be applied to zooplankton. The upper lethal thermal limit for any of the numerous species of zooplankton found in the area probably will occur only during unusual warm periods, if at all. The effect of such a brief occurrence on the overall ecology would be insignificant because of the rapid turnover times of zooplankton populations and the continual recruitment from other areas.

Monitoring

Monitoring of the impact of Units 1 and 2 on the marine biota will be accomplished through continual examination of the indicator species. At least two organisms identified in Diablo Cove—bull kelp and red abalone—should prove useful for this purpose. The bull kelp, *Nereocystis leutkeana*, should serve as a useful indicator of the thermal effects. This cold water species, widely distributed in the area, may be affected by temperature increases. A program of photographing and mapping the kelp canopy from Point San Luis to Point Buchon on a seasonal basis has been in effect since 1969.

Summary

Ecological studies indicate that operation of Units 1 and 2 at Diablo Canyon will cause a change in species composition over a limited area. From observations at Morro Bay power plant discharge it is anticipated that at Diablo Cove some but not all the cold water species will be replaced by warm water species, resulting in some reduction in species diversification near the discharge. Observations at the site suggest that the ecological changes that will occur will remain within Diablo Cove. Thus, no general ecological disruption is expected.

PG&E believes that its studies have characterized adequately the fauna and flora and established distribution patterns within the Diablo Cove region. Continuing studies, as described in Appendix A, are being conducted to further evaluate the natural temporal and spatial changes which occur in Diablo Cove and vicinity.

Radioactive Discharges

Introduction

The operation of any nuclear power reactor results in the production of radioactive materials essentially all of which are contained within the fuel elements in the reactor vessel. These radioactive materials are produced as a direct result of the fission process or are activated materials in the reactor core resulting from nuclear reactions. Small quantities of gaseous and liquid radioactive wastes will be released from the plant by a strictly controlled process. The power plant is designed to keep these releases of radioactive materials as low as practicable and within AEC limits.

Waste Processing

During normal operation, the majority of radioactivity generated is retained within the fuel rods. At the end of their useful life, the fuel assemblies containing radioactive fission products will be removed from the reactors and shipped to a fuel reprocessing plant. To handle those radioactive wastes not contained within the spent fuel, the power plant will be equipped with an extensive waste handling system. This system will include a waste disposal system (WDS) and one chemical and volume control system (CVCS) for each of the nuclear steam supply systems (NSSS).

System Description

Essentially all of the waste not removed with the spent fuel will be collected first by a CVCS and then will be processed by the WDS (Plate 4). These systems are designed to process all wastes generated during continuous full power operation of both NSSS, assuming that fission products diffuse into the reactor coolant system from one percent of the fuel rods having defects in the cladding. In addition, these systems will have adequate holdup capacity and equipment capability to process all wastes generated during unit load changes and refueling outages. Radiation monitors and radiochemical analysis will be employed to maintain surveillance over releases from the WDS, and a record of all releases will be kept. The environmental monitoring program which has already been initiated at the site will be used to detect and assist in the evaluation of the environmental effect of these releases.

The bulk of the radioactive wastes generated within the plant will be processed and retained within the plant by the CVCS. This will minimize waste input to the WDS with the result that the WDS will process relatively small quantities of generally low activity level wastes. Radioactive wastes entering the WDS from various sources will be collected in sumps and tanks until determination of appropriate treatment can be made. Waste will then be processed to an extent dictated by chemical and radiochemical analyses.

Radioactive wastes generally originate in the reactor coolant of an NSSS, and each CVCS continuously removes this activity. The cleanup operation will be performed by a series of demineralizers, evaporators, filters and gas strippers. In addition, these systems will contain a number of large tanks which will be used to hold used coolant within the plant and allow the radioactivity to decay. Once the coolant is purified to an acceptable quality, it will be reused within the plant.

Liquid Wastes

Some leakage or intentional releases from the NSSS and CVCS will occur. In the case of liquid wastes, they will be segregated at their source as to radioactivity levels. This segregation will be maintained throughout the processing system in order to optimize the cleanup efficiency of the individual components and the system. The entire liquid handling system is fabricated from corrosion resistant materials to limit the introduction of foreign contamination to the radioactive liquid wastes. After a holdup period of as much as seven days for decay in the waste receiver tanks, the waste either can be filtered and released or processed in the waste concentrator. Distillate from the concentrator then can be filtered and released to the condenser cooling water system while the concentrated waste is processed as solid waste. The degree of waste treatment to be employed will depend upon the levels of radioactivity present in the collected waste.

Gaseous Wastes

Gaseous wastes will consist primarily of: (1) Hydrogen stripped from coolant discharged to the volume control tank of the CVCS during boron dilution; and (2) Nitrogen from the closed gas blanketing system on the CVCS holdup tanks. These gaseous wastes will be pumped by compressors to one of several gas decay tanks. Since most of the waste gas handled by the system will be nitrogen, provisions have been incorporated which allow the gas to be recycled after a decay period of approximately 45 days. This holdup time is adequate to allow most of the radioactivity to decay. In order to reduce the hydrogen content of the stored gas, it will be necessary to discharge intermittently waste gas at a controlled rate through the monitored exhaust duct. This gas then will be mixed with ventilation air from various equipment compartments. These gases in turn will be exhausted through a monitored vent at the top of the containment structure.

Solid Wastes

Radioactive solids removed from liquid streams by the CVCS and WDS will be collected on demineralizer resins, filter cartridges or as waste concentrates. These wastes will be packaged in accordance with Department of Transportation regulations and stored at the power plant until shipped off-site for disposal.

Quantity of Radioactivity

Liquid Wastes

Quantities and activity levels of liquid wastes may be quite variable during operation of the plant. Table 23 provides an estimate of the annual amount of the principle radionuclides expected to be discharged into the condenser cooling water with both units in operation. This estimate assumes continuous operation with 1 percent defective fuel rod cladding. Using this assumption for fuel cladding defects, the liquid waste discharge excluding tritium which is discussed below, is not expected to exceed 7.06 curies per year.

Units 1 and 2 will use zircaloy clad fuel, which is expected to contain most of the tritium generated in the fuel. Tritium which diffuses through the fuel cladding and reaches the waste system cannot be removed by treatment. However, the maximum amount of tritium released from the plant is not expected to exceed 1/10 of 1 percent of that allowed by 10CFR20 limits.

Units 1 and 2 will use zircaloy clad fuel, which is expected to contain most of the tritium generated in the fuel. Tritium which diffuses through the fuel cladding and reaches the waste system cannot be removed by treatment. However, the

TABLE 23

Estimated Liquid Waste Activity to be Released with the Condenser Cooling Water (Units 1 and 2 — Diablo Canyon Site)

Isotope	Curies Per Year
Cr 51	6.20×10^{-5}
Mn 54	2.04×10^{-4}
Fe 59	3.10×10^{-4}
Mn 56	5.56×10^{-3}
Co 58	6.20×10^{-3}
Co 60	7.32×10^{-4}
Sr 89	1.91×10^{-3}
Sr 90	1.21×10^{-3}
Y 90	2.24×10^{-4}
Sr 91	5.24×10^{-4}
Y 91	4.44×10^{-4}
Y 92	1.08×10^{-3}
Zr 95	3.56×10^{-4}
Nb 95	3.52×10^{-4}
Zr 97	2.28×10^{-4}
Mo 99	2.64
I 131	1.392
Te 132	1.47×10^{-1}
I 132	5.90×10^{-2}
I 133	1.08
I 134	4.54×10^{-3}
I 135	5.48×10^{-1}
Cs 134	1.83×10^{-1}
Cs 136	1.76×10^{-2}
Cs 137	9.64×10^{-1}
Ba 140	4.80×10^{-4}
La 140	4.94×10^{-4}
Ce 144	1.65×10^{-3}
Total Activity	7.06 Curies

Note: This table does not include tritium nor isotopes having short half lives or insignificant production rates.

TABLE 24

Estimated Annual Gaseous Activity to be Released (Units 1 and 2 — Diablo Canyon Site)

Isotope	Curies per Year
Kr 85	11,820
Kr 85m, 87, 88	negligible
Xe133	3,320
Xe 133m, 135, 135m, 138	negligible
I 131	negligible
Total Activity	15,140

maximum amount of tritium released from the plant is not expected to exceed 1/10 of 1 percent of that allowed by 10CFR20 limits.

Gaseous Wastes

Table 24 contains an estimate of the annual gaseous activity released from both units if both units operate at full power with 1 percent fuel cladding defects.

Exposure to Man

Two primary pathways of exposure to man have been identified: external exposure due to gaseous wastes and internal exposure due to the ingestion of seafood which has concentrated liquid wastes. The terrestrial food chain pathways have been identified and are accounted for in the environmental monitoring program. Under normal conditions, the design of the waste disposal system is such that only small quantities of the noble gases, krypton and xenon, are released through the vents following retention for radioactive decay. The predominant effect of these gases derives from the external radiation exposure they may contribute since, as inert gases, they cannot be reconcentrated within the human food chain. If the releases tabulated in Table 24 occurred, it has been estimated that the exposure to any member of the public who may be in the vicinity of the plant would be 0.6 millirem (mrem) per year. (See Appendix L for the assumptions used in this exposure estimate.)

A study has been undertaken of the site's marine environment to evaluate the exposure which could result from the consumption of edible marine species removed from Diablo Cove. The maximum concentration of radioactivity expected to occur in red abalone (the only edible marine species removed in significant quantities from the area) was calculated. Calculations were based on concentration factors obtained from the field literature and from laboratory analysis conducted on abalone removed from Diablo Cove.

Using data shown in Tables 23 and 25, a concentration of approximately five picocuries per gram above background radiation in abalone collected near the site was estimated. The concentrations were then used to compute a possible exposure to persons consuming these abalone. Assuming that an individual's entire protein source was abalone from Diablo Cove, it was estimated that he would receive from this source an annual dose of 0.4 mrem (see Appendix L for assumptions used in this calculation).

Exposure to Species

Similar techniques were used to estimate the total body burden which might accumulate in other species found at the site (Table 25). It was determined that in no case would body burden of any species group found in Diablo Cove exceed the maximum permissible body burden for man as allowed by 10CFR20. Lower forms of life as found in Diablo Cove are less sensitive to radiation than is man. Therefore it is concluded that no hazard exists to the marine ecology as a result of plant operation.

Radioactivity Environmental Monitoring

In order to verify the preceding conclusions, PG&E has undertaken an extensive environmental monitoring program. The program, which was initiated in December 1969, has two purposes: (a) to obtain information concerning naturally occurring radioactivity in the vicinity of the site before plant operation begins and (b) to aid in confirming the effectiveness of waste disposal systems and procedures in protecting the public from radioactivity as a result of power plant operation.

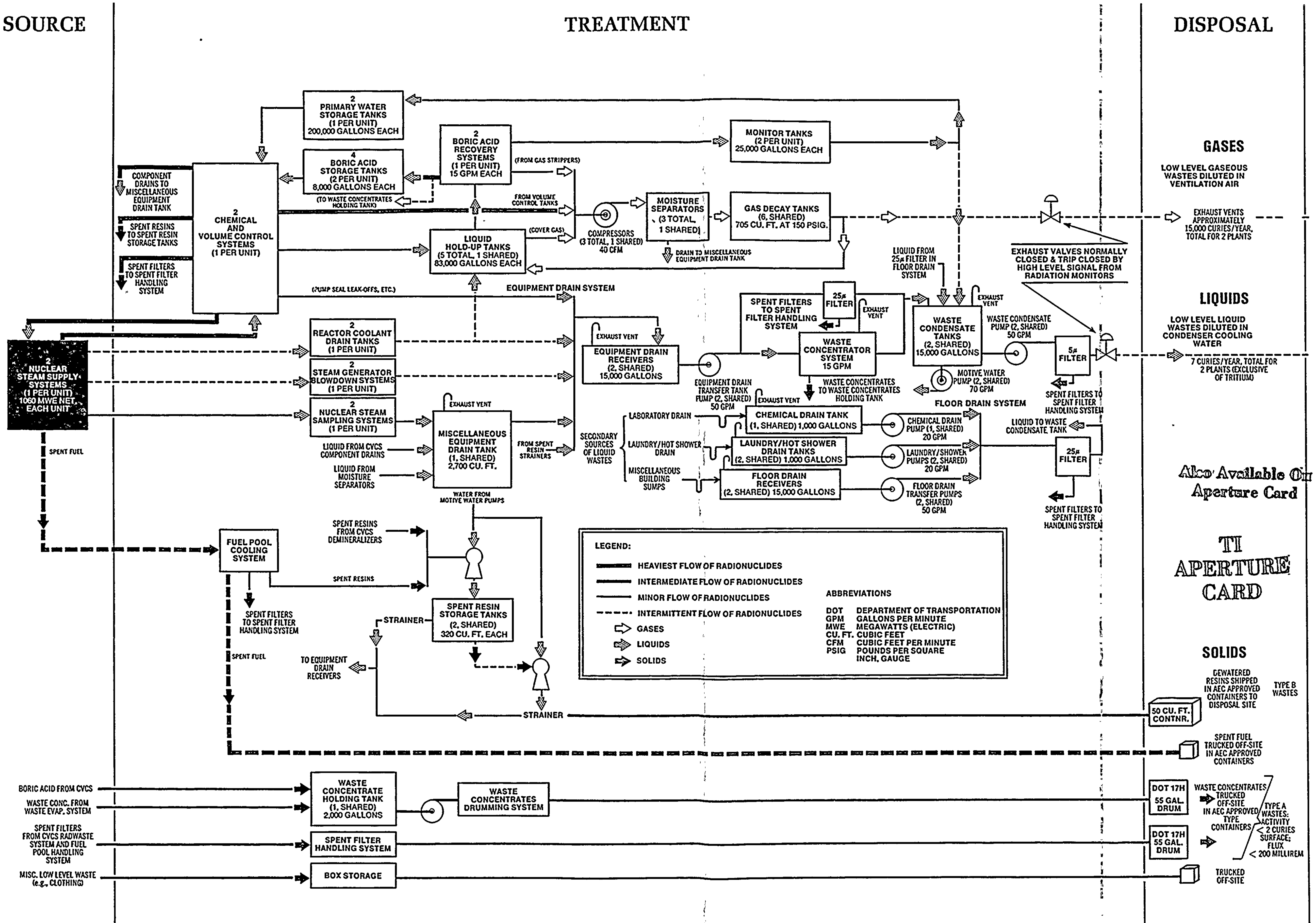
The monitoring program has been developed in cooperation with the State of California Department of Public Health, Bureau of Radiological Health, and other interested state agencies. As described in detail in Appendix K, the program includes analysis on the following samples: air particulate and seawater (gamma dosimeters will be used to measure the direct exposure in the vicinity of the plant); milk, vegetables, abalone, clams and fish (to be analyzed to detect radioactivity entering man's food chain); bovine thyroid, barnacles, mussels, kelp, algae and ocean bottom sediment (to be analyzed to provide early indication of changes in radioactivity levels in the environment).

TABLE 25

Approximate Concentration Factors for Different Elements in Marine Specimens (Live Weight Basis) Collected from the Diablo Canyon Area

	Element								
	Fe	Cr	Co	Mn	Mo	Na	Y	Cs	I
Red Abalone Meat	500	100	300	60	500	1	10	20	1.3
Red Abalone Viscera	30,000	600	600	600	1,000	1	40	30	-
Red Abalone Shell	20,000	-	2,000	1,000	-	.4	10,000	-	-
Black Abalone Meat	5,000	200	1,000	60	800	-	500	40	-
Black Abalone Viscera	30,000	800	400	300	2,000	1	900	30	-
Black Abalone Shell	2,000	-	-	2,000	-	.9	10,000	-	-
Sole (except fillet)	30,000	2,000	-	3,000	-	.6	2,000	500	-
Sole (fillet)	2,000	2,000	-	200	-	.05	-	30	5.8*
Sea Perch (fillet)	60	200	-	100	-	.06	200	50	2.0*
Sea Perch (except fillet)	7,000	-	-	2,000	-	.3	600	200	-
Sea Perch Scales	100,000	1,000	-	6,000	-	.2	2,000	500	-
Red Rockfish (except fillet)	800	1,000	1,000	100	-	.2	1,000	200	-
Red Rockfish (fillet)	70	300	500	40	-	.08	200	80	3.2*
Blue Rockfish	600	500	1,000	100	-	.2	500	100	-
Mussels	2,000	-	1,000	1,000	-	.1	10,000	-	57.2*
Kelp	10,000	200	500	1,000	-	-	1,000	20	1*
Red Algae	1,000	-	1,000	200	-	-	800	-	.5*
Gooseneck Barnacles	2,000	-	5,000	400	-	.08	-	-	-

*The value for I is taken from Vinogradov, A. P. "The Elementary Chemical Composition of Marine Organisms. Sears Foundation for Marine Research, Yale University, Mem. No. 2, 647 p. (1953).



DIABLO CANYON RADIOACTIVE WASTE MANAGEMENT SYSTEM

THE ENVIRONMENTAL EFFECTS OF THESE LOW LEVEL WASTES ARE DISCUSSED UNDER SUBHEADINGS "EXPOSURE TO MAN" AND "EXPOSURE TO SPECIES" IN THE REPORT TEXT

Also Available On Aperture Card

TI APERTURE CARD

8506030233-04

Construction Effects

General

In building the units at Diablo Canyon, PG&E has adopted an environmentally oriented construction and restoration program. This has been done to minimize the adverse environmental effects often associated with large scale construction activity. Contractors on the job have been instructed that construction activities are to be geared towards preservation of the area's ecology and conservation of natural resources.

Schedules

Work first commenced on the access road in mid-1968. Site excavation work for Unit 1 began shortly thereafter. As of May 1, 1971, Unit 1 was approximately 22 percent complete and Unit 2 less than 1 percent. Scheduled commercial operating dates are spring 1974 for Unit 1 and spring 1975 for Unit 2.

Environmental Impact

During construction, most of the environmental effects have been localized in the immediate plant area and in the area of the two switchyards. Flora in these areas has been removed and undoubtedly some wildlife has been disturbed. However, overall topographic, vegetative and wildlife characteristics of the site have experienced relatively little disturbance.

Described below are the major construction activities and their associated environmental effects, and the efforts PG&E has made to mitigate these effects.

Access Road

The access road from the town of Avila Beach to the site, a distance of about seven miles, was designed and constructed after consultations with public agencies of San Luis Obispo County and the adjacent land owners. The road was carefully routed to accommodate any future potential land use and to consider the natural and scenic features. The natural contour was followed as much as possible. Cuts were kept to a minimum, and grading was rounded where possible to match natural contours. To avoid excess material, cuts and fills were balanced and then seeded to control erosion. The entrance to this road is marked by an architecturally designed gatehouse.

Temporary Facilities

Locations of facilities normally associated with large scale construction, such as laydown areas, outdoor storage, warehouses and the construction camp, were carefully planned to be as unobtrusive as possible.

The concrete batch plant was located away from the power plant building because of noise and dust. An earth color was used on the structure to match the natural surroundings.

Whenever possible, construction buildings were located on the inland side of the access road in order to provide visitors with an unobstructed ocean view. In addition, these buildings were carefully designed and sited to be functional and to blend with their surroundings.

The camp site for construction personnel is in a naturally protected area away from the main construction area.

Pismo Beach Laydown Area

This laydown area for the heavy construction equipment and materials is located near the town of Pismo Beach adjacent to the Southern Pacific Railroad line. The site is zoned by the county for this type of use.

Approximately one-third of the site is landscaped (Plate 5). Trees and shrubs have been planted along the public road to partially conceal the yard.

Barge Landing—Avila Beach

Because of the size and weight of the nuclear reactor pressure vessels, special seagoing barges were required for shipment of the vessels from the manufacturer. A dock was built at Avila Beach to accommodate these barges. This structure is temporary and is planned to be dismantled after completion of construction.

Switchyards

The 230 kilovolt and 500 kilovolt switchyards lie across Diablo Canyon and over Diablo Creek. These sites were chosen for their functional arrangements to the power plant.

Some concern was expressed by conservation groups as to the appropriateness of locating the switchyards in the canyon and across the creek. They were concerned primarily with a grove of large oak trees situated in this area. Most of this grove was destroyed by construction of the switchyard fills but only after PG&E thoroughly studied the ecological significance of these trees. The study was undertaken by a company forester, and his report was independently reviewed by Dr. Richard F. Nelson, plant pathology consultant. The results of the study are described in the following paragraphs.

Description of Studies

The major focus of PG&E's terrestrial investigations has been a study of the California or coast live oak (*Quercus agrifolia*) stands in Diablo Canyon. Within this area, all oak tree stands were evaluated in terms of uniqueness, size, health and vigor and compared to oak compositions in other similar coastal areas. In order to fully anticipate the range and degree of the terrestrial impact of the plant development, investigations included an evaluation of the biological features of supporting or otherwise important floral and faunal species.

Observations

Results of PG&E investigations revealed no unique features of Diablo Canyon with regard to oak compositions. Other than a few particularly large trees, the oaks were the same as those in other small canyon flats along the California coast from San Francisco Bay south to San Diego. There were many indications that the large trees in Diablo Canyon were declining in health, vigor and quantity due to normal and abnormal pressures from rodents, disease and wind. Several rotting limbs were noted on some of the larger trees as well as evidence of heart rot and virus seeps on many others. Few stands of young oaks had been established, indicating that, as a major oak grove, the area would probably have been short-lived.

Palatable vegetation growing in the open areas of the oak grove had been heavily eaten back, indicating very heavy grazing pressures. The abundance of nonpalatable weeds and thistles also indicates prolonged grazing pressure. These

Concrete tribars protect the breakwater from heavy ocean surf.

same areas showed evidence of a large rodent population that had loosened the ground and allowed loose soil to move down the slopes. The earth movement along with the heavy grazing undoubtedly was a primary factor in preventing the establishment of young oaks that would eventually have replaced the older trees as they deteriorated with age and died out. Previous land usage, primarily grazing, contributed to the decline in terrestrial quality of Diablo Canyon.

Nevertheless, the required switchyard areas were kept to a minimum in order to control further removal of the coast live oaks. The switchyards were arranged at different elevations to fit the topography. Fill material was taken from an adjacent hill. This borrow area was graded to harmonize with the surrounding terrain.

Both the switchyards and the borrow area have been planted with native plant material and the resulting growth of the plants indicates that the reseeding program will be successful.

Overall, the effects of switchyard construction on the ecology of Diablo Canyon can be considered as moderate when compared to the total site area. The cutting of a portion of coast live oak grove removed food and cover for the wildlife; however, reseeding has returned a portion of this area for wildlife habitat.

Breakwater Construction

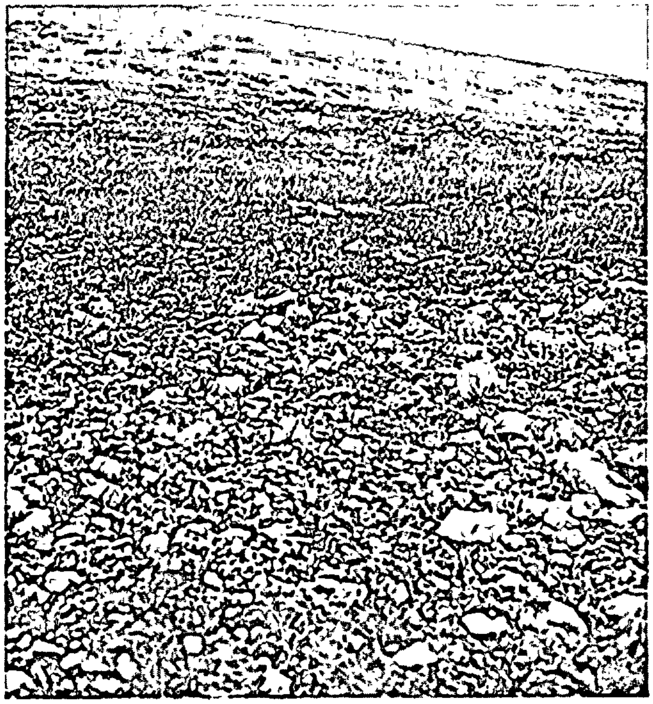
Special criteria are being used for breakwater construction to prevent adverse environmental effects. Dirt and debris discharges to the ocean are controlled to prevent objectionable foaming, discoloration and floating solids. Beaches impaired during construction will be restored to their original condition wherever possible. For protection against the heavy ocean surf, a layer of precast concrete tribars will be placed around the breakwaters.

The effect of the construction of the breakwaters and discharge structure on the marine ecological habitat has been reviewed and approved by the California Department of Fish and Game. To protect the abalone population during construction of the breakwaters and discharge structure, abalone removal and transplanting operations were carried out. In addition, the Department of Fish and Game is inspecting the actual construction of the breakwaters on a continual basis.

Site Restoration

To help restore the site area after construction, PG&E has sought the services and advice of many people knowledgeable in restoration methods and consulted researchers familiar with the native flora. Those persons consulted were: Prentiss French, Landscape Architect, Fellow American Society of Landscape Architects, San Francisco, California; and representatives from the following: Department of Environmental Horticulture, University of California at Davis; Ornamental Horticulture Department, California State Polytechnical College, San Luis Obispo, California; Farm Advisor-Agricultural Extension Service, San Luis Obispo, California.

This group, in cooperation with PG&E, is testing various seeding and restoration methods. A field



A reseeded fill area resulting in uniform coverage and strong growth of the native seeds irrigated only by rainfall. This photo was taken shortly after reseeding.

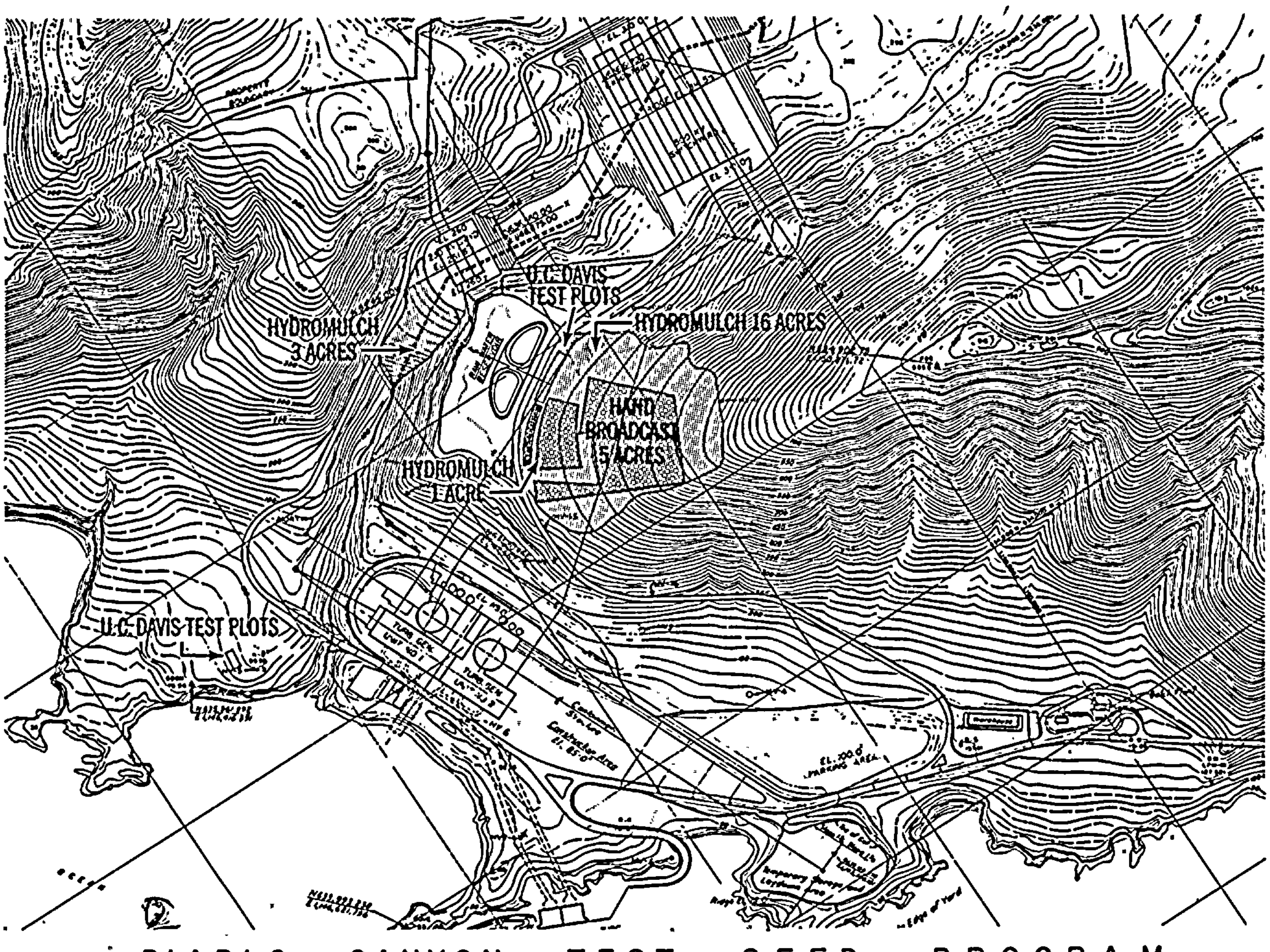
This tree lupine was seeded by the hydromulch method with fertilizer.

test program is being conducted in order to obtain the following data:

1. Methods of soil stabilization.
2. Ways to reestablish native vegetation species as quickly as possible.
3. Development of an economical program for supplying revegetation and natural landscape material to be employed during the final stages of the Diablo Canyon project.

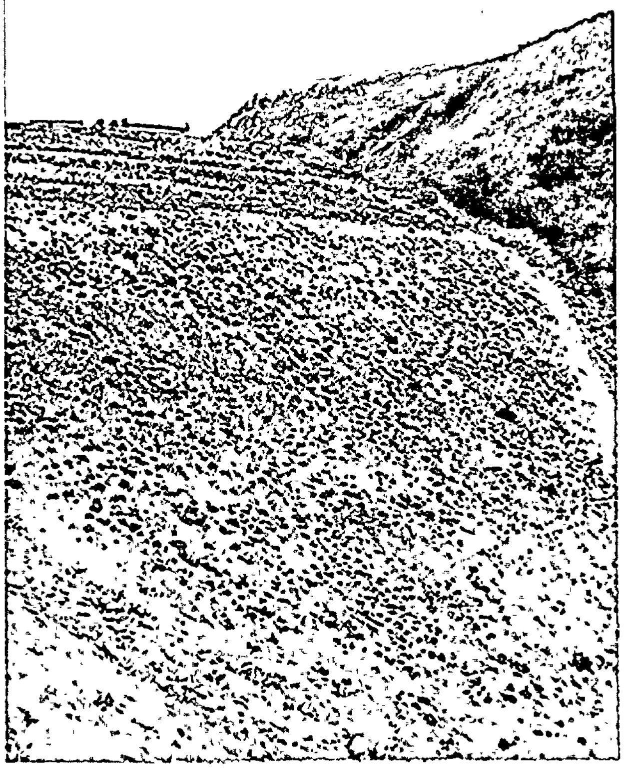
The test program covers about nine acres of varied terrain. Ecotypes range from annual grasses and sedges to Bishop pines and manzanita. In addition, sixteen acres of bare cutface soil at the borrow area east of the plant site were seeded with domestic and native species in December 1970 (Figure 9). This test program will provide data on which to base trial plantings on road cuts and fills. A variety of local plants and grasses from seeds collected in the area is being used. They are planted and germinated under several different methods using various fertilizing techniques. Results have been positive, although the program is not yet complete.

These experiments and testing programs are guiding the restoration policy at the site. Cuts,



DIABLO CANYON TEST SEED PROGRAM

FIGURE 7



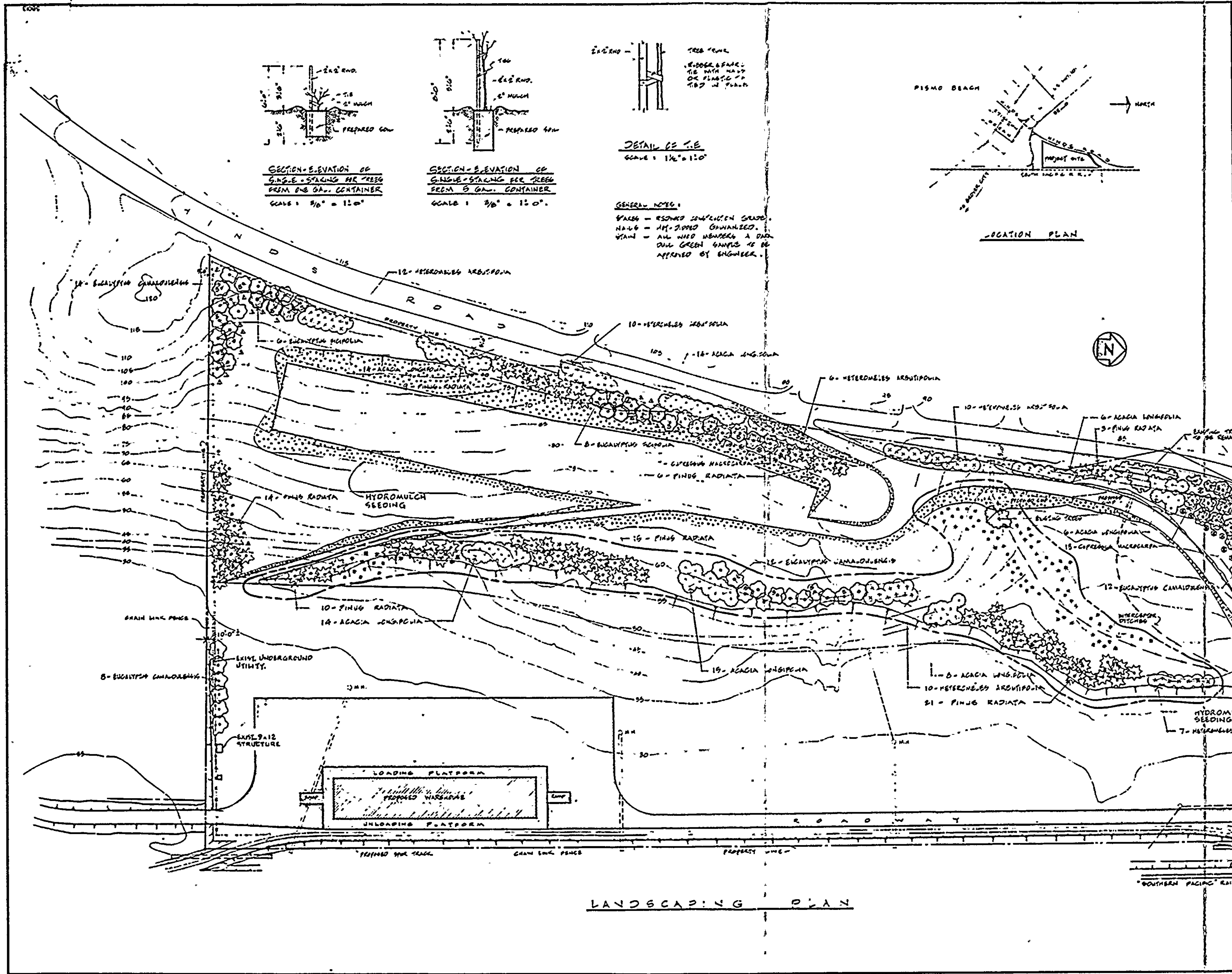
Part of the switchyard fill seeded by use of native plant seeds gathered near the site. Plants irrigated by rainfall only. Photo taken shortly after reseeding.

fills and other altered areas will be seeded with native vegetation to reduce erosion, restore natural appearance and to provide forage for wildlife. Where possible, other disturbed areas will be restored to the original terrain and then planted with natural ground cover.

Conclusion

A variety of wildlife has been observed in the Diablo Canyon area. Some of this wildlife has been displaced during construction. However, the restoration program of planting and reseeding which has been followed throughout the construction period will replace the forage lost to wildlife and help mitigate adverse effects. Consequently, the long-term impact is considered to be insignificant.

PLATE 5



PLANT SCHEDULE

SYMBOL	NAME	QUANTITY	CONTAINER SIZE	HEIGHT	REMARKS	ULTIMATE PLANT HEIGHT
	PINUS RADIATA MONTEREY PINE	20 / 58	5 GAL. / 1 GAL.	5' / 2'		80'
	EUCALYPTUS CAMALDULENSIS RED GUM	14 / 34	5 GAL. / 1 GAL.	7' / 4'		70'
	EUCALYPTUS FICIFOLIA RED FLOWER GUM	5 / 14	5 GAL. / 1 GAL.	7' / 4'		40'
	CUPRESSUS MACROCARPA MONTEREY CYPRESS	6 / 16	5 GAL. / 1 GAL.	6' / 4'		45'
	HETEROMELES ARBUTIFOLIA TOYON	65	1 GAL.	2'		20'
	ACACIA LONGIFOLIA EVERBLOOMING ACACIA	107	1 GAL.	2'		20'
	PINUS RADIATA MONTEREY PINE	200	TREEPOT	—	PLANT AT 5'-0" O.C.	80'
	CUPRESSUS MACROCARPA MONTEREY CYPRESS	100	TREEPOT	—	PLANT AT 5'-0" O.C.	45'
	EUCALYPTUS FICIFOLIA RED FLOWER GUM	100	TREEPOT	—	PLANT AT 5'-0" O.C.	40'
	HYDROMULCH SEEDING	—	—	—	BY P.G.&E. CO.	—

EXISTING TREES

PLANT IN 5 GAL. CONTAINER 1 GAL. OTHERWISE.

PLANTING PLAN
PISMO BEACH MATERIAL YARD
PACIFIC GAS AND ELECTRIC CO.

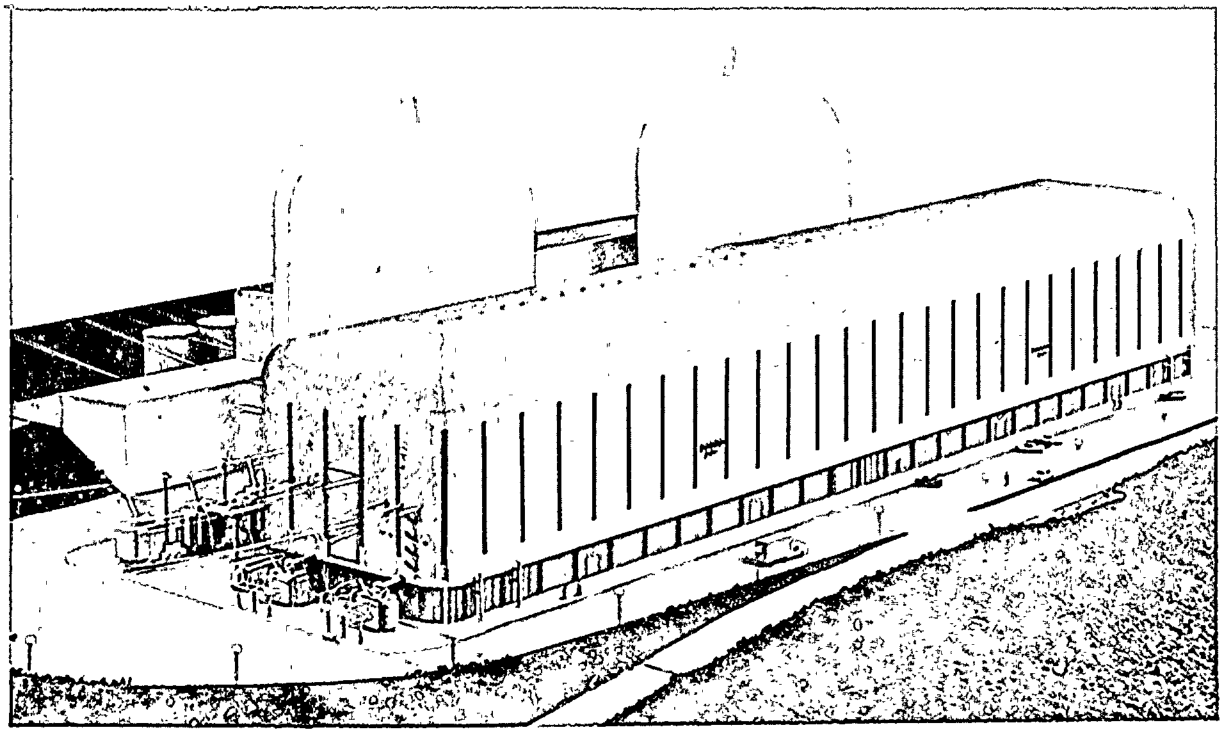
0 100 200 300
SCALE IN FEET
1971

8506030233-05

Aesthetics

General

Many conceptual ideas of appearance and other environmental amenities were considered in the aesthetic design of the power plant. The power plant was not treated as an isolated object but as part of its surroundings. The most problematic design criteria involved the housing of massive equipment and the accommodation of large-scale operations in an efficient and aesthetically pleasing manner. To assist in solving this design problem, PG&E engaged the services of a nationally known architectural consultant.



Simplicity, clarity and functionality were the design criteria used for the power plant complex.

Architectural Design

Due to its large scale and size, it would be virtually impossible to hide a nuclear power plant. The philosophy, then, which has governed the design of the power plant at Diablo Canyon is that it should make a bold statement while complementing the natural coastal setting. The architectural framework is meant to unify and contain the various power plant functions within as limited an area as possible.

The design concept has been to have contrast of tone, texture and form. The power plant buildings are arranged so as to give proportion and balance to the setting. For instance, the turbine-generator building is a horizontal building with narrow windows and a rounded roof structure to reflect the sloping hills in the background. In contrast, the reactor containment structure is the vertical element in the composition. This form reflects the functions contained within the containment structure.

Building colors have been selected to blend with the background. The reactor containment structures will be natural concrete finish to contrast with the other buildings and to blend with the sea cliffs.

Parking and Circulation

Circulation and parking were planned to be functional and still not become a dominant site feature. Parking areas will be landscaped.

Landscape Design

A landscaping program is being developed for the site which will be started after completion of Units 1 and 2. The landscape plan retains all of the major physical features and uses plants native to the area as a transition zone to the surrounding undisturbed environment.

Adverse Environmental Effects Which Cannot Be Avoided

The objective of this report has been to define the potential environmental effects of the proposed and ongoing operations and to identify those areas where recognizable "adverse" environmental impact might exist. Preventive measures taken to minimize such impact have been discussed in previous sections of this report.

Nevertheless, in several instances there will arise predictable areas of change in the local environment which, over the short term, must be considered unavoidable. In general, these occur during the construction phase and include dust and waste generation. All reasonable efforts are being exerted to lessen the effect of this temporary activity.

Some physical alterations are also unavoidable. Plant erection and construction material laydown areas will involve a limited loss. Endemic flora and resident fauna will be displaced; however, these species are found in abundance in the central California coastal range. Terrestrial management programs have been undertaken to minimize these effects. The construction of the intake and discharge structures, the breakwaters and the barge landing will have an effect on the marine environment. The construction operations will cause some loss of marine life and the physical presence of the structures will eliminate a small portion of the coastline as habitat. The artificial area created is expected to form a new habitat which will largely compensate for the disturbances. PG&E's abalone transplant program has attempted to keep the loss of this important species to the smallest amount.

The project structures contribute to a change in the present landscape; however, architectural and aesthetic considerations will ameliorate these changes as much as possible.

Alternatives

Alternatives

Alternatives to Units 1 and 2 at Diablo Canyon included consideration of several different sites, sources of power other than nuclear and alternative cooling systems. These alternatives are described below.

Alternative Generation

In 1970, hydroelectric capacity constituted nearly half of the power resources available to meet PG&E area system requirements as shown in Table 1. Much of this hydroelectric capacity is low capacity factor power which is used principally in the peak of the load. Because PG&E has the availability of this peaking hydroelectric capacity, system requirements in the 1970's are principally for base load duty generation. Economic considerations led to the selection of nuclear-fueled generation to meet these base load requirements. This choice also serves the need to conserve fossil fuel resources, some of which are in short supply. It also avoids air pollution problems that may be associated with a fossil-fueled plant. Furthermore purchased power was not considered a feasible alternative to Units 1 and 2 at Diablo Canyon. During the period when these units are scheduled for service, the magnitude of new power requirements is nearly 1,000 megawatts annually. There simply are no sources of firm capacity available from interconnected neighboring utilities that could provide more than a small fraction of these power requirements.

Alternative Sites

Selection of Diablo Canyon Site

After extensive study, the Diablo Canyon site was selected to satisfy the need for additional generation, particularly in the southern part of PG&E's system. PG&E, in making this selection, not only weighed the needs of its electric customers but also the varied public and private interests in land use, ecological values, conservation of natural resources and recreation. The search for a suitable southern site began in 1960, and by 1962, attention was centered on a 1,121-acre site in the coastal sand dunes near Nipomo, about 18 miles southeast of the Diablo Canyon site. The Nipomo site had been zoned by San Luis Obispo County in 1957 for heavy industrial use. However, after PG&E announced acquisition of this acreage in late 1963, those interested in preserving the Nipomo Dunes area for its ecological and recreational values urged PG&E to seek another site. This PG&E did in cooperation with representatives from the State

Resources Agency, San Luis Obispo County Planning Commission, the Sierra Club, and other interested organizations and individuals. The Diablo Canyon site was finally selected.

Alternative Cooling System .

Offshore Discharge

As an alternate to the shoreline discharge, consideration was given to construction of an offshore discharge that would extend well out into Diablo Cove. However, because of difficult construction conditions and because of the lack of any demonstrated environmental advantages, it was decided that the relatively high additional construction costs did not justify an offshore discharge.

Other Cooling Methods

It is PG&E's belief that the optimum medium, from an environmental standpoint, for receiving waste heat from Diablo Units 1 and 2 is the cold Pacific Ocean (ambient temperature of approximately 55°F). Once-through cooling, using the ocean water, is the least expensive alternative, will result in the highest power plant efficiency, and requires the least amount of land space. It does not create any obtrusive visual impact on the landscape, and the thermal discharge causes no significant adverse environmental effects, as discussed in the section, Biological Impact. Alternatives to once-through cooling and reasons as to why they were not selected are as follows:

Cooling Towers

There are a number of types of cooling towers. A "wet" tower, employing either a mechanically-induced or a naturally-induced draft, cools by evaporating large quantities of water. A 1,000 megawatt unit would evaporate about 25,000 acre-feet of water per year. In California, where a vast investment of time, money, and effort is being made to develop new supplies of fresh water for municipal, agricultural, and industrial uses, it would be poor policy to evaporate valuable fresh water for power plant cooling purposes when ocean sites are available. Although salt water could be used in the towers, there would be some unavoidable emission of salts to the atmosphere. This type of particulate matter emission would not meet strict California air quality standards and could cause serious local environmental damage.

Dry towers, which employ the same principle as used by an automotive radiator, would avoid the loss of water by evaporation. However, they would be the most expensive alternative, are relatively inefficient and would require considerable research and development for use by power plants as large as the Diablo units. They also would have very large land requirements because of their enormous size. At this time, dry towers simply have not been proven practical for use at large nuclear power plants.

Cooling Ponds

Using cooling ponds would avoid raising the temperature of receiving water in Diablo Cove. However, the cooling ponds would require substantial land areas, as much as one to two acres per megawatt of capacity, together with a source of water supply to make up for the large evaporation losses. The fresh water required would be difficult to obtain in the Diablo Canyon area, and, as discussed above under cooling towers, evaporating such water would be a poor use of a scarce resource.

Short Term Uses and Long Term Productivity

The short-term use of man's environment will involve several changes in the site area. The major ones are construction of roads and buildings for the plant and transmission line structures. There will be discharges of warm water, small amounts of radioactivity and nontoxic treated chemical and sanitary wastes to the ocean. The short-term impact of these activities on the environment will be slight.

There will be no long-term cumulative effects upon productivity of the area. Offsetting any impact will be the major benefits of additional electric generating capacity in PG&E's service area. This capacity will be used, in part, to support programs presently underway to improve man's environment. Among these are urban rapid transit, advanced sewage treatment, and refuse recycling.

Thus, Units 1 and 2 at Diablo Canyon will play a key role in meeting the important needs of man. After decommissioning of the facility, the site could be returned, if found desirable, to its former agrarian state with only small changes in the shoreline remaining.

Irreversible and Irretrievable Commitments of Resources

Numerous resources are involved in construction and operation of a major power generating facility such as Units 1 and 2 at Diablo Canyon. These resources include the land upon which facility is located, the materials and chemicals used to construct and maintain the plant, fuel used to operate the plant, and human talent, skill and labor.

Major resources committed irreversibly and irretrievably due to the construction and operation of the power plant are essentially the materials and labor used in construction, and uranium consumed by the reactors.

APPENDIX A
Continued Studies

CONTINUED STUDIES

The Pacific Gas and Electric Company will continue pre-operational and initiate operational environmental monitoring programs. The objective of this continuing surveillance is to provide a valid assessment of the impact of both construction and operation of the plant on the environment. These monitoring programs consist of biological, radiological, physical and meteorological activities.

Biological Program

Surface water temperatures are being monitored continuously in Diablo Cove and South Cove to obtain pre-operational background data. Upon plant operation, temperatures also will be measured at the power plant intake and discharge.

Kelp, a very sensitive monitor of thermal change, will be mapped during February, June and October by means of aerial infrared photographs. These mappings will be performed on both a pre- and post-operation basis for purposes of comparison.

The quantitative studies of the plant and animal populations are being conducted by the California Department of Fish and Game under the terms of the Resource Agency Agreement with PG&E (Appendix F).

A sampling system will be used to determine population sizes of important sport and commercial marine species and their major predators, competitors and prey. The study area will continue to be both in the predicted thermal plume area and in the actual plume area after plant operation. A control area of similar ecology will be studied simultaneously adjacent to the site but not within the area of either projected or actual thermal influence. Sedentary animals and algae of selected species will be counted, but visual estimates will be used to determine fish abundance. These surveys will be conducted on a seasonal basis. Standard methods will be used at each random station.

The quantitative studies will yield population sizes of the major sport and commercial species. These in turn will be used as indices of changes other than natural cyclic phenomena that take place after the plant goes into operation. The random survey also will help delineate areas of significant biological importance such as nursery areas, kelp beds and large concentrations of shellfish.

Both intertidal surveys, and subtidal surveys using SCUBA, will be conducted. Photographs will be taken to document the various types of communities and presence of major species. Transect methods standardized by the California Department of Fish and Game will be employed. Underwater rotonone (chem-fish collector) operations will be conducted at selected stations to determine fish species present and their relative abundance.

The principal ecological communities will be described qualitatively in order to make a refined prediction of the thermal impact of the plant on these communities. The permanent transect information will also provide a valuable reference point to compare the actual impact against the predicted impact after plant operation. Transect locations will be chosen deliberately in the areas of maximum predicted ecological impact, as well as in control areas removed from the plant thermal influence.

Studies on the survival of planktonic organisms passing through the cooling water systems of several different PG&E plants operating in the marine environment are presently underway. If certain key species of concern at Diablo Canyon, such as larval abalone, are not being sampled at the other plants, shock thermal tolerance tests will be made in the laboratory to simulate the effects of passage through the condenser cooling water system.

Radiological Program (See also Appendix K)

The pre-operational environmental radiation monitoring program initiated in December 1969 at the Diablo Canyon site and the surrounding environs will be continued pre- and post-operationally. The objective of this program has been to: (1) establish the magnitude and range of the natural background radioactivity in the vicinity of the site prior to and during plant operation and (2) confirm the effectiveness of the radiation waste discharge controls during plant operation by comparing the levels of radioactivity measured in samples to the natural background levels. This program consists of dosimetry, continuous air particulate sampling with analysis for gross beta activity, and gross beta and gamma activity of various specimens collected periodically from the site environs. Radiological procedures will be continually reviewed and modified as necessary.

