FOREWORD

This environmental statement was prepared by the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation (hereinafter referred to as the staff) in accordance with the Commission's regulations, 10 CFR 51, which implement the requirements of the National Environmental Policy Act of 1969 (NEPA).

The NEPA states, among other things, that it is the continuing responsibility of the Federal government to use all practicable means, consistent with other essential considerations of national policy, to improve and coordinate Federal plans, functions, programs, and resources to the end that the Nation may:

- Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.
- Assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings.
- Attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences.
- Preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment that supports diversity and variety of individual choice.
- Achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities.
- Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

Further, with respect to major Federal actions significantly affecting the quality of the human environment, Sect. 102(2)(C) of the NEPA calls for preparation of a detailed statement on:

(i) the environmental impact of the proposed action;

(ii) any adverse environmental effects which cannot be avoided should the proposal be implemented;

(iii) alternatives to the proposed action;

(iv) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity; and,

(v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

An environmental report accompanies each application for a construction permit or for a full-power operating license. A public announcement of the availability of the report is made. Any comments by interested persons on the report are considered by the staff. In conducting the required NEPA review, the staff meets with the applicant to discuss items of information in the environmental report, to seek new information from the applicant that might be needed for an adequate assessment, and generally to ensure that the staff has a thorough understanding of the proposed project. In addition, the staff seeks information from other sources that will assist in the evaluation and visits and inspects the project site and surrounding vicinity. Members of the staff may meet with state and local officials who are charged with protecting state and local interests. On the basis of all the foregoing and other such activities or inquiries as are deemed useful and appropriate, the staff makes an independent assessment of the considerations specified in Sect. 102(2)(C) of the NEPA and 10 CFR Part 51.

This evaluation leads to the publication of a draft environmental statement, prepared by the Office of Nuclear Reactor Regulation, which is then circulated to Federal, state, and local governmental agencies for comment. A summary notice of the availability of the applicant's environmental report and the draft environmental statement is published in the Federal Register. Interested persons are also invited to comment on the proposed action and on the draft statement.

After receipt and consideration of comments on the draft statement, the staff prepares a final environmental statement, which includes a discussion of questions and concerns raised by the comments and the disposition thereof; a final benefit-cost analysis, which considers and balances the environmental effects of the facility and the alternatives available for reducing or avoiding adverse environmental effects with the environmental, economic, technical, and other benefits of the facility; and a conclusion as to whether – after the environmental, economic, technical, and other benefits are weighed against environmental costs and after available alternatives have been considered – the action called for, with respect to environmental issues, is the issuance or denial of the proposed permit or license or its appropriate conditioning to protect environmental values. This final environmental statement and the safety evaluation report prepared by the staff are submitted to the Atomic Safety and Licensing Board for its consideration in reaching a decision on matters in controversy regarding the application. The same format as used in the Draft Environmental Statement is used in this Final Statement to facilitate its review.

This environmental review deals with the impact of operation of San Onofre Nuclear Generating Station Units 2 and 3 (SONGS 2 & 3). Assessments that are found in this statement supplement or modify those described in the Final Environmental Statement (FES-CP) that was issued in March 1973 in support of issuance of construction permits for the units. The information found in the various sections of this Statement updates the FES-CP in four ways: (1) by identifying differences between environmental effects of operation (including those which would enhance as well as degrade the environment) currently projected and the impacts that were described in the preconstruction review, (2) by reporting the results of studies that had not been completed at the time of issuance of the FES-CP and that were required by the NRC staff to be completed before initiation of the operational review, (3) by evaluating the applicant's preoperational monitoring program and by factoring the results of this program into the design of a postoperational surveillance program and into the development of environmental technical specifications, and (4) by identifying studies being performed by the applicant that will yield additional information relevant to the environmental impacts of operating SONGS 2 & 3.

Copies of this statement are available for inspection at the Commission's Public Document Room, 1717 H Street, N.W., Washington, D.C.; the Mission Viejo Branch Library, 24851 Chrisanta Drive, Mission Viejo, California; and the NRC Office of Inspection and Enforcement, 1990 N. California Boulevard, Walnut Creek, California. Copies of this statement may be obtained as indicated on the inside front cover. Mr. Dino C. Scaletti is the NRC Project Manager for this statement. Mr. Scaletti may be contacted at (301) 492-8443.