Concentration Factors Program

The program to determine the concentration factor (the ratio of the concentration of a specific element in an organism to that in the surrounding waters) for several elements in the marine organisms from the vicinity of the plant site is being continued. This program includes but is not limited necessarily to those elements which can reasonably be anticipated to be released through the plant cooling water discharge and those edible marine species which reasonably can be expected to be consumed by humans.

Meteorological Field Measurement Program

The basic on-site meteorological measurement program initiated in July 1967 at the Diablo Canyon Site consists of meteorological sensors mounted on a 250-foot permanent tower. In addition, wind direction and wind speed observations have also been recorded from light weight cup and vane assemblies at several other locations from July 1967 through October 1969.

The following measurements are being continued on the tower:

Wind Speed	25 and 250 feet
Wind Direction	25 and 250 feet
Azimuth and Vertical Wind Angles	25 and 250 feet
Ambient Temperature	25 feet
Vertical Gradient of Temperature	250 and 25 feet
Precipitation	Near plant site

Data collected during the period July 1967 through October 1969 have been utilized to establish short-term and long-term averages of wind speed, wind direction, stability and wind direction persistence. Estimates of annual and seasonal diffusion patterns have also been determined. Supplemental reports will be issued periodically.

APPENDIX B
AEC Construction Permit for Unit 1

UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

PACIFIC GAS AND ELECTRIC COMPANY

(Diablo Canyon Nuclear Power Plant)

DOCKET NO. 50-275

PROVISIONAL CONSTRUCTION PERMIT

Construction Permit No. CPPR-39

1. Pursuant to Section 104 b. of the Atomic Energy Act of 1954, as amended (the Act), and Title 10, Chapter 1, Code of Federal Regulations, Part 50, "Licensing of Production and Utilization Facilities," and pursuant to the order of the Atomic Safety and Licensing Board, the Atomic Energy Commission (the Commission) hereby issues a provisional construction permit to Pacific Gas and Electric Company (the applicant) for a utilization facility (the facility), designed to operate at 3,250 megawatts (thermal), described in the application and amendments thereto filed in this matter by the applicant and as more fully described in the evidence received at the public hearing upon that application. The facility, known as Diablo Canyon Nuclear Power Plant, will be located at the applicant's Diablo Canyon site in San Luis Obispo County, California.

2. This permit shall be deemed to contain and be subject to the conditions specified in Sections 50.54 and 50.55 of said regulations; is subject to all applicable provisions of the Act, and rules, regulations and orders of the Commission now or hereafter in effect; and is subject to the conditions specified or incorporated below:

   A. The earliest date for the completion of the facility is December 31, 1970, and the latest date for completion of the facility is December 31, 1971.

   B. The facility shall be constructed and located at the site as described in the application, as amended, at Diablo Canyon, San Luis Obispo County, California.

   C. This construction permit authorizes the applicant to construct the facility described in the application and the hearing record in accordance with the principal architectural and engineering criteria set forth therein.

3. This permit is provisional to the extent that a license authorizing operation of the facility will not be issued by the Commission unless (a) the applicant submits to the Commission, by amendment to the application, the complete final safety analysis report, portions of which may be submitted and evaluated from time to time; (b) the Commission

finds that the final design provides reasonable assurance that the health and safety of the public will not be endangered by the operation of the facility in accordance with procedures approved by it in connection with the issuance of said license; and (c) the applicant submits proof of financial protection and the execution of an indemnity agreement as required by Section 170 of the Act.

FOR THE ATOMIC ENERGY COMMISSION

for Peter A. Morris, Director
Division of Reactor Licensing

Date of Issuance: APR 23 1968

APPENDIX C
Corps of Engineers Permit for Breakwater and Intake

Diablo Powerplant

2231-10-0046

DEPARTMENT OF THE ARMY

NOTE.—It is to be understood that this instrument does not give any property rights either in real estate or material, or any exclusive privileges; and that it does not authorize any injury to private property or invasion of private rights, or any infringement of Federal, State, or local laws or regulations, nor does it obviate the necessity of obtaining *State assent* to the work authorized. ~~IT MERELY EXPRESSES THE ASSENT OF THE FEDERAL GOVERNMENT SO FAR AS CONCERNS THE PUBLIC RIGHTS OF NAVIGATION. (See *Cummings v. Chicago*, 188 U. S., 410.)~~ 16—13160-6

PERMIT

U. S. Army Engineer District, Los Angeles
Corps of Engineers.
Los Angeles, California
10 June., 1969

Pacific Gas and Electric Company
Land Department
245 Market Street
San Francisco, California 94106

Gentlemen:

Referring to written request dated 8 April 1969 for permission to construct two breakwaters, construct a water intake structure, excavate a water intake channel and place a fill,

I have to inform you that, upon the recommendation of the Chief of Engineers, and under the provisions of Section 10 of the Act of Congress approved March 3, 1899, entitled "An act making appropriations for the construction, repair, and preservation of certain public works on rivers and harbors, and for other purposes," you are hereby authorized by the Secretary of the Army.

to construct two breakwaters, about 800 and 1,000 feet long; construct an intake structure; excavate an intake channel; and fill an area about 1,400 feet long by 50 to 400 feet wide
(Here describe the proposed structure or work.)

in the Pacific Ocean
(Here to be named the river, harbor, or waterway concerned.)

at a location about .3 mile southerly of the mouth of Diablo Canyon and about 6 miles northwest of Point San Luis, San Luis Obispo County, California
(Here to be named the nearest well-known locality—preferably a town or city—and the distance in miles and tenths from some definite point in the same, stating whether above or below or giving direction by points of compass.)

in accordance with the plans shown on the drawing attached hereto marked "Proposed Breakwaters, Intake Structure and Intake Channel", Diablo Canyon Site. Application by Pacific Gas and Electric Co. March 28, 1969."
(Or drawings; give file number or other definite identification marks.)

subject to the following conditions:

(a) That the work shall be subject to the supervision and approval of the District Engineer, Corps of Engineers, in charge of the locality, who may temporarily suspend the work at any time, if in his judgment the interests of navigation so require.

(b) That any material dredged in the prosecution of the work herein authorized shall be removed evenly and no large refuse piles, ridges across the bed of the waterway, or deep holes that may have a tendency to cause injury to navigable channels or to the banks of the waterway shall be left. If any pipe, wire, or cable hereby authorized is laid in a trench, the formation of permanent ridges across the bed of the waterway shall be avoided and the back filling shall be so done as not to increase the cost of future dredging for navigation. Any material to be deposited or dumped under this authorization, either in the waterway or on shore above high-water mark, shall be deposited or dumped at the locality shown on the drawing hereto attached, and, if so prescribed thereon, within or behind a good and substantial bulkhead or bulkheads, such as will prevent escape of the material in the waterway. If the material is to be deposited in the harbor of New York, or in its adjacent or tributary waters, or in Long Island Sound, a permit therefor must be previously obtained from the Supervisor of New York Harbor, New York City.

(c) That there shall be no unreasonable interference with navigation by the work herein authorized.

(d) That if inspections or any other operations by the United States are necessary in the interest of navigation, all expenses connected therewith shall be borne by the permittee.

(e) That no attempt shall be made by the permittee or the owner to forbid the full and free use by the public of all navigable waters at or adjacent to the work or structure.

(f) That if future operations by the United States require an alteration in the position of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army, it shall cause unreasonable obstruction to the free navigation of said water, the owner will be required upon due notice from the Secretary of the Army, to remove or alter the structural work or obstructions caused thereby without expense to the United States, so as to render navigation reasonably free, easy, and unobstructed; and if, upon the expiration or revocation of this permit, the structure, fill, excavation, or other modification of the watercourse hereby authorized shall not be completed, the owners shall, without expense to the United States, and to such extent and in such time and manner as the Secretary of the Army may require, remove all or any portion of the uncompleted structure or fill and restore to its former condition the navigable capacity of the watercourse. No claim shall be made against the United States on account of any such removal or alteration.

(g) That the United States shall in no case be liable for any damage or injury to the structure or work herein authorized which may be caused by or result from future operations undertaken by the Government for the conservation or improvement of navigation, or for other purposes, and no claim or right to compensation shall accrue from any such damage.

(h) That if the display of lights and signals on any work hereby authorized is not otherwise provided for by law, such lights and signals as may be prescribed by the U. S. Coast Guard, shall be installed and maintained by and at the expense of the owner.

(i) That the permittee shall notify the said district engineer at what time the work will be commenced, and as far in advance of the time of commencement as the said district engineer may specify, and shall also notify him promptly, in writing, of the commencement of work, suspension of work, if for a period of more than one week, resumption of work, and its completion.

(j) That if the structure or work herein authorized is not completed on or before 31st day of December, 19 72, this permit, if not previously revoked or specifically extended, shall cease and be null and void.

(k) That the permittee shall comply promptly with any regulations, conditions, or instructions affecting the work hereby authorized if and when issued by the Federal Water Pollution Control Administration and/or the State water pollution control agency having jurisdiction to abate or prevent water pollution. Such regulations, conditions, or instructions in effect or prescribed by the Federal Water Pollution Control Administration or State agency are hereby made a condition of this permit.

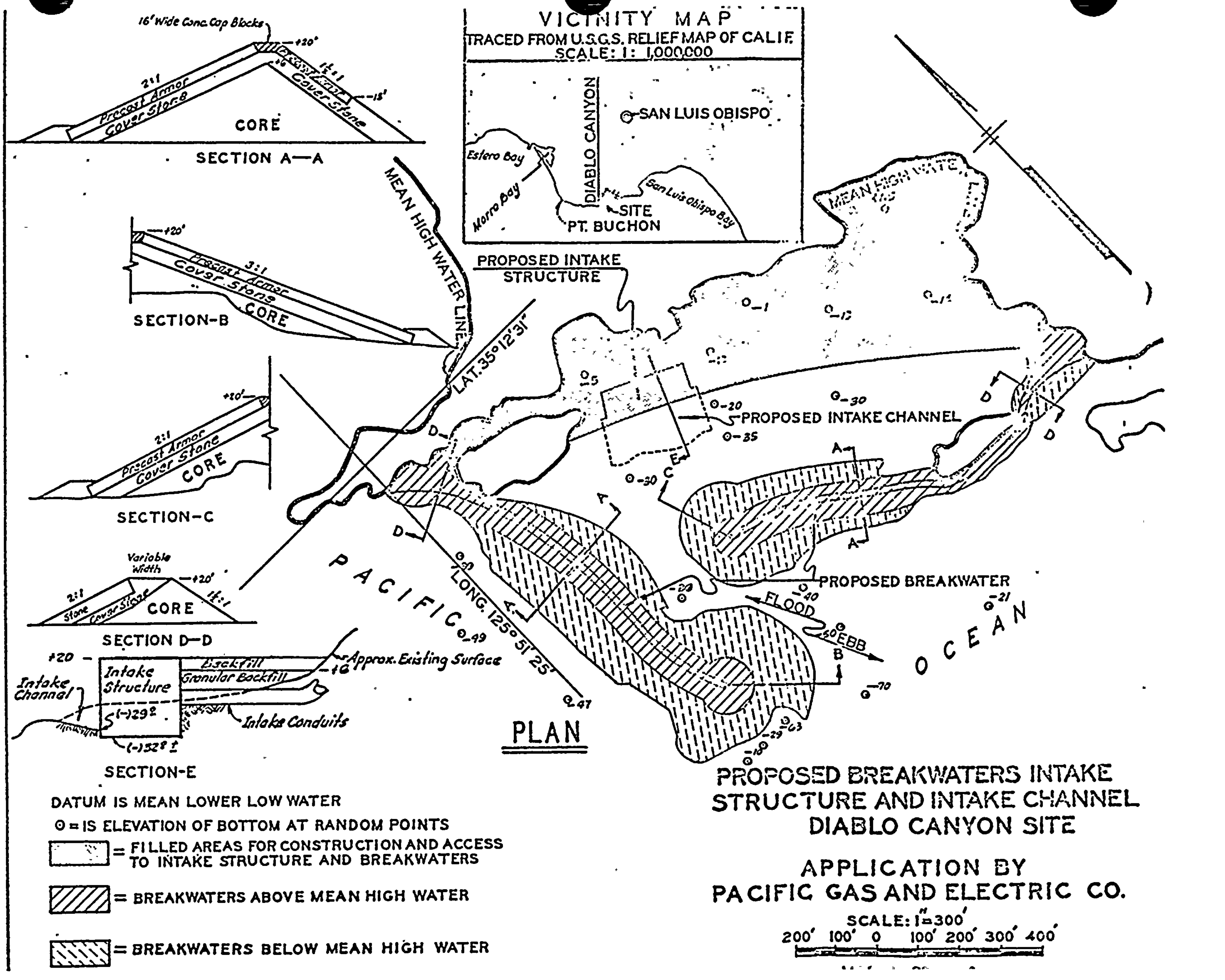
By authority of the Secretary of the Army:

Norman E. Pehrson

NORMAN E. PEHRSON
Colonel, CE
District Engineer

ENG FORM 1 SEP 48 1721 (Civil) This form supersedes ED Form 96, dated 1 Apr 43, which may be used until exhausted.

U. S. GOVERNMENT PRINTING OFFICE 16—13163-5


16' Wide Conc. Cap Blocks
+20'
2:1
Precast Armor
Cover Stone
1½:1
Precast Armor
Cover Stone
-15'
CORE
SECTION A—A
+20'
3:1
Precast Armor
Cover Stone
CORE
SECTION-B
+20'
2:1
Precast Armor
Cover Stone
CORE
SECTION-C
Variable Width
+20'
2:1
Stone
Cover Stone
CORE
1½:1
SECTION D—D
+20
Intake Structure
Backfill
Granular Backfill
Approx. Existing Surface
+6
Intake Channel
(-)29'
Intake Conduits
(-)32' ±
SECTION-E
VICINITY MAP
TRACED FROM U.S.G.S. RELIEF MAP OF CALIF.
SCALE: 1: 1,000,000
DIABLO CANYON
SAN LUIS OBISPO
Estero Bay
Morro Bay
SITE
PT. BUCHON
San Luis Obispo Bay
MEAN HIGH WATER LINE
MEAN HIGH WATER
PROPOSED INTAKE STRUCTURE
LAT. 35°12'31"
PROPOSED INTAKE CHANNEL
PROPOSED BREAKWATER
FLOOD
EBB
PACIFIC
OCEAN
LONG. 125°51'25"
PLAN
DATUM IS MEAN LOWER LOW WATER
⊙ = IS ELEVATION OF BOTTOM AT RANDOM POINTS
= FILLED AREAS FOR CONSTRUCTION AND ACCESS TO INTAKE STRUCTURE AND BREAKWATERS
= BREAKWATERS ABOVE MEAN HIGH WATER
= BREAKWATERS BELOW MEAN HIGH WATER
PROPOSED BREAKWATERS INTAKE STRUCTURE AND INTAKE CHANNEL DIABLO CANYON SITE
APPLICATION BY PACIFIC GAS AND ELECTRIC CO.
SCALE: 1"=300'
200' 100' 0 100' 200' 300' 400'

APPENDIX D
Corps of Engineers Permit for Cofferdam

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT, CORPS OF ENGINEERS
P. O. BOX 2711
LOS ANGELES, CALIFORNIA 90053

IN REPLY REFER TO
SPLCO-O

17 April 1970

Pacific Gas and Electric Company
Land Department
245 Market Street
San Francisco, California 94106

Gentlemen:

In accordance with your written request dated 9 April 1970, the revised plans hereto attached are approved to supersede the plans for the work authorized by the Secretary of the Army, in letter dated 16 January 1970, from the District Engineer at Los Angeles, to place approximately 5,000 cubic yards of material for a temporary coffer-dam, to be removed upon completion of construction of the outlet structure, and to remove about 42 cubic yards of material to form a discharge channel near Diablo Canyon, San Luis Obispo County, California.

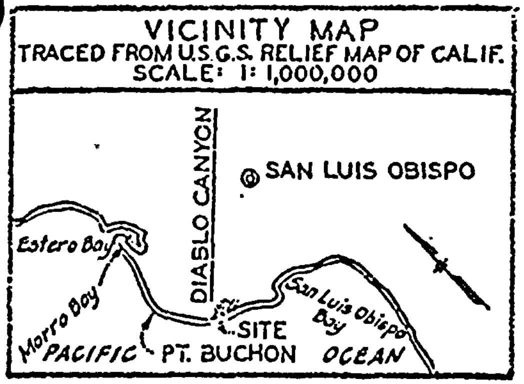
The conditions to which the work is made subject remain in full force and effect.

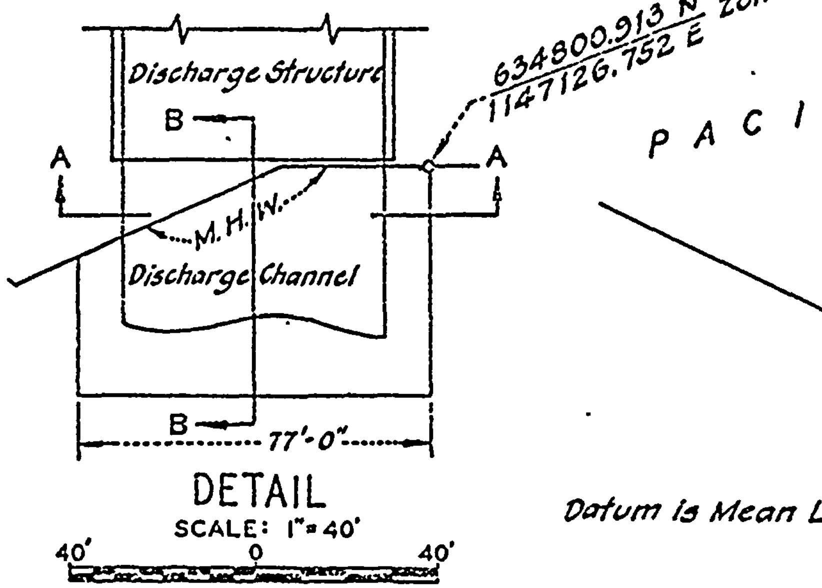
BY AUTHORITY OF THE SECRETARY OF THE ARMY:

Robert J. Malley

ROBERT J. MALLEY
Colonel, CE
District Engineer

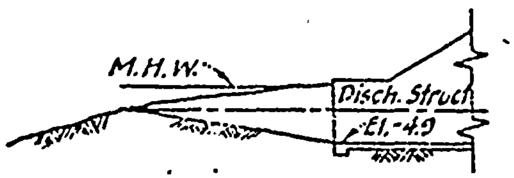
(T. 31 S. R. 10 E. M.D.B. & M.)



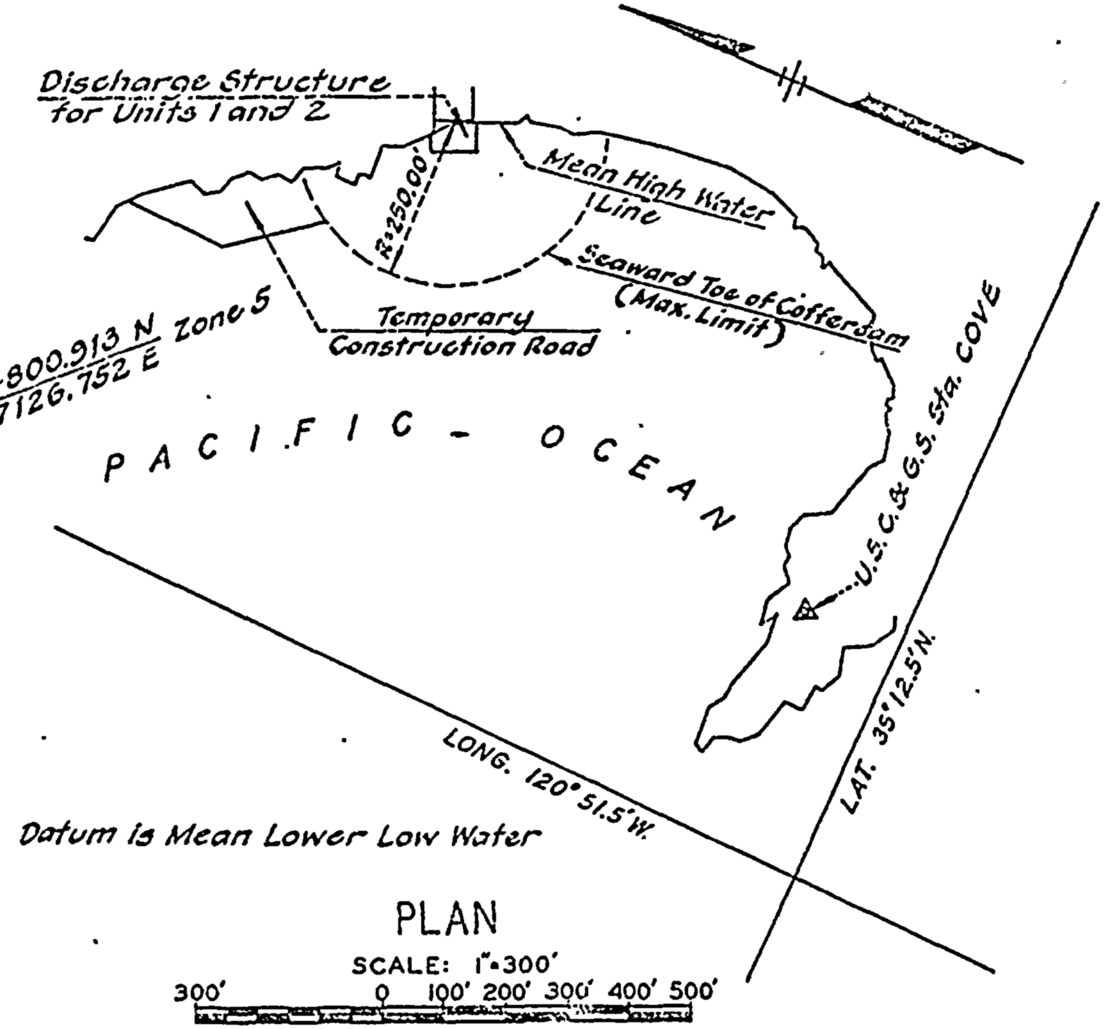


DETAIL
SCALE: 1" = 40'

SECTION A-A



SECTION B-B



PLAN
SCALE: 1" = 300'

PROPOSED
DISCHARGE CHANNEL
DIABLO CANYON SITE

APPLICATION BY
PACIFIC GAS AND ELECTRIC CO.

DECEMBER 1, 1969
AMENDED APRIL 6, 1970

Estimated volume of cofferdam : 28,000 cu. yds.
Estimated volume of temporary construction road : 15,000 cu. yds.

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT, CORPS OF ENGINEERS
P. O. BOX 2711
LOS ANGELES, CALIFORNIA 90053

IN REPLY REFER TO
SPLCO-O

16 January 1970

Pacific Gas and Electric Company
Land Department
245 Market Street
San Francisco, California 94106

Gentlemen:

Reference is made to your request of 18 December 1969 for permission to install a temporary coffer-dam and to remove about 42 cubic yards of material to form a discharge channel near Diablo Canyon. Upon the recommendation of the Chief of Engineers approved March 3, 1899, entitled "An act making appropriations for the construction, repair, and preservation of certain public works on rivers and harbors, and for other purposes," you are hereby authorized by the Secretary of the Army to place approximately 5,000 cubic yards of material for a temporary coffer-dam, to be removed upon completion of construction of the outlet structure, and remove about 42 cubic yards of material to form a discharge channel near Diablo Canyon, San Luis Obispo County, California, as shown on the attached drawing.

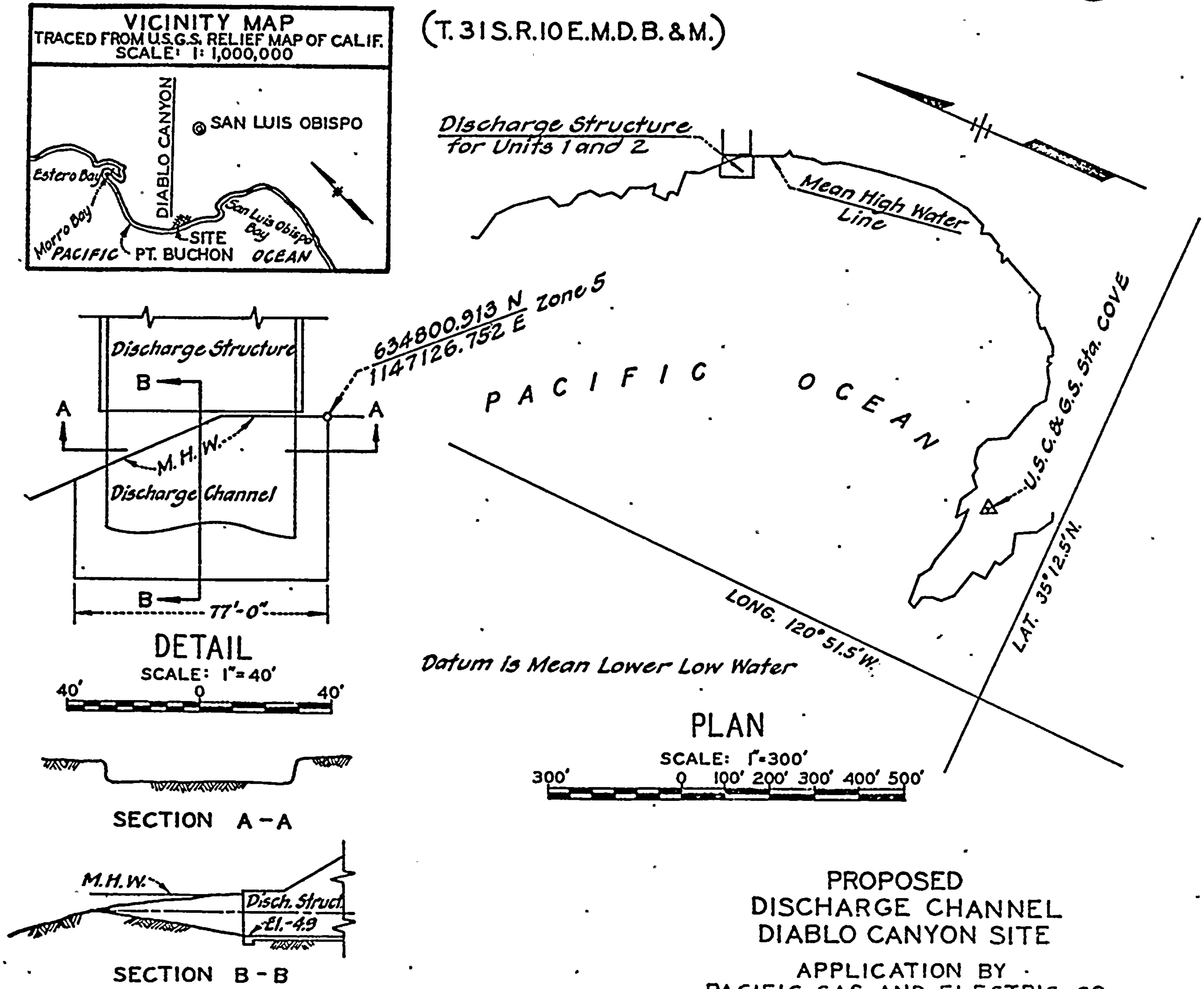
The permittee shall comply promptly with any regulations, conditions, or instructions affecting the work hereby authorized if and when issued by the Federal Water Pollution Control Administration and/or the State water pollution control agency having jurisdiction to abate or prevent water pollution. Such regulations, conditions, or instructions in effect or prescribed by the Federal Water Pollution Control Administration or State agency are hereby made a condition of this permit.

This authorization does not give any property rights, either in real estate or material, or any exclusive privileges; and does not authorize any infringement of Federal, State, or local laws or regulations, nor does it obviate the necessity of obtaining State assent to the work authorized.

BY AUTHORITY OF THE SECRETARY OF THE ARMY:

Robert J. Malley

ROBERT J. MALLEY
Colonel, CE
District Engineer



PROPOSED
DISCHARGE CHANNEL
DIABLO CANYON SITE

APPLICATION BY
PACIFIC GAS AND ELECTRIC CO.

DECEMBER 1, 1969

APPENDIX E
AEC Construction Permit for Unit 2

UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

PACIFIC GAS AND ELECTRIC COMPANY

(Diablo Canyon Nuclear Power Plant, Unit 2)

DOCKET NO. 50-323

PROVISIONAL CONSTRUCTION PERMIT

Construction Permit No. CPPR-69

1. Pursuant to § 104 b. of the Atomic Energy Act of 1954, as amended (the Act), and Title 10, Chapter 1, Code of Federal Regulations, Part 50, "Licensing of Production and Utilization Facilities," and pursuant to the order of the Atomic Safety and Licensing Board, the Atomic Energy Commission (the Commission) hereby issues a provisional construction permit to Pacific Gas and Electric Company (the applicant) for a utilization facility (the facility), designed to operate at 3,250 megawatts (thermal) described in the application and amendments thereto (the application) filed in this matter by the applicant and as more fully described in the evidence received at the public hearing upon that application. The facility, known as Diablo Canyon Nuclear Power Plant, Unit 2, will be located at the applicant's Diablo Canyon site in San Luis Obispo County, California.

2. This permit shall be deemed to contain and be subject to the conditions specified in § § 50.54 and 50.55 of said regulations; is subject to all applicable provisions of the Act, and rules, regulations and orders of the Commission now or hereafter in effect; and is subject to the conditions specified or incorporated below:

   A. The earliest date for the completion of the facility is December 31, 1973, and the latest date for completion of the facility is December 31, 1974.

   B. The facility shall be constructed and located at the site as described in the application at Diablo Canyon, San Luis Obispo County, California.

   C. This construction permit authorizes the applicant to construct the facility described in the application and the hearing record in accordance with the principal architectural and engineering criteria set forth therein.

   D. The applicant shall observe such standards and requirements for the protection of the environment as are validly imposed pursuant to authority established under Federal and State law and as are determined by the Commission to be applicable to the facility covered by this construction permit. This condition does not apply to (a) radiological effects since such effects are dealt with in other provisions of this construction permit or (b) matters of water quality covered by section 21(b) of the Federal Water Pollution Control Act.

3. This permit is provisional to the extent that a license authorizing operation of the facility will not be issued by the Commission unless (a) the applicant submits to the Commission, by amendment to the application, the complete final safety analysis report, portions of which may be submitted and evaluated from time to time; (b) the Commission finds that the final design provides reasonable assurance that the health and safety of the public will not be endangered by the operation of the facility in accordance with procedures approved by it in connection with the issuance of said license; and (c) the applicant submits proof of financial protection and the execution of an indemnity agreement as required by S. 170 of the Act.

FOR THE ATOMIC ENERGY COMMISSION

Peter A. Morris

Peter A. Morris, Director
Division of Reactor Licensing

Date of Issuance:

DEC 9 1970

APPENDIX F
California Resources Agency Agreement

Appendix

PACIFIC GAS AND ELECTRIC COMPANY

Agreement Between the Resources Agency
State of California
and
Pacific Gas and Electric Company

AGREEMENT

THIS AGREEMENT, entered into in the City of Sacramento, State of California, this 6th day of December, 1966, between the State of California acting through its Resources Agency, and Pacific Gas and Electric Company (hereinafter called Pacific),

WITNESSETH:

WHEREAS, Pacific proposes to construct and operate a thermal electric generating station at a coastal site near Diablo Canyon in Rancho Canada de Los Osos y Pecho y Islay in San Luis Obispo County; and

WHEREAS, Pacific plans to construct a compacted fill across Diablo Creek to provide level areas for plant switchyard facilities; and

WHEREAS, Pacific plans to utilize sea water from the Pacific Ocean as condenser cooling water; and

WHEREAS, Pacific recognizes its responsibility to the general public to assist in the protection of the natural resources of the State of California; and

WHEREAS, the Resources Agency in its statement of policy dated June 30, 1965, has defined its objectives and principles regarding the location and operation of power plants, Now, Therefore, it is mutually agreed as follows:

1. The Resources Agency agrees that with respect to matters covered by this agreement or by Resources Agency's said statement of policy, it will not oppose Pacific in its applications for a certificate of public convenience and necessity for said plant, in proceedings before the Public Utilities Commission of the State of California, or other pre-operational permits or operating licenses required by the Atomic Energy Commission or any other body having jurisdiction, and will indicate thereto that all matters covered by this agreement have been resolved to the satisfaction of the Resources Agency.

2. Pacific agrees that it will not deposit any surplus material excavated from the plant site in the Pacific Ocean or its tidelands, or in any bays, rivers, streams or inlets in the State of California, without first obtaining written authorization from the Resources Agency.

3. Pacific agrees that any fill to be constructed across Diablo Creek about 4,000 feet east of the mouth of Diablo Creek will be provided with adequate by-pass facilities to pass flood waters of said creek and will be placed, graded, compacted, and provided with surface drainage facilities so as to minimize erosion of said fill.

Pacific further agrees to make any required application to the Central Coastal Regional Water Quality Control Board for construction of said fill.

4. Pacific agrees that any spoil material deposited on the land will be placed, graded, and compacted so as to minimize any transfer by erosion of the material to the beaches and ocean waters.

5. Pacific agrees that vehicular access, retaining walls, fences, buildings, and equipment will be located and designed in such a way that the physical appearance

of the entire installation will be aesthetically compatible with the surroundings.

6. Pacific agrees that this agreement does not constitute approval of the State Lands Commission, the Central Coastal Regional Water Quality Control Board, or the State Water Quality Control Board if its jurisdiction is invoked, with respect to construction or operation or other activities of Pacific at the plant site, and Pacific further agrees that it will make appropriate applications to those agencies whenever reviews or approvals from such agencies are required for any activities in connection with the said plant. The Resources Agency agrees that it will not oppose Pacific in its seeking of required pre-operational reviews or approvals from such agencies with respect to matters covered by this agreement, and will indicate thereto that all matters covered by this agreement have been resolved to the satisfaction of the Resources Agency.

7. Pacific agrees to conduct or support investigations as outlined in the attachment titled "Ocean background investigation for proposed power plant site near Diablo Canyon, San Luis Obispo County, Pacific Gas and Electric Company", and to establish mutually acceptable design criteria for the protection of aquatic life in the waters which may be affected by the proposed facility or its operation. Resources Agency agrees to participate in these investigations and assist in the coordination with other agencies on studies which may yield desirable information.

The ecological study outlined under paragraph 7 "Specifications for Study" of the above-mentioned attachment will be conducted by Department of Fish and Game at Pacific's expense. Department of Fish and Game may conduct said study using its own personnel or by subcontracting with other groups.

Resources Agency and Pacific will jointly evaluate the data and from time to time during the course of the investigation may agree upon modifications of the investigation to achieve the objectives set forth in the attachment.

In the event critical problems relating to aquatic life or recreational uses occur after and as a result of plant installation, Pacific agrees to continue its cooperative investigations with the objective of modifying plant operation or design to eliminate these problems. In the event that adverse effects accrue to aquatic life or recreation uses due to plant construction or operation, Pacific will provide reasonable mitigation for losses incurred, provided such mitigation will not interfere with the construction or operation of the plant unless otherwise agreed.

8. Pacific agrees to conduct such water quality and radiological surveillance programs, both pre-operational and post-operational for the life of the plant, as may be developed in accordance with statutory authority of the State and Regional Water Quality Control Boards and the State Department of Public Health.

9. Pacific agrees to conduct a comprehensive geologic survey to determine the geologic conditions of the site—with particular reference to the nature of the foundation materials and seismic activity.

10. Pacific agrees that it will continuously evaluate the additional geologic information that is revealed during preparation of the site for construction, and take the appropriate steps in design and construction of the plant recognizing the geologic conditions.

11. Pacific agrees to furnish the Resources Agency with copies of all geologic reports pertaining to the site filed with other governmental agencies.

12. A copy of this agreement will be filed with the California Public Utilities Commission for its information.

IN WITNESS WHEREOF, the parties have executed this agreement the day and year first hereinabove written.

PACIFIC GAS AND ELECTRIC COMPANY
By /s/ JOHN F. BONNER
JOHN F. BONNER
Senior Vice President

STATE OF CALIFORNIA
By /s/ HUGO FISHER
HUGO FISHER, *Administrator*
Resources Agency
On Behalf of the:
Department of Conservation
Department of Water Resources
Department of Parks and Recreation
Departmentof Fish and Game
Department of Harbors and Water Craft

Ocean Background Investigation for Proposed Power Plant Site Near Diablo Canyon, San Luis Obispo County Pacific Gas and Electric Company

OBJECTIVES

The general objective of the investigation consistent with requirements of Central Coastal Water Quality

Control Board is to develop information and data that will permit a quantitative description of environmental conditions prior to plant construction and operation and assist in the resolution of the effect of future plant discharges on the various beneficial uses of ocean waters near the plant site. This general objective includes the following specific objectives:

1. To develop qualitative and quantitative biological descriptions of the biotic community near the plant site, with due regard to seasons, tidal action and other temporal changes in order to provide background data prior to the construction and operation of discharge facilities.

2. To make a hydrographic study of temperature, salinity structure, and other physical factors that may influence the dilution and dispersion and reconcentration of waste discharge.

3. To evaluate, insofar as practical, simple indices or parameters that can be used for continuing surveillance after the plant is operating in order to determine quantitatively the effect of such discharges upon beneficial uses of ocean waters.

Specifications for Studies

The pre-operational study will be carried on commencing as far in advance as practicable of Pacific's application to the California Public Utilities Commission for a Certificate of Public Convenience and Necessity. Based on the results of the pre-operational study, a continuous program of monitoring during the operation of the plant will be established. The pre-operational study will include the following specific items:

1. A contour map showing bottom topography will be prepared of the area within one quarter mile of the plant.

2. Tide will be recorded locally over a long enough period of time to establish, if possible, a correlation with published tidal data.

3. Water surface temperatures in the area surrounding the plant site will be taken by near-instantaneous methods during a series of runs covering a tidal cycle. Data will be plotted for each run to define the existing thermal surface. These measurements will be repeated often enough to establish seasonal and other variations.

4. Vertical temperature and salinity profiles will be taken simultaneously with the measurements of surface temperature at not less than six stations offshore from the plant site.

5. Continuous water temperature records will be taken at not less than two stations during the preoperational investigation. Data obtained will be correlated, if possible, with long-time temperature records obtained in the area by others.

6. Currents will be measured at at least six stations in the ocean waters during several tidal cycles and correlated, if possible, with tides. Measurements will be repeated often enough to establish seasonal and other variations. Additional studies will be made utilizing dyes to study dispersion and dilution.

7. An ecological study will be conducted having as its objective the establishment of a base inventory of the marine biota present from which the effect of the plant on the marine biota will be determined. All biota will be inventoried in order to establish

that any ecological changes due to the plant operation are distinct from natural cyclic changes.

The study will require three field trips per year over a two-year period. Each trip will be conducted by a field party of three men covering a period of nine days. Total field work required covers approximately 81 man days per year. Laboratory work, evaluation and write-up requires 90 man days per year. Total time required is equivalent to eight man months per year.

The study will be conducted during the two-year period immediately prior to plant operation. The data obtained in the ecological study may be published by the Department of Fish and Game.

Post-operation studies will be determined following review of pre-operational study results and a program for further studies will be determined and mutually agreed upon. The post-operational study program will be reviewed periodically and revised to satisfy the parties hereto.

REPORTS

Quarterly reports of results without detailed data will be prepared. An annual report will be prepared which contains all observation in tabular or graphic form plus description. In addition, methods of observing, reducing data and analysis and laboratory tests will be described. Results will be presented in text and summarized in conclusions.

PACIFIC GAS AND ELECTRIC COMPANY

PG&E + 245 MARKET STREET · SAN FRANCISCO, CALIFORNIA 94106 · TELEPHONE 781-4211

JOHN F. BONNER
SENIOR VICE PRESIDENT

October 9, 1968

The Resources Agency of California
1416 Ninth Street
Sacramento, California 95814

Gentlemen:

The Resources Agency of the State of California and the Company entered into an agreement on December 6, 1966, relating to the nuclear-fueled generating station to be constructed by the Company near Diablo Canyon in San Luis Obispo County.

Since that date, the Company has received the necessary regulatory authorizations from the California Public Utilities Commission and Atomic Energy Commission to construct Unit No. 1 of the plant, and it has entered into contracts for initial construction phases. It has filed applications with the California Public Utilities Commission and the Atomic Energy Commission for authorization to construct Unit No. 2 of the plant. Copies of the applications have been provided to you.

We now desire to clarify application of the December 6, 1966 agreement to our proposed construction. We presently anticipate that Diablo Unit No. 1 will be in operation in 1972; Unit No. 2 will be in operation in 1974. We suggest that the date of commercial operation of Unit No. 1 be the date of operation of the plant for the purposes of defining investigations provided for in the agreement, and that after that date the investigations will enter the post-operational phase provided for. It should be clearly understood, however, that it may be necessary during the post-operational phase to continue the investigations specified in the pre-operational study, to provide base-line data relative to future units. In all other respects, the agreement will apply to the plant, without regard to the unit under construction.

If this suggestion is acceptable to the Agency, please so indicate by signing and returning the enclosed duplicate copy of this letter.

Very truly yours,

John F. Bonner

JFB:Mc

Enclosure

61-6187

APPENDIX G

California Public Utilities Commission Certificate Unit 1

SW/ds

Decision No. 73278

BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

In the matter of the application of PACIFIC GAS AND ELECTRIC COMPANY for a certificate of public convenience and necessity to construct, install, own, operate, maintain and use a nuclear fueled power plant in the County of San Luis Obispo, together with transmission lines and related facilities. (Electric)	Application No. 49051 (Filed December 23, 1966)

P G & E LAW DEPT. · PUC PROCEEDINGS

FILE NO. ....

(Appearances are listed in Appendix A)

INTERIM OPINION

Applicant's Request

Pacific Gas and Electric Company requests a certificate of public convenience and necessity under Section 1001 of the Public Utilities Code to construct, operate and maintain a nuclear fueled power plant at a site in Diablo Canyon, San Luis Obispo County, together with transmission lines and related facilities.

Public Hearing

After due notice public hearing was held before Commissioner Gatov and Examiner Patterson at San Luis Obispo on February 16, 17 and 28, March 1, 2, 29, 30 and 31, at San Francisco on April 12, 13 and 14 and again at San Luis Obispo on April 26, 27 and 28, May 10, 11, 12, 24, 25 and 26, 1967.

The matter was submitted subject to the receipt of concurrent opening briefs and concurrent reply briefs which have been received and it is now ready for decision.

Applicant presented evidence in support of the application through 17 witnesses and 41 exhibits. Four other witnesses testified in favor of the proposal, 18 additional supporting exhibits were received, and supporting statements were made by approximately 60 individuals most of whom represented governmental, civic or other organizations.

Those in opposition to a part or the whole of the project presented 32 exhibits, the testimony of 12 witnesses and statements by three individuals.

The Commission staff did not present any evidence but it took an active part through extensive cross-examination of witnesses.

Proposed Power Plant

The power plant, as proposed, would be located upon a 685 to 785-acre site near the mouth of Diablo Canyon in San Luis Obispo County. The site is on the coast approximately 7 miles northwest of Avila Beach and 12 miles southwest of the City of San Luis Obispo. The 585 acres south of and adjoining Diablo Creek has been leased from the private landowner for a term of 99 years with an option to renew for an additional 99 years.1/ The 100 to 200 acres required on the north side of the creek is in the process of being acquired from another private owner.

1/ By Decision No. 71441, dated October 18, 1966, in Application No. 48806, P.G. and E. was authorized to guarantee loans by other parties to San Luis Obispo Bay Properties, Inc., an affiliate of the property owner.

The power production facilities will be situated on a sloping terrace set back several hundred feet from the ocean and 70 to 100 feet above sea level. The San Luis Mountains rise sharply in back of the plant site and it is planned that the 500 kv switchyard will be located in Diablo Canyon more than one-half mile from the ocean and at an elevation higher than the generating unit. It appears the switchyard will not be visible from ground level at the site of the power production facilities.

The nuclear power unit for which authorization is sought under this application is expected to have a net electrical output of 1,060,000 kilowatts. The unit will include a nuclear fueled steam generating system, a turbine-generator and the necessary reactor and turbine auxiliaries together with related steam plant equipment, including high voltage step-up transformers and switching equipment.

The reactor system will be a pressurized-water, closed cycle, forced circulation type, fueled with slightly enriched uranium dioxide enclosed in zirconium alloy tubes. Water circulated through the reactor will act as a coolant and moderator. Control will be effected through neutron absorbing control rods and a soluble chemical neutron absorber. Steam from the steam generator will be supplied to the turbine at approximately 506° Fahrenheit and 710 pounds per square inch pressure. Ocean water will be circulated in the condenser cooling system at a rate of approximately 820,000 gallons per minute. Looking ahead to expected future expansion the intake structure is being designed to handle sufficient cooling water for three units, and the record shows that applicant contemplates the eventual installation of a total of six units.

The switchyard area as shown in Exhibit No. 5 is sized to accommodate switchgear for six units but the initial installation of equipment will be only that necessary for one or two units.

The reactor containment structure will consist of a reinforced concrete vertical cylinder with a flat base and a hemispherical dome. A welded steel liner attached to the inside face of the concrete shell will assure a high degree of leak tightness.

Load Growth and Resources

The peak load growth in applicant's gross service area has been 8.54% compounded annually over the last eight years. Applicant has conservatively estimated future growth at rates which average 6.52% compounded annually through the year 1972 when it is contemplated the Diablo Canyon nuclear unit will be required. Estimates have also been carried forward from that year to 1980 at an annual compounded rate of 6.95%. The historical peak loads and estimates as set forth in Exhibit No. 3 may be summarized as follows:

YEAR	ACTUAL	ESTIMATED AVERAGE YEAR	ESTIMATED ADVERSE YEAR	ANNUAL GROWTH MW
1958	4,154			
1959	4,769			615
1960	5,310			541
1961	5,698			388
1962	5,830			132
1963	6,300			470
1964	6,769			469
1965	7,357			588
1966	7,994			637
1967		8,360	8,440	366
1968		8,980	9,060	620
1969		9,540	9,620	560
1970		10,250	10,330	710
1971		10,900	10,980	650
1972		11,680	11,760	780
1973		12,500	12,580	820
1974		13,380	13,460	880
1975		14,310	14,390	930
1976		15,300	15,380	990
1977		16,360	16,440	1,060
1978		17,490	17,570	1,130
1979		18,700	18,780	1,210
1980		19,990	20,070	1,290

To help meet the growth in power needs as illustrated by the above figures applicant has planned the following additions to its generating capacity:

Moss Landing Unit 6	735 MW in Summer 1967
Moss Landing Unit 7	735 MW in Spring 1968
Geysers Unit 4	26.7 MW in Winter 1968
Geysers Unit 5	50 MW in Winter 1971
Belden Hydro Plant	117 MW in Winter 1969
Nuclear Unit -- Diablo	1060 MW in Spring 1972

These additions plus firm power available from others will result in 1972 in a firm power capacity of 13,621 megawatts to meet an estimated 1972 total peak demand of 11,600 megawatts[2/] leaving a margin in a dry year of 2,021 megawatts or 17.4% after allowance for overhaul. Without the proposed Diablo Canyon unit the margin would drop to 8.3%. These figures compare with recorded margins of 17.3%, 11.1%, 17.7%, 19.7%, 25.7% and 15.3% for each of the years 1961 through 1966.

In order to meet a reliable operation date for the spring of 1972 applicant presented a construction schedule which calls for the start of work on the access roads and utilities in the fall of 1967.

Site Selection

In selecting the general location for the proposed generating plant applicant gave considerable weight to the relationship which will exist between loads and generating resources by 1972 in the various geographical regions of its service area.

2/ This differs from the estimated peak demand in the preceding tabulation due to exclusion of loads of interruptible customers.

Exhibit No. 4 shows that without the Diablo Canyon unit the southernmost area designated as Bakersfield and which includes all or portions of Kern, Santa Barbara, San Luis Obispo, Kings and Tulare counties will have a deficiency of about 1300 megawatts by 1972, the largest deficiency of the eleven areas into which the system is divided. By locating the proposed plant in the southern part of the system this deficiency will be reduced and a witness for applicant testified that improved system reliability and reduced transmission losses will result.

In selecting a specific site applicant was virtually constrained to look only at the coastal region because of the enormous quantity of cooling water which is required for a plant of the proposed size. Exhibit No. 19 shows a comparison of eleven south coastal area sites which were considered, ranging from Pt. Sierra Nevada on the north to Jalama on the south. The exhibit shows comparisons on the basis of circulating water, topography, land availability, transmission right of way, physical features, community acceptance, and transportation. The extent of investigation of each site varied depending upon preliminary evaluation of the various factors.

The record shows that after several possible sites had been considered interest centered by the year 1962 on a site of 1121 acres in the sand dunes near Nipomo which had been zoned for heavy industrial use. After applicant announced it had acquired this acreage in late 1963 a strong movement by the Sierra Club and others developed to preserve the Nipomo Dunes as a scientific and recreational area. This was about the time the State Resources

Agency and the Health and Welfare Agency - Department of Public Health and Coordinator of Atomic Energy Development and Radiation Protection began collaboration with those state entities that had particular interests in conservation or protection of the natural environment from the effects of power plant installations. Those entities include the Department of Fish and Game, Department of Conservation, Department of Parks and Recreation, Department of Water Resources, Department of Harbors and Watercraft and the Water Quality Control Board. Members from each of these entities comprise the Resources Agency Task Force on Power Plant Siting in California, which together with members from Public Health and Coordinator have been active with applicant and other utilities in considering possible plant sites.

It was indicated to applicant by the Sierra Club, the State Resources Agency and others that a power plant at Nipomo would not be acceptable unless located well back from the shore line and off the sand dunes. The setback discussed varied from 4000 feet to one and one-eighth miles. Such a setback would increase costs considerably and in applicant's opinion make the plant economically unacceptable.

Applicant with the assistance of the State Resources Agency, County Planning Commission, Sierra Club and other organizations turned its attention to other possible sites along the South Coastal Region and finally in the summer of 1966 it appears that agreement was reached on Diablo Canyon as being a satisfactory alternative to the Nipomo Site.

Applicant then conducted an intensive investigation to establish the suitability of the site from all aspects of safety, and acceptability from the standpoint of minimal effects on the environment. This investigation included detailed studies and reports from consulting experts in the fields of geology, seismology, marine biology, oceanography and structural engineering.

Transmission Lines

To connect the proposed power plant to its interconnected system applicant proposes to construct two 500 kv single circuit-transmission lines and a single 230 kv double-circuit line. One 500 kv line would extend eastward from the plant for some 84 miles, and south of the City of San Luis Obispo to Midway substation; the other 500 kv line would extend generally northeastward from the plant some 79 miles to Gates substation. Both of these lines would connect at these substations to applicant's 500 kv intertie system. The physical separation of these two lines would insure greater reliability of service than would be the case if they were to follow a single route. The two lines would handle somewhat more than the output of the proposed unit but an additional circuit would be required upon construction of a second generating unit at the site. The single 230 kv line would be only about 10 miles long and would connect the plant to the existing Morro Bay-Mesa 230 kv line and would be used for plant start-up and emergency station service power.

Estimated Plant Costs

The estimated cost of constructing the facilities based on price levels as of September, 1966 and including firm manufacturers' bids for the turbine-generator and nuclear steam-supply system may be summarized as follows:

Item	Cost	
Production facilities	$153,633,000	
Step-up substation	8,910,000	
Total plant		$162,543,000
Terminal substation	6,277,000	
Transmission	19,593,000	
Subtotal		25,870,000
Total Investment		$188,413,000

If a conventional thermal unit of the same capacity were to be constructed at the Diablo Canyon site its estimated cost including transmission and substation facilities would be $149,153,000. It is estimated that fuel costs for such a unit would be higher, however, and the total cost of energy would also be higher than for the nuclear unit.

Estimated Cost of Power

Because of the large investment and because of the low incremental heat rate the nuclear unit would be operated at the highest capacity factor possible. The estimates supporting the economic feasibility of the project are shown on both an 80 percent and 90 percent capacity factor basis. The testimony shows, however, that applicant expects to attain a 90 percent capacity factor operation. At 90 percent capacity factor it is estimated the Diablo Canyon nuclear unit will produce power at 4.04 mills per kwhr. A second unit at that site would produce power at 3.88 mills per kwhr or 3.96 mills per kwhr for the two units. These figures are for cost of power at the generating plant.

To deliver the power into the system requires use of the project's step-up, transmission and terminal substation facilities. With these costs included the delivered costs into the system at 90 percent capacity factor become 4.61 mills per kwhr for one unit and 4.39 mills kwhr for two units.

These costs were testified to be lower than the costs of power from any of applicant's existing thermal power plants or from Units 6 and 7 at Moss Landing and were compared with a 1965 average system cost of 6.97 mills per kwhr (5.2 for hydro and 8.17 for thermal production).

Applicant also presented estimated costs for power delivered into its system from comparable units if they could be located on the beach at the Nipomo site, at a 4000-foot setback at the Nipomo site and at the South Moss Landing site, the latter a site which applicant owns and plans to develop ultimately. These estimated costs at 90 percent capacity factor may be summarized as follows:

	One Unit	Two Units
	Mills per	kwhr
Diablo Canyon - Nuclear	4.61	4.39
Diablo Canyon - Conventional	5.47	-
Nipomo Beach - Nuclear	4.53	4.38
Nipomo 4000-foot setback - Nuclear	4.68	4.53
South Moss Landing - Nuclear	4.59	4.46
South Moss Landing - Conventional	5.03	-

Safety

Applicant presented considerable testimony as to the design features and steps which will be taken to insure that there will be no undue hazard to the public. The design features include in addition to the inherent safety of this type of reactor, the reactor containment structure, multiple barriers to limit the release of radioactivity, a safety injection system for emergency core cooling, air recirculation coolers, containment spray in the safety injection system, multiple sets of protective controls, and backup and emergency power supplies.

Applicant's consulting geologist after making an extensive study of the site including the deep exploratory trenches, testified that the site has a good bedrock foundation with only insignificant faults that have shown no movement for at least 100,000 and possibly millions of years.

A consulting seismologist testified as to the maximum size earthquakes that can be expected to occur on active faults located some 20 to 50 miles from the site and a consulting structural design engineer testified and presented a study showing that the plant can be designed and constructed to operate safely during and after such earthquakes.

An oceanographer presented a study and testimony which indicated that seismic sea waves or tsunamis would present no design or operating problems for the plant.

Ecological Effect of Plant on Marine Life

Witnesses for applicant testified that the ocean in the vicinity of Diablo Canyon is turbulent and that adequate mixing of the warm water discharge will occur. A marine biologist studied the marine life in the vicinity and concluded that although some cold water species might be displaced they would be replaced by warm water species but with no net decrease in fauna and flora.

With respect to the low level radioactive waste products which will be released into the cooling water discharge from time to time, the record shows that the amount of such releases will be fixed by the Atomic Energy Commission. On the assumption the releases would be similar to the limits allowed at applicant's Humboldt Bay nuclear unit at Eureka, an expert in radiation biology testified for applicant that there would be no detectable effect on the marine population in Diablo Cove or surrounding waters.

Licenses and Permits

The status of licenses and permits which applicant must secure in order to construct and operate the proposed plant and associated facilities are set forth in Exhibit No. 25. Applicant has obtained from the County of San Luis Obispo a use permit for the plant at the proposed site provided it is constructed with approval of this Commission; also use permits or equivalents for the proposed transmission lines from the Counties of San Luis Obispo, Fresno, Monterey, Kern and Kings. It has also executed an agreement with the Resources Agency State of California, Exhibit No. 26, which, in effect, indicates that all matters relative to the plant which would affect conservation of the natural resources have been or will be resolved to the satisfaction of the agency.

In addition to the authority being sought herein the two other major items of authorization applicant must secure are from the United States Atomic Energy Commission, first a construction permit, application for which was filed January 17, 1967, and second an operating license for the plant. It is anticipated that hearings will soon be held in connection with the application for the construction permit but the operating license would not be applied for nor acted upon until the plant has been virtually completed.

Opposing Testimony

Some nine individuals testified in opposition to the proposed plant being located at Diablo Canyon on the basis that it would be an unnecessary encroachment upon a unique coastal area which has been virtually untouched by the inroads of man. Two of these witnesses were sponsored by the Scenic Shoreline Preservation Conference Inc. (Conference) and three were employees of the State Division of Beaches and Parks who were subpoenaed by the Conference. The others while assisted by counsel for Conference in varying degrees, appeared as individual conservationists who were interested in preserving Diablo Canyon in its natural state. All of these individuals spoke with great sincerity and some most eloquently of the desirability of preserving more of the public domain for public use as parks, recreational areas or simply open spaces.

The canyon and surrounding Point Buchon area was described as the only significant coastal area south of San Francisco without either an improved road or railroad passing nearby. The stand of live oak in the canyon which will be largely obliterated by the switchyard was described as one of unusual density with individual trees of great size. Other trees are big leaf maple, laurel and the relatively rare Bishop pine. The watershed was stated to be particularly unusual for California as it supports a perennial stream whose flow varies but little as the seasons change.

No specific idea or plan was advanced as to how the Diablo Canyon area could and would be preserved in its natural state but the hope was expressed repeatedly that ways might be found if applicant's proposal were to be denied. The record clearly shows that neither the State Department of Parks and Recreation nor any other agency have any plans for developing the Diablo Canyon area as a park site.

The testimony of three individuals was directed solely at the proposed transmission line routings. One was a property owner located some three miles from the proposed route of the line to Gates substation and the other two expressed concern as to the possible hazard to aviation the proposed line to Midway substation could create south of the City of San Luis Obispo.

The Sierra Club played an important role prior to this proceeding in urging applicant to seek a site other than the one at Nipomo, and although individuals who stated they were members of the club presented their own views, no testimony or evidence was presented in this proceeding on behalf of the club nor did the Sierra Club make a formal appearance.

Discussion

The evidence has clearly established the need for the power plant by the year 1972, the economics of the project as being reasonable, the overwhelming support for the project by the local community, the safety of the project aside from radiation hazard considerations,[3/] and the ability of applicant to finance and construct the project.

The only issues which remain for consideration are:

(1) possibilities of using an alternative site, and

(2) the impact of the proposed plant on the environment.

Turning our attention to the first issue, the record shows that none of the alternative sites in the South Coastal area are as suitable as Diablo Canyon. Whereas the Nipomo Beach site ranks high in efficiency, a location on the beach is clearly unacceptable and, in any event, the Division of Beaches and Parks is wisely planning to develop that area for park use. In addition to several other shortcomings, a setback location at Nipomo would not be economical, particularly when it becomes necessary to add additional generating units.

The possibility of an inland site (closer to load center) using cooling water from the proposed State-Federal San Joaquin Valley Master Drain was considered by applicant and was advanced by the Conference in argument as a realistic possibility. The record

---

3/ Radiation hazards are subject to the exclusive jurisdiction of the United States Atomic Energy Commission. Northern California Association to Preserve Bodega Head and Harbor Inc. v. Public Utilities Commission; Pacific Gas and Electric Company, 61 C 2d 126 (1964), also Section 274 of the Atomic Energy Act of 1964.

shows, however, that there is too much uncertainty of the time of completion and of the quantity of water available from that project to make it feasible to plan an electric generating facility of the magnitude needed, which would be dependent upon water from that project.

Another alternative which was explored in depth on the record and which was strongly supported by the Conference in argument was the South Moss Landing site. Applicant did not consider this as a suitable alternative as its considerably greater distance from Midway substation, 195 miles as compared with 84 miles from Diablo Canyon, would require longer transmission lines with greater exposure to line outages and an adverse effect on system stability. The record shows that although a first unit at South Moss Landing would be comparable economically with one at Diablo Canyon, the cost with succeeding units favors the Diablo Canyon site. Of perhaps even more significance is the fact that with the projected continued growth of electrical load, applicant will soon need to develop additional sites such as South Moss Landing as well as Diablo Canyon and others.

With respect to the second issue the record shows that the plant will have a minimal effect on the marine fauna and flora, there will be no pollution of the atmosphere such as from a conventional thermal plant, and the release of radioactive materials into the atmosphere will be subject to limitations imposed by the Atomic Energy Commission. The location of the switchyard in the canyon will destroy a large portion of the live oak stand but will permit that facility to be well concealed from coastal or offshore viewing. The power plant itself will be situated on the marine terrace in full view from points along the coast or offshore.

From the extensive and often eloquent testimony of the conservationists we recognize that the Diablo Canyon site is one of unusual natural beauty. We also recognize from the testimony of the engineers and other expert consultants that the site possesses that rare combination of physical and geographical features which makes it suitable as a location for a major nuclear power plant.

After weighing these opposing factors we find that the public interest requires the use of the Diablo Canyon site by applicant for a nuclear power plant despite the impact it will have on the environment.

In our recent interim opinion[4] concerning the undergrounding of electric and communications services and facilities we stated " . . . the time had long passed when we could continue to ignore the need for more emphasis on aesthetic values in those new areas where natural beauty has remained relatively unspoiled . . .".

The same philosophy holds true in locating a power plant in an area of natural beauty such as we have here and we recognize our responsibility to insure that the impact on the environment will be held to a minimum and that aesthetics will receive adequate consideration.

4/ Decision No. 73078 dated September 19, 1967, in Case No. 8209.

Findings

We find that:

1. Applicant has need for a 1,060,000 kw generating unit in the southern portion of its system by the year 1972.

2. The economics of the project as supported by the estimates presented are not unreasonable.

3. The project has the overwhelming support of the local community.

4. There is no evidence in the record concerning safety within our jurisdiction which would cause us to reject the proposed project as being unsafe.

5. Applicant has the ability to finance and construct the project.

6. There is no alternative project which will better meet the needs of applicant and the public.

7. The proposed project will not create irreconcilable conflicts with conservation, ecology and aesthetics provided the plant, switchyard and attendant facilities are designed in an aesthetically pleasing manner.

8. Present and future public convenience and necessity will require the construction and operation by applicant of a nuclear power unit rated at approximately 1,060,000 kilowatts at the Diablo Canyon site, together with transmission lines and other appurtenances generally as described by applicant in this proceeding but subject to the conditions that the certificate is interim in form and may be made final by further order of the Commission upon issuance by the United States Atomic Energy Commission of final authorization to construct and operate the nuclear energy plant.

The certificate hereinafter granted shall be subject to the following provision of law:

> The Commission shall have no power to authorize the capitalization of this certificate of public convenience and necessity or the right to own, operate, or enjoy such certificate of public convenience and necessity in excess of the amount (exclusive of any tax or annual charge) actually paid to the State as the consideration for the issuance of such certificate of public convenience and necessity or right.

The action taken herein is for the issuance of a certificate of public convenience and necessity only and is not to be considered as indicative of amounts to be included in future proceedings for the purpose of determining just and reasonable rates.

It is concluded that the application should be granted to the extent set forth in the order which follows.

INTERIM ORDER

IT IS ORDERED that:

1. A certificate of public convenience and necessity is granted to Pacific Gas and Electric Company to construct, operate and maintain a nuclear fueled power generating unit of approximately 1,060,000 kilowatts capacity together with appurtenant facilities and transmission lines generally as described by applicant in this proceeding, but subject to the condition that the certificate is interim in form and may be made final by further order of the Commission on the establishment by evidence in the record that final authority has been obtained from the Atomic Energy Commission to construct and operate the nuclear energy plant.

filed 6.10.68 ff

2. Prior to construction applicant shall submit an artist's rendition of the project based on the architect's design.

3. Applicant shall file with this Commission a detailed statement of the capital costs of the project including transmission lines and other appurtenances within one year following the date on which the unit is placed in commercial operation.

4. The authorization herein granted shall expire if not exercised within five years from the date hereof.

The effective date of this order shall be twenty days after the date hereof.

Dated at San Francisco, California, this 7th day of NOVEMBER, 1967.

PETER E. MITCHELL
President
WILLIAM M. BENNETT
A. W. GATOV
WILLIAM SYMONS, JR.
FRED P. MORRISSEY
Commissioners

Certified as a True Copy
ASSISTANT SECRETARY
PUBLIC UTILITIES COMMISSION
STATE OF CALIFORNIA

A. 49051

WILLIAM M. BENNETT, CONCURRING OPINION

While I concur -- reluctantly -- in today's order, I am compelled to point out that little has been learned from the series of mistakes which led to the rejection of a nuclear plant at Bodega Bay. The record makes it abundantly clear that the initiative here as to the selection of nuclear sites -- precious coast line -- is clearly in the hands of the utility. This comes about because of its power of condemnation of property given to it by the people and secondly but more importantly because the State of California has no plan or comprehensive program for the preservation of beach land as against nuclear plants. It is plain to me that the recreational needs of man are just as important as the energy requirements, indeed perhaps more so. And yet aware of the fact that nuclear plants are going to dot the California landscape in increasing numbers, the public utilities are left to themselves to pick and choose desirable beach properties for utility construction purposes. What is called for is attention by the Legislature -- if no one else -- to the concept of zoning an entire coast line. Nuclear plants of all public utilities should be considered with the possibility of placing all of them whether separately owned or not in a common setting which would insure a minimum of interference with recreational areas. And this is a function which should be undertaken by this Commission in a broad investigation to determine how many nuclear plants are to be constructed for all reasonable time and where located. Absent a broad development program for location of these plants, the precious dwindling beach area is going to go as has much of the other natural beauty of California.

I regret the failure of the Sierra Club to participate in these proceedings. It occurs to me that they could have made a significant contribution to the record herein so far as the issue of aesthetics is concerned. The Sierra Club has a great responsibility in proceedings such as this and that responsibility will grow and will play a vital part in other proceedings involving other beach sites and other nuclear plant proposals.

It may be coincidence, it may be lack of planning or it may be an insensitivity upon the part of utility management to the need of man for an environment which retains the purity of the natural scene which somehow has heretofore always led to the selection of a beach site which is a thing of great and untouched beauty. Whether at Bodega Bay or at the splendid beach at Camp Onofre or at San Luis Obispo, as here, the public utility and Pacific Gas & Electric now on a second occasion has selected a location which is the ideal of conservationists who have a broader outlook for the true and the beautiful than cold engineering judgment. This is why it is imperative that the public utilities be directed in the selection of a site by the undertaking of an investigation as to their future plans for nuclear plants. This is why the State of California through this agency should select those least desirable beach locations whose destruction will have a minimal impact upon the ecology. Utility management is not infallible indeed utility planners have an almost inescapable attraction to the true and beautiful as construction sites. The use of such areas for recreation is at best a secondary consideration with Pacific Gas & Electric in this case and at worst is not even considered.

There are areas along the coast line and in the inland waters of this state some of which are singularly unattractive and contain no great recreational realities or potentialities.

These are the places where the public utility industry of California should be told to place its nuclear plants.

I would remind the electric utilities of this state -- Pacific Gas & Electric, Southern California Edison, San Diego Gas & Electric, at present that Californians are deeply concerned about the dwindling natural landscape and public utilities because of the public trust they have must consider questions involving more than a cold engineering judgment. In the future our children are going to look to us in amazement and anger at the State of California which this generation is readying to hand over to it.

I should also point out that this Commission is the last agency other than the Atomic Energy Commission to scrutinize a utility as here. There is presently no single agency nor common hearing place where a local agency, another state division or agency, this Commission and most importantly of all the public may know of such proposals and effectively participate in the decision making process. And because of this dichotomy of authority a steam roller operation is created, consents are secured on a local basis involving a statewide question and then this Commission is confronted with other decisions of lesser bodies in which it did not participate nor did any significant portion of the public. California is long overdue for a statewide approach to the preservation of beauty and because beauty is the concern of all of us, natural settings such as beaches and other areas should not be left at mere local judgments or utility initiative.

I should also point out that this is the third proceeding involving the hard choice between energy and beauty and again the staff of this Commission has made no showing on behalf of the public -- it has left the selection of a site entirely to the public utility and has left the attempt to preserve the area such as here to those individual conservationists with individual resources as are available to them to make the case forthe preservation of another stretch of beach. Such a one sided battle is never going to be won by the conservationist which again makes it highly important that the Sierra Club whether it agrees or disagrees with the selection of a utility site must participate in the proceeding.

/s/ WILLIAM M. BENNETT

WILLIAM M. BENNETT
Commissioner

DATED: November 7, 1967
San Francisco, California

APPENDIX A

LIST OF APPEARANCES

For Applicant: F. T. Searles, by John C. Morrissey, Philip A. Crane, Jr., and Ross Workman.

Protestants: Andrew Renetzky, Arch E. Ekdale, Harry C. Murphy, Thomas B. Adams, by Andrew Renetzky and Thomas B. Adams, for O. C. Field and Ruby Hale Field; Lyders & McKaskle, by Paul L. McKaskle, for Scenic Shoreline Preservation Conference, and Fred Eissler, for self.

Interested Parties: Chickering & Gregory, Sherman Chickering, Donald J. Richardson, Leslie P. Jay and C. Hayden Ames, by C. Hayden Ames and Leslie P. Jay, and Stanley Jewell, for San Diego Gas and Electric Company; Stanley J. McElhaney, for Labor and General Construction Local 1222, Santa Maria; Gene A. Blanc, for State Office of Atomic Energy Development and Radiation Protection, Lyle Carpenter, for County of San Luis Obispo, Irving J. Hogan, for self; M. A. Walters, for International Brotherhood of Electrical Workers; William L. Knecht, for San Luis Obispo County Farm Bureau and California Farm Bureau Federation; Harold Johnson and Mayor Clell W. Whelchel, for City of San Luis Obispo; Muller, Woolpert & McWhinney, by Wickson R. Woolpert, for Nationwide Development Company, San Luis Obispo; Remy L. Hudson, for San Luis Obispo County Development Association; W. H. Ahrendt, Sr., for Pacific Coast Development and Recreation Association; Hal Stroube and Crossman & Weaver, by Bernard S. Crossman, for Robert B. Marre and San Luis Obispo Bay Properties, Inc.; Donald Campbell, for San Luis Obispo County Farm Bureau; James W. Powell, District Attorney, by Scovil F. Hubbard, Deputy District Attorney, for County of San Luis Obispo; Ian I. McMillan, for self; Paul N. McCloskey, Jr., for Committee for Green Foothills; Brian R. Van Camp, for The Resources Agency, The Transportation Agency, The Department of Public Health, The Co-ordinator of Atomic Energy Development & Radiation Protection, all of the State of California; Paul McKeehan, for California Wildlife Federation; Frank M. King, for San Leandro Chamber of Commerce; and David C. Hansen, for Hayward Chamber of Commerce.

For Commission Staff: Vincent V. MacKenzie, Counsel, and Melvin E. Mezek.

APPENDIX H

California Public Utilities Commission Certificate Unit 2

Decision No. 75471

BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Application of PACIFIC GAS AND ELECTRIC COMPANY, for a certificate of public convenience and necessity to construct, install, own, operate, maintain and use a second nuclear-fueled power plant in the County of San Luis Obispo, together with transmission lines and related facilities. (Electric)	Application No. 50028 Filed February 16, 1968; Amended September 10, 1968 and December 10, 1968.

F. T. Searls, John C. Morrissey, Philip A. Crane, Jr., and Ross Workman, by John C. Morrissey, Philip A. Crane, Jr., and Ross Workman, for applicant.

Ian I. McMillan, for Scenic Shoreline Preservation Conference; Ernest C. Porter, for Abalone Industry; A. E. Andreoli and B. P. Fasig, protestants.

William L. Knecht and Ralph O. Hubbard, for California Farm Bureau Federation; F. W. Boone, for Office of Atomic Energy Development, State of California; James W. Powell, District Attorney, Robert J. Schum and Scovil F. Hubbard, for the County of San Luis Obispo; M. A. Walters, for Local 1245, International Brotherhood of Electrical Workers; Stanley Jewell, Sherman Chickering, C. Hayden Ames, Donald J. Richardson, Jr., and Leslie P. Jay, by Leslie P. Jay, for San Diego Gas and Electric Company; Paul McKeehan, for California Wildlife Federation; Hal Stroube, for Marre Land and Cattle Company and San Luis Obispo Bay Properties, Inc., and John S. Whelen, interested parties.

Vincent MacKenzie, Counsel, and Melvin E. Mezek, for the Commission staff.

INTERIM OPINION

Pacific Gas and Electric Company requests a certificate of public convenience and necessity under Section 1001 of the Public Utilities Code to construct, operate and maintain a second nuclear fueled power plant in Diablo Canyon, San Luis Obispo County, together with transmission lines and related facilities.

Unit No. 1

The Commission, by Decision No. 73278, dated November 7, 1967, in Application No. 49051, granted applicant an interim certificate of public convenience and necessity to construct the first nuclear fueled power plant at Diablo Canyon subject to the condition that the certificate may be made final by further order of the Commission on the establishment in the record that final authority has been obtained from the Atomic Energy Commission to construct and operate the nuclear power plant. During the hearings relative to Unit No. 1, applicant presented evidence in support of the project through 17 witnesses and 41 exhibits. Four other witnesses testified in favor of the proposal; 18 supporting exhibits were received; and supporting statements by approximately 60 individuals most of whom represented governmental, civic or other organizations.

Those in opposition to a part or the whole of the project presented 32 exhibits; the testimony of 12 witnesses and statements by three individuals. Among those individuals or groups which presented evidence were the Scenic Shoreline Preservation Conference and Fred Eissler.

The Record in the Present Application

After notice to interested parties, a prehearing conference was held before Examiner Rogers in San Francisco on September 10, 1968. The parties agreed that the staff counsel would present interrogatories to applicant and applicant would file written answers thereto. The staff counsel served 31 interrogatories on applicant. Answers to these interrogatories (Exhibits Nos. 12, 13 and 14) were submitted by applicant and served on all appearing parties.

After due notice, public hearing was held before Examiner Rogers in San Luis Obispo, on December 10, 11 and 12, 1968. The matter was submitted subject to the receipt of concurrent briefs which have been received. The matter is ready for decision.

Motion for Continuance

The Scenic Shoreline Preservation Conference, which appeared at the hearing relative to Unit No. 1 as a protestant (Decision No. 73278, supra), appeared as a protestant in this matter and moved for a continuance to enable it to present studies relative to the dangers to the marine environment from the heated water discharge of nuclear power plants and studies relative to the geology and hydrology of the Diablo Canyon area. The motion was directed to earthquake danger, sea cliff retreat, mud flows, radiation and tides. Each of these matters was considered by this Commission in its decision relative to Unit No. 1. Notice of the hearing was mailed to all known interested parties, including Fred Eissler, President of Scenic Shoreline Preservation Conference, on October 14, 1968. Also notice of a prehearing conference held September 10, 1968 was sent to all interested parties and no appearance was made by petitioner at that time. The motion was denied by the examiner. We concur in this ruling.1/

Proposed Power Plant Site

The locations of the plant site and switchyard, and a description of the area are set forth in Decision No. 73278, in Application No. 49051, supra. At the hearing thereon, results

1/ The Scenic Shoreline Preservation Conference raised the same points in its petition to set aside the submission. This petition was denied (Dec. No.75283, dated Feb. 4, 1969, in Application No. 50028).

of investigations of several possible sites for the plant showing comparisons on the basis of circulating water, topography, land availability, transmission right-of-way, physical features, community acceptance and transportation were presented for consideration. Results of an intensive investigation to establish the suitability of the site from all aspects of safety and acceptability from the standpoint of minimal effects on the environment were considered. This investigation included detailed studies and reports from consulting experts in the fields of geology, seismology, marine biology, oceanography and general engineering.[2/]

In selecting the general location for the Diablo Canyon power plant, the relationship which will exist between the loads and generating resources of the various geographical regions of the service were weighed. The record in the first application shows that the applicant was looking ahead to future expansion of Diablo Canyon with a possible total of six units.

Unit No. 2

Applicant proposes to construct Unit No. 2 to be located adjacent to Unit No. 1, to be virtually a duplicate of Unit No. 1 with respect to capacity and operation. It is expected to have a net electrical output of 1,060,000 kilowatts. The unit will include a nuclear fueled steam generating system, a turbine-generator and the necessary reactor and turbine auxiliaries, together with related steam plant equipment, high voltage step-up transformers, and switching equipment.

2/ The suitability of the site from geological (Exhibit No. 18) and seismological (Exhibit No. 19) standpoints was affirmed at the hearing herein. The same earthquake resistant design recommended for Unit No. 1 was recommended for Unit No. 2 (Exhibit No. 20).

The estimated cost to install Unit No. 2, together with the related transmission facilities, based on current labor and material prices, is shown on Exhibit No. 9. This cost is summarized as follows:

Unit No. 2

Production Plant	$166,170,000
Substation	
Diablo Canyon	6,930,000
Midway	690,000
Total Substation	7,620,000
Transmission	9,407,000
Total Project ..	183,197,000

Applicant proposes to finance the cost of constructing these additions by using to the extent available, its working capital, moneys in reserve, funds not required for immediate use, and the proceeds of the issue and sale of such stocks, bonds, notes or other evidence of indebtedness as the Commission shall hereafter upon application, authorize.

The development of annual fuel costs and the costs of power for Unit No. 2 are shown in Exhibits Nos. 10 and 11. The total annual fuel cost is estimated to be $16,730,000 and $18,280,000 for operation at 80 and 90 percent capacity factors, respectively.

Applicant estimates the average delivered cost of power for operation at various capacity factors as follows:

Capacity Factor	Average Delivered Cost Mills/Kwhr
90%	4.42
80%	4.78

Exhibit No. 4 shows the historical average annual growth of peak load within applicant's gross service area to be 550 plus megawatts for the period 1963 through 1967. Applicant predicts the rate of growth in peak load of 800, 876 and 932 megawatts in 1972, 1973 and 1974, respectively. The historical and estimated area peak loads set forth in said exhibit are summaried as follows:

AREA PEAK LOADS
(Megawatts)

Year	Actual	Estimated Average Year	Estimated Adverse Year	Annual Growth
1958	4,154			
1959	4,769			615
1960	5,310			541
1961	5,698			388
1962	5,830			132
1963	6,300			470
1964	6,769			469
1965	7,357			588
1966	7,994			637
1967	8,514			520
1968		8,999	9,079	485
1969		9,597	9,667	598
1970		10,361	10,431	764
1971		11,020	11,080	659
1972		11,820	11,880	800
1973		12,696	12,756	876
1974		13,628	13,678	932

In order to meet future load growth and to maintain reasonable reserve capacity, applicant has planned the following additions to its generating capacity (Exhibit No. 5):

Moss Landing Unit 7	735 mw	Summer 1968
Geyser Unit 4	27 mw	Winter 1968
Belden Hydro Plant	117 mw	Winter 1969
Geyser Unit 5	53 mw	Summer 1971
Diablo Canyon Unit 1	1060 mw	Spring 1972
Pittsburg Unit 7	735 mw	Fall 1972
Geyser Unit 6	53 mw	Fall 1972
Geyser Unit 7	53 mw	Fall 1973
Diablo Canyon Unit 2	1060 mw	Summer 1974
Geyser Unit 8	53 mw	Fall 1974

These additions, plus firm power available from others, will result in 1974 in a dry year firm power capacity of 16,242 megawatts to meet an estimated 1974 total peak demand of 13,508 megawatts (Exhibit No. 6) leaving a margin of 2,734 megawatts or 20.2 percent after allowance for over haul. Without the proposed Diablo Canyon Unit No. 2, the margin would drop to 12.4 percent. These figures compare with recorded margins of 17.7, 19.7, 25.7, 15.3 and 13.3 percent for each of the years 1963 through 1967, respectively.

<u>The Transmission Line</u>

The transmission route will run southeasterly from the Diablo Canyon plant along the south slopes of the Irish Hills crossing U.S. Highway 101 north of Squire Canyon and about five miles south of San Luis Obispo; thence southeasterly to the south of Indian Knob and crossing Price Canyon approximately 2.3 miles southwest of Edna; thence easterly and northeasterly crossing the Arroyo Grande Valley at the junction of the upper

Arroyo Grande Road and the Biddle Ranch Road; thence southwesterly and easterly crossing Tar Spring Ridge approximately 1.5 miles south of the proposed Lopez Reservoir; thence easterly and northeasterly passing approximately one-half mile south of Aqua Escondida Spring; thence northeasterly through the Los Padres National Forest and crossing the easterly forest boundary southeast of the Scott Ranch; thence northeasterly to approximately 1-1/2 miles northwest of the Goodwin Ranch; thence easterly across the north edge of Soda Lake adjacent to the south boundary of the California Valley Subdivision; thence northeasterly across the Temblor Hills to east of Highway Route 58 (also known as State Highway 178). From Diablo Canyon to this point, a distance of 65.6 miles, the line is proposed to be parallel and adjacent to and on the north side of the transmission line to be built for Unit No. 1.

From a point in the vicinity of Highway Route 58, the proposed route will deviate to the north of the Unit No. 1 line route and run northeasterly to a junction with the existing Morro Bay-Midway 230 kv line approximately 1/2 mile west of Highway 33 and 1/4 mile south of Lokern Road; thence east parallel to and immediately north of the Midway substation at Buttonwillow. The latter section is 19.1 miles in length.

The proposed 500 kv transmission line will be of the same design as the line for Unit No. 1. It will be supported on single circuit steel towers. The average span will be approximately 1300 feet. The line will meet the requirements of the Commission's General Order No. 95.

Rights-of-way for 6.8 miles of the 84.7 miles have been acquired. All of the property owners have been contacted and negotiations have started for the remainder of the rights-of-way.

The proposed route deviates from the Unit No. 1 route as the applicant could not find a single corridor wide enough to contain the lines for four proposed units at Diablo Canyon through oil fields north of McKittrick, there not being sufficient space between the oil wells.

Applicant's reasons for a separate route for lines from Unit No. 1 and Unit No. 2 are:

1. With the lines on separate rights-of-way there is less chance of simultaneous outage of both lines due to aircraft, landslides, fire, sabotage, etc.
2. The rights-of-way for both routes in the 19.1 mile sections east of Highway Route 58 are being secured in order to provide for the ultimate transmission lines from Diablo Canyon to the Midway substation. With a line constructed on the right-of-way, it is less likely that impediments or interfering land use will be placed within the right-of-way and later have to be removed.

The transmission lines were the subject of discussion by the public witnesses.

One protestant has 80 acres located approximately 10 miles from Morro Bay and seven miles from Atascadero. His property is now crossed by an existing 230 kv line from applicant's Morro Bay power plant, and applicant's proposed northern 500 kv line from Diablo Canyon Unit No. 1 is to cross his property parallel to the 230 kv line. This man wants the property owners notified of the definite plans for the transmission lines.

The second protestant owns 12 acres approximately 10 miles east of Diablo Canyon and along the proposed southern transmission line from Unit No. 1 and the proposed parallel line from Unit No. 2. This witness objected to what he called the indiscriminate routing of power lines all over the County of San Luis Obispo.

The third protestant resides in Atascadero but has unimproved land in See Canyon slightly north of the proposed route of the southern transmission line from Unit No. 1 and the proposed line from Unit No. 2. He stated that the transmission lines will ruin the aesthetics of the area and it will no longer be a pretty place to live.

The approximate locations of the properties of the protestants are marked respectively 1, 2 and 3, on the map attached to Interrogatory No. 15 on Exhibit No. 12.

No proposals for a general revision of the route were made.

A question was asked regarding the possibility of placing the transmission lines underground. The applicant stated that if the lines could be installed underground, an 84-mile, 500-kv transmission line installed underground and having the same capacity as the proposed overhead line would cost in the order of 400 to 500 million dollars.

Licenses and Permits

The status of licenses and permits which applicant must secure in order to construct and operate the proposed plant and related facilities is set forth in Exhibit No. 23. Planning Commission approval has been received from both Kern and San Luis Obispo Counties. Applicant has executed agreements with the Resources Agency of the State of California relative to the conservation resources (Exhibits Nos. 15 and 16).

Findings

The Commission finds that:

1. Applicant has need for a second 1,060,000 kw generating unit in the southern portion of its system by the year 1974.

2. The economics of the project as supported by the estimates presented are not unreasonable.

3. Applicant has the ability to finance and construct the project.

4. Present and future public convenience and necessity will require the construction and operation by applicant of a second nuclear power unit rated at approximately 1,060,000 kw at the Diablo Canyon site, together with the transmission and other appurtenances generally as described by applicant in this proceeding, but subject to the conditions that the certificate is

interim in form and may be made final by further order of the Commission upon issuance by the United States Atomic Energy Commission of final authorization to construct and operate the nuclear energy plant.

5. Applicant plans to design and construct its plant, switchyards, transmission lines, and attendant facilities with full consideration given to aesthetic values and conservation of as much of the natural resources of the region as possible.

The certificate herein granted shall be subject to the following provision of law:

> The Commission shall have no power to authorize the capitalization of the certificate of public convenience and necessity, or the right to own, operate or enjoy such certificate of public convenience and necessity in excess of the amount (exclusive of any tax or annual charge) actually paid to the State or to a political subdivision thereof as the consideration for the issuance of such certificate of public convenience and necessity or right.

The action taken herein is for the issuance of a certificate of public convenience only, and is not to be considered as indicative of amounts to be included in future proceedings for the purpose of determining just and reasonable rates.

We conclude that the application should be granted to the extent set forth in the order which follows.

INTERIM ORDER

IT IS ORDERED that:

1. A certificate of public convenience and necessity is granted to Pacific Gas and Electric Company to construct, operate and maintain a nuclear fueled power generating unit of approximately 1,060,000 kilowatts capacity, together with appurtenant facilities and transmission lines generally as described by applicant in this proceeding, but subject to the condition that the certificate is interim in form and may be made final by further order of the Commission on the establishment by evidence in the record that final authority has been obtained from the Atomic Energy Commission to construct and operate the nuclear energy plant.

2. Applicant shall file with this Commission a detailed statement of the capital costs of the project, including transmission lines and other appurtenances, within one year following the date on which the unit is placed in commercial operation.

3. Within one month after the effective date hereof applicant shall advise all affected parties of the exact route of the transmission line for Units Nos. 1 and 2, and shall file a statement with the Commission that all parties have been advised.

4. In designing its plant, switchyards, and attendant facilities, applicant shall give full consideration to aesthetic values and conservation of the natural resources of the area. Applicant shall submit to the Commission artists' renditions of the major aspect of the project, based on the architect's design, within six months from the date hereof.

5. The authorization herein granted will expire if not exercised within five years from the date hereof.

The effective date of this order shall be twenty days after the date hereof.

Dated at San Francisco, California, this 25th day of MARCH, 1969.

E!! 4.14.69

WILLIAM SYMONS, JR.
President
A. W. GATOV
J. P. VUKASIN, JR.
THOMAS MORAN
Commissioners

Commissioner Fred P. Morrissey, being necessarily absent, did not participate in the disposition of this proceeding.

Certified as a True Copy
ASSISTANT SECRETARY
PUBLIC UTILITIES COMMISSION
STATE OF CALIFORNIA

APPENDIX I

Regional Water Quality Control Board Waste Discharge Requirements

The Resources Agency of California
CENTRAL COASTAL REGIONAL WATER QUALITY CONTROL BOARD
1108 Garden Street
San Luis Obispo, California

ADOPTED OCT. 1 7 1969

Waste Discharge Requirements
Pacific Gas & Electric Company - Diablo Canyon
Nuclear Power Plant, San Luis Obispo County

A report of the Pacific Gas & Electric Company, Diablo Canyon Nuclear Power Plant, San Luis Obispo County, dated April 25, 1969, of a proposed industrial waste discharge has been considered by the Central Coastal Regional Water Quality Control Board.

Proposal

1. The Diablo Canyon Nuclear Power Plant is located adjacent to the Pacific Ocean and Diablo Canyon Creek about 10 miles south of Morro Bay, San Luis Obispo County, California.

2. Condenser cooling water will be taken from the Pacific Ocean adjacent to the shore and will be discharged near the shore in Diablo Cove. Design volume is 867,000 gallons per minute for each unit.

3. Temperature of cooling water will be raised approximately 18°F during normal, continuous operation. Periodic thermal treatment of the cooling water system is provided to minimize growth of marine organisms in the piping and heat exchangers. The required frequency of this operation varies seasonably but will not normally have a duration of more than a few hours per month. During this operation, the total heat discharged to the ocean will be substantially less than the design full load heat output.

4. Slime and algae control will consist of periodic chlorination of the cooling water so as to maintain a residual chlorine concentration at the condenser outlet of 0.5 mg/l for periods of up to one hour and/or twice a day during periods when control is required.

5. The large volume of condenser cooling water flow will be used as a diluting media for the following small waste streams which will be intermittently discharged into the cooling water outfall at flow rates ranging up to a few hundred gpm:

   a. Concentrated seawater produced through the operation of seawater evaporators used to produce distilled water for plant use.

   b. Miscellaneous chemical wastes characteristic of a pressurized water reactor nuclear power plant consisting of small quantities of demineralizer regenerant chemicals (a neutralized mixture of sulfuric acid and sodium hydroxide); chemical laboratory wastes; equipment cooling water; reactor water containing treatment chemicals including boric acid, lithium hydroxide, and ammonium hydroxide; steam generator water containing treatment chemicals including sodium phosphate, sodium hydroxide, ammonium hydroxide and hydrazine; chemical cleaning and decontamination reagents; and laundry waste waters containing detergents. These discharges will be designed such that, after mixing, there will be no significant change in pH or dissolved oxygen level of the cooling water discharge, and chemical concentrations will be less than 1 ppm.

   c. Sanitary wastes will receive primary treatment in a septic tank prior to discharge. The permanent staff at the plant will be about 70 employees. Provisions for chlorination of this effluent will be included in the design of the plant and will be installed if a need for such treatment is demonstrated.

   d. Drainage from equipment areas susceptible to possible oil spillage will be processed in an air flotation type separator. Effluent from the separator will contain less than 20 ppm oil. After mixing with the cooling water, concentration of oil will be less than 0.01 ppm.

   e. Radioactive liquid wastes from the reactor system will be collected, treated, and monitored in a radioactive liquid waste treatment system. This system includes storage tanks to permit radioactive decay, and evaporators, ion exchangers and filters to remove radioactive matter from the waste streams. High level wastes produced by these processes (evaporator concentrates, ion exchange resins, filter media) will be collected and packaged for ultimate offsite shipment to an approved burial site. After decay and/or treatment, individual batches of low level liquid waste will be sampled and analyzed to determine compliance with discharge limits. The batch will then be discharged into the cooling water discharge.

Beneficial Uses

In March 1967, the Board adopted a Water Quality Control Policy for Coastal Waters, Point Arguello to Point Piedras Blancas. Recognized beneficial uses of the Pacific Ocean waters and adjacent shoreline in the general vicinity of the proposed discharge are as follows:

1. Scenic attraction and aesthetic enjoyment.
2. Marine habitat for sustenance and propogation of fish, aquatic, and wildlife.
3. Fishing.
4. Industrial water supply.
5. Boating, shipping and navigation.
6. Scientific study.
7. Potential water contact sports.

Objective

It shall be the objective of this Board to protect the public health, to protect beneficial uses made of the receiving waters and adjacent shorelines from unreasonable impairment and to prevent nuisance conditions from occurring.

Requirements

1. All radioactive wastes in the liquid waste discharge shall be in solution at the time of discharge or shall be filtered through a filter medium with a maximum nominal 5 micron particle removal capacility.

2. The concentration of radioactive materials of plant origin in the effluent stream at the point of last control shall not exceed either of the following:

   a. 1×10^{-6} microcuries per milliliter (except tritium) or 3×10^{-2} microcuries per milliliter of tritium when averaged over any period of seven consecutive days; for the purpose of this requirement, where tritium and unknown mixed fission and activation products may be present, the limiting weekly average concentration shall be:

$$\frac{\text{tritium, } \mu c/ml}{3 \times 10^{-2}\ \mu c/ml} + \frac{\text{Mixed fission \& activation products, } uc/ml}{1 \times 10^{-6}\ \mu c/ml} \leq 1$$

b. 1×10^{-7} microcuries per milliliter (except tritium) or 3×10^{-3} microcuries per milliliter of tritium when averaged over any calendar year; for the purpose of this requirement, where tritium and unknown mixed fission and activation products may be present, the limiting annual average concentration shall be:

$$\frac{\text{tritium, } \mu c/ml}{3 \times 10^{-3} \ \mu c/ml} + \frac{\text{mixed fission \& activation products, } \mu c/ml}{1 \times 10^{-7} \ \mu c/ml} \leq 1$$

provided that radium-226, radium-228, and iodine-129 are known to be absent in the discharge.

3. The discharge shall be controlled to the degree necessary to prevent any noticeable change in the receiving waters. This shall include change in natural appearance resulting from discoloration, floating or suspended solids, grease, oil, oil slicks and foam.

4. There shall be no visible solids or oil resulting from the discharge deposited along the shore.

5. The discharge shall be controlled to the extent that floating, suspended and settleable solids and toxic substances will not interfere with marine life, including fish, plant and bird life and the organisms upon which they depend.

6. The discharge shall not cause the pH, dissolved oxygen, or temperature of the receiving waters to exceed the following limits:

a.	pH	- within range 7.0 - 8.5
b.	Dissolved Oxygen	- not less than 5.0 mg/l
c.	Temperature	- change shall not cause undesirable ecological change or deleterious effect upon aquatic plant and animal life.

7. Near shore waters in the vicinity of the discharge shall not have a coliform most probable number (MPN) greater than 1000 per 100 ml. provided that not more than 20 percent of the samples at any sampling station, in any 30 consecutive samples, exceed 1000 per 100 ml. (compliance with this requirement in the total plant discharge itself will be equivalent to meeting the bacterial standard for near shore receiving waters).

Reports

1. The discharger shall furnish technical reports as provided in Section 13055, California Water Code, on operation, discharge characteristics, and receiving water quality. Such reports shall be submitted in accordance with specifications attached to these requiremebts, which specifications the staff of this Board is authorized to revise whenever necessary and such revision being subject to review at the request of the discharger.

2. Chemical and physical analyses of samples and bioassay techniques shall be in accordance with the latest edition of Standard Methods, published by the American Public Health Association.

3. Analytical methods and equipment related to measurement of radiation shall be approved by the Bureau of Radiological Health of the State Department of Public Health.

Review of Requirements

1. These requirements shall apply only to the discharge of waste waters at the location described. Any modification of operations which will change the point of discharge must be reported to the Board.

2. Material change in beneficial water uses or conditions in the aroa will be considered as sufficient reason for the Board to review these requirements.

3. These requirements apply to Units No. 1 and No. 2 of the Diablo Canyon nuclear power plant. Any expansion of the discharge facilities will require submission of a new report on waste discharge by the company and a review of requirements by the Regional Board.

Undesirable Ecological Change

The California Department of Fish & Game has defined "undesirable ecological change or deleterious effect upon aquatic plant and animal life" as follows:

1. For any point in the receiving water, including the area within Diablo Cove, there shall be no acute toxicity to the marine biota due to the waste discharge.

2. For the ocean waters beyond Diablo Cove, this discharge should not either directly or indirectly cause the following undesirable ecological changes or deleterious effects upon the marine environment:

a. A reduction in abundance or distribution of:

Bull Kelp (Nereocystis leukana)
Pea Kelp (Macrocystis angustifolia)
Abalones (Haliotis sp.)
Bony fishes

b. A reduction in abundance, distribution or variety of attached indigenous animal and plant life on rocky substrates.

c. An increase in the distribution or abundance of:

Round Stingrays (Urolophus halleri)
Bat Rays (Mylobatus, californicus)
Sunray Starfish (Pyncnopodia, helianthoides)
Rock Crabs (Cancer sp.)
Sea Urchins (Strongylocentrus sp.)

d. An introduction of undesirable species such as the Moray Eel (Gymnothorox mordax).

e. Any unforeseen change that adversely alters the ecological balance or productivity of the marine environment.

Monitoring Program and Schedule of Technical Reports to be Submitted to Regional Board by Pacific Gas & Electric Company - Diablo Canyon Nuclear Power Plant, San Luis Obispo County

I. Records to be maintained concerning plant discharge:

A. Average daily volume of waste discharge.

B. Oil content of discharge from oil removal facilities - intermittent discharge to be sampled quarterly.

C. pH of discharge -- daily when chemical cleaning of equipment is in progress.

D. Temperature of cooling water intake and discharge -- daily.

E. Bioassay (96 hour Tlm, using species indigenous to receiving water area) of discharge during pre-startup cleaning of equipment and piping. Bioassay of discharge once quarterly during first two years of plant operation.

F. Bacteriological samples shall be collected from the plant effluent at the point of final discharge to determine the most probable number (MPN) coliform organisms -- monthly.

G. Concentration of radioactivity in the discharge, including the total quantity -- daily.

II. Records to be maintained concerning receiving waters:

A. Complete radiological waste monitoring program as deemed adequate by the State Department of Public Health and relevant to the receiving waters, environment and discharge.

B. Ecological studies as specified by the Department of Fish and Game shall be continued in order to evaluate changes of the marine plant and animal distribution and abundance within Diablo Cove.

C. Ecological studies as specified by the Department of Fish and Game shall be conducted in the marine environment outside of Diablo Cove in order to evaluate the ecological conditions.

D. Aerial photographs of the existing kelp beds from Pecho Rock to Point Buchon shall be taken three times per year, during February, June and October, for a period of at least two years.

E. Surface water temperatures shall be determined at two-month intervals beginning in February from Point Buchon to Pecho Rock for at least two years following the beginning of discharge. Isotherms shall be determined in 2°F. intervals. Individual surveys shall be conducted consistently during the late morning hours at the same time each day.

F. Water temperatures shall be measured at one meter intervals from the surface to the bottom at seven stations prescribed by the Department of Fish and Game inside and adjacent to Diablo Cove. Measurements shall be taken in February, June, and October. Precision of measurements shall be within ± 0.2° F.

G. Five 1/2 square meter quadrats in the rocky intertidal zone at locations formerly documented by the Department of Fish and Game shall be photographed three times per year for at least two years following discharge. A 2-1/4" color transparency shall be used for this purpose. Photographic scheule will conform to recommendations of the Department of Fish and Game.

H. pH and dissolved oxygen content of the receiving waters in February, June, and October.

III. Collection of samples:

A. Temperature, oil, dissolved oxygen, coliform and pH samples shall be grab samples.

B. Sampling for radioactivity monitoring shall be approved by the State Department of Public Health Bureau of Radiological Health.

C. All other samples shall be collected in accordance with accepted procedures having approval of the Department of Fish and Game or the staff of this Regional Board.

IV. Reports to the Board:

A. A report shall be made to the Board quarterly on that portion of the State Department of Public Health's approved environmental monitoring program relating to the marine environment and the discharge, including daily radiological concentration and total quantity in the discharge.

B. Reports shall be made to the Board annually, not later than March 1st of each year and shall include the following:

1. Results of daily volume measurements.

2. Results of daily cooling water intake and discharge temperature measurements.

3. Results of oil content analyses of discharge from removal facilities.

4. Results of all bacteriological analyses of effluent.

5. Results of all bio-assay (96 hour TLm) tests performed.

6. Results of ecological studies as specified in Paragraph II. B., C., E., F., and H., above.

7. Copies of photographs as specified in Paragraph II. G., above.

8. The occurrence of any incident causing the level of radioactivity to exceed permissible levels or causing the release of other toxic materials in concentrations detrimental to human, plant, bird or fish life shall be reported within 12 hours after its occurrence, and its cause, effect, and corrective action shall be described in detail in the next regular report submitted to the Regional Board.

V. Review and Evaluation of Monitoring Program, etc.:

Upon receipt of the Company's report at the end of the second year of plant operation, this Monitoring Program and Schedule of Technical Reports shall be re-evaluated in consultation with representatives of the Company, State Departments of Fish and Game and Public Health, and will be revised as deemed necessary to assure continued compliance with the Waste Discharge Requirements.

APPENDIX J

County Zoning Ordinance

ORDINANCE NO. 375

ORDINANCE AMENDING SAN LUIS OBISPO COUNTY
ORDINANCE CODE SECTION 11-481(3)

The Board of Supervisors of the County of San Luis Obispo do ordain as follows:

SECTION 1: That Section 11-481(3) of the San Luis Obispo County Ordinance Code be and hereby is amended to read as follows:

"3. Public Buildings, Water Wells, Tanks and Reservoirs, subject to the securing of a Conditional Use Permit in each case, except in those zones where such use is permitted.

Public utility buildings, structures, and uses, including but not limited to switch yards and electric generating plants and appurtenant facilities, shall be a permitted use without height limitation in all districts, except in any "R" District, provided such building or structure is constructed with the approval of the Public Utilities Commission of the State of California."

SECTION 2: That this ordinance shall be in full force and effect 30 days after its passage, and before the expiration of 15 days after the passing of this ordinance it shall be published with the names of the members voting for and against the same, once, in The Telegram-Tribune, a newspaper of general circulation published in the County of San Luis Obispo, State of California.

PASSED AND ADOPTED by the Board of Supervisors of the County of San Luis Obispo, State of California, on the 3rd day of October, 1966, by the following roll call vote, to-wit:

AYES: Supervisors Hans Heilmann, Lyle F. Carpenter, M. Roland Gates, Samuel Borradori, and Chairman Fred C. Kimball.

NOES: None

ABSENT: None

Chairman, Board of Supervisors,
County of San Luis Obispo,
State of California.

ATTEST:

County Clerk and ex-officio clerk,
Board of Supervisors,
County of San Luis Obispo,
State of California.

(SEAL)

APPENDIX K
Radiological Monitoring

RADIOLOGICAL MONITORING PROGRAM

A radiological monitoring program is being conducted at Diablo Canyon by PG&E's Department of Engineering Research with special assistance from qualified contractors and in cooperation with the State of California Department of Public Health, Bureau of Radiological Health. This program consists of gamma dosimetry with thermoluminescent dosimeters (TLD's) and film badges, continuous air particulate sampling with analysis for gross beta activity and gross beta activity analyses of various specimens collected periodically from the site environs. This procedure has been successfully used for the past eight years at PG&E's Humboldt Bay Nuclear Power Plant near Eureka, California.

Dosimetry

The level and variance of penetrating radiation in the environment in the vicinity of the Diablo Canyon site are continuously monitored by sets of integrating dosimeters at 18 monitoring stations; eight on the site property and 10 off site. Station locations are shown on the two maps included in this appendix. Each set consists of two TLD's and a standard film badge.

All dosimeters are collected and read monthly. Shown below are the measurements from these stations.

Diablo Canyon Dosimeter Measurements[1] – Millirems per Month

Location	II/70	III/70	IV/70	I/71
	Qtr/Year			
1	11.4	10.5	10.2	9.9
2	11.0	10.0	9.7	9.0
3	11.8	11.8	11.3	9.6
4	10.8	12.3	11.8	9.7
5	9.7	10.1	9.7	8.8
6	11.2	9.3	8.3	8.5
7	10.3	10.4	8.7	9.3
8	10.7	11.2	10.5	9.5
9	9.9	9.9	10.5	9.5
10	9.5	8.7	8.8	7.9
11	12.1	9.5	9.3	8.2
12	10.7	10.9	8.8	8.5
13	11.9	9.4	9.3	8.9
14	10.0	10.1	9.2	8.7
15	11.1	12.0	9.7	10.4
16	-	10.5	10.2	10.2
17	-	12.5	10.0	10.0
18	-	9.3	8.1	9.9

[1] Measured by EG&G Model TL-15 TLD's

Air Particulate Monitoring

Four air particulate samplers continuously monitor the level and variance of radiation from radioactive particles in the atmosphere. These samplers are located at stations 1, 9, 12, and 14 as shown on the two maps. Charcoal cartridges are used in the samplers to collect I-131. The exposed filters from the samplers are collected and counted weekly. Average, high and low measurements from the particulate samplers are shown in the following table.