1. INTRODUCTION

1.1 HISTORY

On May 28, 1970, the Southern California Edison Company and the San Diego Gas and Electric Company filed an application with the Atomic Energy Commission (now Nuclear Regulatory Commission) for permits to construct San Onofre Nuclear Generating Station Units 2 and 3 (SONGS 2 & 3). Construction Permits Nos. CPPR-97 (Unit 2) and CPPR-98 (Unit 3) were issued on October 18, 1973, following reviews by the AEC regulatory staff and the Commission's Advisory Committee on Reactor Safeguards, as well as a public hearing before an Atomic Safety and Licensing Board in San Diego and San Clemente, California on January 16 to 24, March 13 to 15, and May 14 to 22, 1973. An additional session of the hearing was held in Los Angeles, California on May 19, 20, and 21, 1976. The conclusions reached in the staff's environmental review were issued in a Final Environmental Statement (FES-CP) in March 1973.

As of December 1980, construction of Unit 2 was about 97% complete and construction of Unit 3 was about 68% complete. Each unit has a pressurized-water reactor that will produce up to 3410 MWt and a net electrical output of up to 1106 MWe.

In November 1976 Southern California Edison Company and San Diego Gas and Electric Company submitted an application including a Final Safety Analysis Report (FSAR) and Environmental Report (ER) requesting issuance of operating licenses for Units 2 and 3. These documents were docketed on March 22, 1977, and the operational safety and environmental reviews were initiated at that time.

The City of Anaheim, California, and the City of Riverside, California have recently been added as co-holders of the Construction Permits for San Onofre 2 and 3 and will soon request to be included as applicants for Operating Licenses. The four groups are co-owners of the facility and are referred to herein as the applicant.

1.2 PERMITS AND LICENSES

The applicant has provided a status listing of environmentally related permits, approvals, licenses, etc., which are required from Federal, regional, state, and local agencies in connection with the proposed project (ER, Sect. 12). The staff has reviewed that listing. An amendment to the permit from the California Coastal Commission may be required to obtain approval for the modified exclusion area plan. The staff is not aware of any other potential non-NRC licensing difficulties that would significantly delay or preclude the proposed operation of the plant.

2. THE SITE

2.1 RESUME

The staff visited the SONGS site in May 1977 primarily to determine what changes had occurred at the site and in surrounding areas since the preconstruction environmental review in late 1972. In addition, more detailed information about the operation of SONGS 2 & 3 was obtained as a result of this visit.

Population distribution estimates have been updated and extended to the year 2020. The major land use change has been the construction of the plant itself. Transmission line routes have undergone some changes.

An updated description of the surface-water hydrology is given in Sect. 2.3.1.

The section on meteorology has been revised to include the results of recent observations.

Considerable additional field work and sampling is reflected in the description of terrestrial and aquatic ecology in Sect. 2.5.

2.2 REGIONAL DEMOGRAPHY AND LAND USE

2.2.1 Population change

Population for 1976 by sectors within 80 km (50 miles) of the plant and the projected population estimates to the year 2020 are provided in Tables 2.1-2 through 2.1-15 of the ER. The population within a 16-km (10-mile) radius of the site in 1976 was 57,241. By 1980 this population was expected to increase to 67,547 - an annual growth rate of 4.2% (ER, Sect. 2.1.3.2.1). The major cities in the area and their 1975 populations are San Clemente (20,794), 6.4 km (4 miles) northeast; San Juan Capistrano (13,658), 16.8 km (10.5 miles) northwest; Oceanside (54,900), 27.2 km (17 miles) southeast; and San Diego (1,518,000), 81.6 km (51 miles) southeast. Table 2.1 provides 1976 population data by sector within 16 km (10 miles) of the site.

Table 2.1. Population by sector and distance with 10 miles of San Onofre site (1976)

Sector	Distance (miles)						
	0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 10	Total 0 to 10
W	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0
NW	0	656	54	3532	5298	21,979	31,519
NNW	0	732	630	0	0	6,541	7,903
N	0	0	0	4300	0	519	4,819
NNE	0	0	0	0	0	0	0
NE	0	0	4600	0	0	0	4,600
ENE	0	0	0	0	0	0	0
E	0	0	0	0	4300		4,300
ESE	0	0	0	0	0	3,100	3,100
SE	0	0	0	0	0	1,000	1,000
SSE	0	0	0	0	0	0	0
Total	0	1388	5284	7832	9598	33,139	57,241

Source: ER, Table 2.1-2.