Air Particulate Gross Beta Activities (pCi/m^3)

Qtr/Year		Sta. 1	Sta. 9	Sta. 12	Sta. 15*
II/70	ave	.24	.27	.23	.27
	high	.34	.34	.39	.37
	low	.09	.15	.11	.20
III/70	ave	.10	.15	.18	.15
	high	.28	.31	.26	.23
	low	.04	.07	.13	.08
IV/70	ave	.09	.08	.10	.11
	high	.20	.14	.17	.23
	low	.02	.02	.04	.04
I/71	ave	.16	.11	.16	.13
	high	.41	.17	.46	.26
	low	.06	.07	.05	.05

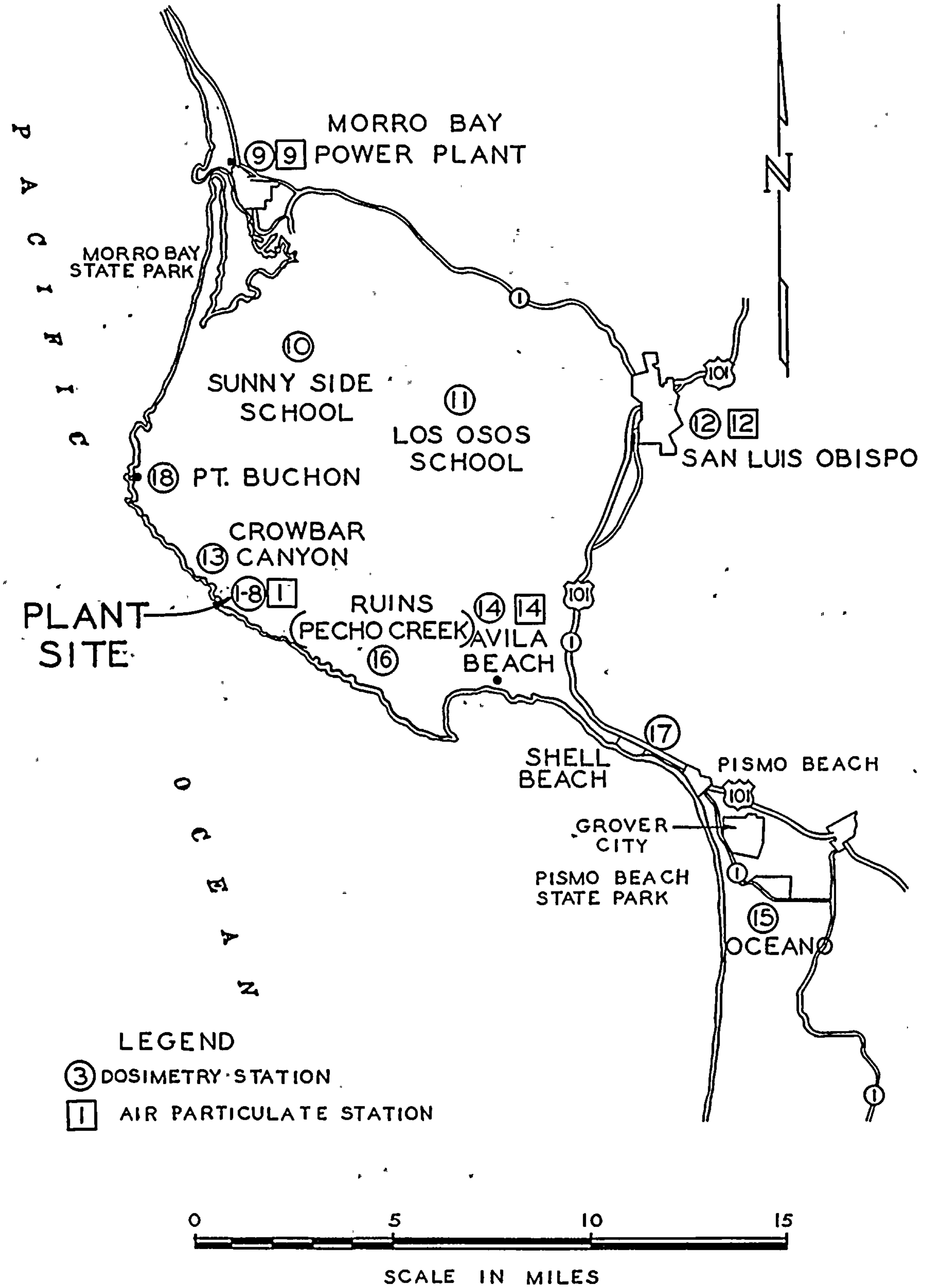
*Moved to Station 14 at end of first quarter 1971

Presented in the following table are the gross beta activities measured in the terrestrial and marine specimens collected from the environs of the Diablo Canyon site. All samples were counted with a proportional counter calibrated with Potassium-40.

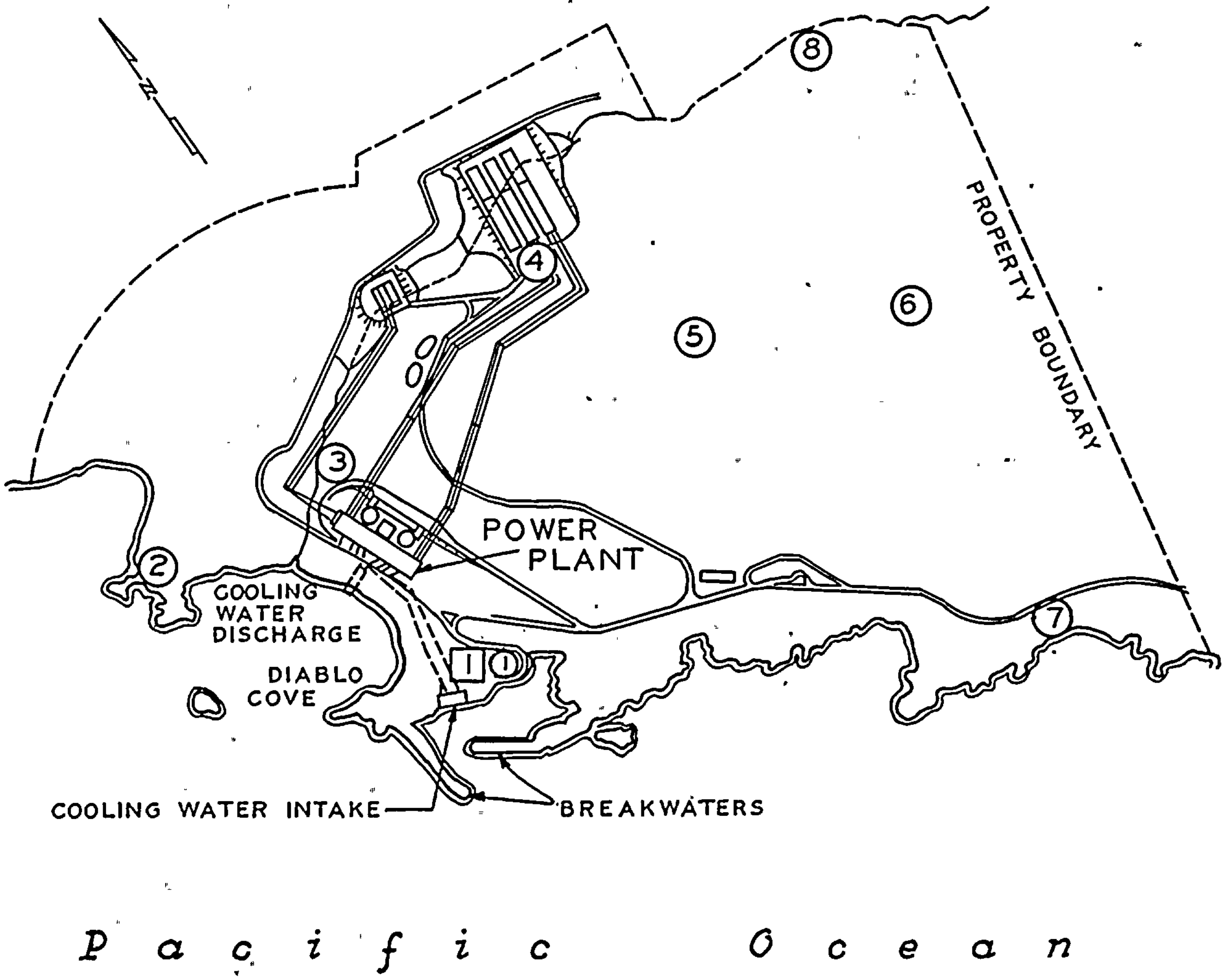
Gross Beta Activity of Diablo Canyon Marine and Terrestrial Samples[1] – pCi/gm Original Sample

Sample	IV/69	II/70	Qtr/Year III/70	IV/70	I/71
Bull Kelp (*Nereocystis*)	9.9	9.3	6.1	9.8	9.8
Red Algae (*Iridaea flaccidum*)	1.0	2.1	2.7	1.5	2.5
Red Abalone, meat (*Haliotis rufescens*)	-	2.7.	3.8	3.4	3.3
Black Abalone (*Haliotis cracherodii*)	2.2	1.6	2.7	1.9	3.1
Goose Barnacles, meat (*Pollicipes polymerus*)	0.9	1.6	1.3	1.1	1.1
California Mussels, meat (*Mytilus californianus*)	1.9	3.0	2.6	2.0	2.6
Pismo Clams (*Tivela stultorum*)[2]	-	-	-	-	1.5
Cabezon (*Scorpaenichthyes marmoratus*)	-	-	-	3.6	2.8
Rockfish, meat (*Sebastes sp.*)	-	2.2	1.8	2.4	2.1
Seawater (pCi/1)	5.1	8.7	2.2	9.9	6.1
Bottom Sediment	10.5	13.9.	15.3	21.5	8.6
Commercial					
Red Abalone[3]	-	-	2.3	1.9	-
Salmon[3]	-	-	1.1	-	-
Leafy Vegetable[4]					
Romaine lettuce	2.1	8.6	2.9	4.8	3.2
Red lettuce	-	-	-	-	3.3
Cauliflower	-	-	-	-	4.2
Rockfish (Red Snapper)[3]	-	-	5.3	-	3.5
Milk (pCi/1)[5]	-	600.0	1,320.0	1,333.0	1,063.0
Bovine Thyroid[5]	-	-	4.2	1.3	

[1] All samples taken at Diablo Cove unless noted
[2] Sample from Pismo Beach
[3] Sample from Morro Bay
[4] Sample from truck farms in Arroyo Grande and Los Osos Valley
[5] Sample from San Luis Obispo



DOSIMETRY AND
PARTICULATE STATIONS OFF SITE



LEGEND

③ DOSIMETRY STATION

[1] AIR PARTICULATE STATION

0 1600 3200

SCALE IN FEET

DOSIMETRY AND PARTICULATE STATIONS ON SITE

APPENDIX L
Radiation Data

POTENTIAL OFF-SITE DOSES FROM NORMAL OPERATION

Potential Radiation Dose From Exposure to Gaseous Releases

The potential radiation doses which could result from the activity releases given in Table 24, Page 53, were evaluated using accepted methods and the following assumptions:

For the surface body doses from beta emitters, and the whole body gamma doses, the infinite cloud models recommended in Meteorology and Atomic Energy[1] and by the AEC Safety Guides[2] were used. The beta and gamma energies were taken from data given by Perkins and King[3].

Whole body doses in all sectors were calculated using values of the atmospheric dilution factors developed for the Diablo Canyon site during a two year meteorological program. The annual average values of the dilution factors ranged from 2.5×10^{-7} sec/m^3 to 7.5×10^{-7} sec/m^3 at a distance of 800 meters, and from 3.0×10^{-9} sec/m^3 to 1.8×10^{-8} sec/m^3 at a distance of 20,000 meters.

The whole body doses (beta plus gamma) ranged from 0.2 mrem/yr to 0.6 mrem/yr at the site boundary a distance of 800 meters, and from 0.002 mrem/yr to 0.01 mrem/yr at a distance of 20,000 meters (12.4 miles). Doses at distances greater than 12 miles would be still lower.

[1] D. H. Slade, Editor, *Meteorology and Atomic Energy*, Division of Technical Information, Atomic Energy Commission, Report Number TID-24190, July 1968

[2] *Safety Guides for Water-Cooled Nuclear Power Plants*, U.S. Atomic Energy Commission, Washington, D.C., November 1970.

[3] J. F. Perkins and R. W. King, *Energy Release From the Decay of Fission Products*, Nuclear Science and Engineering: 3, 726-746, 1958

[4] Concentration factors for elements not listed in Table 25 were taken from Chapman, et al, 1968 UCLR 50564 *Concentration Factors of Chemical Elements in Edible Aquatic Organisms*

Potential Radiation Dose to Man From Consumption of Edible Species

The following assumptions were made in developing the estimated exposure to man resulting from consumption of edible marine species removed from Diablo Cove:

The average discharge from the plant was assumed to be 0.003 PCi/ml of fission and corrosion products (listed in Table 23, page 53) and 5 PCi/ml of tritium.

Abalone will concentrate discharged radionuclides at the same rate as they concentrate stable nuclides of the same element from seawater and listed in Table 25.[4]

No dilution will occur between the point of discharge and the commercial abalone beds. (Because it is illegal for commercial operators to remove abalone from depths less than 20 feet and because the 20-foot contour is approximately 600 feet offshore at the proposed point of discharge, this assumption is very conservative.)

The individual of concern is assumed to obtain his entire protein requirement of 220 grams per day from abalone raised in the plant discharge water.

APPENDIX M
Published Information

REPORTS ON BIOLOGICAL, ECOLOGICAL, OCEANOGRAPHIC AND OTHER STUDIES BY PACIFIC GAS AND ELECTRIC COMPANY THAT RELATE TO THE DIABLO CANYON SITE

1. CHENEY, W.O.—"Contra Costa Power Plant Fish Control Program," PG&E Bureau of Tests T.D. 1314.1–1314.75 (1951-1952) mimeo.

2. CHENEY, W.O. and DUNCAN, J.—"Preliminary Water Temperature Study, Morro Bay Power Plant," PG&E Bureau of Tests Report No. 1539 (June 1959) mimeo.

3. CHENEY, W.O. and DOYLE, M.J., Jr.—"Morro Bay Water Temperature Studies," PG&E Bureau of Tests Report No. 1637 (April 1961) mimeo.

4. CAYOT, R.F. and GORMLY, J.H.—"Investigation of Cooling Water Discharge Mixing for the Proposed Diablo Canyon Nuclear Plant Site," PG&E DER Report No. 6674-67 (February 1967) mimeo.

5. GLENN, W.K. and CULVER, W.H.—"Determination of the Composition of Red Abalone and Comparison With the Composition of Pacific Oysters," PG&E DER Report No. 6242.1-67 (March 13, 1967).

6. CHENEY, W.O., ADAMS, J.R., DOYLE, M.J., Jr., and GORMLY, H.J.—"Report No. 2, Oceanographic Background Study, Diablo Canyon Nuclear Power Plant Site, Period Ending April 15, 1967," PG&E DER Report No. 6242.2-67 (June 21, 1967).

7. CHENEY, W.O., GORMLY, H.J. and DOYLE, M.J., Jr.,—"Report No. 3, Oceanographic Background Study, Diablo Canyon Nuclear Power Plant Site, Period Ending June 30, 1967," PG&E DER Report No. 6242.3-67.

8. GORMLY, H.J. and KRITIKOS, W.T.—"Prediction of Cooling Water Intake Temperatures for the Diablo Canyon Nuclear Plant Site," PG&E DER Report No. 6674.3-67 (October 1967) mimeo.

9. DOYLE, M.J., Jr., and ADAMS, J.R.—"The Use of a Thermal 'Mapper' in Cooling Water Studies," PG&E DER Report No. 7041.1-68 (1968) 6p. (mimeo).

10. CAYOT, R.F. and NORTH, Dr. W.J.—"Oceanographic Background Study, Diablo Canyon Nuclear Power Plant Site, 1967," PG&E DER Report No. 6242.4-68 (1968) mimeo.

11. ADAMS, J.R.—Thermal Effects and Other Considerations at Steam Electric Plants. A Survey of Studies in the Marine Environment. PG&E (August 20, 1968) DER Report 6934.4-68 (1968) 87p.

12. CAYOT, R.F. and NORTH, Dr. W.J.—"Oceanographic Background Study, Diablo Canyon Nuclear Power Plant Site 1968," PG&E DER Report No. 7331-69 (June 30, 1968).

13. MOONEY, M.L. and CRAMER, H.E.—"Meteorological Study of the Diablo Canyon Nuclear Power Plant Site," PG&E Gas Control Department (May 1970)

SOME OF THE PAPERS PRESENTED BY PACIFIC GAS AND ELECTRIC COMPANY AUTHORS ON COOLING WATER ENVIRONMENTAL STUDIES

1. CHENEY, W.O. and RICHARDS, G.V.
   1966 Ocean Temperature Measurements for Power Plant Design. *Proc. ASCE 1965 Coastal Engr. Conf.* Santa Barbara, California: 955-989.

2. PACIFIC GAS AND ELECTRIC COMPANY
   1969 Summary of Ecological Studies and Agreements Between California Resources Agency and Pacific Gas and Electric Company, for Thermal Power Plants. 47p.

3. ADAMS, J.R., GORMLY, H.J. and DOYLE, M.J., Jr.
   1969 Ecological Investigations Related to Thermal Discharges. Presented at Pacific Coast Electrical Assoc. E. & O. Section. Annual Meeting, Los Angeles, California (March 13-14, 1969): 16p. mimeo.

4. ADAMS, J.R.
   1969 Thermal Power, Aquatic Life and Kilowatts on the Pacific Coast. Presented at American Power Conference. Annual meeting, Chicago, Illinois (April 22-25, 1969). *Nuclear News* 12 (9): 75-79 (September 1969); *Proceedings of the American Power Conference* 31: 350-359.

5. ADAMS, J.R.
   1969 Ecological Investigations Around Some Thermal Power Stations in California Tidal Waters. Proceedings of 2nd Workshop on Effects of Thermal Additions in the Marine Environment, Solomons, Md. (November 1968). *Chesapeake Science. 10* (3-4): 145-154.

6. ADAMS, J.R.
   1969 Thermal Effects and California's Waters. Presented at Symposium on "Nuclear Power Plants in Perspective in California". Sir Francis Drake Hotel, San Francisco, California. Sponsored by Pacific Gas and Electric Company as adjunct to American Nuclear Society Winter Annual Meeting. (December 3, 1969): 12p.

7. ADAMS, J.R.
   1970 "Thermal Effects of Power Plants on Tidal Waters." Delivered to State Commission on Navigation and Ocean Development, Oakland City Hall, Oakland, California. (April 17, 1970) 19p.

8. ADAMS, J.R.
   1970 "Thermal Effects of Electric Power Plants." Hearings before the Joint Committee on Atomic Energy, Congress of the United States, Ninety-first Congress, on the Environmental Effects of Producing Electric Power, February 24-26, 1970. Washington, D.C.: U.S. Government Printing Office: Part 2 (Volume I): 1781-1800.

9. ADAMS, J.R., GORMLY, H.J. and DOYLE, M.J., Jr.
   1970 "Thermal Investigations in California," *Marine Pollution Bulletin,* Volume I (NS) No. 9 (September 1970) pp 140-142.

COOPERATIVE REPORTS ON COOLING WATER ENVIRONMENTAL STUDIES IN WHICH PACIFIC GAS AND ELECTRIC COMPANY HAS PARTICIPATED THAT RELATE TO THE DIABLO CANYON SITE

1. EBERT, E.E.
   1966 An Evaluation of Marine Resources, Point Buchon to Point San Luis, San Luis Obispo County, with special reference to abalone and the Diablo Canyon area, May 2-4, 1966. California Department of Fish and Game MRO Reference Report 66-11: 16p.

2. NORTH, W.J.
   "An Evaluation of the Marine Flora and Fauna in the Vicinity of Diablo Cove, California," Marine Advisors, La Jolla, California (December 1966) mimeo. 38p.

3. CLARK, F.J.
   "Fishing Activity in the Diablo Cove Area," Marine Advisors, La Jolla, California (December 1966) mimeo. 8p.

4. NORTH, W.J.
   1969 An Evaluation of the Marine Flora and Fauna in the Vicinity of Diablo Cove, California. Marine Advisors, La Jolla, California, in *Thermal Pollution–1968 Part 4* Hearings before the Senate Subcommittee on Air and Water Pollution, U.S. Senate. Ninetieth Congress: 1097-1128.

5. NORTH, W.J.
   1969 Biological Effects of a Heated Water Discharge at Morro Bay, California. Madrid, Spain: *Proceedings Intl. Seaweed Sym. 6:* 275-286.

REPORTS ON EFFECTS OF COOLING WATER DISCHARGE ON PELAGIC COMMUNITIES

1. BARNETT, P.R.O. and HARDY, B.L.S.
   1969 The Effects of Temperature on the Benthos near the Hunterston Generating Station, Scotland. *Chesapeake Science* 10 (3-4):255-256.

2. COUTANT, C.C.
   1970 Biological Aspects of Thermal Pollution. 1. Entrainment and Discharge Canal Effects. *C.R.C. Critical Reviews in Environmental Control.* (November 1970):341-381.

3. HAIR, J.R.
   1971 Upper Lethal Temperature and Thermal Shock Tolerances of the Oppossum Shrimp, *Neomysis awatschensis,* from the Sacramento–San Joaquin estuary, California. *California Department of Fish and Game 57* (1):17-27.

4. HEINLE, D.R.
   1969 Temperature and Zooplankton. *Chesapeake Science 10* (3-4):186-209.

5. HIRAYAMA, K. and HIRANO, R.
   1970 Influences of High Temperature and Residual Chlorine on Marine Phytoplankton. *Marine Biology* 7:205-213.

6. JOHNS HOPKINS UNIVERSITY
   1970 EEI Cooling Water Discharge Project (RP-49) Semi-Annual Research Progress Report to 31 October 1970. Report to the Cooling Water Task Force, Edison Electric Institute, from the Johns Hopkins University Research Staff of RP-49:29 p.

7. MARINE BIOLOGICAL CONSULTANTS, INC.
   1971 Temperature Time Effects on Marine Plankton Passing Through the Cooling Water System at San Onofre Generating Station. Report prepared for Southern California Edison Co. by Marine Biological Consultants, Inc., Costa Mesa, California. (January 1971):132 p.

APPENDIX N
Physical Oceanography

INTRODUCTION

The physical oceanography data in this appendix is an excerpt from PG&E's Department of Engineering Research Report No. 6242.4-68 entitled "Oceanographic Background Study, Diablo Canyon Nuclear Power Plant Site, 1967".

Information included in this appendix encompasses the following areas of the oceanographic investigations which were conducted in 1966 and 1967:

1. Underwater topography
2. Tides
3. Seasonal variation in the vertical temperature and salinity structure
4. Annual variation in sea surface temperatures
5. Stability
6. Currents
7. Ocean dilution

The remainder of report No. 6242.4-68 covers the marine biology studies conducted at Diablo Canyon by Dr. W. J. North, consultant to PG&E. These studies are described in detail in the section, BIOLOGICAL IMPACT.

PHYSICAL OCEANOGRAPHY

Physical oceanographic surveys were conducted at Diablo Canyon as outlined in Table 1. The procedure for these surveys required the outfitting of a sea going vessel (a 65 foot steel hull commercial fishing boat) with standard oceanographic instruments. A complete list of the instrumentation used is contained in Table 8. The surveys were conducted in sea state conditions up to Code 4 (WMO)[1], (Waves from 4 to 8 feet high). Conditions not exceeding Code 4 can be expected in the vicinity of Diablo Cove approximately 75% of the time.[2]

TABLE 1

CHRONOLOGY OF PHYSICAL OCEANOGRAPHY SURVEYS

Date	Nature of Survey	Date	Nature of Survey
3/25/67	Oceanographic Stations	9/25/67	Current Measurements
3/27/67	Current Measurements	9/26/67	Current Measurements
3/28/67	Current Measurements	9/27/67	Dye Study
4/4/67	Dye Study	9/28/67	Oceanographic Stations
4/5/67	Dye Study	9/29/67	Current Measurements
		9/30/67	Current Measurements
6/22/67	Current Measurements	10/1/67	Current Measurements
6/23/67	Current Measurements		
6/24/67	Current Measurements	12/3/67	Current Measurements
6/25/67	Oceanographic Stations	12/4/67	Current Measurements
6/26/67	Underwater Topographic Surveys	12/6/67	Oceanographic Stations
6/27/67	Underwater Topographic Surveys	12/7/67	Current Measurements
6/27/67	Current Measurements	12/8/67	Current Measurements
6/28/67	Underwater Topographic Surveys	12/9/67	Current Measurements
6/29/67	Underwater Topographic Surveys	12/10/67	Current Measurements
6/30/67	Underwater Topographic Surveys		

During 1967 studies were undertaken to:

1. Develop a map showing the bottom topography of the area within one quarter mile of the proposed plant site.

2. Record tide to establish a correlation with published data.

3. Determine vertical temperature and salinity profiles at various times of the year and evaluate changes in stability.

4. Continuously measure surface water temperatures and correlate this data with long time temperature records.

5. Measure currents to establish seasonal and other variations.

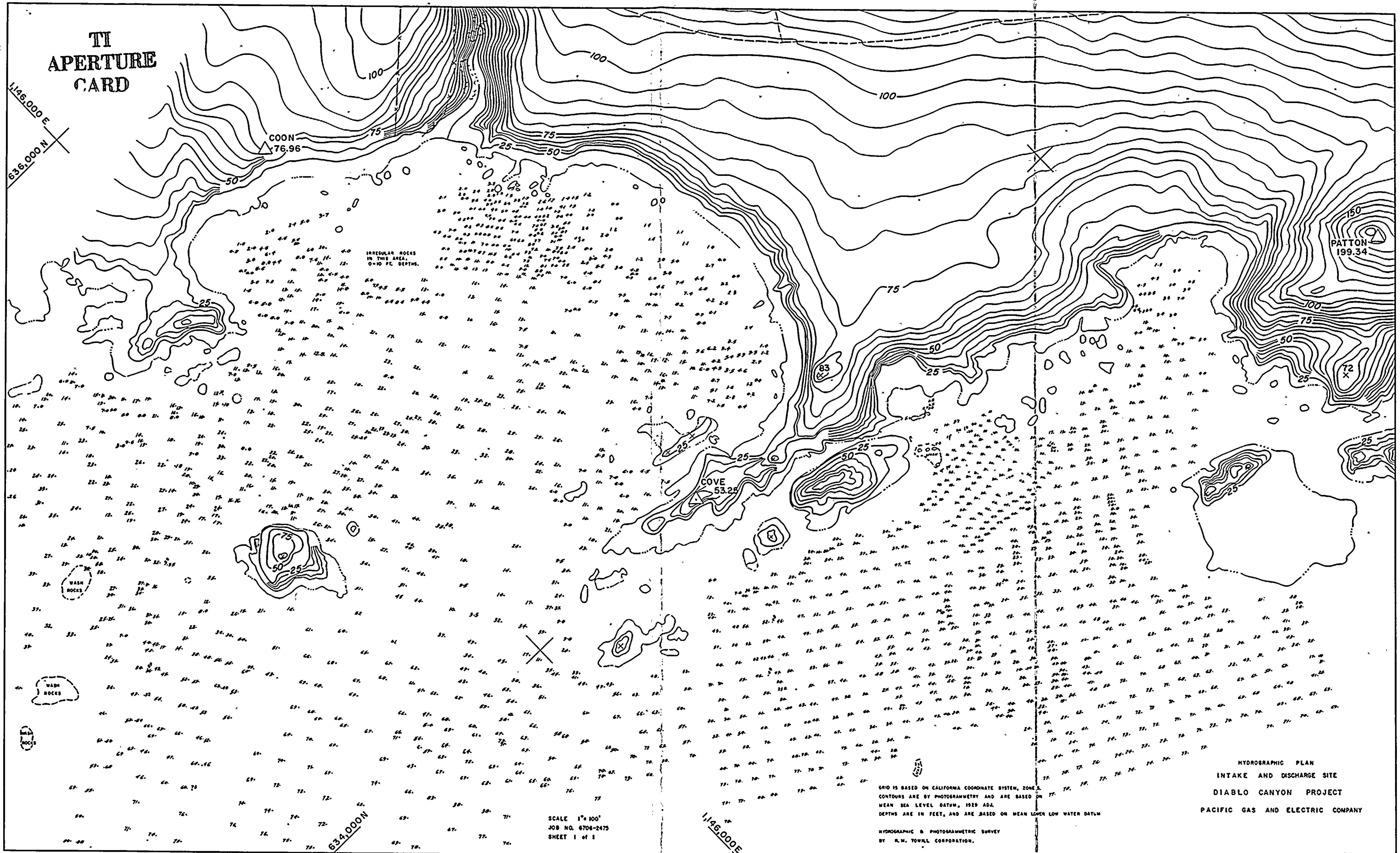
6. Study dye dispersion and dilution rates.

OFFSHORE TOPOGRAPHY:

A map of soundings taken adjacent to the plant site was prepared by R. M. Towill Corporation and is included in this report (see Figure 1).

Also Available On
Aperture Card

TI
APERTURE
CARD



8506030233-06

TIDAL OBSERVATIONS:

Tide was recorded for approximately 90 days, at the location shown in Figure 2.

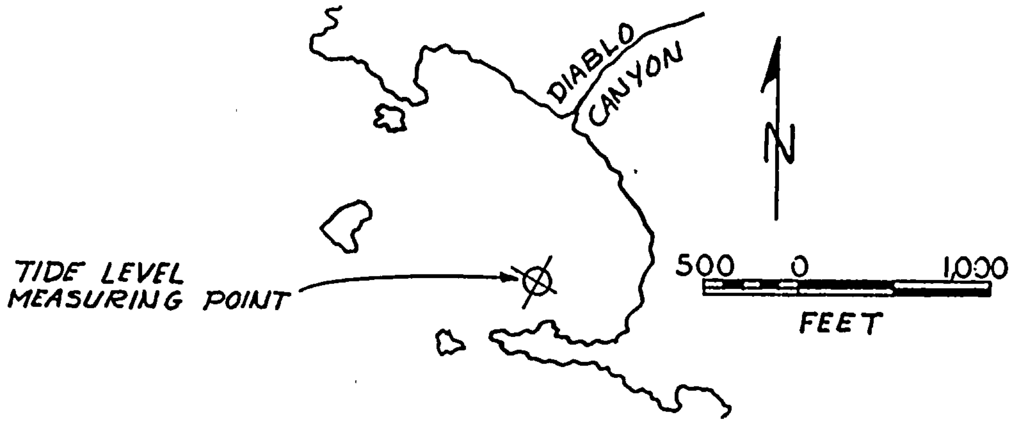


FIGURE 2

The data have been reduced and compared with predicted tides for Avila Beach.[3] Correlation of published tidal correction factors for Avila with similar factors developed from observations in Diablo Cove for the period studied has been good (see Table 2); nevertheless, recordings of tidal elevations will continue at least until a complete year's data are available for correlation. A complete tabulation of the information collected thus far is contained in Appendix B.

TABLE 2

OBSERVED TIDAL DIFFERENCES AND OTHER CONSTANTS IN DIABLO COVE COMPARED WITH PUBLISHED DATA FOR AVILA BEACH

			TIME		RANGES		Mean[c] Tide Level
	Latitude	Longitude	High Water h m	Low Water h m	Mean[a] feet	Diurnal[b] feet	feet
Avila Beach	35°10'	120°44'	00 + 47	00 + 52	3.6	5.3	2.8
Diablo Cove	35°12'	120°57'	00 + 47	00 + 52	3.4	5.3	3.1
			± 05*	± 02	±0.2	±0.4	±0.2

[a] MEAN RANGE: The difference in height between mean high water and mean low water.

[b] DIURNAL RANGE: The difference in height between mean higher high water and mean lower low water.

[c] MEAN TIDE LEVEL: A plane midway between mean low water and mean high water.

*The ± term is the standard deviation of the mean of the measured data at Diablo Cove.

TEMPERATURE/SALINITY PROFILES:

Temperature and salinity (T/S) profiles were made at the offshore stations shown in Figure 3. T/S vs. Depth Composites (Figures 4A, 4B, and 4C) show seasonal variations in the T/S structure. Complete data are contained in Appendix C.

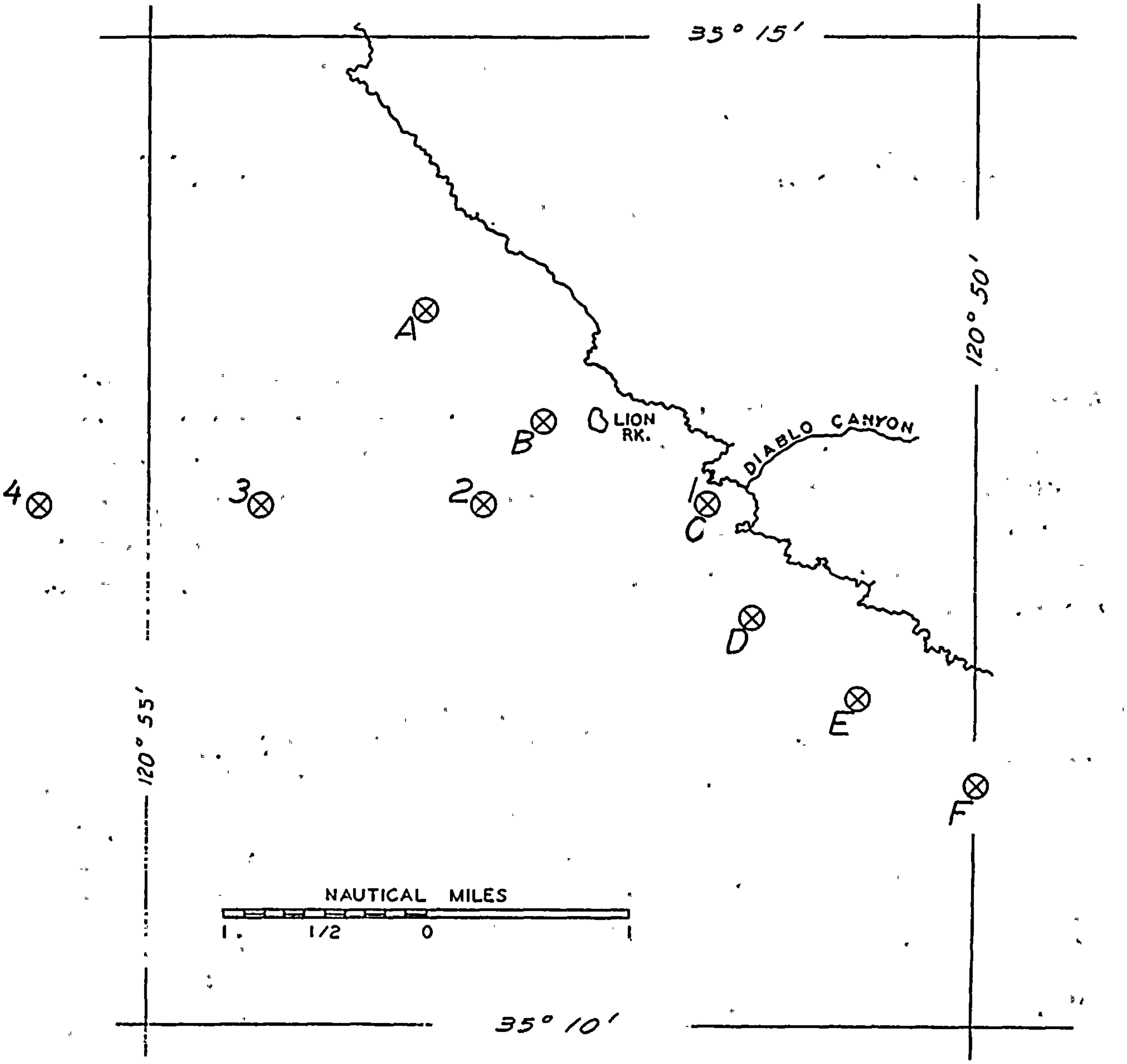
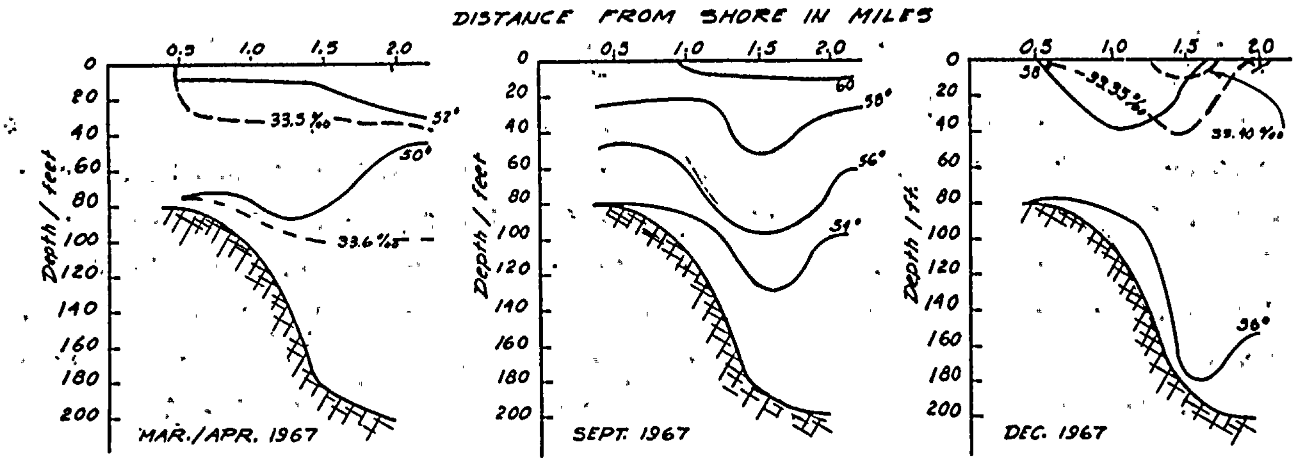


FIGURE 3



COMPOSITE TEMPERATURE / SALINITY DIAGRAMS

FIGURE 4A 4B 4C

Density (σt) values at 0, 20, 40, and 60 feet were computed from the data using Knudsen's method.[4] This information was then used to calculate the stability (S') the rate of change in density (σt) with depth (z) using the relationship shown below:

$$S' = \frac{d\sigma t}{dz} \times 10^4$$

This is one measure of the mixing or vertical dilution capability of the ocean.[5] The smaller the value of S', the smaller the resistance to vertical mixing. A water column is classified as stable, indifferent or unstable depending on the sign of S'. $\overline{S'}$ (z = 10') values for each of the studies are shown in Table 3, and are in agreement with published data for this section of the California Coast.[6]

TABLE 3

STABILITY VALUES S'

Period	$\overline{S'}$
March-April	54
June	28
September	57
December	23

SITE TEMPERATURE VS. LONG TERM MEASUREMENTS:

Figure 5 shows the locations of two underwater, self-contained temperature recorders. The recorder in Diablo Cove has been in relatively continuous operation for eight months (March-December 1967). These data are tabulated in Appendix D. The instrument in Diablo Cove measures temperatures in the upper 1 foot of the water column and is located at a point where the water is approximately 15 feet deep. For comparison of the data from this recorder with five years of surface water temperature data from Avila Beach,[7] see Table 4.

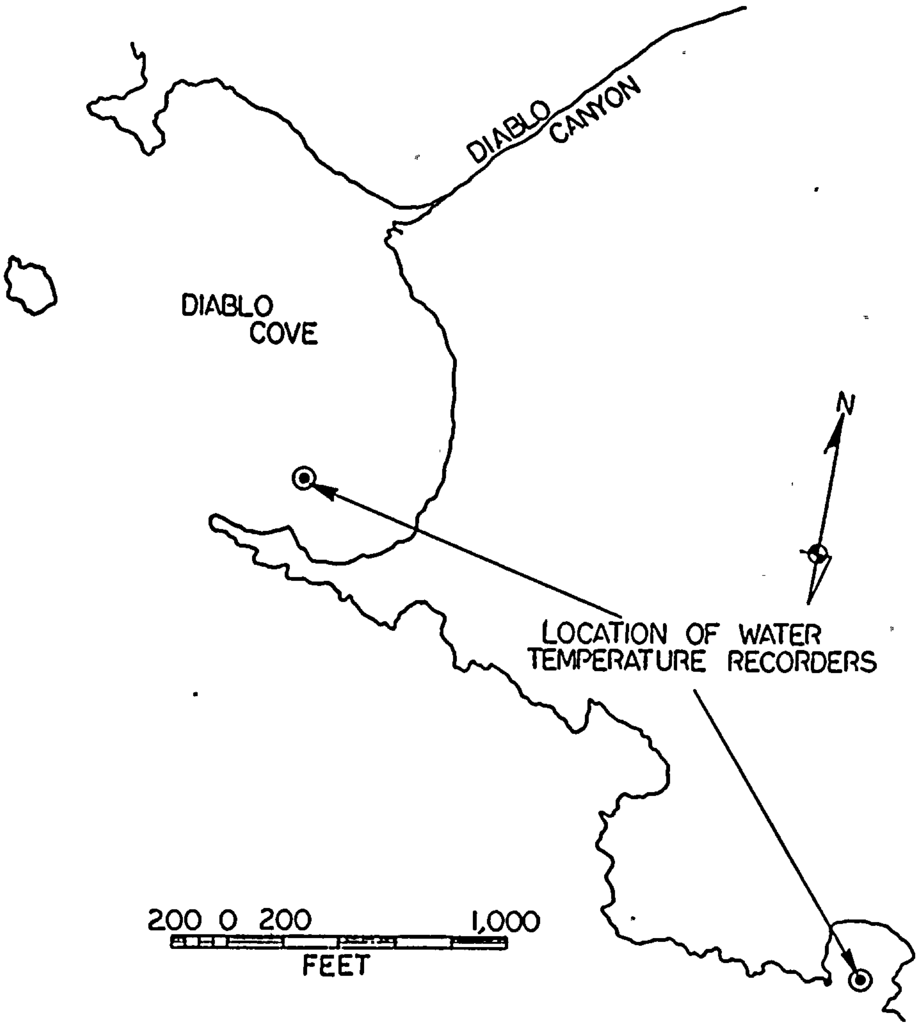


FIGURE 5

TABLE 4
TEMPERATURE COMPARISON

Month	Mean Temperature °F	
	Avila Beach	Diablo Cove
March	53.8±2.2	51.2±1.1
April	55.2±2.0	50.5±1.7
May	55.8±2.0	50.3±1.3
June	57.8±1.6	49.6±1.5
July	60.0±1.3	52.3±1.4
September	61.4±1.8	59.7±1.3
November	57.8±2.0	61.4±1.0
December	56.0±0.9	55.6±2.0

The temperature recording system located in the cove to the south of Diablo Canyon will become operational early in 1968. Temperature measurements at both locations will continue during 1968.

CURRENTS:

Comprehensive 25-hour current studies were made using both flow and path methods,* (refer to Table 1 for test schedules) in order to establish current patterns during the several oceanographic seasons. Data acquired during these operations have been reduced and current vectors, drogue paths, wind roses, and tidal elevations for the respective periods are provided in Figures 6, 7, 8, and 9.

Flow measurements at a depth of 15 feet were made while the research vessel was anchored near the mouth of Diablo Cove. Continuous recordings of current speed and direction were made for 25 hours during three of the four surveys. During the March survey adverse sea state conditions prevented the completion of the scheduled test.

Path measurements were made by tracking a passive reflector equipped current drogue set to run at a depth of 15 feet. At thirty minute intervals radar bearings were taken to determine the research vessel's position relative to fixed landmarks and thereby establish the drogue's position. Studies were scheduled so that observations could be made during spring and neap tides and thereby provide information related to astronomical as well as seasonal effects on the currents.

---

* The flow (Lagrangian) method (uses a current meter) measures the velocity and direction of fluid passing a fixed point. The path (Eulerian) method traces the movement of a particular volume of water with a drogue.