(To convert miles to kilometers, multiply by 1.6.)

Table 2.2 presents projected population and annual growth rates within 16 km (10 miles) of the plant between 1976 and 2020. The total percentage change in population for the area between 1976 and 2020 is projected to be 99.4%. These projections are based on surveys made by the Southern California Association of Governments, the Comprehensive Planning Organization of San Diego County, the California State Department of Finance, and the applicant (ER, Sect. 2.1.3.2.3).

Table 2.2. Projected population and annual growth rate within 16 km of the San Onofre site

Year	Projected population	Annual growth[a] (%)		Change (%)
1976	57,241	4.2	1.6	99.4
1980	67,547			
1980	67,547	2.9		
1990	89,521			
1990	89,521	0.3		
2000	91,949			
2000	91,949	1.0		
2010	101,945			
2010	101,945	1.1		
2020	114,139			

[a]Compounded annually.

Source: Adapted from ER, Table 2.1-8.

2.2.2 Changes in land use

Since issuance of the FES-CP in 1973, the construction of SONGS 2 & 3 is the only major change in land use in the site vicinity. Site preparation required the excavation of 16.39 ha (40.5 acres) of the San Onofre Bluffs, which otherwise could be used primarily for recreation. Most of this material was deposited on 34 ha (84 acres) at Japanese Mesa, a relatively flat area just north and across Interstate 5 from the site on Camp Pendleton Marine Base (ER, Sect. 4.1.2). In addition, about 304.8 m (1000 ft) of beach front has remained closed except as a passageway during the construction period (ER, Appendix 12-B, p. 7).

The area within an 8-km (5-mile) radius of the site occupies parts of two counties. The part of this area that lies in Orange County is entirely within San Clemente. The predominant land use in San Clemente is single family residential, light commercial, and recreational. Industrial land use in San Clemente is limited to light industry only. Because the available developable land is steep, future development in that area is expected to be slow with only low residential densities permitted by the city (ER, Sect. 2.1.4.3.1). In San Diego County, the 8-km (5-mile) radius area lies within Camp Pendleton Marine Base. About 95% of Camp Pendleton is unimproved land that is used for military purposes, recreation, and conservation (FES-CP, Sect. 2.2.2). Figure 2.1-12 of the ER provides a detailed land use map of the area within an 8-km (5-mile) radius of the site.

Heavy-haul components for the plant arrive by barge or by vessel at the Del Mar Boat Basin near Oceanside, about 22.5 km (14 miles) south of the site (ER, Suppl. 2, Item 37). The haul route, which was not available at the time the FES-CP was issued, required that a road be cut through the bluffs between the beach and Highway 101, about 11 km (7 miles) north of the Del Mar Boat Basin (ER, Suppl. 2, Item 37).

The description of the transmission lines as presented in Sect. 3.7 of the FES-CP has been modified (Sect. 3.2.5). No new rights-of-way were required: about 5.2 ha (12.8 acres) will be used for new tower bases and for access-road extensions, and 2 ha (5 acres) of land will be covered by the Talega Substation (ER, Suppl. 2, Item 36). Three changes in land use adjacent to the San Onofre–Santiago transmission line route have occurred since the issuance of the FES-CP: (1) construction of a paved road immediately adjacent to a significant portion of the proposed transmission line, (2) bulldozing of a firebreak adjacent to the transmission line on Camp Pendleton Marine Base, and (3) active operation of a large aggregate borrow site adjacent to the line in a third location (ER, Appendix 6A).

2.2.3 Changes in the local economy

Construction activity peaked in late 1979 with an estimated work force of about 3000. The applicant has estimated, after discussions with officials of the labor unions represented at SONGS 2 & 3, that 20%, or about 600 workers, relocated to the southern California area from other parts of the country (ER, p. S.2-167). Although all union craft workers at the site were hired from unions located within a 96-km (60-mile) radius of the site, all of the workers who relocated were travel card members who were assigned by the local unions to SONGS 2 & 3 after the local list was exhausted. Because the construction workers lived throughout the metropolitan areas of San Diego, Orange County, and Los Angeles, the impact of the workers' income was diffuse.

From 1974 through 1976 the applicant estimated that about $4.1 million was spent within a 48-km (30-mile) radius of the site for materials and services. These expenditures accounted for about 0.2% of the total forecast plant cost (ER, p. S.2-174).

2.3 WATER USE

2.3.1 Surface-water hydrology

The only significant water resource in the vicinity of SONGS is the Pacific Ocean. A few streams are located near the site, but these are intermittent.

The currents in the San Onofre vicinity are a superposition of many effects. This current system can be decomposed into individual components. The two most persistent components are the California Current and the tides.

The California Current is evident close to shore and north of Point Conception. However, south of this point the coastline recedes to the east, and water is available for entrainment from the east side of the current. This entrainment tends to make the California Current more diffuse south of Point Conception. Furthermore, the effect of this entrainment in addition to upwelling, winds, and baroclinic instabilities[1] can produce a counter-rotating eddy through the Channel Islands which is known as the Southern California Eddy; the nearshore northward flowing current is the Southern California Countercurrent. Observations indicate that this eddy can exist year-round; however, it is strongest in the fall and in the early winter.

Tides along the California coast are a mixed type with diurnal and semidiurnal components. The diurnal period lasts about 25 hr, and the semidiurnal period is about half the duration of the diurnal. As a result of tidal rotation, flood tide flows up the coast and ebb tide flows down the coast. A more detailed discussion of the tides in the San Onofre vicinity can be found in Sect. 2.6.3 of the FES-CP.

The total near-shore current is the sum of the large-scale current systems, the tides, and other effects such as local winds and offshore storms. The net result is a highly complex current structure that is quite variable in speed and direction. An additional complication is stratification. During the winter when vertical homogeneity exists, near-shore currents are fairly uniform with depth. However, during the summer the presence of the thermocline divides the water column so that only certain components of the net flow are uniform with depth. These components, such as tides, are driven over the entire water column. Surface driving forces (the wind) will penetrate the epilimnion; however, the thermocline represents a barrier to these stresses reaching the hypolimnion. The wind energy is then concentrated in the epilimnion, resulting in an increased intensity of wind-driven flow which can dominate all other components. In contrast, the hypolimnion is relatively free of wind effects and, therefore, is strongly influenced by the tides. The net result is a two-layered flow regime in which the flow in the two layers is only weakly correlated. This already-complicated flow structure can be altered by large amplitude internal waves. The breaking of these waves provides periodic vertical mixing.

A survey of the currents in the San Onofre area was conducted in 1972 by Intersea Research Corporation.[2] Data from this study have been analyzed by Koh and List.[3] From this analysis the following summary information has been extracted.

1. A net drift current can occur in a number of directions; however, the onshore/offshore component of the drift is necessarily smaller than the longshore component.

2. The longshore component of the drift changes direction every 3 to 6 days with downcoast flow typically having a longer duration.

3. The magnitude of the longshore drift is less than 30 cm/sec (0.6 knot).

4. The onshore/offshore component of drift is less than 15 cm/sec (0.3 knot).

5. An upcoast component of drift usually is associated with an onshore component of drift, and vice versa.

6. Both components of tidal flow are typically 10 cm/sec (0.2 knot).

The most detailed study of natural temperature variations in the San Onofre vicinity is that of Koh and List.[3] This study was based on daily temperature measurements from 1966 through 1970 taken at the ends of piers at Balboa, San Clemente, Oceanside, and La Jolla. These data were separated into three frequency ranges - low, middle, and high. The low-frequency component represents data averaged over two months, and it reflects seasonal variations. After removal of these low frequencies, the data were averaged over one week. This is the middle-frequency band, which represents variation within periods from one week to two months. The residual data, the high-frequency band, represents daily to weekly fluctuations. Figure 2.1 is a plot of temperature vs time for the three frequency bands and the raw data for San Clemente. The temperature ranges from 12.1°C (54°F) to 22.9°C (73°F). The low-frequency curve shows an annual temperature cycle with a maximum in midsummer and a minimum in midwinter.