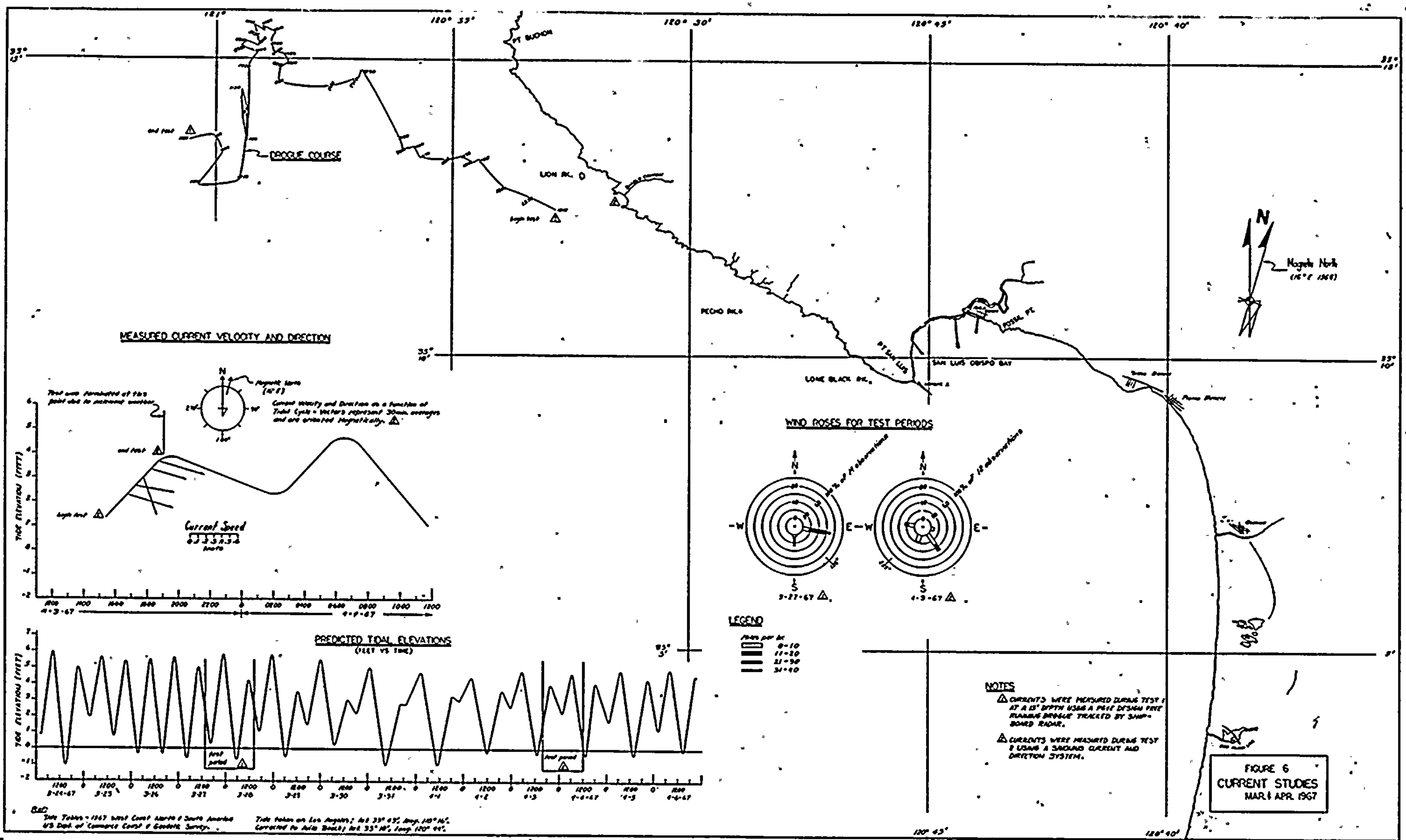


FIGURE 6
CURRENT STUDIES
MAR & APR 1967

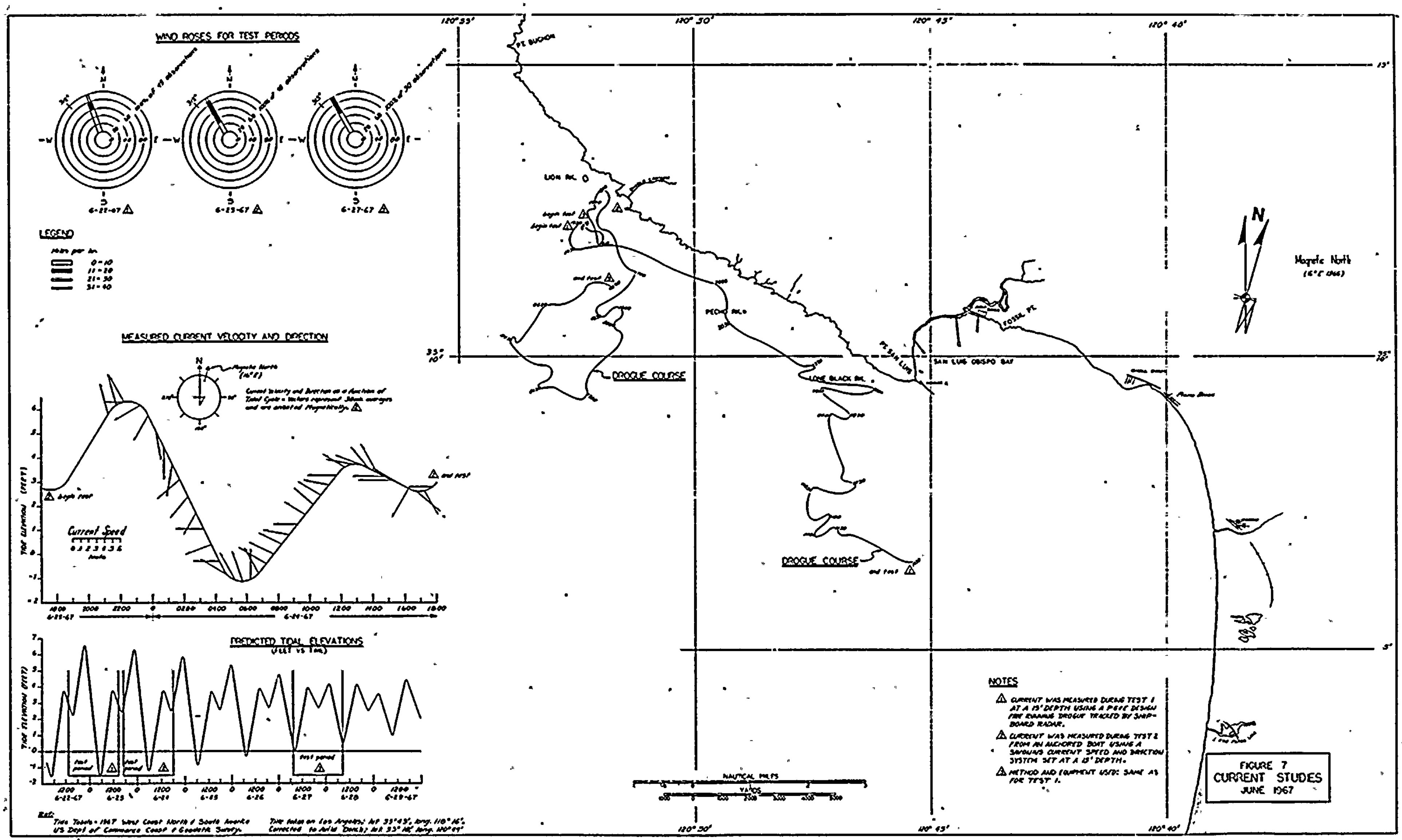


FIGURE 7
CURRENT STUDES
JUNE 1967

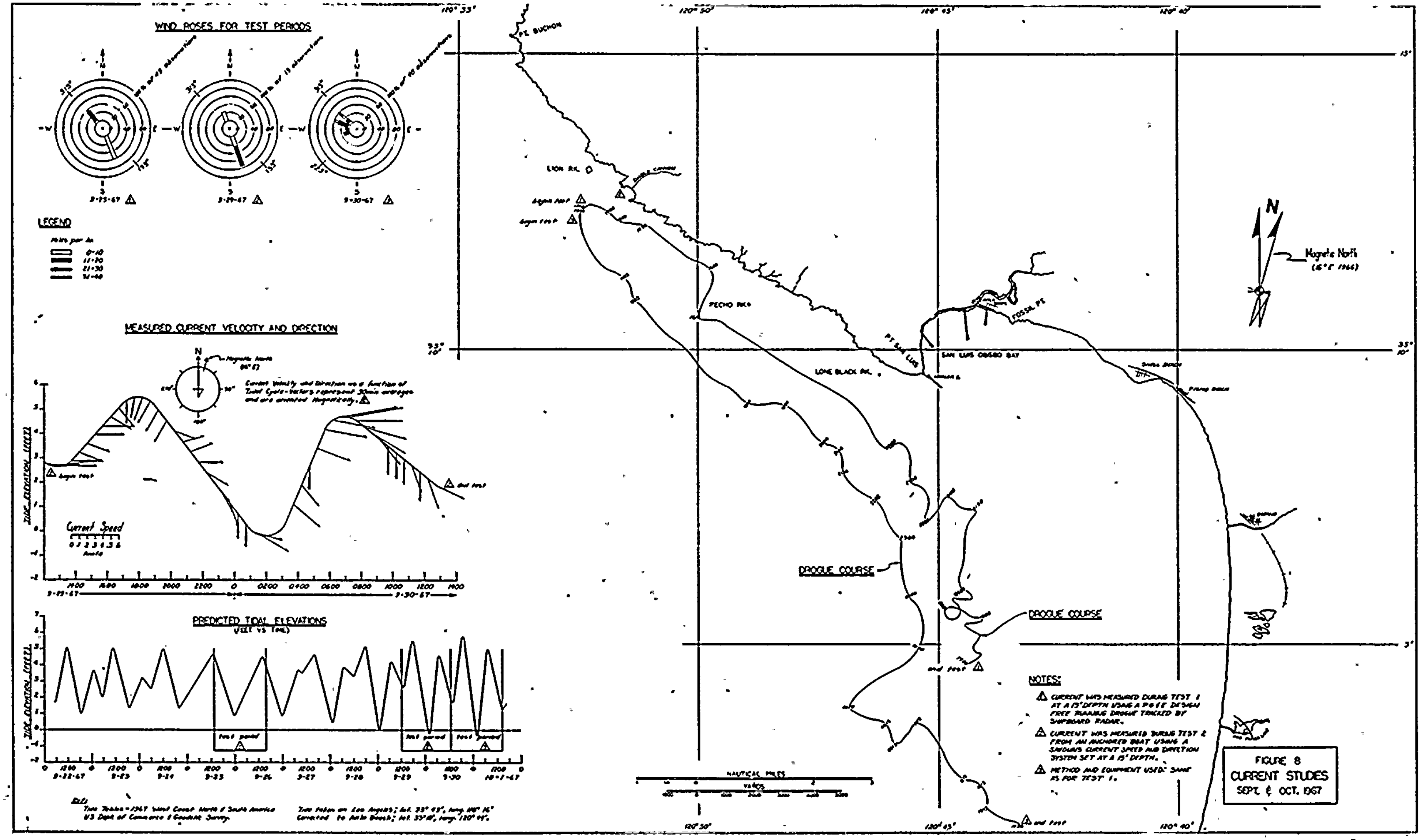


FIGURE 8
CURRENT STUDES
SEPT. & OCT. 1967

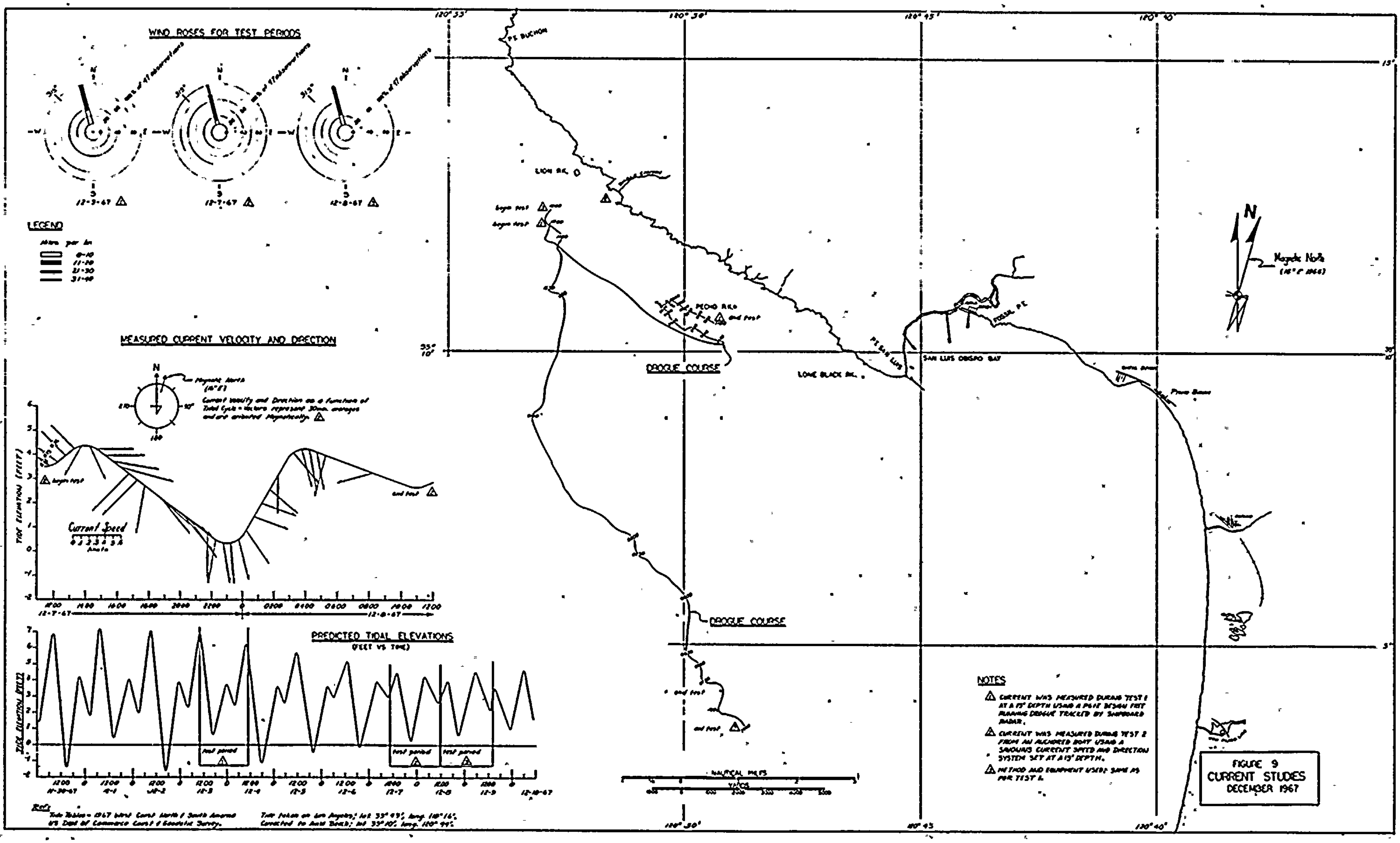


FIGURE 9
CURRENT STUDIES
DECEMBER 1967

DYE STUDIES:

Dye dispersion and dilution studies were conducted twice during 1967.* An instantaneous dump of 250 lbs of Rhodamine B dye was made each time at the location shown in Figure 10. Sampling equipment, including water samplers and a fluorometer with a flow thru door was installed on a 20' motor launch. Each Dye study began (Time of injection) at a point in the tidal cycle when the dye would be expected to remain in Diablo Cove for a maximum period of time.

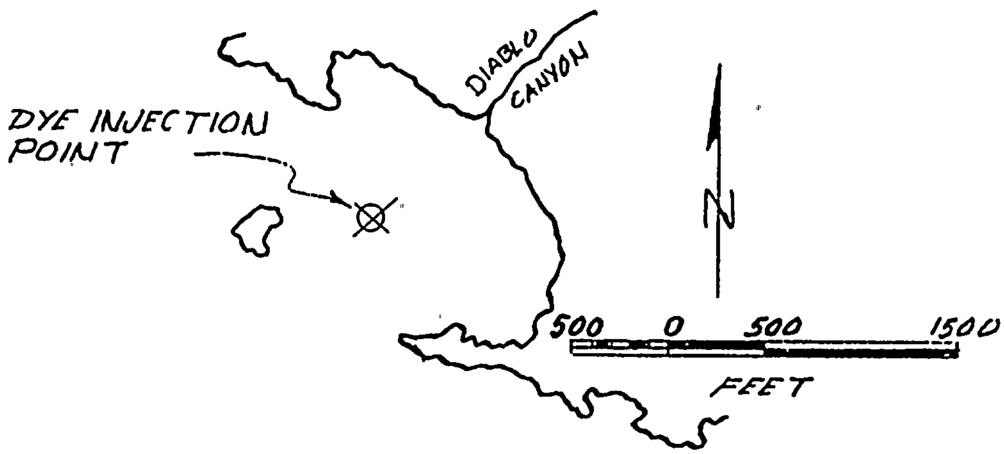


FIGURE 10

Dye concentrations (C_{max}) at the apparent center of the dye patch were measured as the test progressed in time (t): These measurements were utilized through least squares analyses to provide an estimate of n (the decay factor) in the following dilution prediction equation.

$$C_{max} : t^{-n}$$

where n predicts effect of wind, water column stability and sea conditions on the rate of dilution of an effluent. According to theoretical studies of Joseph and Sendner, the decay factor should be between -1 and -3.

* The test concept and procedures were based on the work of Joseph and Sendner,[8] Pritchard and Carpenter,[9] and as specifically described in State Water Control Board Publication No. 29.[5]

Our experimental data gave values of -1.12 and -1.23. A graphical presentation of the concentration vs. time relationships for Diablo Cove is shown in Figure 11. Oceanographic conditions during the dye studies are summarized in Table 5.

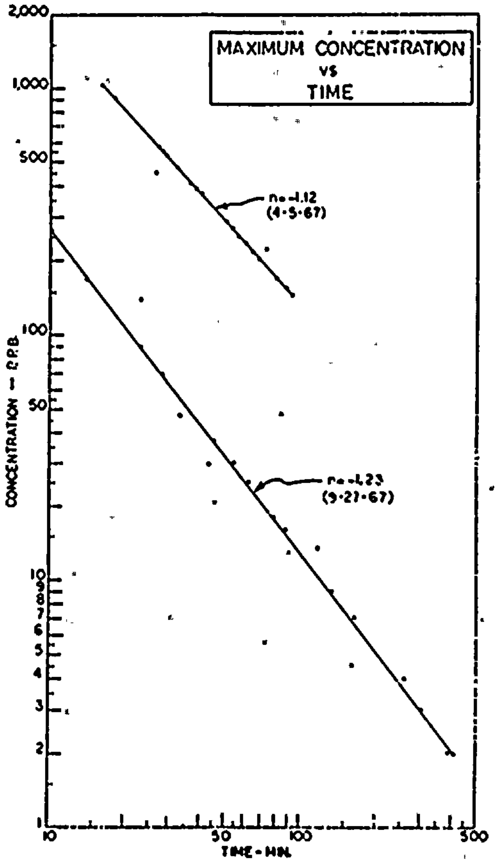


FIGURE 11

TABLE 5

SUMMARY OF OCEANOGRAPHIC CONDITIONS DURING DYE STUDIES

Date*	Dye Release Time	WMO Code	Stability S'	Patch Speed, Knots $\overline{U}$	Wind Speed Knots $\overline{W}$	Wind Direction
4-5-67	1430	1	54	0.08	0.7	206°
9-27-67	0750	1	57	0.25	2.5	300°

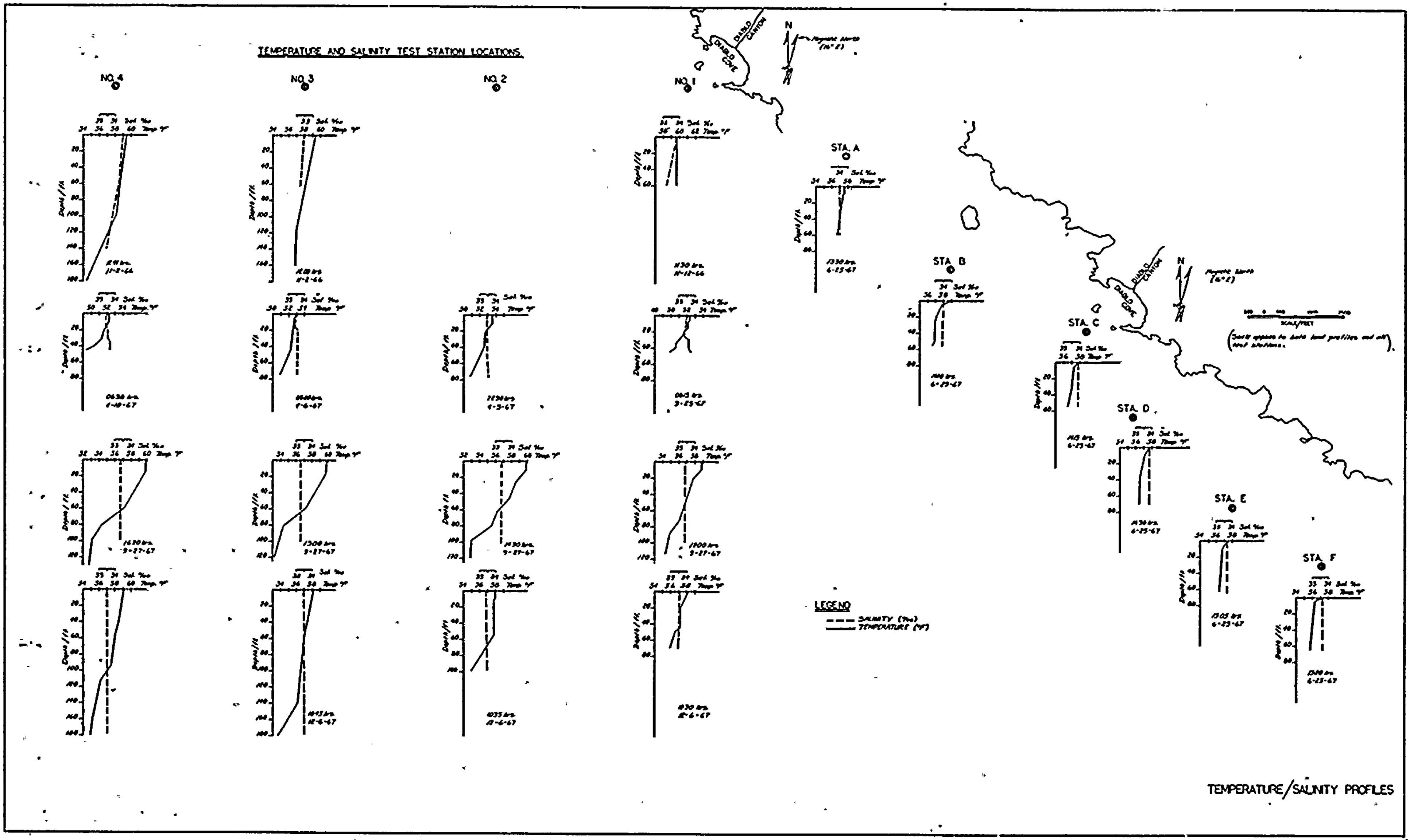
* Figures 6 and 8 give tidal cycles for the dye study period.

TABLE 8

OCEANOGRAPHIC EQUIPMENT USED

Parameter Measured	Instrument	Manufacturer & Model
TEMPERATURE	Bathythermograph	Wallace & Tiernan
	Bucket Thermometer (10°-20°)	Hytech
	Submersible Temp. Recorder	Ryan Co.
SALINITY	Induction Salinometer	Bisset-Berman No. 6210
	Electrodeless Conductivity Cell	Industrial Instr. No. RS 5-3
	Frautschy Bottles (1L)	Hytech
CURRENT (SPEED/DIRECTION)	Ekman Merz Current Meter	CM^2
	Current Drogue	P G and E
	Savonius Current Meter	Marine Advisers B5-A/B1a S11
	Radar	Raytheon 1900
WIND (SPEED/DIRECTION)	Cup and Vane	Beckman Whitley K100A
OFFSHORE TOPOGRAPHIC	Tellurometer	R. M. Towill, Inc.
	Fathometer	Raytheon No. DE 109
DILUTION AND DISPERSION	Tracer Dye, Rhodamine B	American Cyanimid
	Fluorometer	G. K. Turner No. 111
TIDE LEVEL	Transducer	Fairchild S-5746

APPENDIX C
(Report No. 6242.4-68)


TEMPERATURE AND SALINITY TEST STATION LOCATIONS
NO. 4
NO. 3
NO. 2
NO. 1
DIABLO CANYON
DIABLO COVE
N
STA. A
STA. B
STA. C
STA. D
STA. E
STA. F
LEGEND
SALINITY (‰)
TEMPERATURE (°F)
TEMPERATURE/SALINITY PROFILES

PROPOSED

Environmental Technical Specifications

APPENDIX B

to

Facility Operating License No. _______

for

Diablo Canyon Nuclear Power Plant

Pacific Gas & Electric Company

Docket Nos. 50-275 and 50-323

(February 28, 1974)

REGULATORY DOCKET FILE COPY

CONTENTS

LIST OF TABLES

LIST OF FIGURES

SECTION 1.0

DEFINITIONS

The terms in this section are defined for uniform interpretation of the Diablo Canyon environmental technical specifications.

<u>Company</u>: Pacific Gas & Electric Company

<u>Diablo Canyon Plant</u>: units 1 and 2 of the Diablo Canyon Nuclear Power Plant

<u>Diablo Cove</u>: inlet of the Pacific Ocean about 12 miles WSW of the city of San Luis Obispo, California

<u>Intake Cove</u>: cove, immediately south of Diablo Cove, created by two breakwaters constructed to protect the intake structure

<u>Licensee</u>: Pacific Gas & Electric Company

<u>Receiving water</u>: the Pacific Ocean in and contiguous with Diablo Cove

SECTION 2.0

LIMITING CONDITIONS FOR OPERATION

2.1 THERMAL

2.1.1 Maximum Temperature Difference Across Condenser

Objective

Limiting the thermal stress to the aquatic ecosystem by limiting the maximum Δt across the condenser during normal operation.

Specification

Maximum Δt across the condenser during normal plant operation shall be limited to 25.0°F.

If during normal plant operation the main condenser Δt exceeds 25.0°F for a period of:

a) 16 hours in any calender day, or

b) 8 consecutive hours twice or more in any given 7-day period,

the cause of this deviation shall be determined and action taken to reduce the Δt to the specified maximum. Action also shall be taken, to the extent practicable, to define and minimize such deviations. In addition, a report shall be submitted in accordance with Section 5.0.

Monitoring Requirement

Condenser Δt shall be measured and recorded once per hour, to ensure that the maximum Δt across the condenser will not exceed the specified protection limit.

Bases for Limiting Conditions

Power output (at design power) is expected to require a total cooling water flow of 3,864 cfs through the main condenser. This flow will raise the circulating water temperature about 19°F.

Surveys at other Company plants have indicated that no significantly adverse effects on the ecosystem will occur with Δt below 20°F. A Δt up to 25°F during unusual conditions of limited duration is also not expected to have adverse effects. These higher temperatures may occur under such circumstances as operation with one half of a condenser out of service for cleaning or with condenser tubes partially obstructed.

Bases for Monitoring Requirement

The temperature sensors in the intake and discharge systems will be used to calculate the Δt across the condenser.

2.1.2 Temperature Alteration During Defouling

Objective

Limit the thermal stress to the aquatic ecosystem during heat treatment of the condenser cooling system for defouling

Specification

The Δt between intake and discharge during defouling shall not exceed 50° for the unit being defouled. Only one unit shall be defouled at a time.

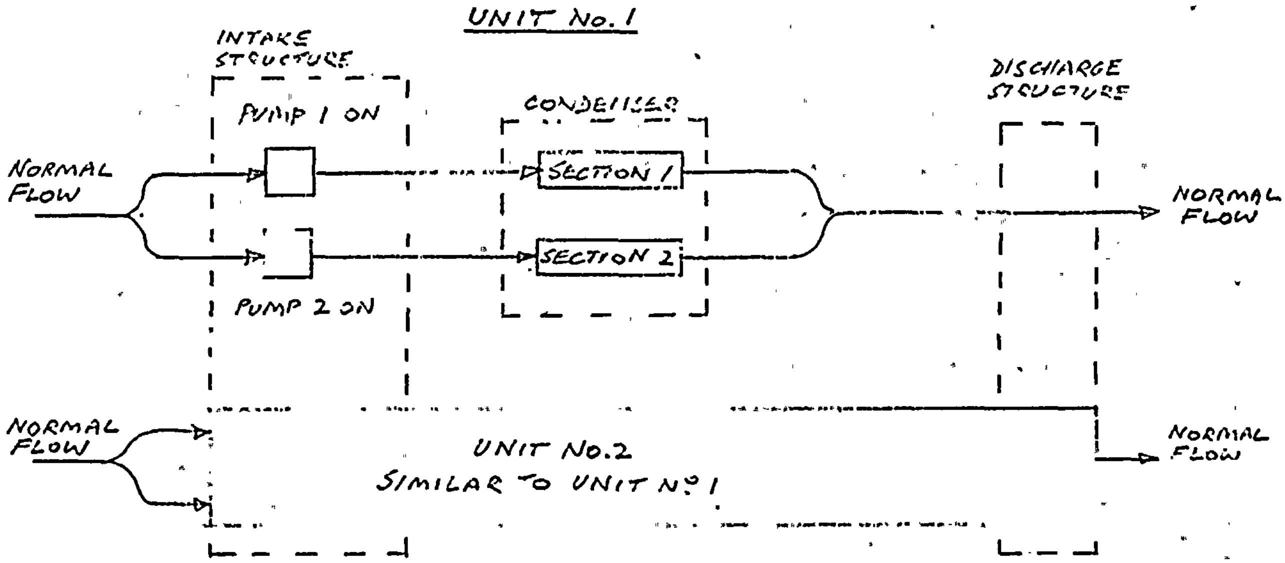
Monitoring Requirement

Condenser Δt shall be measured and recorded once per hour, to ensure that the maximum Δt across the condenser will not exceed the specified protection limit.

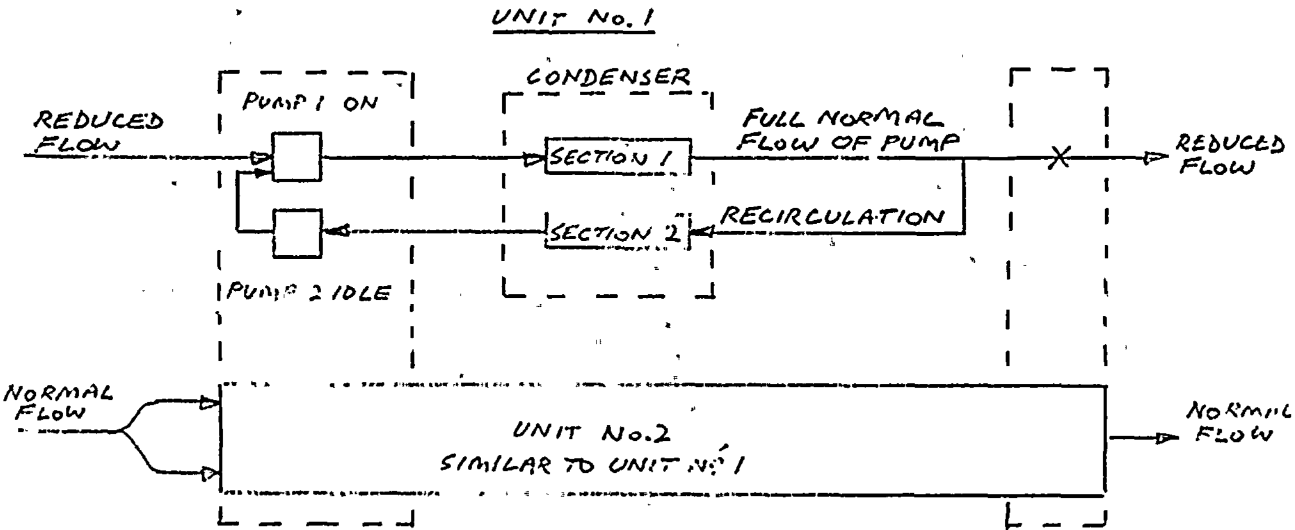
Bases for Limiting Condition

Heat treatment is used for defouling. The treatment kills and dislodges mussels that would impair condenser cooling by plugging the tube sheet. Regular defouling at intervals of 4-6 weeks removes the mussels while they are still small enough to pass through the tubes to the discharge. One unit is treated while the other continues to operate normally.

Figure 2.1.2-1 contrasts normal operation with heat treatment. In normal operation, both units of the plant are functioning. Cooling water is pumped once through both separate halves of each condenser and discharged into Diablo Cove.



(a) Normal operation of both units



(b) Heat treatment of unit No. 1

Fig. 2.1.3-1. Schematic diagram contrasting normal operation with heat treatment for defouling.

Defouling consists in subjecting the mussels to a thermal shock by raising the temperature of the water in the inlet conduit 30-40°F and maintaining this elevated level for one hour.

Assuming, for example, that unit No. 1 is to be heat-treated, the power of this unit is first reduced. Normal flow of cooling water to unit No. 1 is reduced by turning off one of the pumps. Cooling water passes through the first section of the condenser to the discharge structure. There, some of the effluent is allowed to flow out to the ocean while part is diverted by gates so as to pass through the second section of the condenser in reverse. The recirculating flow continues through the idled pump and is mixed with the cooling water entering the first section of the condenser. Recirculation continues for several hours while the temperature of the water in the inlet conduit rises about 30°F. One hour at the elevated temperature is sufficient to destroy mussels attached to the inner surfaces of the cooling system. At the end of the hour, operation is restored to normal.

2.2 CHEMICAL--BIOCIDES

Objective

Limit the total available chlorine (free and combined chlorine) discharged into Diablo Cove to less than the amount that would be harmful to the aquatic biota.

Specification

Total available chlorine in the plant effluent at the point of discharge into Diablo Cove shall not exceed a level of 0.5 ppm with both units in operation, or 1.0 ppm with one unit in operation.

Monitoring Requirement

Measurements performed continuously during chlorine use shall verify that total available chlorine in the discharged cooling water does not exceed the specified limit.

Bases for Limiting Conditions

Chlorine is used periodically to control organic growth on exposed surfaces in the condenser cooling system. Each of the four pump systems is treated individually in sequence, i.e., no more than one pump system at a time. Free chlorine is injected into the circulating water ahead of the pumps to ensure thorough mixing. The injection rate is adjusted between 5 and 10 lb/min to produce a concentration of 0.5-1.0 ppm of free chlorine at the inlet water box of the condenser.

Chlorine added to the single pump conduit will be diluted by the other half of the condenser coolant stream, plus the cooling water from the other unit. Experience at other ocean plants indicates that, at these injection rates, the free chlorine at the outlet of the discharge structure will be less than 0.1 ppm with both units in operation. Total (free and combined) chlorine may reach a maximum of 0.5 ppm with both units in operation and 1.0 ppm with one unit in operation.

Bases for Monitoring Requirement

The effect of the discharge of 0.1 ppm free available chlorine may be enhanced by the combined available chlorine species present. Total maximum discharge from the chlorine addition is predicted to be approximately 55 lb of biologically active chlorine (in the form of molecular chlorine, hypochlorous acid, hypochlorite ion, chloroamines, and other chloro derivatives) per day per unit.

2.3 CHEMICAL--SUSPENDED AND DISSOLVED SOLIDS

Objective

Limit the stress to the aquatic ecosystem by restricting the concentration of suspended and dissolved solids in the plant effluents.

Specification

NONE

Monitoring Requirement

NONE

Bases for Limiting Conditions

Introduction of suspended and dissolved solids into the discharge is controlled by plant design to prevent any statistically significant stress to aquatic species in the receiving waters. Change in the natural appearance of the receiving waters such as discoloration, floating or suspended solids, grease, oil slicks or foam will also be avoided.

Bases for Monitoring Requirement

The large volume of circulating cooling water will dilute any added suspended or dissolved solids to concentrations too small for practical detection at the point of entry of discharge into the cove. Bioassay (96 hour, Tlm) of the discharge sampled at point of entry into the cove will insure that any concentrations are within the tolerance limits of species indigenous to the area. Bioassay to be performed during pre-startup cleaning of equipment and once quarterly during the first two years of operation.

2.4 RADIOACTIVE DISCHARGE

Objective

To define the conditions for release of radioactive wastes to the circulating water discharge and to the plant vent to ensure that any radioactive material released is kept as low as practicable, and in any event, within the limits of 10 CFR 20.*

Specifications

A. Liquid Effluents

1. The maximum instantaneous release rate of radioactive liquid effluents from the site shall be such that the concentration of radionuclides in the circulating water discharge does not exceed the limits specified in 10 CFR 20, Appendix B, Table II, Column 2.
2. During release of radioactive liquid effluents, at least one condenser circulating water pump shall be in operation.

---

*At the present time the Atomic Energy Commission is considering radiation release objectives and limits in a different form from those specified in 10 CFR 20. When the form and content of these regulations are finalized, the Diablo Canyon Environmental Technical Specifications will be revised to incorporate any changes necessary to conform with the full range of AEC regulations.

3. During the release to the environment of radioactive liquid waste from the liquid waste treatment system, the liquid waste system discharge monitor shall be in service and the automatic waste effluent isolation valve shall be operable.
4. Liquid effluents shall be sampled and analyzed for radioactive materials in accordance with Table 2.4-1.
5. All liquid effluent radiation monitors shall be calibrated at least annually. Each monitor shall also have a functional test at least monthly and a channel check at least daily.

B. Airborne Effluents

1. The maximum instantaneous release rate of gaseous effluents for two Units shall be limited as follows:

$$\left(\frac{X}{Q}\right)_1 \sum_i \frac{Q_{1i}}{(MPC)_i} + \left(\frac{X}{Q}\right)_2 \sum_i \frac{Q_{2i}}{(MPC)_i} \leq 1.0$$

Where:

i refers to any radioisotope;

Q_{1i} is the release rate, in Ci/sec, of any radioisotope i from Unit No. 1;

$Q2_i$ is the release rate, in Ci/sec, of any radioisotope i from Unit No. 2;

$(MPC)_i$ is the maximum permissible concentration, in μCi/cc, for the given radioisotope i, as listed in

10 CFR 20, Appendix B, Table II, Column 1, except that for isotopes of iodine and particulates with half lives greater than eight days, the values of $(MPC)_i$ shall be reduced by a factor of 700;

$(\frac{X}{Q})_1$ and $(\frac{X}{Q})_2$ are the meterological dispersion co-efficients for Units No. 1 and No. 2, respectively, at the site releasing the effluent from the plant vent, air ejector discharge, and blowdown tank vent when applicable; and the values for these coefficients are

$(\frac{X}{Q})_1 = 7.5 \times 10^{-7}$ sec/m^3,

$(\frac{X}{Q})_2 = 7.5 \times 10^{-7}$ sec/m^3.

2. During release of gaseous wastes to the plant vent from the gas decay tanks, the following conditions shall be met:

   a. At least one Auxiliary Building exhaust fan shall be in operation.

   b. The gas decay tanks discharge monitor shall be in service and the automatic waste effluent isolation valve shall be operable.

3. A plant vent gas and particulate monitor shall be in operation during effluent releases as required by Sec. 16.4.10 of Appendix A, Technical Specifications.

4. Gaseous effluents shall be sampled and analyzed for radioactive material in accordance with Table 2.4-2.
5. All gaseous waste monitors shall be calibrated at least annually. Each monitor shall also have a functional test at least monthly and a channel check at least daily.

Bases

It is expected that releases of radioactive material in effluents will be kept at small fractions of the limits specified in 10 CFR 20. At the same time the licensee is permitted the flexibility of operation, compatible with considerations of health and safety, to ensure that the public is provided a dependable source of power even under unusual operating conditions which may temporarily result in releases higher than such small fractions, but still within the limits specified in 10 CFR 20. It is expected that in using this operational flexibility under unusual operating conditions the licensee will exert his best efforts to keep levels of radioactive material in effluents as low as practicable.

Buildup of long lived radioisotopes in the ocean in the vicinity of the plant has been considered. On the basis of the analyses presented in Chapter 11 of the FSAR for the Diablo Canyon plant,* it can be concluded that neither

*See Chapter 11, Radioactive Waste Management, Final Safety Analysis Report, Units 1 and 2 Diablo Canyon Site, USAEC Docket Nos. 50-275, 50-323 gaseous nor liquid effluents will cause exposures in excess of the dose bases used to develop the maximum permissible concentrations in 10 CFR 20. Since the plant uses ocean water for cooling, no exposures will result via the drinking water pathway.

Prior to release to the atmosphere, gaseous wastes from the radioactive waste disposal system are mixed in the plant vent with the flow from at least one of two Auxiliary Building exhaust fans. Further dilution then occurs in the atmosphere.

The formula prescribed in Specification B1 takes into account combined releases from the site, and ensures that at any point on or beyond the site boundary the requirements of 10 CFR 20 will be satisfied. Atmospheric dilution is taken into account with the meteorological dispersion coefficients (X/Q) for Diablo Canyon Units No. 1 and No. 2, the values being based on the worst sector yearly average meterology and sector distance to the site boundary.

TABLE 2.4-1

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS

A Liquid Radwaste Treatment System

Sampling Frequency	Type of Activity Analysis	Sensitivity of Analysis
Each Batch	Gross β,γ (a)	10^{-7} μCi/ml
One Batch/Month	Dissolved Fission and Activation Gases	10^{-5} μCi/ml
Weekly Proportional Composite (b)	Ba-140, La-140, I-131	10^{-6} μCi/ml
Monthly Proportional Composite (b)	Gamma Emitters	5×10^{-7} μCi/ml (c)
	H-3	10^{-5} μCi/ml
	Gross α	10^{-7} μCi/ml
Quarterly Proportional Composite (b)	Sr-89, Sr-90	10^{-8} μCi/ml

B. Steam Generator Blowdown

Sampling Frequency (d)	Type of Activity Analysis	Sensitivity of Analysis
Weekly	Gross β,γ	10^{-7} μCi/ml
	Ba-140, La-140 I-131	10^{-6} μCi/ml
One Sample/Month	Dissolved Fission and Activation Gases	10^{-5} μCi/ml
Monthly Proportional Composite (e)	Gamma Emitters	5×10^{-7} μCi/ml
	H-3	10^{-5} μCi/ml
	Gross α	10^{-7} μCi/ml
Quarterly Proportional Composite (e)	Sr-89, Sr-90	10^{-8} μCi/ml

NOTES (a) Gross β,γ measurements (i.e. gross βor gross β in conjunction with gross γ measurements) should approximate the total activity in the sample. This comment applies to all gross β,γ measurements required by these Technical Specifications.

NOTES

(b) A proportional sample is one in which the quantity of liquid sampled is proportional to the quantity of liquid waste discharged from the plant.

(c) For certain mixtures of gamma emitters, it may not be possible to measure radionuclides in concentrations near their sensitivity limits when other nuclides are present in the sample in much greater concentrations. Under these circumstances, it will be more appropriate to calculate the concentrations of such radionuclides using observed ratios with those radionuclides which are measurable.

(d) Normally, only gross β,γ measurements will be made weekly. However, if gross β,γ measurements indicate activities greater than 1×10^{-7} μCi/ml, the other analyses in Part B of Table 2.4-1 will be made.

(e) Since these potential sources of liquid radioactive waste are discharged on a continuous rather than batch basis, the volume of liquid to be used as a basis for obtaining proportional samples from secondary blowdown and leakage is that amount discharged over the period of one week.

TABLE 2.4-2

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS

A. Gas Decay Tank Releases

Sample Type	Sampling Frequency	Type of Activity Analysis	Sensitivity of Analysis (a)
Gas	Each Tank Release	H-3	10^{-6} μCi/cc
		Individual Gamma Emitters	10^{-4} μCi/cc (b)

B. Containment Purge Releases

Sample Type	Sampling Frequency	Type of Activity Analysis	Sensitivity of Analysis (a)
Gas	Each Purge	Individual Gamma Emitters	10^{-4} μCi/cc (b)
		H-3	10^{-6} μCi/cc

C. Condenser Air Ejector Releases

Sample Type	Sampling Frequency	Type of Activity Analysis	Sensitivity of Analysis (a)
Gas	Monthly (c)	Individual Gamma Emitters	10 μCi/sec (b)

D. Plant Vent

Sample Type	Sampling Frequency	Type of Activity Analysis	Sensitivity of Analysis (a)
Gas	Monthly (c)	Individual Gamma Emitters	10 μCi/sec (b)
	Quarterly	H-3	10^{-2} μCi/cc

TABLE 2.4-2 (Cont'd)

Sample Type	Sampling Frequency	Type of Activity Analysis	Sensitivity of Analysis (a)
Charcoal	Weekly	I-131	10^{-4} µCi/sec
	Quarterly	I-133, I-135	10^{-4} µCi/sec
Fixed filter particulates	Weekly	Gross β,γ	10^{-5} µCi/sec
	Weekly	Ba-140, La-140,	10^{-4} µCi/sec
		I-131	10^{-4} µCi/sec
	Monthly Composite	Individual Gamma Emitters	10^{-4} µCi/sec
	Quarterly Composite of monthly samples	Sr-89, Sr-90	10^{-5} µCi/sec
	One weekly sample/ quarter	Gross α	10^{-5} µCi/sec

NOTES

(a) The above sensitivity of Analysis is based on Technical feasibility and on the potential significance in the environment of the quantities released. For some nuclides, lower detection limits may be readily achievable and when nuclides are measured below the stated limits they should also be reported.

(b) For certain mixtures of gamma emitters, it may not be possible to measure radionuclides at levels near their sensitivity limit when other nuclides are present in the sample at much higher levels. Under these circumstances, it will be more appropriate to calculate the levels of such radionuclides using observed ratios with those radionuclides that are measurable.

(c) Analysis shall also be made within one month of the initial criticality and following each refueling process change or other occurrence which could alter the mixture of radionuclides.

SECTION 3.0

ENVIRONMENTAL SURVEILLANCE

The purpose of the environmental surveillance program is to determine the extent to which plant operation may cause changes in the ecosystem. Surveillance is comprehensive enough to cover all elements of the ecosystem that could reasonably be expected to be affected by plant operation.

The program is specified in such a manner that, if operating experience and surveillance data show no significant detriment to the ecosystem, the relevant portions of the program may be terminated automatically by the Company. This provision would make it unnecessary to modify the environmental technical specifications in every such instance.

3.1 NONRADIOLOGICAL SURVEILLANCE

The nonradiological surveillance program is designed to detect and measure the nonradiological impact of plant operation on environmental parameters that (1) are potentially subject to alteration by plant operation, and (2) have significance in relation to the quality of animal (including human) and plant life in the environs of the Diablo Canyon Nuclear Power Plant.

Biotic parameters to be surveyed are generally those defined in Sec. 2.7 of Regulatory Guide 4.2 as "important species".

3.1.1 ABIOTIC SURVEILLANCE PROGRAM

a. Aquatic

(1) Water Quality Surveys

Objective

Identify and define potential abiotic problems in water quality adversely affecting the aquatic ecosystem; then solve the problems before significant harm occurs.

Specification

Grab samples of water shall be taken at one-meter intervals from the surface to the bottom in and adjacent to Diablo Cove. Sampling shall take place during February, June, and October for a two-year period following operational startup. The California Deaprtment of Fish and Game will designate the sampling points. From the samples shall be determined the temperature, pH, and dissolved oxygen content.

Analytical techniques shall be in accordance with the latest edition of Standard Methods for Examination of Water and Wastewater, published by the American Public Health Association.

Reporting Requirement

Any incident causing a monitored parameter to attain a level detrimental to human, plant, bird, or fish life shall be reported. Its cause, effect, and corrective action shall be described in detail in the next regular report submitted to the California Regional Water Quality Board.

Bases

Section 6.3 of the Final Environmental Statement requires the licensee to monitor the thermal and chemical effluents from the plant operation and to monitor their impact on the receiving waters. The same section also specifies the reporting requirements as above.

(2) Temperature of Cooling Water

Objective

Determine the temperature of the condenser cooling water intake and discharge.

Specification

Temperature of the cooling water shall be measured once a day in the intake system and in both conduits of the discharge system.

Bases

Section 6.3 of the final Environmental Statement requires the temperature of the cooling water intake and discharge to be measured daily. Sensors in the intake system and the discharge system will continuously monitor these temperatures, thus more than meeting the requirement.

(3) Surface Temperature of Receiving Waters

Objective

Determine the extent of the thermal effluent on the receiving waters.

Specification

Surface water temperatures shall be measured at two-month intervals from Pt. Buchon to Pecho Rock. Airborne infared techniques shall be used for these measurements. Surface grab samples shall be obtained to complement the airborne measurements. Isotherms shall be determined in $2^{o}F$ intervals. This sampling shall begin in the month of February following operational startup and continue for a period of two years. At the end of this two-year survey period, the results shall be evaluated by the company and a report with appropriate recommendations as to the future of the program shall be submitted to the Directorate of Licensing for consideration.

Bases

Section 6.3 of the Final Environmental Statement requires sampling of surface temperatures as specified above.

(4) Average Volume of Circulating Water Discharge

Objective

Determine the average volume of discharge.

Specification

The flow rate of the circulating water shall be measured periodically in order to calculate the column of circulating water discharged daily.

Bases

Section 6.3 of the Final Environmental Statement requires the Licensee to determine this quantity.

3.1.2 BIOTIC SURVEILLANCE PROGRAM

3.1.2.1 Aquatic

3.1.2.1.1 General Ecological Survey

Objective

Determine the effects of plant operation on the planktonic, nektonic, and benthos populations of the receiving water. Specific features of this effort are listed in Table 3.1.2-1. The table also lists the section in which each feature is described.

Specification

The effects of plant operation will be determined by comparing selected ecological parameters of the study populations during plant operation with the same parameters previously determined in the Pre-operational Baseline Survey. This survey will be undertaken for at least two years after the plant becomes operational. The locations of the sampling stations are shown in Figure 3.1.2-1.

TABLE 3.1.2-1 Biotic Surveillance and Special Research and Study Activities Planned for Diablo Canyon Power Plant

Parameter	Responsible Agency	Described In Section No.
1. General Ecological Survey		
Phytoplankton	PG&E	4.5
Zooplankton	PG&E	4.5
Macrophytes		
Intertidal	CDF&G and PG&E	3.1.2.1.1.1.1 and 4.4
Subtidal	CDF&G and PG&E	3.1.2.1.1.1.2 and 4.4
Aerial Surveys	PG&E	3.1.2.1.1.1.3
Invertebrates		
Intertidal	CDF&G and PG&E	3.1.2.1.1.2.1 and 4.4
Subtidal	CDF&G and PG&E	3.1.2.1.1.2.2 and 4.4
Fish	PG&E	3.1.2.1.2
Eggs, Larvae and Juveniles	PG&E.	4.5
2. Impingement of Organisms		
3. Entrainment of Organisms Through Condenser	PG&E	4.6
4. Onsite Chlorination Studies	PG&E	4.7
5. Heavy Metals Study	PG&E	4.3
6. Abalone Life History Studies	PG&E and CDF&G	4.8

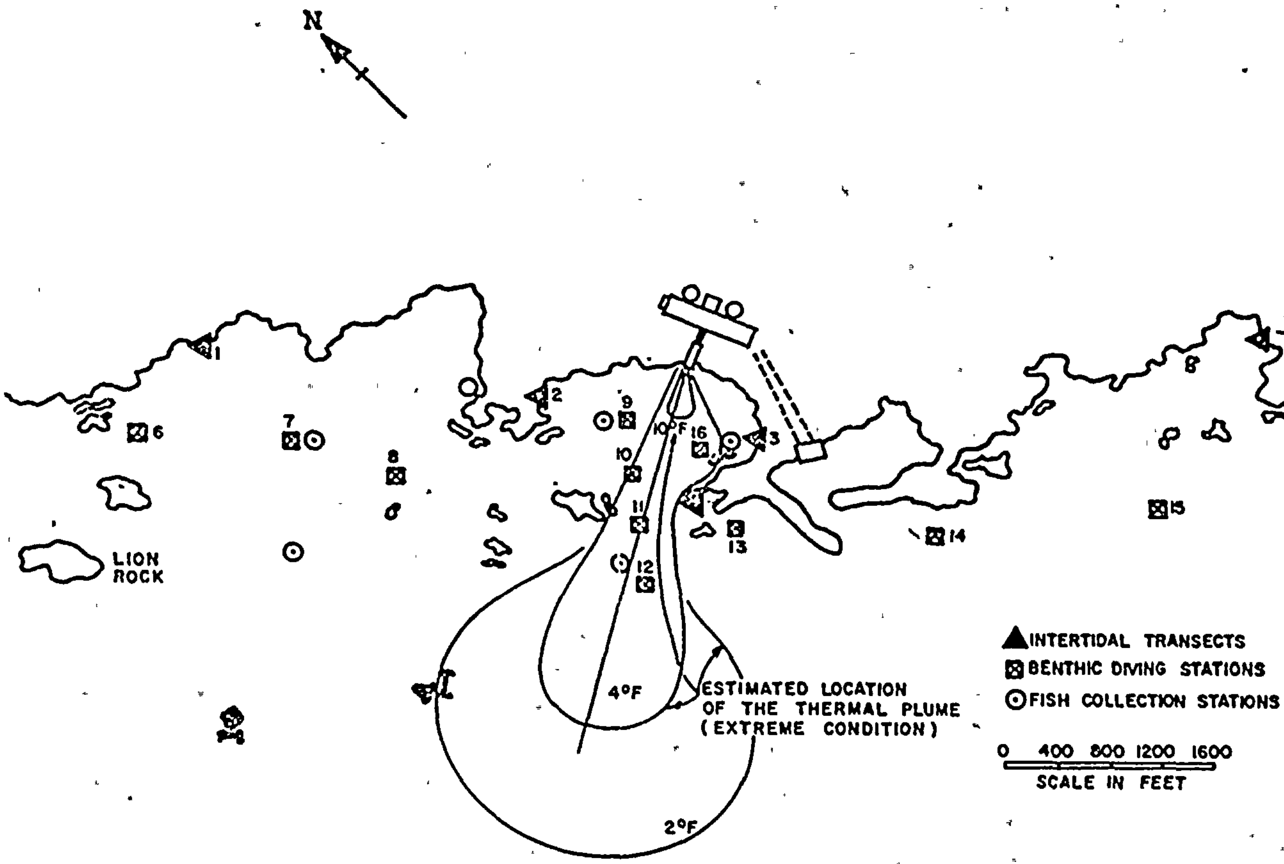


Fig. 3.1.2-1. Diablo Canyon study area, including locations of permanent intertidal, subtidal, and fish-collection stations of the California Department of Fish and Game.

Reporting Requirements

At the end of one year, the results from the General Ecological Survey shall be analyzed, evaluated by the Company , and submitted in summarized form as part of the semiannual report. The report shall include the proposed preliminary monitoring levels for the various environmental parameters surveyed. The report may also include substantiated recommendations for modifications of the monitoring program.

The proposed monitoring levels shall not become binding until final values have been established.

At the end of the second year, the results from the general ecological survey shall be analyzed, evaluated by the Company., and submitted in summarized form to the Directorate of Licensing. The report shall include proposed final values of the monitoring levels or appropriate substantiated recommendations for modifications or discontinuance of the various portions of the monitoring program.

Bases

Section 6.2 of the Final Environmental Statement requires that the Company continue the biological monitoring program conducted by the California Department of Fish and Game and PG&E. The general ecological survey, as specified, will characterize the distribution, in time and space, of the fish, plankton, and benthos population in the vicinity of Diablo Cove. Results obtained from this study, together with those obtained in the entrainment and impingement studies, will provide enough data to evaluate the impact, if any, of the plant on the local aquatic ecology and to determine program modifications that should be implemented in future studies.

The information outlined under Specifications is needed for interpretative analysis of changes occurring in the aquatic ecosystem in and around Diablo Cove. This information is also required for determining the significance of changes caused by the plant so that corrective measures may be taken if necessary.

3.1.2.1.1 Macrophytes

3.1.2.1.1.1. Intertidal

Five permanent intertidal stations consisting of 11 transects and 22 quadrats have been established in the Pre-Operational Baseline Survey by the California Department of Fish and Game (CDF&G), with two stations located inside Diablo Cove, a third along the south point, and control stations one mile north and one mile south of the cove (Fig. 3.1.2-1). The transects are 2 m wide, and the quadrats are 1/4 m^2 in area (Burge and Schultz, 1973). The relative abundance of approximately 50 species of marine algae and flowering plants will be noted on each transect and quadrat. Photographic records of the 1/4 m^2 quadrats will be taken. The surveys will be made three times a year for a period of two years.

3.1.2.1.1.1.2 Subtidal

Five permanent subtidal stations have been established in Diablo Cove at depths of 10, 20, 35, 50, and 70 feet (Figure 3.1.2-1). Six permanent control stations were established outside the cove, three to the north and three to the south, at intervals of about 1/3 mile during the Pre-Operational Baseline Survey by CDF&G (Burge and Schultz, 1973). Transects of 30 m x 2 m at each station will be surveyed by SCUBA three times a year for a period of two years. The relative abundance of about 30 species of marine algae and flowering plants will be noted in each transect. Actual counts will be made on bull kelp *(Nereocystis leutkeana)* and giant kelp *(Macrocystis pyrifera)*.

3.1.2.1.1.1.3 Aerial Surveys

The distribution of bull kelp *(N. leutkeana)* will be mapped three times a year between Point Buchon and Point San Luis, a distance of 13 miles, by aerial photography with infrared color film (Ektachrome Type 2443). The color transparencies, 9 inches by 9 inches in size, provide a ground coverage of 6,750 feet at a scale of 1 inch = 750 feet (Doyle, 1972). The distribution of kelp beds following plant operation will be compared to the Pre-Operational Aerial Survey information, which started in October, 1969.

3.1.2.1.1.2 Invertebrates

3.1.2.1.1.2.1 a. Intertidal

Counts of abalone and important associates will be made 3 times a year for two years as the permanent intertidal transects and quadrats described in 3.1.2.1.1.1.1 Intertidal Macrophytes. The species counted will be *Cancer sp., C. attenarius, C. productus, Astrea gibberosa, Haliotis cracheroidii, H. rufescens, Patiria miniata, Pisaster ochraceous,* and *Pycnopodia helianthoides*. The relative abundance of other species will be recorded. For the 1/4 m^2 quadrats, all animals and plants will be counted, except for aggregated forms. Photographic records will be taken of the 1/4 m^2 quadrats.

3.1.2.1.1.2.2 Subtidal

Actual counts of abalone and important associates will be made 3 times a year for two years at the 11 permanent subtidal transects described in 3.1.2.1.1.1.2 Subtidal Macrophytes. The species counted will be *Haliotis kamtschatkana, H. rufescens, Cancer attenarius, Pycnopodia helianthoides, Strongylocentrotus franciscanus,* and *S. purpuratus*. The relative abundance of other species will be recorded.