As part of their analysis, Koh and List performed a correlation study among the temperature records from the various locations. Both the low- and middle-frequency ranges showed very high correlations at zero lag time between Oceanside and San Clemente. This indicates that the mechanisms influencing these frequency components have a length scale greater than the distance between the two sampling locations. Therefore, temperature variations at San Onofre within periods of one week or longer can be represented adequately by the corresponding temperature variations at either San Clemente or Oceanside. The correlation of the high-frequency components between these two stations is very weak, indicating that short-term temperature fluctuations are a spatially localized phenomenon. This fact is substantiated by near-surface-temperature measurements made from a moving boat which show that horizontal temperature variations of 1.1°C (2°F) over 1.6 km (1 mile) are not uncommon off the coast of southern California.[3]

An additional feature of the thermal structure in the San Onofre vicinity is vertical stratification. During the winter this region is, in general, isothermal over the water column. As warming progresses, a vertical temperature gradient is established and reaches a maximum in late summer. This natural gradient has been as much as 0.55°C/m (0.3°F/ft).

Ocean salinity in the San Onofre vicinity shows little spatial variation. An annual salinity cycle does exist as a result of annual cycles in the local meteorology and large-scale current systems. During this cycle, salinity typically ranges from 33 to 34 ppt, with the minimum occurring in winter and the maximum occurring in summer.

2.3.2 Groundwater hydrology

The average elevation of the water table at the beach line is +1.5m (+5 ft) mean lower low-water level (MLLW) with a slope of less than 1%; inland, the gradients range from 2 to 8% toward the ocean. Some groundwater can be obtained from the San Onofre Groundwater Basin, and it is used at Camp Pendleton Marine Base, but it is not a resource used by the Station. The Station obtains its domestic supply of freshwater from the Tri-Cities Municipal Water District.

2.3.3 Water quality

Dissolved oxygen concentration in southern California coastal waters ranges from about 5 to 13 mg/liter. Observations at the site vary from 5.4 to 10.0 mg/liter (2 to 3.6 grains/gal). The pH of southern California surface waters varies from 7.5 to 8.4 with a mean of about 8.0.

Measurements of coliform concentrations at the site were made during the period 1967 to 1975. Most of the measurements gave a mean probable number (MPN) of 4 to 43 colonies/100ml (1 to 13 colonies/oz). Only two measurements exceeded 43, and these occurred in 1972 and both gave a MPN value of 460 (140).

Turbidity in the vicinity of the site is due primarily to the suspension of bottom material in the surf zone. Outside the surf zone, turbidity generally decreases as distance from shore increases. Typical depths of Secchi Disc visibility range from 2 to 5 m (6.5 to 16 ft).[4] The vertical variation of turbidity is often quite complex, with alternating layers of clear and turbid water. Visible plumes of turbidity have been observed occasionally on the ocean surface in the vicinity of the Unit 1 offshore discharge structure. These plumes have been observed and, depending on ambient conditions, are caused by the intake and subsequent discharge of naturally turbid water and the entrainment of naturally turbid water into the discharge stream as it moves towards the surface (ER, Sect. 2.4.3.8.2).

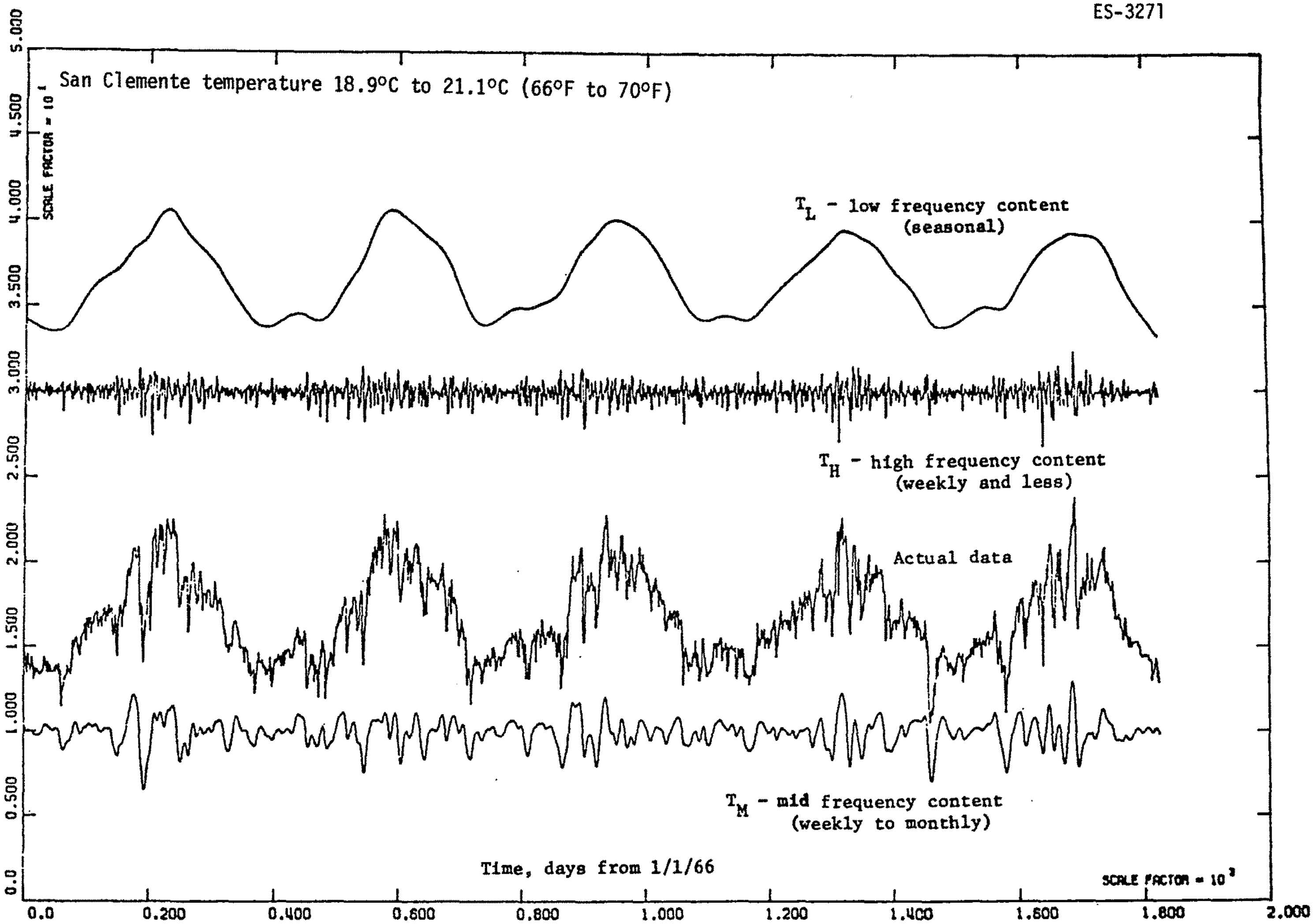

Fig. 2.1. Daily temperatures and decompositions into various frequency bands at San Clemente. Source: R. C. Y. Koh and E. J. List, *Report to Southern California Edison Company on Further Analysis Related to Thermal Discharges at San Onofre Nuclear Generating Station*, Sept. 30, 1974, Fig. 3.2.

2.3.4 Storm runoff

The probable maximum 1-hr thunderstorm rainfall is 17.8 cm (7.0 in). Much of the country to the north and east of the Station site drains into the San Onofre Creek, which flows into the ocean 2 km (1-1/4 miles) northwest of the site. The land immediately east of the site now drains into a 3.7-m-wide (12-ft-wide) ditch that parallels Interstate Highway 5 (I-5) just east of the Station. Both lanes of I-5 also drain into this ditch, which discharges into San Onofre Creek. Storm runoff from the hills above the site drains through one 182-cm-(72-in.-) and one 107-cm-(42-in.-)diam culvert that run north along the highway right-of-way and then turn under the site to the beach. The culverts and channel are designed for the runoff associated with a 1% chance (100-year) storm. To preclude flooding at the site during the occurrence of a probable maximum thunderstorm, an earthen dike will be constructed to the east side of I-5 to divert runoff and debris from the foothills area to San Onofre Creek.

2.4 METEOROLOGY

2.4.1 Regional climatology[5-9]

The climate of the coastal regions of southern California is strongly influenced by the Pacific Ocean. Summers are relatively cool with daytime temperatures averaging only in the low-to-mid-20s (°C) (70°F); daytime seabreezes are frequent. Outbreaks of hot, dry desert air from east of the coastal mountains (Santa Ana winds) may intrude onto the coastal plain several times each year, primarily in the fall, but temperatures exceed 32°C (90°F) usually less than five days annually. The proximity to the Pacific Ocean also results in mild winters, with daytime highs in the upper teens (°C) (60s°F) and nighttime lows around 5 to 10°C (40s°F). Temperatures below freezing are rare.