3.1.2.1.1.3 Fish

3.1.2.1.1.3.1 Eggs, Larvae and Juveniles (See 4.1.1.5.1)

3.1.2.1.1.3.2 Adults

Actual counts of bony fish will be made 3 times a year at the

11 permanent subtidal transects described in 3.1.2.1.1.1.2, Subtidal Macrophytes. Actual counts will be made when possible, but large numbers of fish in schools will be estimated.

3.1.2.1.2 Impingement of Organisms

Objective

To estimate the number and weight of fish impinged on the trash racks and the traveling screens in the intake structure during day and night in various seasons so that the significance of this fish mortality to the ecosystem may be determined and corrective measures taken if necessary.

Specifications

(1) This study shall be undertaken for at least twelve (12) months after the plant becomes operational. After that period, an evaluation report of the study with appropriate substantiated recommendations shall be submitted to the Directorate of Licensing. A summary of the progress and results of these studies shall be included as part of the Semiannual Operating Reports.

(2) Species, numbers, lengths, and weights of all fish removed at the traveling screens and trash racks during a survey shall be recorded on a daily (24 hourly) basis. Samples shall be collected once a week so that seasonal variations can be identified. In the event of large collections, representative subsampling for various parameters will be satisfactory.

Reporting Requirements

Based on the results of at least two years of fish impingement study, proposed limiting conditions and report levels shall be established by the licensee and submitted to the Directorate of Licensing for approval.

Bases

Section 6.2.2. requires the licensee to determine the magnitude of the fish kill at the cooling water intake. Data on fish collected under the Fish Eggs, Larvae, and Juvenile Survey will be used to estimate levels of fish abundance in the Diablo Canyon area. The intake fish-kill data will be analyzed for the significance of impact on the ecosystem in the light of fish abundance data.

3.1.2.1.3 Entrainment of Organisms Through Condenser

(See Sec. 4.6)

3.1.2.1.4 Onsite Chlorination Studies

(See Secs. 4.6 and 4.7)

3.1.2.1.5 Heavy Metals Study

(See Sec. 4.3)

3.1.2.1.6 Abalone Life History Studies

(See Sec. 4.8)

3.2 RADIOLOGICAL SURVEILLANCE

Objective

The environmental monitoring program specified below has a three-fold objective. The preoperational purpose of the program was to provide baseline data on the background radioactivity in the marine and terrestrial environment of the Diablo Canyon plant. A second objective is to maintain a monitoring network, after reactor operation begins, that will provide data on any long-term buildup of radioactivity in the environs of Diablo Canyon. A third objective is to provide backup environmental data for the evaluation of possible exposure pathways to man.

Information obtained from this monitoring program may thus serve to verify the effectiveness of controls on the radioactive discharges from the plant.

Specification

The radiological monitoring program shall be conducted as follows:

1. Marine and terrestrial samples will be collected, processed, and analyzed periodically as specified in Tables 3.2-1 and 3.2-2. The frequency and location of samples may vary due to the unavailability of samples or seasonal conditions.
2. For all biological specimens, samples will be freeze-dried before determining activity. For the water samples, alkali

metals will be separated by adding phosphoric acid and sodium carbonate to the samples; the beta activity of the dried precipitate will then be determined. For all biological and water samples, activity per gram will be reported on both original and dried sample bases.

3. Gross beta activity for environmental samples will be determined on low-background, thin-window, gas-flow proportional counters at least 72 hours after collection to allow for the decay of naturally occurring short-lived radionuclides. The limit of detectability for this type of counter is about 0.5 ρCi/g of a standard containing K-40.

4. Gamma isotopic analyses, using a 3 x 3 in. Na I (Tl) or high-resolution germanium detector and multichannel pulse-height analyzer, will be performed on the milk samples as received, on evaporated water samples, and on the freeze-dried samples. The limit of detectability attained in this type of measurement is typically 10 pCi/liter of water solution containing I-131, and 5 pCi/liter for Co-60.

5. Freeze-dried samples, randomly selected, will be sent to a qualified contractor for confirmatory analysis.

6. During the season when animals are on pasture, samples of fresh milk will be obtained monthly at representative nearby dairy farms, as shown in Table 3.2-2, and analyzed for their radioiodine content, calculated as I-131.

Analysis will be carried out within eight days (one I-131 half-life) of sampling. Suitable analytical procedures will be used to determine the radioiodine concentration to a sensitivity of 0.5 picocuries per liter of milk at the time of sampling. For activity levels at or above 0.5 picocuries per liter, overall error (one sigma confidence level) of the analysis will be within $\pm$ 25 percent. Results will be reported, with associated calculated error, as picocuries of I-131 per liter of milk at the time of sampling, in accordance with Reporting Requirements below.

7. A census of dairy cows will be conducted every six months (during the grazing season) to determine the location of animals within 15 miles of the plant.

8. Specific methods, techniques, and equipment used in the radiological environmental monitoring program may be changed to incorporate state-of-the-art improvements.

Reporting Requirements

All data routinely obtained through the radiological monitoring program shall be reported to the AEC in accordance with Section 5.5.1 of this document.

Bases

The radiological monitoring program outlined in Tables 3.2-1 and 3.2-2 was designed to (1) provide information about naturally occurring radioactivity in the area around the plant site before operation begins, and (2) aid in confirming the effectiveness of control measures for radioactive waste discharges after plant operation begins. The pre-operational portion of the program, put into practice in December 1969, was developed in cooperation with the State of California Department of Public Health, Bureau of Radiological Health, and has been reviewed by other interested State agencies.

The items sampled in the surveillance program were chosen as key indicators along critical pathways for radiation exposure to man and other important biological organisms that could be affected by the plant's operation.

The information provided by the radiological environmental monitoring program is considered adequate to verify that plant effluent controls are effective in keeping radioactive discharges from exceeding the limits specified in 10 CFR 20.

The entire monitoring program will be reviewed periodically to identify any necessary changes, and modified as appropriate.

TABLE 3.2-1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM FOR MARINE SAMPLES

Sample Item	Sample Size	Sampling Location	Type of Analysis	Materials Analyzed	Collection Frequency
Sediment	2 liters	Diablo Cove	Gross beta, gamma isotopic	Complete Sample	Quarterly
Seawater	4 liters	Diablo Cove	Gross beta, gamma isotopic, tritium	Evaporate	Quarterly
Red algae, foliose *(Iridaea sp.)*	1 kg	Diablo Cove	Gross beta, gamma isotopic	Complete Sample	Quarterly
Bull kelp *(Nereocystis leutkeana)*	1 kg	Diablo Cove	Gross beta, gamma isotopic	Frond and stripe	Quarterly
Goose barnacles *(Pollicipes polymerus)*	1 kg	Diablo Cove	Gross beta, gamma isotopic	Complete Sample	Quarterly
Mussels *(Mytilus californianus)*	1 kg	Diablo Cove	Gross beta, gamma isotopic	Muscle and viscera	Quarterly
Black abalone *(Haliotis cracherodii)*	Two 4-6 in. specimens	Diablo Cove	Gross beta, gamma isotopic	Edible muscle and viscera	Quarterly
Black perch *(Embiotoca lateralis)*	1 kg	Diablo Cove	Gross beta, gamma isotopic	Edible muscle	Quarterly
Pismo clams *(Tivela stultorum)*	1 kg from each location	Pismo Beach and Morro Bay	Gross beta, gamma isotopic	Muscle and viscera	Quarterly

TABLE 3.2-1 (Cont'd)

Sample Item	Sample Size	Sampling Location	Type of Analysis	Materials Analyzed	Collection Frequency
Red abalone *(Haliotis rufescens)*	One 7-8 in. specimen	Diablo Cove	Gross beta, gamma isotopic	Edible muscle and viscera	Quarterly
	One whole specimen in in shell (if possible)[a]	El Morro Abalone Plant, Morro Bay	Gross beta, gamma isotopic	Edible muscle and viscera	Quarterly[b]
Blue Rockfish *(Sebastes mystinus)*	1 kg (two specimens)	Diablo Cove	Gross beta, gamma isotopic	Edible muscle and viscera	Quarterly
	1 kg[a]	Commercial landing in Morro Bay	Gross beta, gamma isotopic	Edible muscle and viscera	Quarterly
Salmon	1 kg[a]	Commercial landing in Morro Bay	Gross beta, gamma isotopic	Edible muscle	Quarterly[b]

a. Commercial samples

b. Sampled when in season

TABLE 3.2-2

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM FOR TERRESTRIAL SAMPLES

Sample Item	Sample Size	Sampling Location	Type of Analysis	Frequency
Dosimeters[a]	(Note b)	18 stations[c]	Gamma dose	Monthly
Air Particulates	(Note d)	4 stations[c]	Gross beta	At least 24 hrs after each filter change[e]
			Gamma isotopic	Monthly composite
Iodine	(Note f)	4 stations[c]	Gamma isotopic	Weekly
Groundwater	4 liters	Diablo Creek above 500 kV switchyard	Gross beta, gamma isotopic[g]	Quarterly
Grains and vegetables	0.5 kg from each location[c]	Cal Poly Farm; Bill H. Kawaoka, Star Rte. Box 7-A, Arroyo Grande; M. Albertoni Dairy, Guadalupe	Gross beta, gamma isotopic[h]	At each harvest[i]
Milk	4 liters from each location[c]	Cal Poly Dairy; M Albertoni Dairy Guadalupe	Gross beta, gamma Radioiodine[h]	Monthly Monthly[j]

TABLE 3.2-2 (Cont'd)

NOTES

a. Thermoluminescent dosimeters (TLD) and film packs

b. Two TLDs and one film pack at each station

c. See Fig. 3.2-1 for locations

d. One filter at each station

e. Filters changed weekly or as required by dust loading, whichever is more frequent

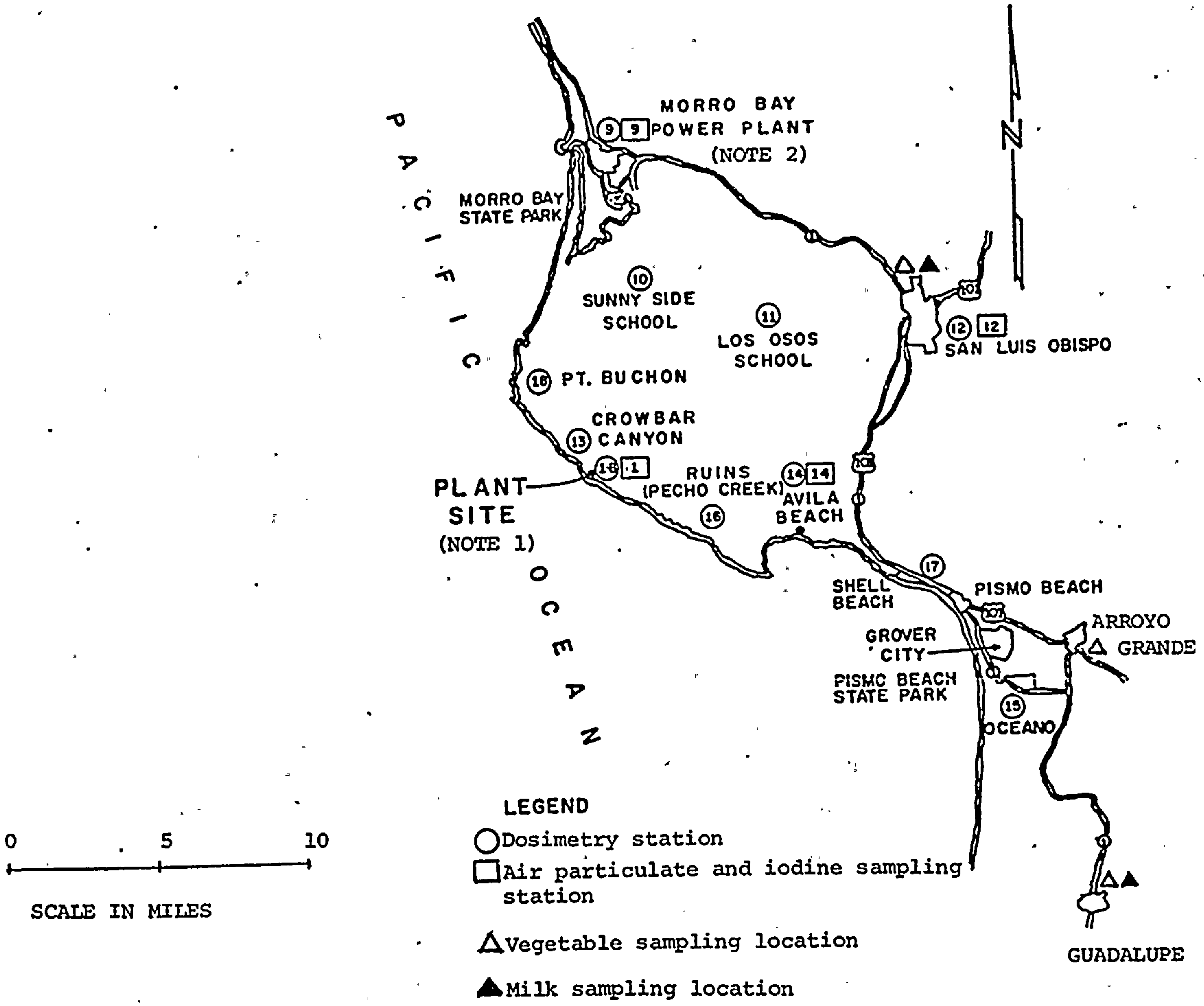
f. One cartridge at each location

g. Analyses performed on evaporate

h. Analyses performed on complete sample

i. Where harvest occurs continuously, sampling frequency will be monthly

j. During grazing season



NOTES

1. Dosimetry stations 1-8 and particulate station 1 are located on the plant site.

2. Control sample location for background data

Fig. 3.2-1 Terrestrial sampling locations for radiological environmental monitoring program.

REFERENCES

Burge, R.T., and S.A. Schultz; The Marine Environment in the Vicinity of Diablo Cove With Special Reference to Abalones and Bony Fishes; California Department of Fish and Game, Marine Resource Technical Report No. 19, 433 pp.; 1973.

North, W.J.; An Evaluation of the Marine Flora and Fauna in the Vicinity of Diablo Cove; Marine Advisors, mimeo, La Jolla, California, 38 pp.; December, 1966.

North, W.J., and E.K. Anderson; Anticipated Biological Effects from Heated Effluents at Diablo Cove; Pacific Gas and Electric Company, Department of Engineering Research, Emeryville, California, vi plus 134 pp.; 1973

Pacific Gas and Electric Company; Supplement No. 2 to Environmental Report, Units 1 and 2, Diablo Canyon Site; PG&E, San Francisco, California, Vol. I; 1972

U.S. Atomic Energy Commission; Final Environmental Statement Related to the Nuclear Generating Station, Diablo Canyon Units 1 and 2, Pacific Gas and Electric Company, Dockets 50-275 and 50-323; Directorate of Licensing, Washington, D.C.; 1973

SECTION 4.0

SPECIAL SURVEILLANCE, RESEARCH AND STUDY ACTIVITIES

4.1 THERMAL PLUME MAPPING

Objective

Determine the actual effect of ocean currents on the thermal plume.

Specification

The extent of the thermal plume will be measured in increments of 2°F from 10°F to 2°F above ambient at 50 percent and 100 percent power of the first unit. Surface and vertical temperature profile measurements shall be made from a boat traveling along several transects in the discharge area. Airborne infra-red systems will also be used to measure the surface water temperatures. The results of these measurements will be compared with the thermal plume predictions in the Final Environmental Statement.

Bases

Sections 3.3.3 and 6.3 of the Final Environmental Statement require the licensee to conduct such studies.

4.2 OCEAN CURRENTS

Objective

Conduct additional ocean current studies.

Specification

Ocean current studies shall be conducted monthly, starting at least one year before the operation of unit No. 1 and continuing for one year after full-power operation of both units.

Bases

Sections 3.3.3 and 6.1 of the Final Environmental Statement require the licensee to conduct additional ocean current studies.

4.3 HEAVY METALS STUDIES

Objective

Determine long-term chronic effects, if any, of copper, nickel, chromium, and other heavy metals released into the environment. Additionally, determine the potential for buildup of these metals in the food chain.

Specification

Samples shall be collected from Diablo Cove. Other samples shall be collected at nearby locations, from which the samples will serve as controls. Collections shall be made at various times of the year.

Collected samples shall be refrigerated and returned to the company for preparation and analysis. Care shall be taken to avoid metal contamination of the tissues to be analyzed.

This precaution shall be accomplished by using nonmetallic instruments where possible, and by minimizing tissue contact with metallic instruments.

The following technique will be suitable: Scrape shells of mussels and clams with glass slides to remove foreign material. Scrub the shells with a bristle brush and rinse them with deionized water to complete the cleaning. Cut the abductor muscles with a carbon steel scalpel, inserted through the bissel threads of mussels to minimize metal contact with the animal. Remove the mussels and clams from their shells with a glass slide. Do not rinse the bodies of the animals after removal from the shells.

Wash anemones thoroughly with saline water to remove sand and small pebbles, completing this task as quickly as possible to minimize leaching of the animals' tissue. Use no mechanical instruments in the washing process.

Scrub crabs lightly with a soft bristle brush to remove sediment, then rinse with deionized water.

Determine the wet weights of all samples before freeze drying. After freeze drying, determine dry weight. Pulverize the samples in a blender equipped with stainless steel blades. Ash portions of the samples at 1100°F (503.8°C) for 24 hours, then take them up with 10 percent hydrochloric acid and analyze them for aluminum, copper, nickel, and zinc. A Perkin-Elmer Model 403 atomic absorption spectrophotometer or equivalent can be used.

Digest additional portions of the freeze-dried samples, using a mixture of sulfuric, nitric, and perchloric acids. After digestion, determine aluminum, copper, nickel, and zinc by atomic absorption as before. Analyze tin with the atomic absorption spectrophotometer in the heated graphite electrode mode. Portions of the freeze-dried samples may be sent to a commercial laboratory for comparative analyses.

Bases

A study was undertaken by the company in 1972 and 1973 to find whether the stable-element corrosion products from the cooling water condenser tubing of the Morro Bay Power Plant, Morro Bay, California, were being accumulated by marine organisms living in the cooling water discharge canal. Information from this study will provide a basis for estimating similar accumulation by organisms living within the discharge of the Diablo Canyon power plant. Morro Bay was selected for several reasons: (1) it is in close proximity to Diablo Canyon; (2) the condenser tubes at Diablo Canyon have a similar composition to those at Morro Bay; (3) the biological communities at the two sites are similar.

Copper and nickel are the principal metals of interest. The condenser tubes consist of 90/10 alloys of these metals at Diablo Canyon, and 70/30 at Morro Bay. The concentrations of aluminum, tin, and zinc in marine organisms will also be determined.

4.4 VERIFICATION OF PREDICTED ECOLOGICAL EFFECTS

Consultants to the company have conducted pre-operational ecological surveys since November 1966 to predict the effect of the thermal discharge on the principal ecological communities (North, 1966; PG&E, 1972; USAEC, 1973; North and Anderson, 1973). These surveys will be continued after plant start-up to verify and refine prediction techniques.

Objective

Conduct ecological surveys at permanent transect sites of the company to verify and refine techniques used to predict the probable effect of the thermal discharge in the principal ecological communities.

Specifications

Permanent transects have been established at three intertidal and three subtidal locations by the company (Figure 4.4-1). Surveys shall be made at least once a year, for two years, to develop qualitative descriptions of the biotic communities along the transects, with emphasis on the species composition and distribution of the principal macrofloral and faunal components. The measured effects of the thermal discharge will be compared with the effects predicted in the pre-operational surveys by the company (PG&E, 1972; North and Anderson, 1973).

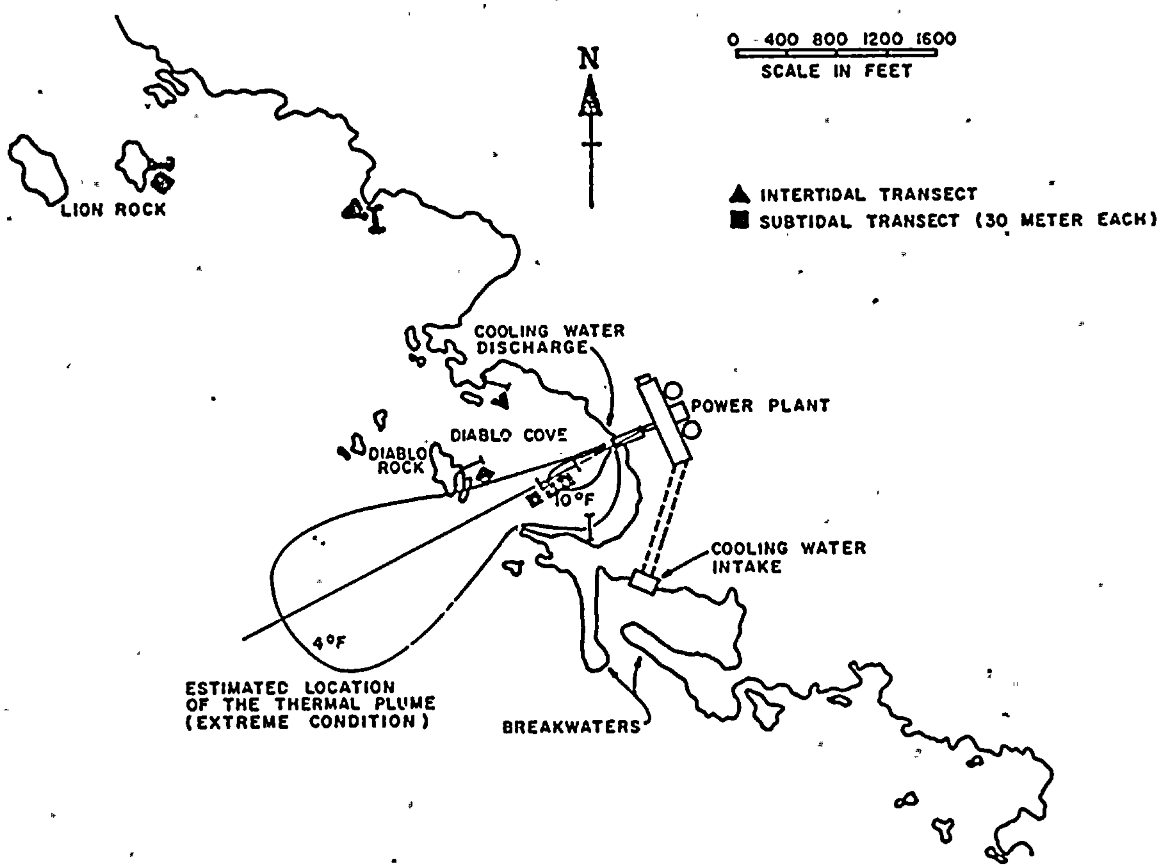


Fig. 4.4-1. Locations of biological monitoring stations in Diablo Cove and vicinity used by the company and its consultants.

Bases

Section 6.2 of the Final Environmental Statement requires the continuation of the biological monitoring program conducted by the company. Considerable effort has been made to predict the impact of the Diablo power plant discharge on aquatic life. The verification and refinement of these prediction techniques will have considerable value both for Diablo and for other power plants in the marine environment.

4.5 EGGS, LARVAE, AND JUVENILE FISH STUDY

Objective

Determine and document the concentration of small fish and the concentration of eggs and larvae of marine organisms in the intake cove.

Specifications

Quantitative temporal and spatial distributions of existing larval and juvenile fish populations shall be determined through appropriate sampling schedules and methods. Stations shall be designated in nearshore (intake cove) and offshore waters of Diablo Canyon. This study approach will enable the company to determine whether any significant natural environmental stresses presently exist at Diablo Canyon. It will also establish baseline preoperational data of inshore-offshore larval fish populations. In addition, the study design will allow complete flexibility with respect to continued pre- and post-operational monitoring as deemed necessary. Zooplankton and phytoplankton collections will be made at the same time as the fish collections.

Bases

Sections 5.3.2 and 6.2.2 of the Final Environmental Statement require the licensee to conduct such studies.

4.6 ENTRAINMENT OF ORGANISMS THROUGH CONDENSERS

4.6.1 Immediate Mechanical, Chemical, and Thermal Mortality

Objective

Determine the immediate mechanical, chemical, and thermal mortality effects on eggs, zooplankton, and larval fish populations entrained in the cooling water systems (plant-entrained) of Diablo Canyon power plant.

Specifications

Quantitative seasonal zooplankton and larval fish survival studies shall be conducted at Diablo Canyon power plant. The latest study methodology shall be used to determine immediate survival of plant-entrained zooplankton and larval fish. This information, in conjunction with inshore-offshore studies, will allow the company to assess the immediate impact of plant operation on zooplankton and larval fish populations at Diablo Canyon.

Bases

Sections 5.3.2 and 6.2.2 of the Final Environmental Statement require the licensee to conduct such studies.

4.6.2 DELAYED MORTALITY STUDIES

Objective

Determine the delayed effects of cooling water system entrainment (plant-entrainment) on zooplankton survival with time.

Specification

Determine the delayed effects of plant-entrainment on important zooplankton species with time. This information, together with information on the immediate effects of plant-entrainment, will allow the company to assess the total impact of power plant operation on zooplankton populations.

Bases

Sections 5.3.2 and 6.2.2 of the Final Environmental Statement require the licensee to conduct such studies.

4.7 ADDITIONAL ONSITE CHLORINE STUDIES

Objective

Determine the acute and chronic impacts of chlorine on both the entrained and the receiving water life.

Specification

Chlorine in the discharge shall be monitored continuously during its use. The short-term effect of chlorine on entrained organisms shall be studied in conjunction with studies outlined in Section 4.6 on entrainment of organisms through the condenser. The chronic impacts of chlorine on marine life in the receiving water will be studied in a seawater laboratory at the power plant. This laboratory uses intake water from the power plant, as well as groups of marine organisms native to the area.

Bases

Sections 3.5.1, 3.5.7, 5.3.3, 6.3, 12.3.4, and 13.3 of the Final Environmental Statement require the licensee to conduct such studies.

4.8 ABALONE LIFE HISTORY AND FOOD HABITS STUDIES

Objective

Gather additional base-line information on the life history and biology of the abalone and associated food forms prior to operation of unit No.1.

Specification

Thermal tolerance studies shall be conducted on both larval, juvenile, and adult red abalone (Haliotis rufescens) to determine the effects of both condenser passage (power plant entrainment) and chronic temperature doses in the receiving water. Important abalone forage species of subtidal brown algae such as bull kelp (Nereocystis leutkeana), Laminaria, and Pterygophora will be studied quantitatively on a seasonal basis to monitor charges in canopy in both Diablo Cove and adjacent control areas. The effects of temperature on the growth rates and sporophyte development of the bull kelp will be studied in a seawater laboratory at the Diablo Canyon power plant. This information will be gathered before the start-up of the first unit.

Bases

Section 6.1 of the Final Environmental Statement requires that this base-line information be obtained prior to start-up of the first unit.

SECTION 5.0

ADMINISTRATIVE CONTROLS

Objective

Administrative controls for implementation of the environmental technical specifications are the means by which environmental protection is subject to management control.

Specifications

5.1 RESPONSIBILITY AND ORGANIZATION

5.1.1 The Plant Superintendent shall have responsibility for ensuring that operation of the generating units at the site gives continuing protection to the environment. He may delegate his authority to other specified members of the management staff of Diablo Canyon plant during his absence.

The Plant Superintendent reports administratively to the Division Steam Superintendent and is under the functional direction of the Company's Manager of Steam Generation. He receives technical support from the Company's General Office Department of Steam Generation.

5.1.2 Operation of the plant so as to implement the Environmental Technical Specifications is the responsibility of the Plant Superintendent, with the assistance of the plant staff and technical personnel from other Company departments.

5.1.3 Company technical personnel and environmental consultant personnel shall perform environmental monitoring. Company biologists and engineers will provide assistance when required.

5.2 REVIEW AND AUDIT

5.2.1 The Company organizations for review and audit of the plant operation consist of: the Plant Staff Review Committee; the General Office Nuclear Plant Review and Audit Committee, and the President's Nuclear Advisory Committee. These committees are described in Amendment 3, Final Safety Analysis Report, Chapters 13 and 16.

The Company's program of independent review and audit of nuclear plant operations has been in effect since the initial operation in 1963 of Humboldt Bay Power Plant Nuclear Unit No. 3. The program, which will also apply to the operation of Diablo Canyon Power Plant, is being reviewed and modified to conform to ANSI N18.7-1972, "Standard for Administration Controls for Nuclear Power Plants". These modifications will include supplementary provisions for review and audit of operations related to Environmental Technical Specifications. When modifications are completed, an FSAR amendment will be submitted describing the changes.

5.3 ACTION TO BE TAKEN IF A LIMITING CONDITION FOR OPERATION IS EXCEEDED.

5.3.1 If a limiting condition for operation is exceeded, corrective action shall be promptly taken to bring the plant and its effects within the specified limits.

5.3.2 The Company shall prepare a report for each occurence and submit it to the Directorate of Licensing as specified in Section 5.5. This report shall evaluate the cause of the occurrence, record the corrective action taken, and recommend appropriate action to prevent or reduce the probability of a recurrence.

5.4 OPERATING PROCEDURES

5.4.1 Prior to initial operation of Unit one, the Company shall prepare detailed written plant operating procedures, including applicable checkoff lists and instructions. During operation the Company shall adhere to these procedures for all systems and components involved in carrying out the Environmental Technical Specifications. Procedures shall include sampling, instrument calibration, analysis, and actions to be taken when limiting conditions for operation are exceeded.

Procedures shall include the frequency of testing alarms. Experience with similar instruments in similar environments and manufacturers' technical manuals shall determine the frequency of testing.

5.4.2 Prior to implementation, the Plant Superintendent shall review and approve all procedures described in 5.4.1 above, and changes thereto. The Shift Foreman may approve temporary changes to procedures which do not affect the intent of the original procedure or the limits and requirements contained in these Environmental Technical Specifications.

5.5 PLANT REPORTING REQUIREMENTS

5.5.1 Routine Reports

The Company shall submit a report on environmental surveillance programs for the previous six months operations as part of the Semiannual Operating Report within 60 days after January 1 and July 1 of each year. The period of the first report shall begin with the date of initial criticality of Unit 1. The report shall be a summary of the results of the environmental activities for the six-month period and an assessment of the observed impacts of the plant operation on the environment. If some results are not available within the 60-day period, the report will be submitted noting and explaining the omissions. The remaining data shall be submitted as soon as possible in a supplementary report.

5.5.2 Non-Routine Reports

If a limiting conditions for operation is exceeded, the Company shall notify the Director of the Region V Regulatory Operations Office, within 24 hours by telephone or telegraph, and follow with a written report within 10 days to the same official (cc to Director of Licensing).

The written report and, to the extent possible, the preliminary notification shall: (a) describe, analyze and evaluate the occurrence, including extent and magnitude of the impact, (b) describe the cause of the occurrence, and (c) indicate the corrective action (including any significant changes made in procedures) taken to preclude repetition of the occurrence and to prevent similar occurrences involving similar components or systems.

5.5.3 Changes

a. If the Company plans a change in the plant design, operation, or procedures described in Section 5.4 and such a change, in the Company's opinion, would have a significant adverse effect on the environment or involve an environmental matter or question not previously reviewed and evaluated by the AEC, a report on the change shall be made to the AEC prior to implementation. The report shall include a description and evaluation of the change including a supporting benefit-cost analysis as appropriate.

b. The Company shall submit requests for changes in Environmental Technical Specifications to the Deputy Director of Reactor Projects, Directorate of Licensing, USAEC, for prior review and authorization. The request shall include an evaluation of the impact of the change, with a supporting benefit-cost analysis, as appropriate.

5.6 RECORDS RETENTION

5.6.1 The Company shall retain, for the life of the plant, records and logs relative to the following areas:

a. Records and drawing changes reflecting plant design modifications made to systems and equipment as described in Section 5.5.3.a.

b. Records of environmental surveillance data.

c. Records to demonstrate compliance with the limiting conditions for operation in Section 2.

5.6.2 All other records and logs relating to the Environmental Technical Specifications shall be retained for six years.

REGULATORY DOCKET FILE COPY

PROPOSED

Environmental Technical Specifications

APPENDIX B

to

Facility Operating License No.________

for

Diablo Canyon Nuclear Power Plant

Pacific Gas & Electric Company

Docket Nos. 50-275 and 50-323

w/ ltr dtd 8-7-75
w/ cert-of-service
To: G.K. Dicker
Fm: P.A. Crane Jr.

#8559

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF ILLUSTRATIONS

SECTION 1.0

DEFINITIONS

The terms in this section are defined for uniform interpretation of the Diablo Canyon Environmental Technical Specifications.

Blowdown: The minimum discharge of recirculating water for the purpose of discharging materials contained in the water, the further buildup of which would cause concentrations in amounts exceeding limits established by best engineering practice.

CDF&G: California Department of Fish and Game.

Channel Calibration: Adjustment, as necessary, of channel output such that it responds with necessary range and accuracy to known values of the parameter that it is monitoring. Channel calibration shall encompass the entire channel, including the sensor and alarm and/or trip functions, and shall include the channel functional test. The channel calibration may be performed by any series of sequential, overlapping or total channel steps such that the entire channel is calibrated.

Channel Check: Qualitative assessment of channel behavior during operation by observation. This determination shall include, where possible, comparison of the channel indication and/or status with other indications and/or status derived from independent instrument channels measuring the same parameter.

Channel Functional Test: Injection of a simulated signal into a channel as close to the primary sensor as practicable to verify operability, including alarm and/or trip functions.

Company: Pacific Gas and Electric Company.

Construction Runoff: The rainfall runoff from a construction activity and the earth surface disturbed by such activity from start of construction until construction is complete and any disturbed earth has been returned to a vegetative or other cover commensurate with the intended land use.

Diablo Canyon Plant: Units 1 and 2 of the Diablo Canyon Nuclear Power Plant.

Diablo Cove: Inlet of the Pacific Ocean about 12 miles WSW of the city of San Luis Obispo, California.

ETS: Environmental Technical Specifications.

FES: Final Environmental Statement.

Free Available Chlorine: The value obtained according to the amperometric titration method for free available chlorine described in *Standard Methods for the Examination of Water and Wastewater*, p. 112 (13th edition).

GONPRAC: General Office Nuclear Plant Review and Audit Committee.

<u>Intake Cove</u>: Cove, immediately south of Diablo Cove, created by two breakwaters constructed to protect the intake structure.

<u>Licensee</u>: Pacific Gas and Electric Company.

<u>Low-Volume Waste Sources</u>: Wastewater, taken collectively as if from one source, from all sources except once-through cooling water, metal cleaning wastes, steam generator blowdown, and material storage or construction runoff. Low volume waste sources include, but are not limited to, waste waters from ion exchange water treatment systems, water-treatment evaporator blowdown, laboratory and sampling streams, floor drainage, and blowdown from recirculating plant service water systems.

<u>Material Storage Runoff</u>: The rainfall runoff from or through any material storage pile.

<u>Metal Cleaning Wastes</u>: Cleaning compounds, rinse waters, or other waterborne residues derived from cleaning of any metal process equipment.

<u>Normal Thermal Operation</u>: Any operation of a Unit wherein one or both circulating water pumps are in service and the reactor is in the power operation mode, except during:

1. Condenser heat treatment.
2. Transient conditions, not to exceed 30 minutes, due to load rejection, steam dump, generator trip, or other conditions resulting from the operation of engineered safety features and protective devices.
3. Transient conditions, not to exceed 30 minutes, resulting from intake structure or condenser tube sheet plugging.

Once Through Cooling Water: Water passed through the main cooling condensers to remove waste heat from the generating unit.

Operable-Operability: A system, subsystem, train, component or device shall be operable or have operability when it is capable of performing its specified function(s). Implicit in this definition shall be the assumption that all necessary attendant instrumentation, controls, electric power, cooling or seal water, lubrication or other required auxiliary equipment are also operable.

Power Operation: Any condition where a reactor is operating with Keff $\geq$ 0.99 at > 5% rated thermal power (excluding decay heat).

<u>Rated Thermal Power</u>: A total reactor core heat transfer rate to the reactor coolant of 3338 MWT for Unit 1 and 3411 MWT for Unit 2.

Receiving Water: The Pacific Ocean in and contiguous with Diablo Cove.

RTD: Resistance temperature detector.

Ten Year, Twenty-Four Hour Rainfall Event: A rainfall event with a probability recurrence interval of once in 10 years as defined by the National Weather Service in Technical Paper No. 40, RAINFALL FREQUENCY ATLAS OF THE UNITED STATES, May 1961, and subsequent amendments, or equivalent regional or state rainfall probability information developed therefrom.

TSS: Total suspended solids.

Frequency Notation: The frequency notation specified for the performance of surveillance and monitoring activities shall correspond to the intervals defined below:

NOTATION	DESCRIPTION	FREQUENCY
H	Hourly	At least once per hour
S	Shift	At least once per 12 hours
D	Daily	At least once per 24 hours
W	Weekly	At least once per 7 days
M	Monthly	At least once per 31 days
Q	Quarterly	At least once per 92 days
SA	Semiannually	At least once per 6 months
R	Refueling	At least once per 18 months

Each surveillance or monitoring requirement shall be performed within the specified time interval with: 1) a maximum extension not to exceed 25% of the surveillance interval, and 2) a total maximum combined interval time for any three consecutive surveillance intervals not to exceed 3.25 times the specified surveillance interval.

SECTION 2.0

LIMITING CONDITIONS FOR OPERATION

2.1 THERMAL

2.1.1 Maximum Temperature Difference Across Condenser

Objective

Limiting the thermal stress to the aquatic ecosystem by limiting the maximum temperature difference (Δt) across the condenser during normal thermal operation.

Specification

a. The Δt across the condenser during normal thermal operation shall be limited to 25°F. This Δt shall be considered to be the average value for all operating condenser sections. If this limit is exceeded, power shall immediately be reduced as required to reduce the Δt to $\leq$ 25°F. Subsequent action shall be taken in accordance with Section 5.4.

b. If during normal thermal operation the condenser Δt exceeds 22°F for a period of:

1) 12 hours in any calendar day, or

2) 24 hours in any calendar week

action shall be taken to reduce the Δt to $\leq$ 22°F. Action also shall be taken, to the extent practicable, to define and minimize such deviations, and such action shall be reported in accordance with Section 5.6.2.

c. If it is found that temporarily degraded equipment performance will cause condenser Δt to exceed 22°F at the planned power level for periods in excess of those specified in 2.1.1(b), the circumstances of the situation and the estimated date for completing necessary maintenance or modifications shall be reported to the Director of the Region V Regulatory Operations Office, U.S. NRC, should it be necessary to continue operation with condenser Δt exceeding 22^{o}F. On reviewing the circumstances, the Commission may grant an extension of the allowable operating time in excess of 22^{o}F on a case-by-case basis.

Monitoring Requirements

a. During normal thermal operations, the Δt across the condenser shall be monitored by either of the following systems:

   1) The system shown in Figure 2.1-1, consisting of a single RTD mounted at the intake structure upstream of the intake gates, and a second RTD installation located in the common discharge tunnel just upstream of the first weir. Both temperatures and/or their difference shall be recorded. The system shall be capable of measuring individual temperatures with an accuracy of ±1^{o}F or better.

   2) The system shown in Figure 2.1-2, consisting of single RTD's mounted on the discharge of each circulating water pump and RTD's installations mounted in the circulating water outlet pipes from each section of the condenser. Measured temperatures shall be transmitted to the computer, where Δt across each section of the condenser and everage condenser inlet temperature are printed hourly on the daily produce fluctuations in condenser Δt of approximately ± 0.5^{o}F about the average.

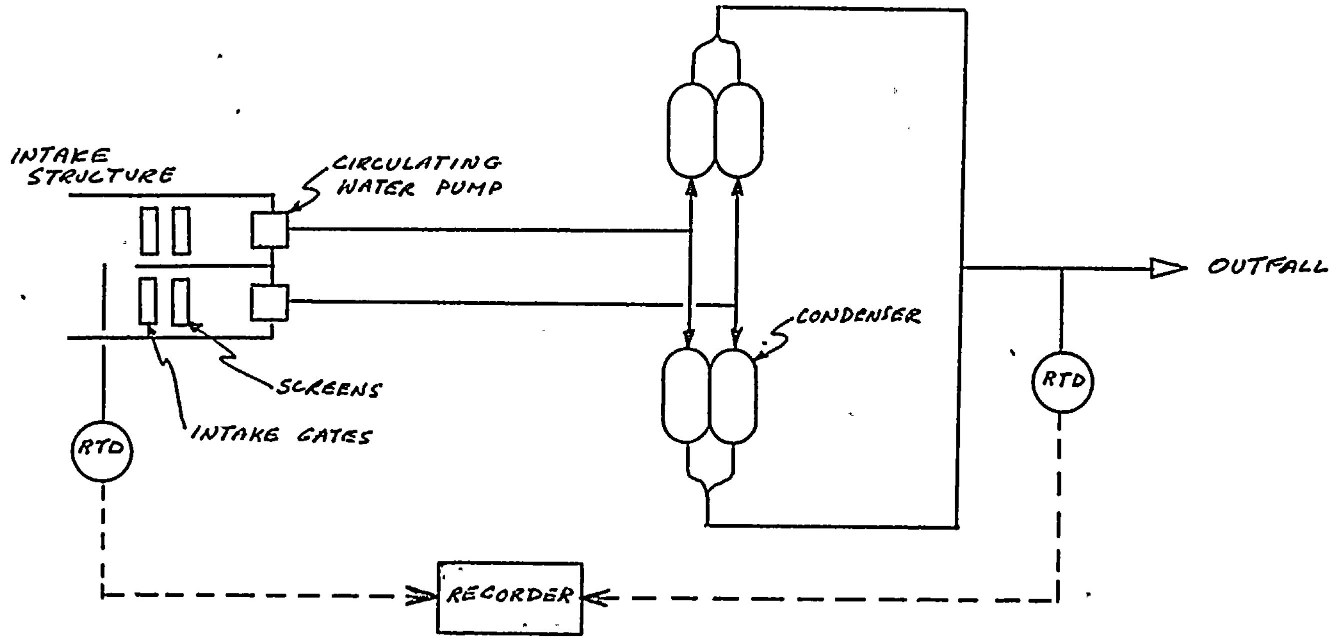


Figure 2.1-1. Condenser Δt monitoring instrumentation: option 1.

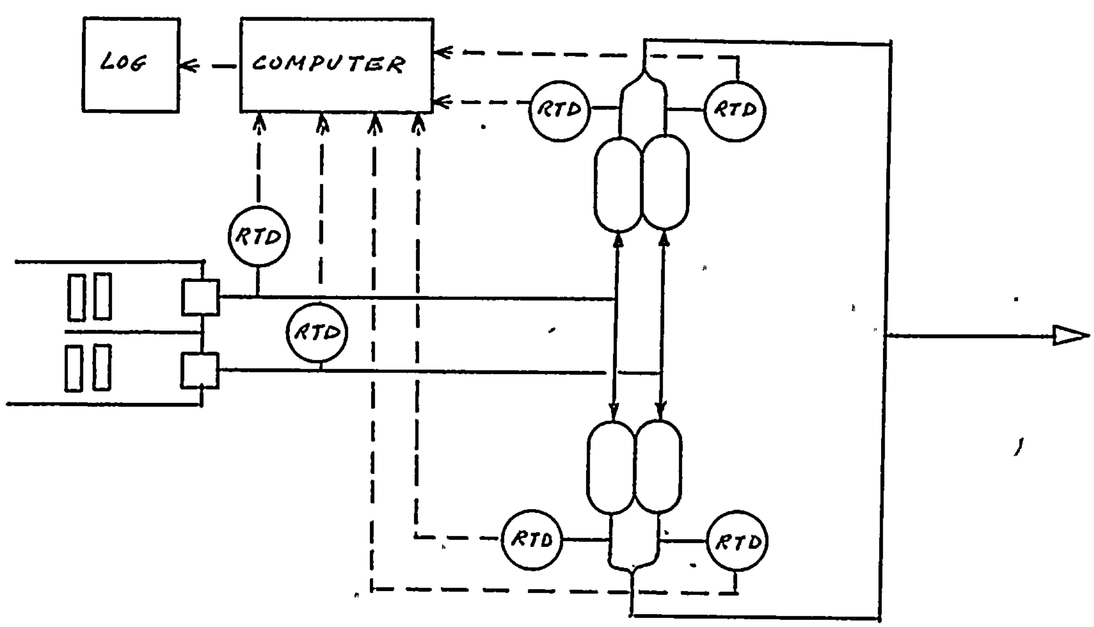


Figure 2.1-2. Condenser Δt monitoring instrumentation: option 2.

logsheet. The system shall be capable of measuring individual temperatures with an accuracy of $\pm$ 1°F or better.

b. 1) Either of the above systems may be out of service indefinitely if the other is fully operational.

2) Both systems may be inoperable for up to eight hours. The system shown in Figure 2.1-2 shall be considered operable only if the Δt's (or the individual temperatures from which the Δt's can be determined) across at least three sections of the condenser are recorded.

3) If at least one of the systems is not restored to service within 8 hours, the Δt across at least one section of the condenser shall be measured by alternative means and logged once each shift. Instruments used to measure individual temperatures shall be capable of an accuracy of $\pm$ 1.5°F or better.

4) If at least one of the systems is not restored to service within 48 hours, the circumstances of the situation shall be reported to the Director of the Region V Regulatory Operations Office, U. S. NRC. The report shall include the estimated date for completing necessary maintenance and the program for determining condenser Δt by alternative means.

Basis

Assuming the design circulating water flow of 1932 cfs for each unit, the Δt across the condensers is expected to be 19^{o}F at rated power. However, several circumstances affecting condenser Δt could cause the design Δt to be exceeded for various periods of time. These include:

a. Circulating water pump performance below design. Basically, condenser Δt at a given power level is inversely proportional to circulating water flow rate. A reduction in flow rate could result from initial failure of the pump(s) to meet design specifications, or from long-term wear. Thus, if either or both of these effects caused a 5% reduction in flow, the condenser Δt would increase by approximately 1^{o}F at rated power.

b. Condenser tube failure. When leaks appear in condenser tubes, action is taken to plug the tubes to prevent salt water intrusion into the condensate system. Condenser tube plugging usually is continued until about 10% of the total are plugged, at which time the condenser is retubed. With tubes plugged, the flow resistance of the condenser increases, reducing the circulating water flow rate. It is estimated that plugging 10% of the condenser tubes at Diablo Canyon would increase Δt by approximately 0.5^{o}F.

c. Fluctuations in tide. The change in circulating-water pump flow rate caused by fluctuations in tide is expected to produce fluctuations in condenser Δt of approximately $\pm$ 0.5^{o}F about the average.

d. Condenser cleanliness. Condenser tube sheet fouling raises the condenser Δt because flow resistance increases. These effects may increase Δt approximately 1 - 2°F between condenser cleaning operations.

e. Maintenance on feedwater heaters or heater No. 2 drain pump. When this equipment is out of service, hot drains must be routed to the condenser, with a subsequent increase in condenser heat load. For example, removal of the heater No. 2 drain pump would increase Δt by approximately 2°F.

f. Periods of circulating-water pump maintenance. When a circulating-water pump is shut down for maintenance, load must be reduced to approximately 50% power on the affected unit. However, load can be increased beyond 50% power with an increase in turbine exhaust pressure and condenser Δt. The ability to increase load beyond 50% power under such circumstances with units the size of Diablo Canyon could greatly enhance reliability of the Company system in periods of peak demand.

To provide necessary operational flexibility in the foregoing circumstances, the normal limit on condenser Δt has been established as 22°F, with provision for short-term operation up to a maximum of 25°F without specific authorization by the Commission. The basis for the times during which operation in excess of 22°F is permitted is the need for the ability to achieve the maximum possible load throughout the daytime period of peak system demand. The rationale for two such occurrences in a week is that, if a high Δt is caused by condenser fouling, it normally takes two days to clean the condenser. Since each half takes 8 to 12 hours, the usual program is to run at maximum load during the day and clean half of the condenser each night.

Units at both the Company's Morro Bay Power Plant and its Moss Landing Power Plant operate with condenser Δt in the range of 22 - 25^{o}F. Experience at these plants indicates that no significant adverse effects will occur with the limits established herein for Diablo Canyon. In addition, studies will continue after plant startup (see Section 4.4) to measure the effects of plant operation.

Two redundant instrumentation systems are installed at the plant, yielding essentially continuous information on condenser Δt. In the highly unlikely event that both systems are completely inoperable, a period of 8 hours is provided to restore at least one to service. This interval is believed to be adequate for a technician to travel from home to the plant and either fix an existing system or install and calibrate a temporary system that would provide continuous recording. During the 8 hours, a knowledge of power history, turbine back pressure, and the number of circulating-water pumps in service will enable condenser Δt to be calculated with reasonable accuracy. If a recording monitoring system is not restored to service within 8 hours, operators will log the condenser Δt as measured by local temperature indicators on the inlet and outlet water boxes.

2.1.2 Maximum Discharge Temperature

Objective

To control thermal stress to the aquatic environment.

Specification

None

Monitoring Requirement

None

Basis

The temperature of the circulating water entering the condenser is simply the ocean temperature, unaffected by the operation of the plant. Historical data exists on maximum ocean temperature, and a limit has been established on a maximum condenser Δt in Section 2.1.1. From this information, an upper limit has effectively been imposed on condenser outlet temperature; hence, this specification is redundant.

2.1.3 Maximum Btu/Hr

Objective

To limit thermal stress to the aquatic environment by limiting the heat discharge rate to the circulating water.

Specification

None

Monitoring Requirement

None

Basis

Limits on reactor power for each unit have been established in the Technical Specifications, and a limit on condenser Δt has been established in Section 2.1.1. These limits effectively established a limit on Btu/hr, making this specification redundant.

2.1.4 Rate of Change of Discharge Temperature

Objective

To limit thermal shock of aquatic organisms.

Specification

None

Monitoring Requirement

None

Basis

During normal thermal operation, the maximum rate of change of discharge temperature is essentially limited by the design response capability of the reactor control system. This system is designed to accept a 10% step load change (corresponding to a change in discharge temperature of approximately 2°F) and a ramp load change of 5% of rated power per minute (approximately 1°F/minute rate of change of discharge temperature.) Since these nominal maximum values are fixed by the design of the plant and cannot be increased by the operator, this specification is unnecessary.

2.1.5 Heat Treatment of Circulating Water Systems

Objective

Limit the thermal stress to the aquatic ecosystem, during heat treatment of the condenser cooling system for defouling, by limiting the duration and frequency of heat treatment and the magnitude of the temperature rise.

Specifications

a. The temperature difference (Δt) between intake and discharge during defouling shall not exceed 50°F for the unit being defouled.

b. Only one unit shall be defouled at a time.

c. The number of complete heat treatments (treatment of both halves of a given condenser) shall be limited to 12 per calendar year per unit.

d. The duration of a single heat treatment operation on one-half of a condenser shall be limited to eight hours with the Δt at 25°F or higher.

Monitoring Requirements

The Δt between intake and discharge shall be monitored continuously by the system described in Figure 2.1-1.