Precipitation along the coastal plain averages around 250 mm (10 in.) annually. The rainfall is very seasonally dependent with 85% of the total occurring from November through March; almost no rain falls during the summer months. Average relative humidities range from about 80% during the early morning hours of summer and fall, down to around 55% during winter afternoons.

2.4.2 Local meteorology[5,6,8,9]

The San Onofre site is located on the relatively narrow coastal plain, near the mouth of San Onofre Canyon. Coastal bluffs, nearby hills and valleys, and the Pacific Ocean contribute to the complexity of the site topography. Within 8 km (5 miles) of the site, elevations range from 525 m (1725 ft) above sea level [about 5.5 km (3.5 miles) east of the site] to sea level along the Pacific Ocean.

To assess the local meteorological characteristics of the San Onofre site, climatological data from San Diego, California [80 km (50 miles) southeast of the site]; from Los Angeles, California [95 km (60 miles) northwest]; and data collected onsite are available. These data are reasonably representative of the climatological conditions expected in the vicinity of the site.

In the site area, average daily maximum and minimum temperatures range between 25°C (77°F) and 18°C (64°F) in August, the warmest month, and between 18°C (65°F) and 8°C (46°F) in January, the coolest month. The extreme maximum temperature recorded was 44°C (111°F) at San Diego in September 1963; the extreme minimum temperature was -5°C (23°F) at Los Angeles in January 1937.

The area receives about 250 mm (10 in.) of rain annually; December, January, and February — the wettest three-month period — averages about 150 mm (6 in.), and June, July, and August combined averages less than 2.5 mm (0.1 in.). The maximum 24-hr rainfall recorded among these stations is 157 mm (6.2 in.) at Los Angeles in January 1956. Snowfall is a rarity, with a trace [less than 0.25 mm (0.01 in.)] being the most ever recorded. Heavy fogs [visibility of 0.4 km (0.25 mile) or less] occur on about 30 to 40 days each year along the coast with about half of the occurrences during October through January.

Windflow at the site has a strong diurnal dependence primarily due to the land-sea breeze effect. During daytime hours the windflow has a predominant onshore directional component, whereas at night windflow tends toward a seaward direction. Table 2.3 shows the wind direction with the greatest frequency of occurrence for each hour of the day for the three-year period of January 25, 1973, through January 24, 1976, as measured at the 10-m (33-ft) level of the onsite meteorological tower. Figure 2.2 shows the directional frequency of onsite winds. About 25% of the total windflow over the site was from the northeast and north-northeast (principally nighttime offshore flow); 19% of the flow occurred from the west and west-northwest (daytime onshore flow). Winds were calm [windspeeds less than 0.34 m/sec (0.75 mph)] less than 1% of the time at the 10-m (33-ft) level.