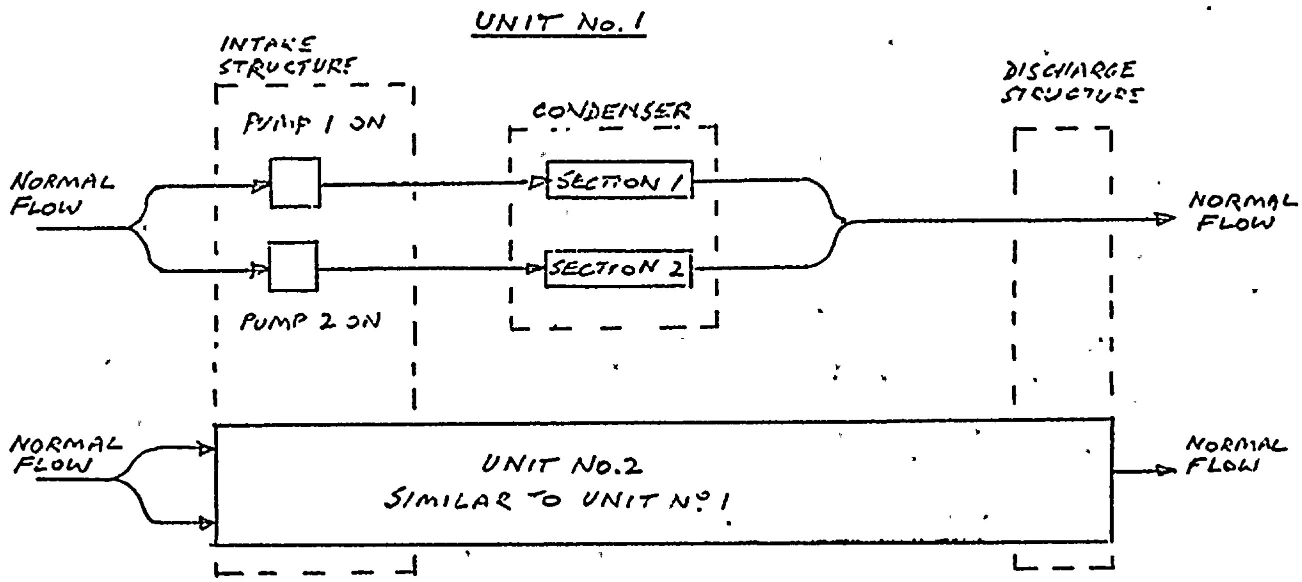
Basis

Heat treatment is used for defouling. The treatment kills and dislodges mussels that would impair condenser cooling by plugging the tube sheet. Regular defouling at intervals of 4-6 weeks removes the mussels while they are still small.

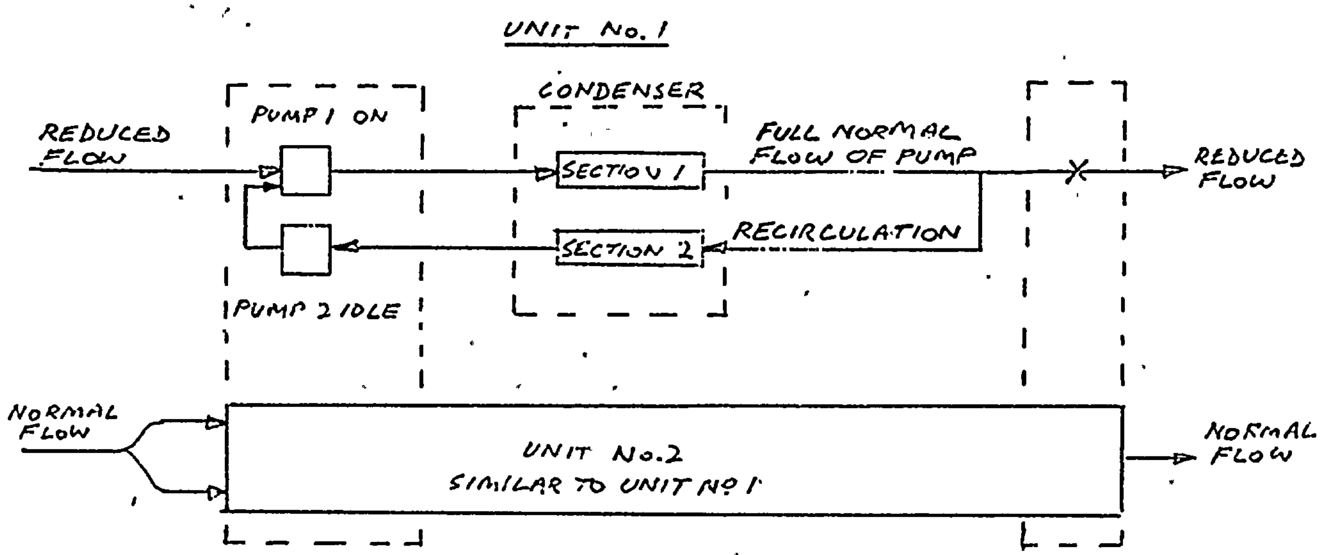
enough to pass through the tubes to the discharge. One unit is treated while the other continues to operate normally.

Figure 2.1-3 contrasts normal operation with heat treatment. In normal operation, both units of the plant are functioning. Cooling water is pumped once through both separate halves of each condenser and discharged into Diablo Cove.

Defouling consists in subjecting the mussels to a thermal shock by raising the temperature of the water in the inlet conduit to be defouled 40-50°F. Assuming, for example, that unit No. 1 is to be heat-treated, the power of this unit is first reduced. Normal flow of cooling water to Unit No. 1 is reduced by shutting down one of the pumps. Cooling water passes through the first section of the condenser to the discharge structure. There, some of the effluent is allowed to flow out to the ocean while part is diverted by gates so as to pass through the second section of the condenser in reverse. The recirculating flow continues through the idle pump and is mixed with the cooling water entering the first section of the condenser. Recirculation continues for several hours while the temperature of the water in the inlet conduit associated with the shut-down pump rises 40-50°F. Operation at the



(a) Normal operation of both units



(b) Heat treatment of Unit No. 1

Fig. 2.1-3. Schematic diagram contrasting normal operation to operation with heat treatment for defouling.

elevated temperature for at least one hour will be required to destroy mussels attached to the inner surfaces of the cooling system. Enough time must be allowed to heat the large mass of concrete in the intake tunnels. (The tolerance of mussels to heat treatment appears to increase if the surface to which they are attached is cooler than the water.) The 8-hour period provided in the specification is intended to allow for 3-4 hours to increase temperature, 1-2 hours at maximum temperature, and 1-2 hours to restore normal operation.

2.2 HYDRAULIC

Objective

To control environmental impact of the circulating water system due to impingement and bottom scouring.

Specification

None

Monitoring Requirement

None

Basis

Hydraulic characteristics of the circulating water system are fixed by the plant design. Hence, the operator cannot change them and no specification or monitoring requirement is required. Impingement studies are included as part of the environmental surveillance program discussed in Section 3.

2.3 CHEMICAL

2.3.1 Biocides

Objective

Limit the chlorine discharged into Diablo Cove to less than the amount that would be harmful to the aquatic biota.

Specification

a. The maximum concentration of free available chlorine in the plant condenser cooling water at the point of discharge into Diablo Cove shall not exceed 0.5 ppm.

b. The quantity of free available chlorine discharged into Diablo Cove shall not exceed the product of the plant condenser cooling water flow during the period of chlorination times an average concentration of 0.2 ppm.

c. Neither free available chlorine nor total residual chlorine may be discharged from either unit for more than two hours in any one day, and only one unit may discharge free available or total residual chlorine at any one time.

Monitoring Requirements

a. During periods of chlorination, a continuous sample shall be drawn from the discharge conduit of the unit being chlorinated. If the circulating water systems for both units are in operation, both discharge conduits may be sampled at the same time to obtain a composite.

b. The sample shall be monitored for free available chlorine using an automatic instrument with the following characteristics or better: a range of 0 to 2 ppm, a design accuracy of 5% full scale, and a design sensitivity of 0.05 ppm. Either the instrument shall continuously record the concentration, or concentration data shall be obtained at least once per minute throughout the chlorination period.

c. If the specified instrument is not available, the free available chlorine concentration in the discharge conduit sample shall be measured at least once during the chlorination period for each pump system. The o-tolidine-arsenite method may be used for the measurement. Use of this method in place of the specified monitor shall be limited to 30 days (in which chlorination is performed) in any calendar year.

Basis

Chlorine is used periodically to control organic growth on exposed surfaces in the condenser cooling system. Each of the four pump systems is treated individually in sequence; i.e., no more than one pump system at a time. Since each pump serves one-half of a unit's condenser, only one-fourth of the total condenser cooling water flow is chlorinated at one time if the complete cooling systems for both units are in operation.

Free chlorine is introduced into the cooling water just ahead of the pumps to ensure mixing throughout the water column. One chlorinator serves both units at Diablo Canyon and has a maximum capacity of 8,000 pounds per 24 hours, or 5.6 pounds per minute. The maximum injection rate would produce a concentration of 1.5 ppm free available chlorine in the treated conduit prior to usage and dilution. The actual injection rate is adjusted so as to produce a free available chlorine concentration of approximately 0.5-1.0 ppm at the inlet water box of the condenser.

Injection is continued for approximately 10 minutes, once a day, for each conduit. Since the chlorine is diluted by the cooling flow through other conduits not being chlorinated, and since additional chlorine will be used up by the organic material inside the cooling water system, the residual free available chlorine at the discharge prior to mixing with Diablo Cove will normally be 0.1 ppm or less.

Diablo Canyon units 1 and 2 have been subcategorized by the Environmental Protection Agency as "generating units," as defined in 40CFR423.11(b), and are therefore subject to the effluent limitation guidelines set forth in 40CFR Parts 423.12 and 423.13. The specifications contained in this section are based upon, and consistent with, the above guidelines.

Diablo Canyon's design includes means for obtaining a continuous sample of the condenser cooling water before discharge. Sample taps are located in the discharge conduit for each unit just upstream of the lowest weir. The samples flow by gravity to a collection trough, which in turn overflows to Diablo Cove. Valving in the sample lines permits samples from either or both units to flow to the trough. Normally, a composite sample is collected from both units.

An automatic chlorine analyzer is provided. The analyzer has a sample pump that takes suction from the sample trough. Operated by a timer, the analyzer starts at the beginning of chlorine injection and continues to run for five minutes after completion. Its output is recorded and indicated. A high-level alarm is provided.

If the chlorine analyzer is out of service, grab samples can be taken from the sample trough and analyzed for free chlorine with a test kit using the o-tolidine-arsenite method. This is an acceptable alternative for periods of limited duration, since the free chlorine concentration in the discharge should not vary substantially (excluding the effect of dilution if less than the full complement of circulating water pumps is in service) from one chlorination operation to the next, once the appropriate feed rate has been determined and established. Thus, the sample program is intended mainly to verify that the free chlorine concentration is in its normal range.

2.3.2 pH

Objective

To maintain effluent pH within a range compatible with indigenous aquatic life.

Specifications

The following specifications shall be effective beginning July 1, 1977:

a. The pH of low volume waste, metal cleaning waste, and steam generator blowdown discharges shall be within the range of 6.0 to 9.0. If waste streams from various sources are combined for treatment or discharge, the pH of each source shall meet the specification.

b. The pH of material storage runoff and construction runoff shall be within the range of 6.0 to 9.0. However, any untreated overflow from facilities designed, constructed, and operated to treat the volume of material storage runoff and construction runoff associated with a 10 year, 24 hour rainfall event shall not be subject to this specification.

Monitoring Requirements

None

Basis

The above specifications are consistent with two sets of guidelines. One set for the application of the best practicable control technology currently available is contained in 40CFR Part 423.12(a). The other set for the best available technology economically achievable is contained in 40CFR Part 423.13(a). Diablo Canyon is required to meet the best practicable control technology guidelines by July 1, 1977, and the best available technology guidelines by July 1, 1983.

In order to comply fully with the guidelines, certain modifications to the waste collection and treatment facilities at Diablo Canyon will be required. A program to develop and provide the necessary facilities for

Diablo Canyon (as well as other Company power plants) has been started by the Company's Engineering Department and is currently in progress.

No specification for monitoring requirements has been included because such a specification depends on the final design of the waste collection and treatment facilities. When these designs are complete, appropriate monitoring requirements will be proposed.

For the period between initial plant startup and July 1, 1977, the Orders of the California Regional Water Quality Control Board, Central Coast Region, will govern the release of chemicals in Diablo Canyon effluents. These orders, including effluent limits, monitoring requirements, and reporting requirements, will ensure that discharges are controlled to minimize environmental impact. However, inasmuch as the orders are subject to modification by the Board, their inclusion in these Technical Specifications is inappropriate.

2.3.3 Other Chemicals That Affect Water Quality

Objective

To limit the release of chemicals that have potential for reducing receiving water quality and causing adverse environmental impact.

Specifications.

The following specifications shall be effective beginning July 1, 1977:

a. There shall be no discharge of polychlorinated biphenol compounds - such as those commonly used for transformer fluid - from low volume waste sources, metal cleaning wastes, steam generator blowdown, or once-through cooling water.

b. The quantity of pollutants discharged from low-volume waste sources shall not exceed the quantity found by multiplying the flow of low-volume waste sources by the concentration listed below:

Effluent Characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
TSS	100 mg/l	30 mg/l
Oil and Grease	20 mg/l	15 mg/l

c. The quantity of pollutants discharged in metal cleaning wastes shall not exceed the result of multiplying the flow of metal cleaning wastes by the concentration listed below:

Effluent Characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
TSS	100 mg/l	30 mg/l
Oil and Grease	20 mg/l	15 mg/l
Copper, Total	1.0 mg/l	1.0 mg/l
Iron, Total	1.0 mg/l	1.0 mg/l

d. The quantity of pollutants discharged in steam generator blowdown shall not exceed the result of multiplying the flow of steam generator blowdown by the concentration listed below:

Effluent Characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
TSS	100 mg/l	30 mg/l
Oil and Grease	20 mg/l	15 mg/l
Copper, Total	1.0 mg/l	1.0 mg/l
Iron, Total	1.0 mg/l	1.0 mg/l

e. If waste streams from various sources are combined for treatment or discharge, the quantity of each pollutant controlled by paragraphs (a) through (d) attributable to each controlled waste source shall not exceed the specified limitation for that waste source.

f. Total suspended solids in material storage runoff and construction runoff shall not exceed 50 mg/l. However, any untreated overflow from facilities designed, constructed, and operated to treat the volume of material storage runoff and construction runoff associated with a 10 year, 24 hour rainfall event shall not be subject to this limitation.

Monitoring Requirements

None

Basis

The basis for Specification 2.3.2 also applies to this specification.

2.4 RADIOACTIVE EFFLUENTS

Objective

To define the limits and conditions for the controlled release of radioactive materials in liquid and gaseous effluents to the environs to ensure that these releases are as low as practicable. These releases should not result in radiation exposures in unrestricted areas greater than a few percent of natural background exposures. The concentrations of effluent discharges of radioactivities shall be within the limits specified in 10 CFR Part 20.

To ensure that the releases of radioactive material above background to unrestricted areas will be as low as practicable as defined in Appendix I to 10 CFR Part 50, the following design objectives apply:[1]

a. For liquid wastes:

1) The annual dose above background to the total body or any organ of an individual from all reactors at a site should not exceed 5 mrem in an unrestricted area.

---

[1] Appendix I has not yet been adopted. This section of the Diablo Canyon ETS is based on the proposed Appendix version of February 20, 1974, contained in the Concluding Statement of the Regulatory Staff for the rule-making hearings. When the Appendix is adopted, this section will be revised as required to conform.

2) The annual total quantity of radioactive materials in liquid waste, excluding tritium and dissolved gases, discharged from each reactor should not exceed 5 Ci.

b. For gaseous wastes:

1) The annual total quantity of noble gases above background discharged from the site should result in an air dose due to gamma radiation of less than 10 mrad, and an air dose due to beta radiation of less than 20 mrad, at any location near ground level that could be occupied by individuals at or beyond the boundary of the site.

2) The annual total quantity of all radioiodines and radioactive material in particulate forms above background from all reactors at a site should not result in an annual dose to any organ of an individual in an unrestricted area from all pathways of exposure in excess of 15 mrem.

3) The annual total quantity of iodine-131 discharged from each reactor at a site should not exceed 1 Ci.

Specifications for Liquid Waste Effluents

2.4.1 Liquid Waste Effluents

a. The concentration of radioactive materials released in liquid waste effluents from all reactors at the site shall not exceed the values specified in 10 CFR Part 20, Appendix B, Table II, Column 2, for unrestricted areas.

b. The cumulative release of radioactive materials in liquid waste effluents, excluding tritium and dissolved gases, shall not exceed 10 Ci/reactor/calendar quarter.

c. The cumulative release of radioactive materials in liquid waste effluents, excluding tritium and dissolved gases, shall not exceed 20 Ci/reactor in any 12 consecutive months.

d. During release of radioactive wastes from the liquid radwaste treatment system, the waste system discharge liquid monitor (RE-18) shall be operable and set to alarm and to initiate the automatic closure of the waste discharge valve (RCV-18) before exceeding the limits specified in 2.4.1.a above. The operability of the waste discharge valve shall be demonstrated monthly.

e. During periods of steam generator blowdown release, the steam generator liquid sample monitor (RE-19) shall be operable and set to alarm and to initiate the automatic closure of the blowdown discharge valve (FCV-498) before exceeding the limits specified in 2.4.1.a above, except that the valve may be inoperable for a period up to 72 hours. The operability of the blowdown discharge valve shall be demonstrated monthly during periods of continuous release, or prior to the start of a release if not tested within the previous month.

f. Steam Generator blowdown shall be processed through the blowdown treatment system if the specific activity of the secondary coolant exceeds Ci/gm.

g. If the cumulative release of radioactive materials in liquid effluents, excluding tritium and dissolved gases, exceeds 2.5 Ci/reactor/calendar quarter, the licensee shall make an investigation to identify the causes of such releases, define and initiate a program of action to reduce such releases to the design objective levels listed in

Section 2.4, and report these actions to the Commission within 30 days from the end of the quarter during which the release occurred, according to Section 5.6.2 of these specifications.

2.4.2 Liquid Waste Sampling and Monitoring

a. Records shall be maintained of the radioactive concentration and volume before dilution of liquid waste discharges and the average dilution flow and length of time over which each discharge occurred. Sample analysis results and other reports shall be submitted in accordance with Section 5.6.1 of these specifications.

b. Sampling and analysis of liquid radioactive waste shall be performed in accordance with Table 2.4-1. Prior to taking samples from a liquid radwaste treatment system tank, at least two tank volumes shall be recirculated.

c. For batch releases from the liquid radwaste treatment system:

   1) The radioactivity shall be continuously monitored during release by the waste system discharge liquid monitor (RE-18). See also Specification 2.4.1.d.

   2) The output recorder for the waste system discharge liquid monitor shall be in service, or the monitor output trend shall be determined by means of the plant computer and either recorded continuously or printed at intervals not to exceed 5 minutes.

   3) The flow rate of liquid radioactive waste shall be continuously measured and recorded during release.

TABLE 2.4-1

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS

A. Liquid Radwaste Treatment System

Sampling Frequency	Type of Activity Analysis
Each Batch	Principal Gamma Emitters[(a)]
One Batch/Month	Dissolved Fission and Activation Gases
Monthly Composite [(b)]	Tritium; Gross Alpha
Quarterly Composite[(b)]	Strontium-89; Strontium-90

B. Steam Generation Blowdown[(c)]

Sampling Frequency	Type of Activity Analysis
Weekly	Principal Gamma Emitters
One Sample/Month	Dissolved Fission and Activation Gases
Monthly Composite[(d)]	Tritium; Gross Alpha
Quarterly Composite[(d)]	Strontium-89; Strontium-90

Notes:

(a) When operational or other limitations preclude specific gamma radionuclide analysis of each batch, gross radioactivity measurements shall be made to estimate the concentrations of radioactive material released in the batch, and a weekly sample composited from proportional aliquots from each batch released during the week shall be analyzed for the principal gamma-emitting radionuclides.

TABLE 2.4-1 Notes (cont.)

(b) A composite sample is one in which the quantity of liquid sampled is proportional to the quantity of liquid waste discharged.

(c) Applicable only during periods when blowdown is being released.

(d) To be representative of the average quantities and concentrations of radioactive materials in liquid effluents, samples should be collected in proportion to the rate of flow of the effluent stream. Prior to analyses, all samples taken for the composite should be thoroughly mixed in order for the composite sample to be representative of the average effluent release.

If the above conditions are not met, no release from a liquid waste tank shall be made and any release in progress shall be terminated.

d. During periods of steam generator blowdown release:

1) The steam generator liquid sample monitor (RE-19), the blowdown liquid effluent monitor (RE-23), and the blowdown gaseous effluent monitor (RE-27) shall be operable. The output recorder shall be in service, or the monitor output trend(s) shall be determined by means of the plant computer and either recorded continuously or printed at intervals not to exceed 1 hour.

2) Any one of the above monitors may be out of service for a period up to 72 hours.

3) The effluent flourate shall be recorded during periods of release.

If the above conditions are not satisfied, blowdown release shall be terminated. See also Specification 2.4.1.e.

e. The effluent monitors shall be checked, tested, and calibrated in accordance with Table 2.4-2. Calibrations may be based on appropriate radioactive standards or on comparison of monitor readings with the results of analyses for specific radionuclides in grab samples from the release path.

Bases for Liquid Waste Effluents

The release of radioactive materials in liquid waste effluents to unrestricted areas shall not exceed the concentration limits specified in 10 CFR Part 20 and should be as low as practicable

TABLE 2.4-2

RADIOACTIVE EFFLUENT MONITOR SURVEILLANCE REQUIREMENTS

CHANNEL	CHANNEL CHECK	FUNCTIONAL TEST	CALIBRATION
1. Waste system discharge liquid monitor (RE-18)	Prior to each release	M	R
2. Steam generator liquid effluent monitor (RE-19)	D	M	R
3. Blowdown liquid effluent monitor (RE-23)	D (1)	M	R
4. Blowdown gaseous effluent monitor (RE-27)	D (1)	M	R
5. Gas decay tank discharge gas monitor (RE-22)	Prior to each release	M	R
6. Plant vent gas monitor (RE-14)	D	M	R
7. Plant vent air particulate monitor (RE-23)	D	M	R
8. Containment air particulate monitor (RE-11)	D	M	R
9. Containment radiogas monitor (RE-12)	D	M	R

(1) During periods of blowdown effluent release.

in accordance with the requirements of 10 CFR Part 50.36a. These specifications provide reasonable assurance that the resulting annual dose to the total body or any organ of an individual in an unrestricted area will not exceed 5 mrem. At the same time, these specifications permit the flexibility of operation, compatible with considerations of health and safety, to assure that the public is provided a dependable source of power under unusual operating conditions which may temporarily result in releases higher than the design objective levels but still within the concentration limits specified in 10 CFR Part 20. It is expected that by using this operational flexibility under unusual operating conditions, and exerting every effort to keep levels of radioactive material in liquid wastes as low as practicable, the annual releases will not exceed a small fraction of the concentration limits specified in 10 CFR Part 20.

The design objectives have been developed based on operating experience taking into account a combination of variables including defective fuel, primary system leakage, primary to secondary system leakage, steam generator blowdown and the performance of the various waste treatment systems, and are consistent with Appendix I to 10 CFR Part 50.

Specification 2.4.1.a requires the licensee to limit the concentration of radioactive materials in liquid waste effluents released from the site to levels specified in 10 CFR Part 20, Appendix B, Table II, Column 2, for unrestricted areas. This specification provides assurance that no member of the general public will be exposed to liquid containing radioactive materials in excess of limits considered permissible under the Commission's Rules and Regulations.

Specifications 2.4.1.b and 2.4.1.c establish the upper limits for the release of radioactive materials in liquid effluents. The intent of these Specifications is to permit the licensee the flexibility of operation to ensure that the public is provided a dependable source of power under unusual operating conditions which may temporarily result in releases higher than the levels normally achievable when the plant and the liquid waste treatment systems are functioning as designed. Releases up to these levels will result in concentrations of radioactive material in liquid waste effluents at small percentages of the limits specified in 10 CFR Part 20.

Specifications 2.4.1.d and 2.4.1.e require that suitable equipment to control and monitor the releases of radioactive materials in liquid wastes are operating during any period these releases are taking place consistent with the requirements of 10 CFR Part 50, Appendix A, Design Criterion 64.

Specification 2.4.1.f assures that releases (both gaseous and liquid) from the blowdown system are maintained at a small fraction of the design objectives.

Specification 2.4.1.g is intended to provide additional assurance that liquid waste management practices are conducted in a manner which maintains releases as low as practicable. If the release in any quarter exceeds 50% of the design objective, an investigation will be conducted to determine what measures can be taken to reduce the releases, and an appropriate program will be instituted. This specification is in agreement with the guides for Limiting Conditions for Operation contained in Appendix I to 10 CFR Part 50.

In "working paper" Regulatory Guide 4.X, the Commission has suggested a specification which states: "The equipment installed in the liquid radioactive waste system shall be maintained and shall be operated to process radioactive liquid wastes prior to their discharge when the projected cumulative release could exceed 1.25 Ci/reactor/calendar quarter, excluding tritium and dissolved gases." This specification has been omitted on the grounds that it is ambiguous and unnecessary.

Specifically, such a specification overlooks the fact that there are varying degrees of treatment, and also that the degree of treatment should be a function of the contained radioactivity. It is possible, for example, to collect a tank of virtually pure, uncontaminated water in the liquid radwaste system. If interpreted literally, this specification would require that such a batch be processed through the waste evaporator, an exercise which is not only technically pointless, but also operationally unsound in that it reduces the time the evaporator is available for use on batches which may require such treatment. The intent of the specification, that releases be minimized by appropriate use of the available equipment as required by 50.36a of 10CFR Part 50, is adequately covered by the requirements of Specification 2.4.1.f. It should be noted that the suggested specification is not contained in proposed Appendix I to 10 CFR Part. 50.

In Regulatory Guide 4.X, the Commission has also suggested a specification which states: "The maximum radioactivity to be contained in any liquid radwaste tank that can be discharged directly to the environs shall not exceed 10 Ci, excluding tritium and dissolved gases." The basis for this specification is that it "limits the amount of radioactive material that could be inadvertently released to the environment to an amount that will not exceed the Technical Specification limit." This specification has been omitted for a variety of reasons, including:

a. Since it is possible to release the contents of any radwaste tank at Diablo Canyon to the environment, albeit through a filter and past the process monitor, this specification would prevent the collection of more than 10 Ci in any radwaste tank. Not only does this contradict the design estimates contained in Section 11.2 of the FSAR,[1] but it could lead to a potential safety problem in the event that a high level waste is generated for any reason. If this occurs, the waste will evidently have to be contained somewhere

---

1 Where, under the "anticipated operational occurrences" case, the floor drain waste activity level is 0.4 μCi/cc, which corresponds to 23 Ci in a full 15,000 gallon floor drain receiver tank.

other than the radwaste tanks (in order to avoid violation of the specification), thereby preventing the use of a facility that has been specifically designed, in terms of shielding, monitors, and interlocks, to handle such waste.

b. The specification does not satisfy its basis, inasmuch as the inadvertent release could take place when prior planned releases were only slightly below the allowable values.

c. There are numerous postulated accidents and malfunctions which could release activity in excess of the "low as practicable" guidelines. Basically, the "low as practicable" guidelines are appropriate for planned releases. Different criteria, such as the guidelines of 10 CFR Part 100, are applicable to releases resulting from accidents and malfunctions.

d. There is no such specification contained in the guidelines for Limiting Conditions for Operation contained in Appendix I to 10 CFR Part 50.

The sampling and monitoring requirements given under Specification 2.4.2 provide assurance that radioactive materials in liquid wastes are properly controlled and monitored in conformance with the requirements of Design Criteria 60 and 64. These requirements provide the data for the licensee and the Commission to evaluate the plant's performance relative to radioactive liquid wastes released to the environment. Reports on the quantities of radioactive materials released in liquid waste effluents are furnished to the Commission according to Section 5.6.1 of these Technical Specifications. On the basis of such reports and any additional information available to it, the Commission may from time to time require the licensee to take such action as the Commission deems appropriate.

The liquid waste sampling and analysis program contained in Table 2.4-1 is based upon, and consistent with, the recommendations of Regulatory Guide 1.21, Revision 1. However, the specification does not include the recommended sensitivity values contained in the Regulatory Guide. The reason for this is that it is not always possible to achieve the guideline sensitivities when mixtures of radionuclides are present in a stream (as the Regulatory Guide acknowledges). Therefore, it is believed that such numbers are inappropriate for inclusion as Limiting Conditions for Operation. At the same time, it is recognized that the Commission must have assurance that the analyses are performed in a manner which will provide sensitivities consistent with the potential significance in the environment of the quantities of radioactive materials released. However, it is felt that this assurance is provided by the following:

a. The types of counting room instrumentation provided for Diablo Canyon have been specified in Section 12.4 of the FSAR.

b. The written analytical procedures have been reviewed by the Commission.

c. The capabilities of the counting room are periodically verified through the analysis of unknown samples submitted to the plant by the Commission.

Specifications 2.4.2.c and 2.4.2.d provide for continuous monitoring of plant effluents. Specification 2.4.2.e ensures that the monitors are appropriately checked, tested, and calibrated. Calibrations will normally be performed by comparison of monitor readings with the results of analyses performed on grab samples from the effluent stream itself, assuming activity levels are high enough to permit a meaningful calibration by this technique. In such a case, this technique is the preferred one in that it most accurately reflects the response of the instrument under actual operating conditions. This technique is also consistent with the recommendations of Regulatory Guide 1.21, Revision 1, which states:

"Frequent comparisons should be made between gross radioactivity measurements of continuous monitors and analyses of specific radionuclides. These comparisons should be the bases for calibrating continuous monitors to establish relationships between monitor readings and concentrations or release rates of radionuclides in continuous effluent releases."

If activity levels are very low, it is generally preferable to use special calibration sources so that the monitor response is checked at a reasonable point in its range.

Specifications for Gaseous Waste Effluents

2.4.3 Gaseous Waste Effluents

a. 1) The release rate limit of noble gases from the site shall be:

$$\sum_i Q_{iv} \; [\_\_\_\_ \; \bar{E}_{i\gamma} + \_\_\_\_ \; \bar{E}_{i\beta}] \leq 1$$

where:

Q_v = release rate from all roof and unit vents in Ci/sec

i = the ith individual nuclide.

$\bar{E}_{i\gamma}$ = the average gamma energy per disintegration for nuclide i

$\bar{E}_{i\beta}$ = the average beta energy per disintegration for nuclide i

Refer to Table 2.4-3 for $\bar{E}_{\gamma}$ and $\bar{E}_{\beta}$ values to be used.

2) The release rate limit of all radioiodines and radioactive materials in particulate form with half-lives greater than eight days, released to the environs as part of the gaseous wastes from the site, shall be:

$$\_\_\_\_ Q_v \leq 1$$

where Q_v is as defined above.

b. 1) The average release rate of noble gases from the site during any calendar quarter shall be:

$$\sum_i \bar{E}_{i\beta} \; [\_\_\_\_ \; Q_{iv}] \leq 1$$

and,

$$\sum_i \bar{E}_{i\gamma} \; [\_\_\_\_ \; Q_{iv}] \leq 1$$

2) The average release rate of noble gases from the site during any 12 consecutive months shall be:

$$\sum_i \bar{E}_{i\beta} \; [\_\_\_\_ \; Q_{iv}] \leq 1$$

TABLE 2.4-3

AVERAGE ENERGY PER DISINTEGRATION

Isotope	$\bar{E}\gamma$ (MeV/dis)	(Ref)	$\bar{E}\beta$ (MeV/dis)	(Ref)
Kr-83m	0.00248	(a)	0.0371	(a)
Kr-85	0.0022	(a)	0.250	(a)
Kr-85m	0.159	(a)	0.253	(a)
Kr-87	0.793	(a)	1.32	(a)
Kr-88	1.95	(a)	0.377	(a)
Kr-89	2.22	(b)	1.37	(b)
Kr-90	2.10	(b)	1.01	(b)
Xe-131m	0.0201	(a)	0.143	(a)
Xe-133	0.0454	(a)	0.135	(a)
Xe-133m	0.042	(a)	0.19	(a)
Xe-135	0.247	(a)	0.317	(a)
Xe-137	0.194	(a)	1.64	(a)
Xe-138	1.18	(a)	0.611	(a)

NOTES:

(a) ORNL-4923, Radioactive Atoms-Supplement I, M.S. Martin, November, 1973

(b) NEDO-12037, "Summary of Gamma and Beta Emitters and Intensity Data," M.E. Meek, R.S. Gilbert, January, 1970. (The average β energy was not computed using the 1/3 value assumption as used in this reference. It was computed from the maximum energy using the equation in the Report of Committee II on Permissible Dose for Internal Radiation (1959), 1CRP Publication 2, Pergamon Press, 1960).

(c) The average β energy includes conversion electrons.

and, $\sum_i \bar{E}_{i\gamma} [\_\_\_\_ Q_{iv}] \leq 1$

3) The average release rate of all iodines and radioactive materials in particulate form per site with half-lives greater than eight days during any calendar quarter shall be:

$$\_\_\_\_ Q_v \leq 1$$

4) The average release rate of all iodines and radioactive materials per site in particulate form with half-lives greater than eight days during any period of 12 consecutive months shall be:

$$\_\_\_\_ Q_v \leq 1$$

5) The amount of iodine-131 released during any calendar quarter shall not exceed 2 Ci/reactor.

6) The amount of iodine-131 released during any period of 12 consecutive months shall not exceed 4 Ci/reactor.

c. Should any of the conditions of 2.4.3.c. (1), (2), or (3) exist, the licensee shall make an investigation to identify the causes of the release rates, define and initiate a program of action to reduce the release rates to design objective levels listed in Section 2.4, and report these actions to the Commission within 30 days from the end of the quarter during which the releases occurred.

1) If the average release rate of noble gases from the site during any calendar quarter is:

$$\sum_i \bar{E}_{i\beta} [\_\_\_\_ Q_{iv}] > 1$$

or, $\sum_i \bar{E}_{i\gamma} [\_\_\_\_ Q_{iv}] > 1$

2) If the average release rate of all iodines and radioactive materials in particulate form per site with half-lives greater than eight days during any calendar quarter is:

$$\_\_\_\_ Q_v > 1$$

3) If the amount of iodine-131 released during any calendar quarter is greater than 0.5 Ci/reactor.

d. During the release of gaseous wastes from the gas decay tanks, the gas decay tank discharge gas monitor (RE-22) shall be operable and set to alarm and to initiate the automatic closure of the automatic waste gas discharge valve (RCV-17) prior to exceeding the limit specified in 2.4.3.a(1) above. The operability of the automatic waste gas discharge valve (RCV-17) shall be demonstrated monthly.

e. During containment purging, either the containment air particulate montior (RE-11) or the containment radiogas monitor (RE-12) shall be operable and set to alarm and to initiate the automatic closure of the containment purge supply valves (FVC-660, 661) and exhaust valves (RCV-11, 12) prior to exceeding the limit specified in 2.4.3.a(1) above. The operability of the automatic containment purge valves shall be demonstrated monthly.

2.4.4 <u>Gaseous Waste Sampling and Monitoring</u>

a. Plant records shall be maintained and reports of the sampling and analyses results shall be submitted in accordance with Section 5.6.1 of these specifications.

b. Sampling and analysis of radioactive material in gaseous waste, particulate form, and radioiodine shall be performed in accordance with Table 2.4-4.

c. During the release of batches from the gas decay tanks:

1) The gas decay tank discharge gas monitor (RE-22) shall be operable (see also Specification 2.4.3.d).

2) A plant vent gas monitor (RE-14A or RE-14B) shall be operable.

3) A plant vent air particulate monitor (RE-23A or RE-23B) shall be operable.

4) The plant vent particulate and iodine sample collection system shall be operable.

5) The output recorder for the specified monitors (RE-14, 22, 23) shall be operable, or the monitor output(s) shall be trended on the plant computer and either recorded continuously or printed at intervals not to exceed 5 minutes.

6) The plant vent flow rate shall be continuously monitored and recorded.

If the above conditions are not met, no release from the gas decay tanks shall be made and any release in progress shall be terminated.

d. During containment purging:

1) The containment air particulate monitor (RE-11) or the containment radiogas monitor (RE-12) shall be operable (see also Specification 2.4.3.e).

TABLE 2.4-4

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS

	GASEOUS SOURCE	SAMPLING FREQUENCY	TYPE OF ACTIVITY ANALYSIS
A.	Waste Gas Decay Tank Releases	Each Tank	Principal Gamma Emitters, Tritium
B.	Containment Purge Releases	Each Purge (a)	Principal Gamma Emitters, Tritium
C.	Plant Vent	Weekly (Gas Sample) (b) (c)	Principal Gamma Emitters (d)
		Weekly (Particulate Sample) (b)	Principal Gamma Emitters (d)
		Weekly (Charcoal Sample) (b)	Iodine-131
		Monthly (Charcoal Sample)	Iodine-133, Iodine-135
		Monthly (Condensed Moisture)	Tritium
		Monthly Composite (Particulates) (e)	Gross Alpha
		Quarterly Composite (Particulates) (e)	Stontium-89, Strontium-90

NOTES:

(a) During periods when containment purging is being conducted continuously for extended periods, analysis for principal gamma emitters shall be made weekly (subject to provisions of notes (c) and (f) below) and tritium measurements shall be made monthly.

TABLE 2.4-4 Notes (Cont.)

(b) The initial sample shall be obtained within one month of the date of initial criticality, and weekly thereafter.

(c) In addition, radionuclide analysis should be performed when continuous monitoring shows an unexplained variance from an established norm which may be indicative of a change in the concentration and composition.

(d) At least Ba-La-140 and I-131. When quantities of released radioactive materials are at low levels, precluding accurate measurement of principal radionuclides, gross beta measurements may be performed as a basis for estimating the quantity of radioactive material released during the week.

(e) To be representative of the average quantities and concentrations of radioactive materials in particulate form released in gaseous effluents, samples should be collected in proportion to the rate of flow of the effluent stream.

(f) When quantities of released radioactive materials are at low levels, precluding accurate measurement of principal radionuclides, gross gamma measurements may be performed as a basis for estimating the quantity of radioactive material released during the week.

2) A plant vent gas monitor (RE-14A or RE-14B) shall be operable.

3) A plant vent air particulate monitor (RE-23A or RE-23B) shall be operable.

4) The plant vent particulate and iodine sample collection system shall be operable.

5) The output recorder for the specified monitors (RE-11, 12, 14A, 14B, 23A, 23B) shall be operable, or the monitor output(s) shall be trended on the plant computer and either recorded continuously or printed at intervals not to exceed 5 minutes.

6) The plant vent flow rate shall be continuously monitored and recorded.

If the above conditions are not met, containment purging shall be terminated.

e. The following requirements for plant vent monitoring are applicable during all modes of Unit operation:

1) A plant vent gas monitor (RE-14A or RE-14B) shall be operable.

2) A plant vent air particulate monitor (RE-23A or RE-23B) shall be operable.

3) If Specifications 2.4.4.e(1) and (2) cannot be met, gas decay tank releases, containment purging, and operations which could result in damage to irradiated fuel in the fuel handling building shall be terminated on the affected unit. In addition, the plant vent shall be sampled daily and analyzed for gross radioactivity.

4) The output recorder for the required monitors (RE-14A, 14B, 23A, or 23B) shall be operable. The output recorder may be out of service for a maximum of 16 hours. If the recorder is not restored to service within this period, the monitor output(s) shall be trended on the plant computer and either recorded continuously or printed at intervals not to exceed 5 minutes.

5) The plant vent flow rate shall be continuously measured and recorded. If this cannot be met, gas decay tank and containment purge releases shall be terminated in accordance with Specifications 2.4.4.c.(6). If the instrument is not restored to service within 7 days, operations in the fuel handling area which could result in damage to the irradiated fuel shall be terminated.

f. The effluent monitors shall be checked, tested, and calibrated in accordance with Table 2.4-2. Calibrations may be based upon appropriate radioactive standards, or upon comparison of monitor readings with the results of analyses of grab samples from the release path.

Bases for Gaseous Waste Effluents

The release of radioactive materials in gaseous waste effluents to unrestricted areas shall not exceed the concentration limits specified in 10 CFR Part 20, and shall be in accordance with the requirements of 10 CFR Part 50.36A.

These specifications provide reasonable assurance that the resulting annual air dose from the site due to gamma radiation will not exceed 10 mrad, and an annual air dose from the site due to beta radiation will not exceed 20 mrad from noble gases, and that the annual dose to any organ of an individual from iodines and particulates will not exceed 15 mrem per site. At the same time, these specifications permit the flexibility of operation, compatible with considerations of health and safety, to ensure that the public is provided with a dependable source of power under unusual operating conditions which may temporarily result in releases higher than the design objective levels but still within the concentration limits specified in 10 CFR Part 20. It is expected that using this operational flexibility under unusual operating conditions, and by exerting reasonable efforts to keep levels of radioactive material in gaseous waste effluents as low as practicable, the annual releases will not exceed a small fraction of the concentration limits specified in 10 CFR Part 20. These efforts should include consideration of meteorological conditions during releases.

The design objectives have been developed based on operating experience taking into account a combination of system variables including defective fuel, primary system leakage, primary to secondary system leakage, steam generator blowdown, and the performance of the various waste treatment systems.

A continuous release rate of gross radioactivity per site in the amount specified in 2.4.3.a.(1) will not result in offsite annual doses above background in excess of the limits specified in 10 CFR Part 20. The specification is based upon an annual dose of 500 mrad in the critical sector. The dose calculations consider site meteorology, buoyancy characteristics, and radionuclide content of the effluent of each unit. Meteorological calculations for offsite locations were performed, and the most critical one was selected to set the release rate. The controlling distance is ______ meters to the ______. The releases were considered to be ground level releases. The beta dose contribution was determined using Equation 7.21, as described in Section 7-4.1 of Meteorology and Atomic Energy - 1968. The beta dose contribution was determined on the basis of an infinite cloud passage with semi-infinite geometry for a ground level release (submersion dose). The applicable annual average X/Q is ______ sec/m^3. The gamma dose contribution was determined using Equation 7.63 in Section 7-5.2.5 of Meteorology and Atomic Energy - 1968. The beta and gamma components of the gross radioactivity in gaseous effluents were combined to determine the allowable continuous release rate.

The average gamma and beta energy per disintegration used in the equation of Specification 2.4.3.a(1) will be based on the average composition of gases determined from the plant vent and ventilation exhausts. The average energy per beta or gamma disintegration for those radioisotopes determined to be present from the isotopic analyses is given in Table 2.4-3. Where isotopes are identified that are not listed in Table 2.4-3, the gamma energies are determined from Table of Isotopes, C.M. Lederer, J.M. Hollander, and I. Perlman, Sixth Edition, 1967, and the beta energies shall be as given in USNRDL-TR-802, II, Spectra of Individual Negatron Emitters (Beta Spectra), O. Hogan, P.E. Zigman, and J.L. Mackin.

For Specification 2.4.3.a(2), dose calculations have been made for the critical sectors and critical pathways for all radioiodines and radioactive material in particulate form, with half-lives greater than eight days. The calculations consider site meteorology for these releases, with credit for building wake. The grass-cow-milk-child thyroid chain is controlling. The nearest milk cow is located in the E sector at a distance of 15,000 meters. The applicable χ/Q at the nearest milk cow is ______ sec/m^3.

There is a reconcentration factor of 243 by which the maximum permissible concentration of radioactive iodine in air should be reduced to allow for the grass-cow-milk pathway. This factor has been derived for radioactive iodine, taking into account the milk pathway. It has been applied to radionuclides of iodine and to all radionuclides in particulate form with a half-life greater than eight days. The factor is not appropriate for iodine where milk is not a pathway of exposure or for the other radionuclides. A grazing factor of 1.0 was also applied.

Specifications 2.4.3.b(1),(2),(3), and(4) establish maximum site release rates such that continuous releases in the amounts specified will not result in offsite doses above background in excess of twice the design objective annual doses during any calendar quarter, or four times the design objective annual quantity during any period of 12 consecutive months. Similarly, Specification 2.4.3.b(5) and(6) limit the iodine-131 release in any calendar quarter to twice the design annual objective and the release during any period of 12 consecutive months to 4 times the design annual objective. The intent of these specifications is to permit the licensee the flexibility of operation to ensure that the public is provided a dependable source of power under unusual operating conditions which may temporarily result in higher releases than the objectives.

In addition to the limiting conditions for operation of Specifications 2.4.3.a and 2.4.3.b, the reporting requirements of 2.4.3.c delineate that the licensee identify the cause whenever the release of gaseous effluents exceeds one-half the design objective annual quantity during any calendar quarter and describe the proposed program of action to reduce such release rates to the design objectives.

Specifications 2.4.3.d and 2.4.3.e require that suitable equipment to monitor and control gaseous releases from the gas decay tanks or the containment purge system are operating during any period these releases are taking place.

In Regulatory Guide 4.X, the Commission has suggested a specification which places a limit on the activity which can be contained in a gas decay tank in order to limit "the maximum offsite dose above background to below the limits of 10 CFR Part 20, postulating that the rupture of a waste gas storage tank holding the maximum activity releases all of the contents to the atmosphere." As with a similar specification on liquid waste collection tanks, this specification has been omitted on the grounds that:

a. Such a specification could preclude the use of the gas decay tanks as a storage location in the unlikely event that high activity gaseous wastes were generated by some means.
b. The appropriate dose criteria for postulated major accidents are the guidelines of 10 CFR Part 100 rather than the limits of 10 CFR Part 20.

The sampling and monitoring requirements given under Specification 2.4.4 provide assurance that radioactive materials released in gaseous waste effluents are properly controlled and monitored in conformance with the requirements of Design

Criteria 60 and 64. These requirements provide the data for the licensee and the Commission to evaluate the plant's performance relative to radioactive waste effluents released to the environment. Reports on the quantities of radioactive materials released in gaseous effluents are furnished to the Commission on the basis of Section 5.6.1 of these Technical Specifications and in conformance with Regulatory Guide 1.21, Revision 1. On the basis of such reports and any additional information the Commission may obtain from the licensee or others, the Commission may from time to time require the licensee to take such action as the Commission deems appropriate.

The sampling and analysis program contained in a Specification 2.4.4.b is based upon, and consistent with, the recommendations of Regulatory Guide 1.21, Revision 1. As with the corresponding specification for liquid effluents, the sensitivity values have been omitted.

The blowdown tank vent is not a path for significant releases unless there is steam generator tube leakage. Therefore, the required sampling program is keyed to the presense of activity in the blowdown liquid. The activity level at which the sampling program must be implemented is established at a value which would result in gaseous releases of about 1% of the design objectives.

2.4.5 Specifications for Solid Waste Handling and Disposal

Objective

To ensure compliance with applicable regulations regarding solid waste handling and disposal.

Specifications

a. Measurements shall be made to determine or estimate the total curie quantity and principal radionuclide composition of all radioactive solid waste shipped offsite.

b. Solid wastes in storage and preparatory to shipment shall be monitored and packaged to ensure compliance with 10 CFR Part 20, 10 CFR Part 71, and 40 CFR Parts 171-178.

c. Reports of the radioactive solid waste shipments, volumes, principal radionuclides, and total curie quantity shall be submitted in accordance with Section 5.6.1.

Basis

The requirements for solid radioactive waste handling and disposal specified under Section 2.4.5 provide assurance that solid radioactive materials stored at the plant and shipped offsite are packaged in conformance with 10 CFR Part 20, 10 CFR Part 71, and 49 CFR Parts 171-178. These requirements provide the data for the licensee and the Commission to evaluate the handling and storage facilities for solid radwaste, and to evaluate the environmental impact of offsite shipment and storage. Reports on the quantities, principal isotopes and volumes of the shipments are furnished to the Commission according to Section 5.6.1 of these Technical Specifications. On the basis of such reports and any additional information the Commission may obtain from the licensee or others, the Commission may from time to time require the licensee to take such action as the Commission deems appropriate.

SECTION 3.0

ENVIRONMENTAL SURVEILLANCE

The purpose of the environmental surveillance program is to determine the extent to which plant operation may cause changes in the ecosystem. Surveillance is comprehensive enough to cover all elements of the ecosystem that could, on the basis of reasonable expectations, be affected by plant operation.

The program is specified in such a manner that, if operating experience and surveillance data show no significant detriment to the ecosystem, the relevant portions of the program may be terminated by the Company. This provision would make it unnecessary to modify the environmental technical specifications in every such instance.

3.1 NONRADIOLOGICAL SURVEILLANCE

The nonradiological surveillance program is designed to detect and measure the nonradiological impact of plant operation on environmental systems that (1) are potentially subject to alteration by plant operation and (2) are significant to the quality of animal (including human) and plant life in the environs of the Diablo Canyon Nuclear Power Plant.

Biota to be surveyed are generally those defined in Section 2.7 of Regulatory Guide 4.2 (USAEC Regulatory Guide Series, March 1973) as "important species."

3.1.1 Abiotic

a. Aquatic

(1) Water Quality Surveys

Objective

Identify and define potential abiotic problems in water quality adversely affecting the aquatic ecosystem; then solve the problems before significant harm occurs.

Specification

Water quality sampling shall be performed regularly at depths and geographical locations specified in the California State Regional Water Quality Control Board Waste Discharge Requirements under "National Pollution Discharge Elimination Systems." The California Department of Fish and Game will designate the sampling points. Temperature, pH, and dissolved oxygen content shall be determined from the samples.

Reporting Requirement

Any incident causing a monitored parameter to attain a level detrimental to human, plant, bird, or fish life shall be reported. Its cause, effect, and corrective action shall be described in detail in the next regular report submitted to the California Regional Water Quality Control Board.

Bases

Section 6.3 of the Final Environmental Statement requires the Company to monitor the thermal and chemical effluents from the plant operation and their impact on the receiving waters. The same section also specifies the reporting requirements as above.

(2) Surface Temperature of Receiving Waters

Objective

Determine the extent of the thermal effluent on the receiving waters.

Specification

Surface water temperatures shall be measured at two-month intervals from Pt. Buchon to Pecho Rock. Airborne infrared techniques shall be used for these measurements. Surface grab samples shall be obtained to complement the airborne measurements. Isotherms shall be determined in $2^{\circ}F$ intervals. These measurements shall be made six times a year, following operational startup, for a period of two years. All measurements shall be made at comparable stages of the tidal cycle. Additionally, measurements of temperature versus depth at 1-meter intervals from surface to bottom shall be made in February, June, and October.

Reporting Requirement

At the end of this two-year survey period, the results shall be evaluated by the Company, and a report with appropriate recommendations as to the future of the program shall be submitted to the Directorate of Licensing for consideration.

Bases

Section 6.3 of the Final Environmental Statement requires sampling of surface temperature as specified above.

3.1.2 Biotic

a. Aquatic

(1) General Ecological Survey

Objective

Determine the effects of plant operation on the planktonic, nektonic, and benthos populations of the receiving waters. Specific features of this effort are listed in Table 3.1-1. The table also shows the section that describes each feature.

Specification

The effects of plant operation shall be ascertained by comparing, during this operation, selected ecological parameters of the study populations with the same parameters determined in the Pre-Operational Baseline Survey. The General Ecological Survey shall be undertaken for at least

TABLE 3.1-1. BIOTIC SURVEILLANCE AND SPECIAL RESEARCH AND STUDY ACTIVITIES PLANNED FOR DIABLO CANYON POWER PLANT

Parameter	Responsible Agency	Described in Section No.
1. General Ecological Survey (Aquatic)		
Phytoplankton	PG&E	4.5
Zooplankton	PG&E	4.5
Macrophytes		
Intertidal	CDF&G and PG&E	3.1.2a (1) §1 and 4.4
Subtidal	CDF&G and PG&E	3.1.2a (1) §2 and 4.4
Aerial Surveys	PG&E	3.1.2a (1) §3
Invertebrates		
Intertidal	CDF&G and PG&E	3.1.2a (1) §4
Subtidal	CDF&G and PG&E	3.1.2a (1) §5
Fish		
Eggs, Larvae, and Juveniles	PG&E	4.5
Adults	CDF&G and PG&E	3.1.2a (1) §7
2. Impingement of Organisms	PG&E	3.1.2a (2)
3. Entrainment of Organisms Through Condenser	PG&E	4.6
4. Onsite Chlorination Studies	PG&E	4.7
5. Heavy Metals Study	PG&E	4.3
6. Abalone Life History Studies	CDF&G and PG&E	4.8

two years after the plant becomes operational. Figure 3.1-1 shows the locations of the permanent sampling stations. Specifications for the individual sections of the survey are as follows:

1. <u>Macrophytes - Intertidal Surveys</u>

   For a period of two years, surveys of marine algae and vascular plants shall be made at least once during each of two oceanographic seasons: the Davidson Period (typically November-February), and Upwelling (typically March-July). The macrophytes sampled shall include soft red, green, and brown algae, articulated corallines, and surf grass (*Phyllospadix*). Samplings shall be made at a total of 23 random stations in Diablo Cove and 9 random stations in the control area north of the cove. Each station shall have a 2 m by 30 m parallel-to-shoreline transect randomly located within the station, and samplings shall be made on four 1/4 m^2 quadrats randomly located on each transect.

   Each survey shall make the following determinations. For brown algae, organisms down to 10 mm in size will be identified, counted, and measured, but not collected. For soft reds and greens, organisms will be collected for biomass determinations (dry weight). For articulated corallines and surf grass, the percentage cover within each quadrat will be estimated.

2. Macrophytes - Subtidal Surveys

Five permanent subtidal stations (nos. 9 through 12 and 16 on Figure 3.1-1) have been established in Diablo Cove at depths of 10, 20, 35, 50, and 70 ft. Four permanent control stations (nos. 6, 7, 8, and 15) were established outside the cove - three to the north and one to the south - during the Pre-Operational Baseline Survey by the California Department of Fish and Game (CDF&G).[1] Transects of 30 m by 2 m at each station shall be surveyed by SCUBA divers three times a year, once during each oceanographic season, for a period of two years. The species composition and relative abundance of red and brown algae shall be determined in each transect. Actual counts of organisms down to 10 mm in size shall be made for four species of large brown algae.

Surveys shall also be made once a year, during summer, for a period of two years at each of 24 random stations in Diablo Cove and 24 random stations in the control area. Samplings shall be made in three depth strata and on 30 m^2 arc transects inscribed with 3.1 m radius

[1]Numbered references appear at the end of Section 3.0.

lines. Each survey shall make the following determinations. For the four species of large brown algae, organisms down to 10 mm in size will be counted in each transect but not collected. For the brown algae, species composition and relative abundance in each transect will be determined. For the red algae, organisms from a representative 1/4 m^2 quadrat within each transect will be collected for biomass determination (dry weight).

3. Macrophytes - Aerial Surveys

The distribution of bull kelp (*N. leutkeana)* shall be mapped three times a year between Pt. Buchon and Pt. San Luis, a distance of 13 miles, by aerial photography with infrared color film (Ektachrome Type 2443). The color transparencies, 9 inches by 9 inches in size, provide a ground coverage of 6,750 ft at a scale of 1 inch = 750 ft. The distribution of kelp beds following the start of plant operation shall be compared to that shown by the Pre-Operational Aerial Survey, which started in April 1971.

4. Invertebrates - Intertidal Surveys

Counts and measurements of red and black abalone shall be made three times a year for a period of two years at each of four permanent intertidal stations established in the Pre-Operational Baseline Survey by the CDF&G. Two of these stations (nos. 2 and 3 on Figure 3.1-1) are located inside Diablo Cove; another (no. 4) is located along the south point, and the fourth (no. 1) is a control station located about one mile north of the cove.

For a period of two years, counts and measurements of red and black abalone shall also be made at a number of random stations at least once during each Davidson Period and once during each Upwelling. These determinations shall be made at each of the randomly located transects and quadrats described in paragraph (1) Macrophytes-Intertidal Surveys. At the same number of stations, determinations shall also be made on randomly located perpendicular-to-shoreline transects measuring 2 m by X m, where the length, X, varies from station to station (average is 35 m) and depends on the slope of the substrate at the station. In addition, on each of the randomly located quadrats, all other macroinvertebrates encountered (down to 10 mm in size) shall be identified and counted and some shall also be measured.

5. <u>Invertebrates - Subtidal Surveys</u>

Actual counts of common macroinvertebrates (35 species) shall be made three times a year--once during each oceanographic season--for two years at the nine permanent subtidal transects described in paragraph (2) Macrophytes-Subtidal Surveys. The species composition and relative abundance of all other invertebrates shall be recorded.

These determinations shall also be made once a year, during summer, for two years at each of the random subtidal transects described in paragraph (2) Macrophytes--Subtidal Surveys.

6. Fish - Eggs, Larvae, and Juveniles

This survey activity is described in Section 4.5.

7. Fish - Adults

The relative abundance and size of bony fish in the intertidal zone shall be determined at irregular intervals for a period of two years. These determinations shall be made at randomly selected tidepools in both Diablo Cove and the control area north of the cove.

The relative abundance of bony fish in the subtidal survey region shall be determined three times a year--once during each oceanographic season--for a period of two years. These determinations shall be made at each of the nine permanent transects described in paragraph (2) Macrophytes-Subtidal Surveys. The same determinations shall also be made once a year, during summer, for a period of two years at each of the randomly located 30 m^2 arc transects described in paragraph (2) Macrophytes-Subtidal Surveys.

Reporting Requirement

Results of the General Ecological Survey shall be submitted as part of the Semiannual Operating Report. At the end of the second year, the results shall be analyzed, evaluated by the Company, and submitted in summarized form to the Directorate of Licensing. The report shall include proposed final values of the monitoring levels or appropriate substantiated recommendations to modify or discontinue parts of the monitoring program.

Bases

Section 6.2 of the Final Environmental Statement requires the Company to continue the biological monitoring program conducted by it and the California Department of Fish and Game. The General Ecological Survey, as specified, will characterize the distribution, in time and space, of the fish, plankton, and benthos populations in the vicinity of Diablo Cove. Results obtained from this study, together with those obtained in the entrainment and impingement studies, will provide enough data to evaluate the impact, if any, of the plant on the local aquatic ecology and to determine program modifications that should be implemented in future studies.

Determination of relative abundance for intertidal macrophytes will consist in qualitatively describing abundance using a set of strictly defined terms. These terms include abundant, common, sparse, and scattered. Sessile species of marine flora are particularly well-suited to this form of determination. Repetitive surveys using the same personnel are necessary if the techniques are to have value. Surveys will be made so as to correspond with the three distinctive oceanographic seasons occurring during the year along the coast of California. Each season is characterized by unique current regimes and associated physical and chemical parameters influencing marine life.

(2) Impingement of Organisms

Objective

Estimate the number and weight of fish impinged on the trash racks and the traveling screens in the intake structure during day and night in various seasons so that the significance of this fish mortality to the ecosystem may be determined and corrective measures taken if necessary.

Specifications

This study shall be undertaken for at least twelve months after the plant becomes operational. A survey shall determine species, numbers, lengths, and weights of all fish removed at the trash racks and traveling screens at six-hour intervals over a twenty-four hour period, once a week. In the event of large collections, representative subsampling for various parameters will be satisfactory.

Reporting Requirement

At the end of, the study undertaken for at least twelve months after plant operation begins, an evaluation report of the study, with appropriate substantiated recommendations, shall be submitted to the Directorate of Licensing. A summary of the progress and results of the study shall be included as part of the Semiannual Operating Reports. Proposed limiting conditions and report levels, based on the results of two years of fish impingement study, shall be established by the Company and submitted to the Directorate of Licensing for approval.

Bases

Section 6.2.2 of the Final Environmental Statement requires the Company to determine the magnitude of the fish kill at the cooling water intake. Data on the fish collected under the Fish Eggs, Larvae, and Juveniles Survey described in Section 4.5 will be used to estimate levels of fish abundance in the Diablo Canyon area. The intake fish-kill data will be analyzed for the significance of impact on the ecosystem in the light of fish abundance data.

(3) Entrainment of Organisms Through Condenser

This survey activity is described in Section 4.6.

(4) Onsite Chlorination Studies

This survey activity is described in Section 4.7.

(5) Heavy Metals Study

This survey activity is described in Section 4.3.

(6) Abalone Life History Studies

This survey activity is described in Section 4.8.

3.2 RADIOLOGICAL SURVEILLANCE

Objective

The environmental monitoring program specified below has several objectives. Its preoperational purpose was to provide baseline data on the background radioactivity in the marine and terrestrial environment of the Diablo Canyon plant. A second objective is to maintain a monitoring network, after reactor operation begins, that will provide data on radiation levels and any buildup of radioactivity in the environs of Diablo Canyon. A third objective is to provide backup environmental data needed to determine whether population exposures in the environment are within prescribed or expected limits.

Information obtained from the program may thus serve to verify that controls on the radioactive discharges from the plant are effective.

Specification

Generalized exposure pathways from internal and external radiation for both atmospheric and aquatic releases are shown in Figures 3.2-1 and 3.2-2, respectively. Based on the expected radiological releases from Units 1 and 2 of Diablo Canyon, as shown in Sections 11.2 and 11.3 of the FSAR and in the tabulated estimates of exposure, none of the releases is expected to increase significantly the total exposure to man relative to natural background. The calculations show that the principal

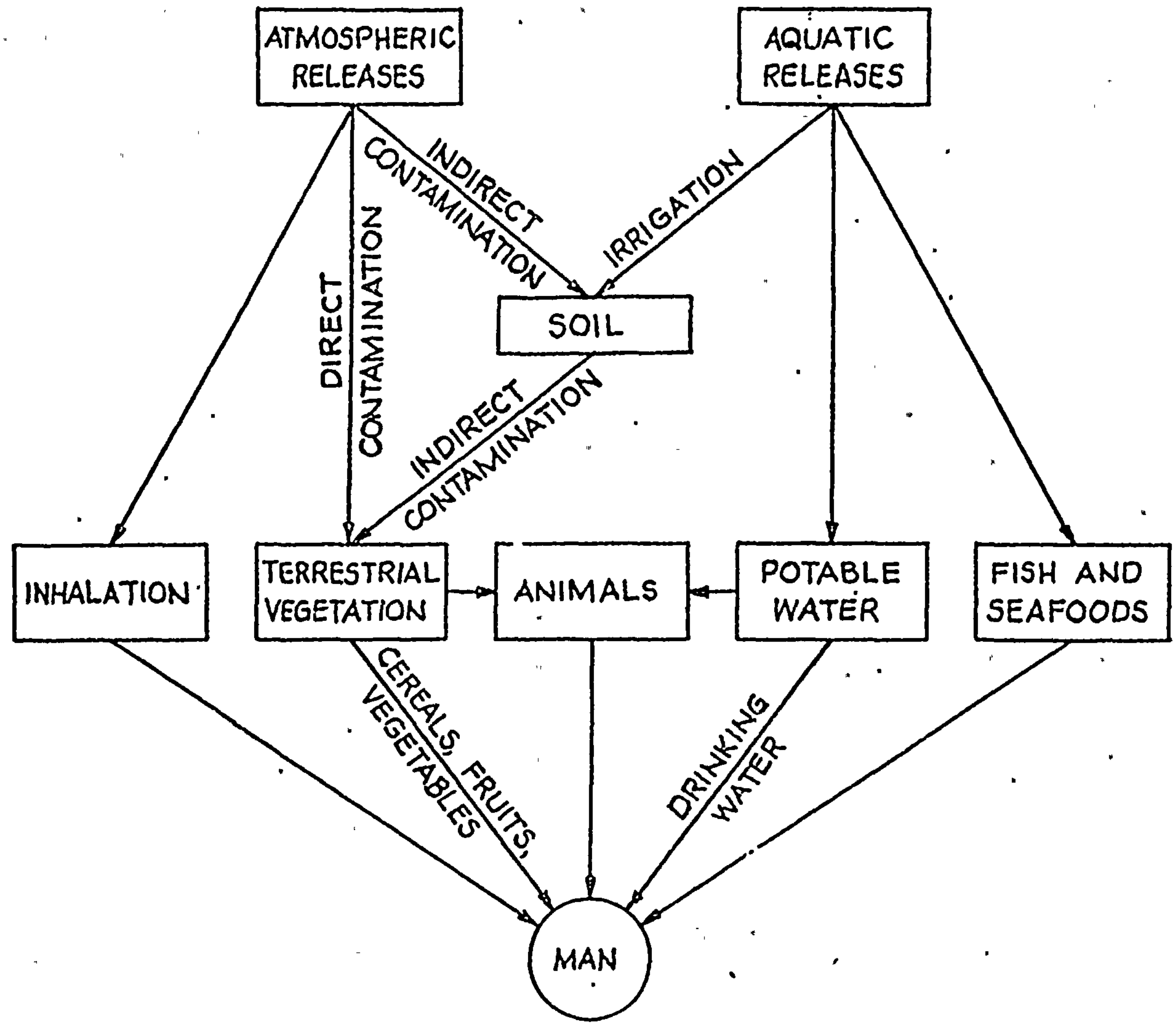


Fig. 3.2-1. Generalized internal radiation exposure pathways.

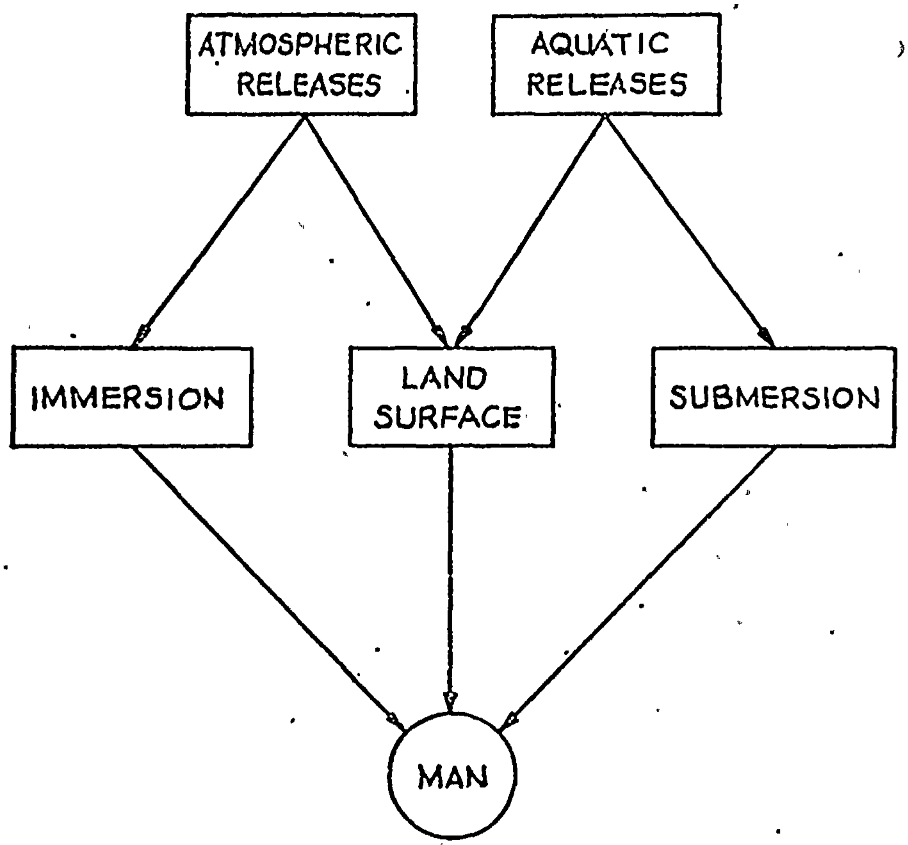


Figure 3.2-2. Generalized external radiation exposure pathways.

radiation-exposure pathways are atmospheric immersion, inhalation of atmospheric releases, and transport of atmospheric release through the grass-cow-milk-man terrestrial pathway. All doses through aquatic releases are expected to be negligible.

For airborne releases, the EMERALD-NORMAL Code[2] will be used with measured local meteorological data, measured release data of the gases and particulates, and local demographic data to estimate individual and population exposure. The probable exposure due to radioactive iodine through the grass-cow-milk pathway will be based on plant gaseous release data and local meteorology, and evaluated at the location of the nearest grade A dairies that allow their cattle to graze. When dairies use silage or stored feeds, exposure through this pathway is considered to be insignificant.

From the 18 gamma dosimeter stations for the direct radiation measurements, several will be chosen to serve as reference points for natural background and man-made environmental radiation that is not associated with plant operations. Consequently, direct radiation exposures above background can be obtained and compared to calculated exposures based on release data and meteorological models.

For radiological releases to the ocean, a dilution model that has been incorporated into the EMERALD-NORMAL Code will be used in conjunction with effluent and environmental monitoring data to estimate exposure from the consumption of aquatic foods grown

[2] Numbered references appear at the end of Section 3.

within the radiological influence of the plant. Annual data on the principal edible fish, crustacea, and mollusks, both sport and commercial, in the area will be obtained from the California Department of Fish and Game for Statistical Block 615, an area of approximately 62 square nautical miles. In addition, radiological reconcentration data for specific species in the vicinity of Diablo Cove have been determined by PG&E research studies. The results, which appear in Section 11.2 of the FSAR, have been supplemented by reconcentration factors compiled by the Lawrence Livermore Laboratory[3] when sufficient measured data were not available. Aquatic food intakes will be based on the best available estimates of per capita consumption of all fish in the United States.[4] Special consideration will be given to any population group that may have unusually high per capita consumption.

The radiological monitoring program shall be conducted as follows:

A. Marine and terrestrial samples from likely exposure pathways will be collected, processed, and analyzed periodically as specified in Tables 3.2-1 and 3.2-2, and at the locations shown in Figures 3.2-3 and 3.2-4. The program will emphasize analyses for the radionuclides expected to occur specifically in the Diablo Canyon effluents, although other radionuclides may also appear in some of the results (e.g., radionuclides

---

[3] [4] Numbered references appear at the end of Section 3.

TABLE 3.2-1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM FOR MARINE SAMPLES

Sample Item	Sample Size	Sampling Location	Type of Analysis	Materials Analyzed	Collection Frequency
Seawater	4 liters	Diablo Cove	Gamma isotopic, tritium	Evaporate	Monthly
			Sr-89, Sr-90	Evaporate	Quarterly
Red algae, foliose *(Iridaea sp.)*	1 kg	Diablo Cove	Gamma isotopic, Sr-89, Sr-90	Complete sample	Semi-annually
Bull kelp *(Nereocystis leutkeana)*	1 kg	Diablo Cove	Gamma isotopic, Sr-89, Sr-90	Frond and stipe	Semi-annually
Goose barnacles *(Pollicipes polymerus)*	1 kg	Diablo Cove	Gamma isotopic	Complete sample	Semi-annually
Mussels *(Mytilus californianus)*	1 kg	Diablo Cove	Gamma isotopic, Sr-89, Sr-90	Muscle and viscera	Semi-annually
Black abalone *(haliotis cracherodii)*	Two 4-6 inch specimens	Diablo Cove	Gamma isotopic, Sr-89, Sr-90	Edible muscle and viscera	Semi-annually
Black perch *(Embiotoca lateralis)*	1 kg	Diablo Cove	Gamma isotopic	Edible muscle	Semi-annually
Pismo clams *(Tivela stultorum)*	1 kg from each location	Pismo Beach and Morro Bay	Gamma isotopic	Muscle and viscera	Semi-annually

TABLE 3.2-1 (Cont.)

Sample Item	Sample Size	Sampling Location	Type of Analysis	Materials Analyzed	Collection Frequency
Red abalone *(Haliotis rufescens)*	One 7-8 inch specimen	Diablo Cove	Gamma isotopic	Edible muscle and viscera	Semi-annually
	One whole specimen in shell (if possible) [a]	El Morro Abalone Plant, Morro Bay	Gamma isotopic	Edible muscle and viscera	Semi-annually [b]
Blue rockfish *(Sebastes mystinus)*	1 kg (two specimens)	Diablo Cove	Gamma isotopic	Edible muscle and viscera	Semi-annually
	1 kg [a]	Commercial landing in Morro Bay	Gamma isotopic	Edible muscle and viscera	Semi-annually
Salmon	1 kg [a]	Commercial landing in Morro Bay	Gamma isotopic	Edible muscle	Semi-annually [b]

NOTES

(a) Commercial samples.

(b) Sampled when in season.

TABLE 3.2-2

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM FOR TERRESTRIAL SAMPLES

Sample Item	Sample Size	Sampling Location	Type of Analysis	Frequency
Dosimeters [a]	(Note b)	18 stations [c]	Gamma dose	Monthly
Air Particulates	(Note d)	4 stations [c]	Gross beta	At least 24 hrs after each filter change [e]
			Gamma isotopic, Sr-89, Sr-90	Monthly composite Quarterly composite
Iodine	(Note f)	4 stations [c]	Gamma isotopic	Weekly
Groundwater	4 liters	Diablo Creek above 500 kV switchyard	Gross beta, Gamma isotopic [g]; tritium	Quarterly
Grains and vegetables	0.5 kg from each location [c]	Cal Poly Farm; Bill H. Kawaoka, Star Rte. Box 7-A, Arroyo Grande; M. Albertoni Dairy, Guadalupe	Gamma isotopic [h]	At each harvest [i]
Milk	4 liters from each location [c]	Cal Poly Dairy; M. Albertoni Dairy, Guadalupe	Gamma isotopic, [h] Radioiodine	Monthly Monthly [j]

TABLE 3.2-2 (Cont'd)

NOTES

a. Thermoluminescent dosimeters (TLD) and film packs.

b. Two TLDs and one film pack at each station.

c. See Figs. 3.2-3 and 3.2-4 for locations.

d. One filter at each station.

e. Filters changed weekly or as required by dust loading, whichever is more frequent.

f. One cartridge at each location.

g. Analyses performed on evaporate.

h. Analyses performed on complete sample.

i. Where harvest occurs continuously, sampling frequency will be monthly.

j. During grazing season.

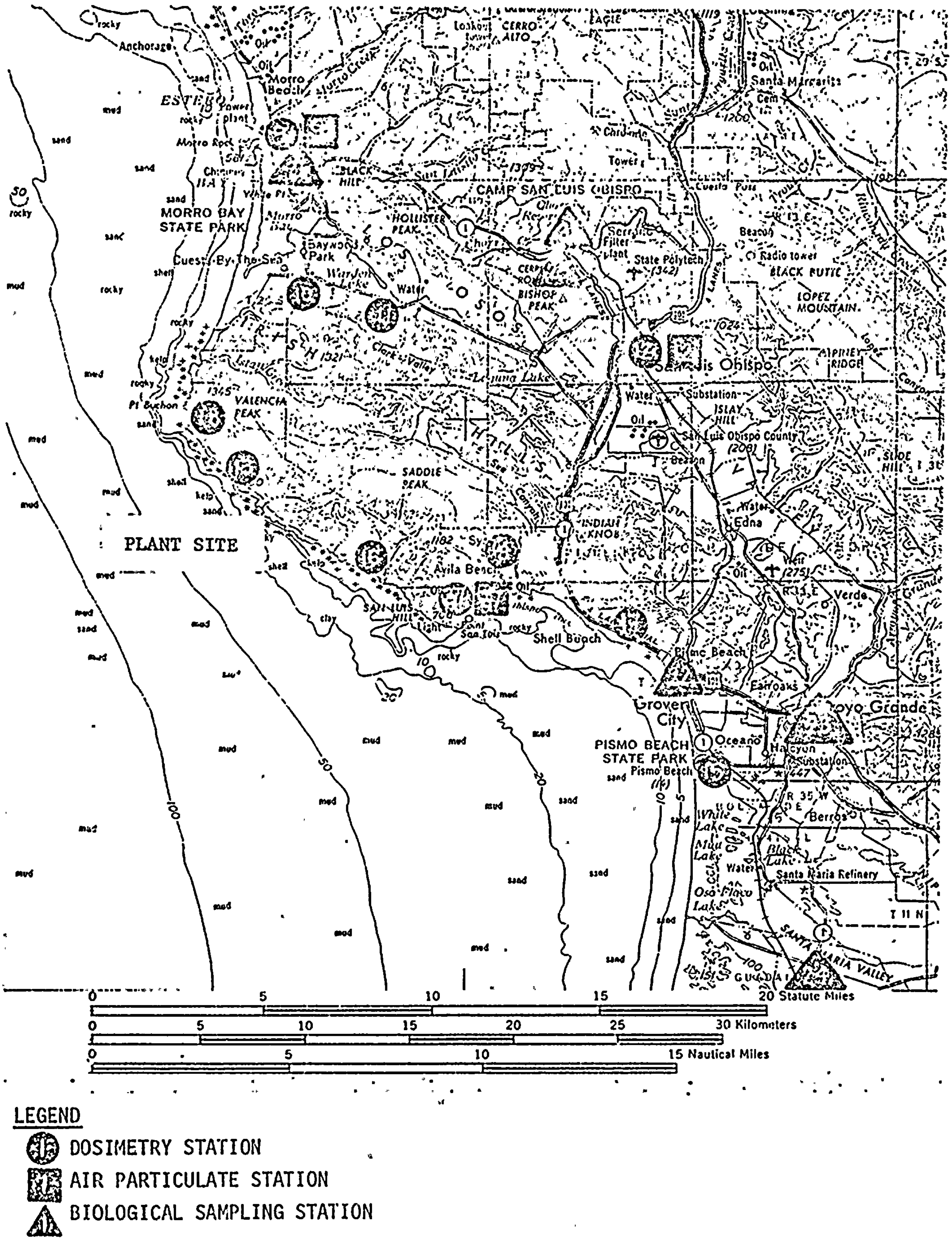


Fig. 3.2-3. Off-site sampling locations for radiological environmental monitoring program.

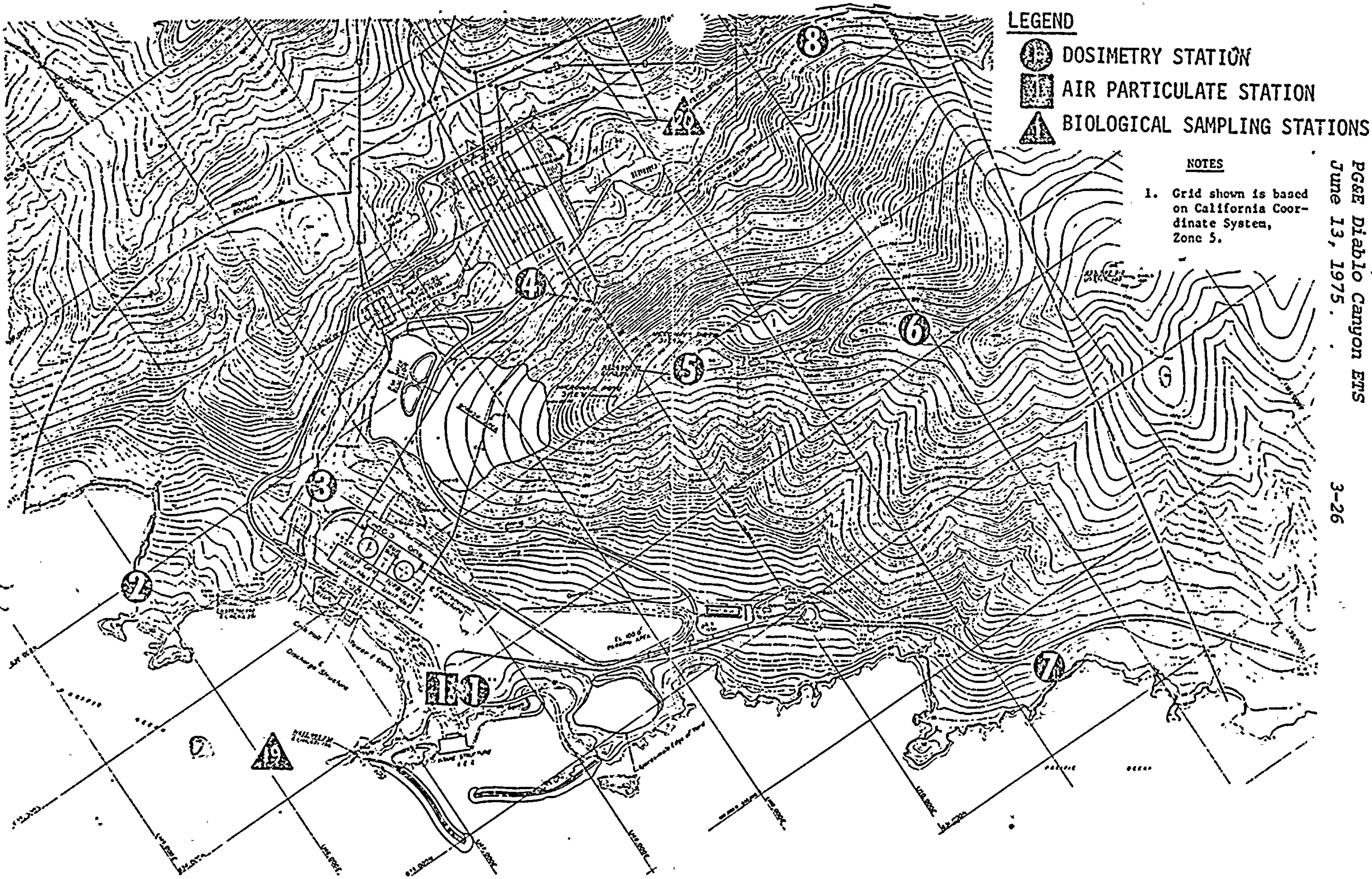


Fig. 3.2-4. On-site sampling locations for radiological environmental monitoring program.

from nuclear weapon fallout or those occurring naturally).

B. Beta and alpha activity determinations, both gross and selected radiochemical analyses, for environmental samples will be made using low-background, thin-window, gas-flow proportional counters with 2π geometry and conventional and anticoincidence shielding. These measurements will be made at least 72 hours after collection to allow for the decay of naturally occurring, short-lived radionuclides.

C. Gamma isotopic analyses, using conventional shielded NaI (Tl) or high resolution Ge (Li) detectors and multichannel pulse-height analyzers, will be made on nearly all samples collected, as shown in Table 3.2-1.

D. Tritium analyses of seawater and groundwater samples will be performed, using a temperature-controlled liquid scintillation spectrometer.

E. Samples of fresh milk will be obtained monthly at representative nearby dairy farms, as shown in Table 3.2-2, and analyzed for their radioiodine content, calculated as I-131. Analysis will be carried out within eight days (one I-131 half-life) of sampling. Suitable analytical procedures will be used to determine the radioiodine concentration to a sensitivity of 0.5 picocuries per liter of milk at the time of sampling. Results will be reported, with associated calculated error, as picocuries of I-131 per liter of milk at the time of sampling, in accordance with Reporting Requirements below.

F. A census of dairy cows located within 25 kilometers of the plant will be conducted every six months during the grazing season.

G. Randomly selected samples will be submitted quarterly to a qualified contractor for analysis.

H. Deviations from the sampling schedule may be made necessary if specimens cannot be collected because of hazardous conditions, seasonal unavailability of samples, or malfunctions of automatic sampling equipment. All deviations from the sampling schedule will be described in the semiannual reports.

I. Specific methods, techniques, and equipment used in this monitoring program may be changed to incorporate state-of-the-art improvements.

Reporting Requirements

All data routinely obtained through the radiological monitoring program shall be reported to the NRC in accordance with Section 5.6, Plant Reporting Requirements, and Section 5.7, Records Retention, of these specifications.

Bases

The radiological monitoring program outlined in Tables 3.2-1 and 3.2-2 was designed to (1) provide information about naturally occurring radioactivity in the area around the plant site before operation begins, and (2) help confirm the effectiveness of control measures for radioactive waste discharges after plant operation begins. The preoperational portion of the program, put into practice in December 1969, was developed in cooperation with the State of California Department of Public Health, Bureau of Radiological Health, and has been reviewed by other interested agencies.

The marine organisms specified for sampling in Table 3.2-1 were selected to represent the various trophic levels in the food web leading to man. Most of these organisms have the inherent ability to concentrate some radionuclides and thus act as integrators of the variable concentrations of radioactivity. A semiannual sampling frequency for marine samples was chosen to focus specifically on the accumulating long-lived isotopes.

Three trophic levels are included in the environmental monitoring program. From the lowest trophic level of the marine ecosystem, two representatives were chosen: the brown alga *Nereocystis leutkeana*, which occurs in subtidal areas, and the red alga *Iridaea sp.*, which occurs in intertidal areas. These two species were selected on the basis of their relatively large biomass, their tolerance of wide temperature fluctuations, their importance as food sources for the organisms in the higher trophic levels, and their individual habitats.[5]

The next trophic level (i.e., the primary consumers), contains a large number of herbivores of various types, having many different habitats, feeding habits, and temperature requirements. Due to the diverse population, several organisms were chosen from this level. Probably the most economically important herbivore is the red abalone *Haliotus rufescens*. This organism is usually present in subtidal areas from 20 to 80 ft in depth, and usually feeds on the large populations of *Nereocystis*, *Macrocystis*, or *Pterygorphora*, also present at these depths.[6] The yearly catches of the red abalone in the area surrounding Diablo Canyon for the years 1967-1970 averaged approximately 350,000 pounds.[5] The black abalone *Haliotus cracherodii* was also selected because of the large populations in the Diablo Cove area. In contrast to the red abalone, the black abalone feeds mainly on the intertidal plants such as the *Iridaea*. The California mussel *Mytylis californianus*, the Pismo clam *Tivela stultorum*, and the goose barnacle *Pollicipes polymerus* were selected as representatives from the large population of filter-feeding organisms that occur along the entire West Coast of the United States. These organisms were also selected because both thermal and radiological data on them are available.[7]

---

[5] Numbered references appear at the end of Section 3.

In addition, they have the capacity to provide information on accumulation of radionuclides by phytoplankton.

Finally, three genera of fish having large populations in the Diablo Canyon area are also sampled. Rockfish *Sebastes*, Lingcod *Ophiodin*, and Cabezon *Scorpaenichthys* are important components of the sport and commercial fisheries operating out of Avila Beach and Morro Bay. The party boat fleet from these ports landed nearly 375,000 pounds of the three genera in 1970.[6] Thus, these organisms have been included in the program because of their economic importance to the area and their high trophic level.

Commercial fish and shellfish samples of the species described above are bought in Morro Bay and analyzed in the same manner as those collected from Diablo Cove. Analyses of the samples provide random information on levels of radionuclides in fish, probably caught within 50 miles of the plant.

Sediments typically play a key role in the accumulation of radionuclides in estuarine and marine situations. These sediments, being chemically very active, serve as a reservoir for many radionuclides. Measurement of radionuclides in sediments is generally mandatory for this reason. Such measurements cannot be made in the Diablo Canyon area, where the open ocean and

[6] Numbered references appear at the end of Section 3.

the wave action produce only isolated pockets of very coarse sand or gravel. However, it is important to investigate the buildup of such nuclides as Sr-89 and Sr-90 because of their radiological significance to man and their long half-life.

The most likely trophic level to accumulate Sr-89 and Sr-90 is that of the primary producers. Therefore, analyses of these radionuclides will be made on the algal species. Similar analyses will be made also on the California mussels and black abalone. Black abalone were selected over red abalone because more of the red are available.

Possible exposures to man could result from atmospheric immersion and inhalation, and from consumption of radionuclides deposited as particulate from the gaseous effluent of the Diablo Canyon plant. To monitor the above pathways, various types of terrestrial samples are collected and analyzed. The four particulate sampling locations shown in Figures 3.2-3 and 3.2-4 were selected to provide data at downwind locations, major population centers, and areas that are essentially not influenced by plant operations.

Gamma dosimetry measurements are made at all 18 environmental monitoring stations. Thermoluminescent dosimeters (TLDs) and film packs are used at all locations. The TLDs were selected because of their much greater sensitivity and the ease in readout.

Groundwater samples are collected from Diablo Creek above the 500 kV switchyard. This sampling location provides information on the only natural freshwater found at the Diablo Canyon site.

Samples of various foodstuffs produced in the area are also collected. These foodstuffs include milk and leafy green vegetables. Samples are taken from the Los Osos Valley, California State Polytechnic College (Cal Poly), Arroyo Grande, and Guadalupe. Milk samples are taken from the Cal Poly dairy and the Guadalupe area. The Los Osos and Cal Poly locations are in areas falling outside the prevailing wind patterns, while Arroyo Grande and Guadalupe are generally in the prevailing wind direction.

The terrestrial sampling frequency reflects the areas that are more sensitive to changes in radioactive level or dose measurement. Thus, air particulate sampling is done weekly, TLD measurements are made monthly, and the terrestrial foods are sampled quarterly or in season. The preoperational milk sampling frequency is quarterly. When the plan becomes operational, the milk sampling frequency will be increased as a function of expected releases, dairy location, and the dairy feeds.

The information provided by the radiological environmental monitoring program is considered adequate to verify that plant effluent controls are effective in keeping radioactive discharges from exceeding the limits specified in 10 CFR 20.*

The entire monitoring program will be reviewed periodically to identify any necessary changes. It will be modified as appropriate.

---

* The Nuclear Regulatory Commission has proposed regulations more stringent than those in 10 CFR 20. These proposed regulations, Appendix I to 10 CFR 50, have not yet been adopted. This section is based on the proposed version of February 20, 1974, contained in the Concluding Statement of the Regulatory Staff for the rule-making hearings. When the Appendix is adopted, this section will be revised as required to conform to the regulations.

3.3 REFERENCES TO SECTION 3.0

1. Burge, R.T., and S.A. Schultz: *The Marine Environment in the Vicinity of Diablo Cove With Special Reference to Abalones and Bony Fishes*. California Department of Fish and Game, Marine Resource Technical Report No. 19, 433 pp, 1973.
2. Gillespie, S.G., and Brunot, W.K.: *EMERALD NORMAL - A Program for the Calculation of Activity Releases and Doses from Normal Operation of a Pressurized Water Plant*. Program Description and User's Manual, Pacific Gas and Electric Company, January 1973.
3. Chapman, William H., H. Leonard Fisher, Michael W. Pratt: *Concentration Factors of Chemical Elements in Edible Aquatic Organisms*. Lawrence Radiation Laboratory, University of California UCRL-50564, December 30, 1968.
4. U.S. Bureau of Census: *Statistical Summary of the United States*.
5. *Environmental Report, Units 1 and 2, Diablo Canyon Site, Supplement 2*. Pacific Gas and Electric Company, San Francisco, California.
6. *Impact on Fish and Wildlife of a Large Desalting Plant at Diablo Canyon*. A Preliminary Evaluation with Recommendations for a Monitoring Program, State of California, Department of Fish and Game, March 1972.
7. *Radioactivity in the Marine Environment*. National Academy of Sciences, 1971.

SECTION 4.0

SPECIAL SURVEILLANCE AND STUDY ACTIVITIES

4.1 THERMAL PLUME MAPPING

Objective

Determine the actual size and temperature characteristics of the thermal plume.

Specification

The extent of the thermal plume shall be measured in increments of $2^{\circ}F$, from $10^{\circ}F$ to $2^{\circ}F$ above ambient, at 50% and 100% power of the first unit. Surface and vertical temperature profile measurements shall be made from a boat traveling along several transects in the discharge area. Airborne infrared systems also shall be used to measure the surface water temperatures. The results of these measurements shall be compared with the thermal plume predictions in the Final Environmental Statement (FES).

Bases

Sections 3.3.3 and 6.3 of the FES require the Company to conduct such studies.

4.2 OCEAN CURRENTS

Objective

Conduct additional ocean current studies.

Specification

Ocean current studies shall be conducted monthly, starting at least one year before the operation of unit No. 1 and continuing for one year after full-power operation of both units begins.

Bases

Sections 3.3.3 and 6.1 of the FES require the Company to conduct additional ocean current studies.

4.3 HEAVY METALS STUDIES

Objective

Determine long-term chronic effects, if any, of copper, nickel, chromium, and other heavy metals released into the environment. Additionally, determine the potential for buildup of these metals in the food chain.

Specification

Samples of species shall be collected from Diablo Cove. Control samples shall be collected at other nearby locations. Collections shall be made twice a year: once in winter and once in summer. The samples shall be analyzed for titanium, aluminum, copper, nickel, and zinc, using an atomic absorption spectrophotometer. Portions of the freeze-dried samples shall be sent to a commercial laboratory for comparative analyses.

Bases

A 1972-73 study was undertaken by the Company to find whether the stable-element corrosion products from the cooling water condenser tubing of the Morro Bay Power Plant, Morro Bay, California, were being accumulated by marine organisms living in the cooling water discharge canal. Information from this study provides a basis for estimating similar accumulation by organisms living within the discharge of the Diablo Canyon power plant. Morro Bay was selected because (1) it is in close proximity to Diablo Canyon and (2) many of the species found at Diablo Canyon also appear in the vicinity of the cooling water discharge from the Morro Bay power plant.

Section 6.3 of the Final Environmental Statement requires the Company to determine long-term chronic heavy metal effects on marine organisms.

4.4 VERIFICATION OF PREDICTED ECOLOGICAL EFFECTS

Objective

Conduct ecological surveys at permanent transect sites of the Company to verify and refine techniques used to predict the probable effect of the thermal discharge on the principal ecological communities.

Specifications

Permanent transects have been established at three intertidal and three subtidal locations by the Company (Figure 4.4-1). Surveys shall be made at least once a year, for two years, to develop qualitative descriptions of the biotic communities along the transects, with emphasis on the species composition and distribution of the principal macrofloral and faunal components. The measured effects of the thermal discharge will be compared with the effects predicted in the pre-operational surveys by the Company.[1,2]

Bases

Section 6.2 of the Final Environmental Statement requires the continuation of the biological monitoring program conducted by the Company. Considerable effort has been made to predict the impact of the Diablo power plant discharge on aquatic life. The verification and refinement of these prediction techniques will have considerable value both for Diablo and for other power plants in the marine environment.

Consultants to the Company have conducted pre-operational ecological surveys since November 1966 to predict the effect of the thermal discharge on the principal ecological communities.[1,2,3,4]

[1,2,3,4] Numbered references appear at the end of Section 4.0.

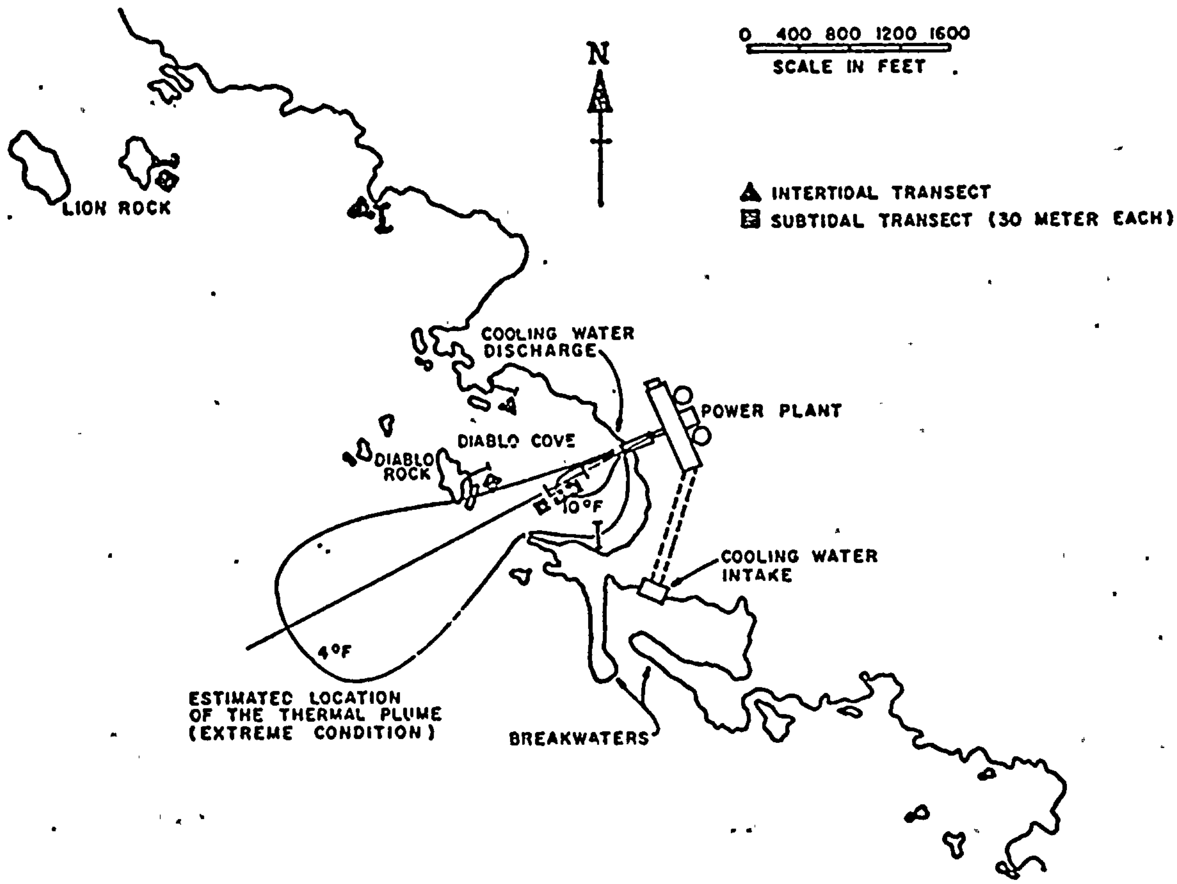


Fig. 4.4-1. Locations of biological monitoring stations in Diablo Cove and vicinity used by the company and its consultants.

4.5 EGGS, LARVAL, AND JUVENILE FISH STUDY

Objective

Determine and document the concentration of small fish and the concentration of eggs and larvae of marine organisms in the intake area.

Specifications

Quantitative temporal and spatial distributions of existing larval and juvenile fish populations shall be determined through appropriate sampling schedules and methods. Stations shall be designated in nearshore (intake area) and offshore waters of Diablo Canyon. Three replicate tows will be made at bi-weekly intervals. The nearshore station will be at a depth of 80 ft, near the mouth of Diablo intake cove. The offshore station will be 1 mile N.W. of Lion Rock at a depth of 200 ft. Collection and processing of the data will follow the techniques of Kramer et al.[5] Zooplankton and phytoplankton collections will be made at the same time as the fish collections by nets towed in a stepped oblique manner, and by whole-water samples. Biomass will be presented as total organic carbon and ATP content for the whole-water samples.

Bases

Sections 5.3.2 and 6.2.2 of the FES require the Company to conduct such studies.

---

[5] Numbered references appear at the end of Section 4.0.

4.6 ENTRAINMENT OF ORGANISMS THROUGH CONDENSER

4.6.1 Immediate Mechanical, Chemical, and Thermal Mortality

Objective

Determine the immediate mechanical, chemical, and thermal mortality effects on eggs, zooplankton, and larval fish populations entrained in the cooling water systems (plant-entrained) of Diablo Canyon power plant.

Specifications

Quantitative seasonal zooplankton and larval fish survival studies shall be conducted at Diablo Canyon power plant.

The studies will be divided into 1) mechanical effects (including pressure) without the addition of heat, 2) combined thermal and mechanical effects, and 3) combined thermal, mechanical, and chlorine effects. The field tests on mechanical effects will be performed only once. The tests involving temperature will be conducted during full power load conditions, when the maximum temperature changes occur. These thermal tests shall be conducted during each of the three oceanographic periods characteristic of the northeast Pacific Ocean. The test methods will consist of live- and dead-specimen observations of the intake and discharge cooling water system, following the techniques described by Icanberry and Richardson,[6] and by Icanberry and Adams.[7]

[6,7] Numbered references appear at the end of Section 4.0.

This information, together with the results of inshore-offshore studies, will allow the Company to assess the immediate impact of plant operation on zooplankton and larval fish populations at Diablo Canyon.

Bases

Sections 5.3.2 and 6.2.2 of the FES require the Company to conduct such studies.

4.6.2 Delayed Mortality Studies

Objective

Determine the delayed effects of cooling water system entrainment (plant entrainment) on the survival with time of important zooplankton species.

Specifications

The delayed mortality studies will consist in holding certain dominant zooplankton species for one week in specially designed incubation chambers. The basic procedure will be the comparison of replicated samples of zooplankters exposed to a thermal increase with other samples not exposed to such an increase. These replicated samples will be incubated in water temperature regimes characteristic of both the intake and the discharge water, in a manner similar to the methods in the delayed mortality tests of Icanberry and Adams.[7]

---

[7] Numbered references appear at the end of Section 4.0.

The tests will be made once, at a time of maximum thermal stress.

The results of the tests, together with information on the immediate effects of plant entrainment, will allow the Company to assess the total impact of power plant operation on zooplankton populations.

Bases

Sections 5.3.2 and 6.2.2 of the FES require the Company to conduct such studies.

4.7 ADDITIONAL ON-SITE CHLORINE STUDIES

Objective

Determine the acute and chronic impacts of chlorine on both the entrained and the receiving water life.

Specifications

Chlorine in the discharge shall be monitored continuously during its use. The short-term effect of chlorine on entrained organisms shall be studied in conjunction with studies outlined in Section 4.6 on entrainment of organisms through the condenser. The chronic impacts of chlorine on marine life in the receiving water shall be studied in a seawater laboratory at the power plant. This laboratory uses intake water from the power plant, as well as groups of marine organisms native to the area. Representative organisms will include abalone and associated food forms.

Bases

Sections 3.5.1, 3.5.7, 5.3.3, 6.3, 12.3.4, and 13.3 of the FES require the Company to conduct such studies.

4.8 ABALONE LIFE HISTORY AND FOOD HABITS STUDIES

Objective

Gather additional baseline information on the life history and biology of the abalone and associated food forms before operation of unit No. 1 begins.

Specifications

Thermal tolerance studies shall be conducted on both larval, juvenile, and adult red abalone *Haliotis rufescens* to determine the effects of both condenser passage (power plant entrainment) and chronic temperature doses in the receiving water. Important abalone forage species of subtidal brown algae such as bull kelp *Nereocystis leutkeana*, *Laminaria*, and *Pterygophora* will be studied quantitatively on a seasonal basis to monitor changes in canopy in both Diablo Cove and adjacent control areas. The effects of temperature on the growth rates and sporophyte development of the bull kelp will be studied in a seawater laboratory at the Diablo Canyon power plant. This information will be gathered before the startup of the first unit.

Bases

Section 6.1 of the FES requires this baseline information to be obtained before startup of the first unit.

4.9 REFERENCES TO SECTION 4.0

1. *Environmental Report, Units 1 and 2, Diablo Canyon Site, Supplement 2.* Pacific Gas and Electric Company, San Francisco, California.

2. North, W.J. and E.K. Anderson: *Anticipated Biological Effects from Heated Effluents at Diablo Cove.* Pacific Gas and Electric Company, San Francisco, California, May 1973.

3. North, W.J.: *An Evaluation of the Marine Fauna and Flora in the Vicinity of Diablo Cove, California.* Pacific Gas and Electric Company, San Francisco, California, December 1966.

4. U.S. Atomic Energy Commission: *Final Environmental Statement, Nuclear Generating Station, Diablo Canyon Units 1 and 2, Pacific Gas and Electric Company.* May 1973.

5. Kramer, D. et al: *Collecting and Processing Data on Fish Eggs and Larvae in the California Current Region.* NOAA Tech. Report/ NMFS Circular 370, 1972.

6. Icanberry, J.W. and R.W. Richardson: *Quantitative Sampling of live zooplankton with a filter-pump system.* Limnol. Oceanogr. 18(2) : 333-335 (1973).

7. Icanberry, J.W. and J.R. Adams: *Zooplankton survival in cooling water systems of four thermal power plants on the California Coast.* Interim report, March 1971 to January 1972, in Proceedings of the Second Entrainment and Intake Screening Workshop, L.D. Jensen (ed.), The Johns Hopkins University Cooling Water Research Project, Rept. 15: 13-22.

[illegible]