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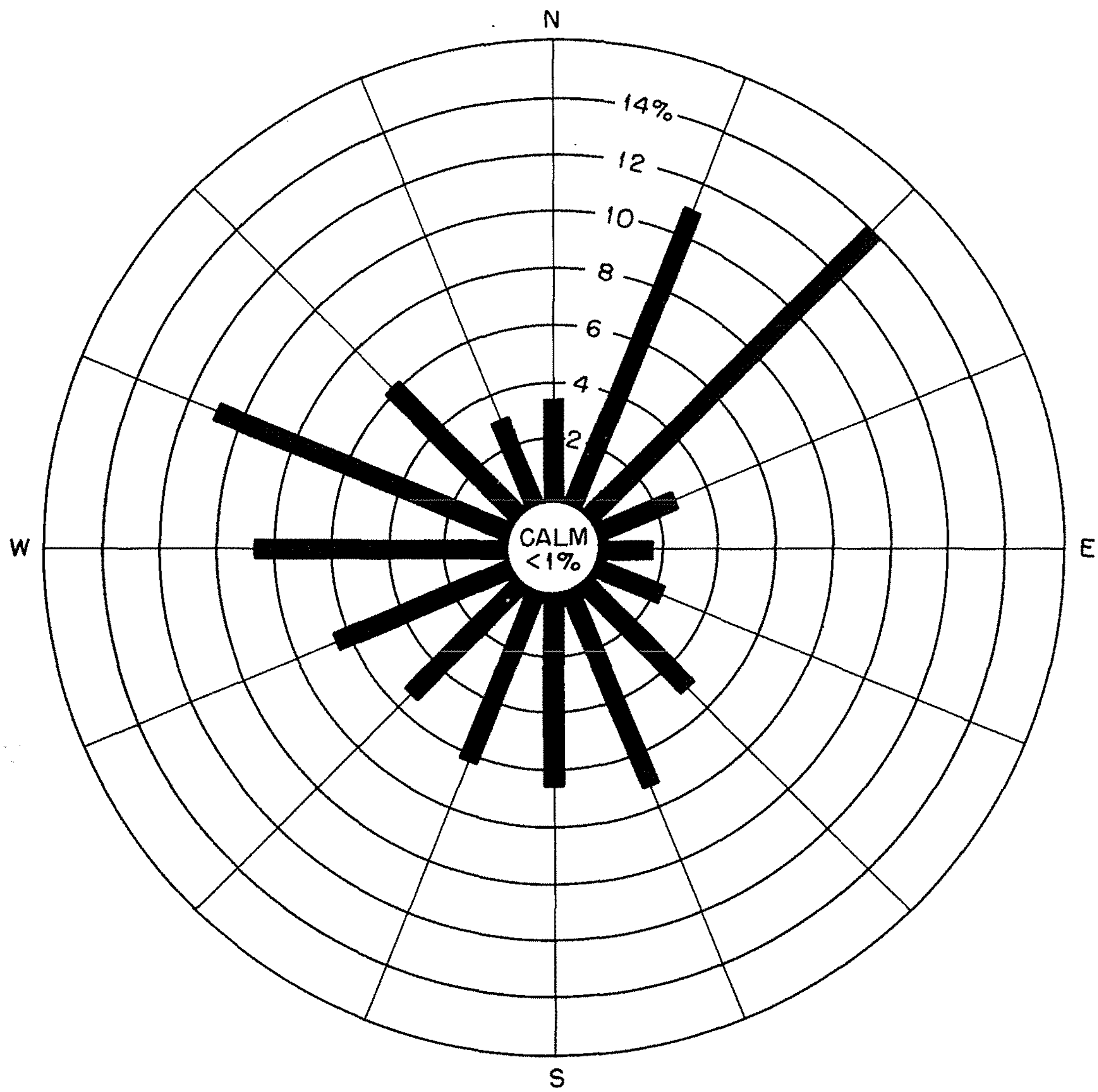

Fig. 2.2. Directional frequency of wind at the San Onofre site. Onsite data at 10 m (33 ft) above ground level, Jan. 25, 1973 through Jan. 24, 1976. Bars show the direction from which the wind blows. Calms are those winds with hourly average speeds less than 0.34 m/sec (0.75 mph).

Table 2.3. Wind direction with greatest frequency of occurrence by time of day at San Onofre Nuclear Generating Station

Data measured at 10-m (33-ft) level of onsite meteorological tower

Hour (AM)	Wind direction	Frequency (%)	Hour (PM)	Wind direction	Frequency (%)
1	NE	28	1	WNW	25
2	NE	26	2	WNW	27
3	NE	27	3	WNW	27
4	NE	28	4	WNW	27
5	NE	30	5	WNW	22
6	NE	30	6	WNW	16
7	NE	25	7	NW	14
8	NE	19	8	NE	13
9	S	12	9	NE	16
10	W	17	10	NE	20
11	W	20	11	NE	23
Noon	WNW	22	Midnight	NE	25

2.4.3 Severe weather[5-13]

Although infrequent, thunderstorms, tornadoes, tropical cyclones, and dust storms can affect the site area. Thunderstorms occur less than 5 days annually. Tropical storms are also rare in the site area, with a storm entering the region less than once every 10 years. The "fastest mile" of wind recorded at Los Angeles was 28 m/sec (62 mph) (March 1952). Snow, glaze, and hail are almost nonexistent in the site vicinity.

Between 1952 and 1975, 23 tornadoes and 21 waterspouts were reported within a 34,000-km^2 (13,000-mi^2) area containing the site. Staff analysis of these tornado data indicates that the mean path area of a tornado in this region is about 0.3 km^2 (0.1 mi^2). Using the methods of Thom, this results in a recurrence interval of 70,000 years for a tornado or waterspout at the plant site.

Dust storms are relatively infrequent within the site region; between 1940 and 1970, dust or blowing dust and sand reduced visibility to under 11 km (7 miles) about 1 hr annually. About 8 days each year there is a high meteorological potential for air pollution.

2.4.4 Atmospheric dispersion[5,6,14,15]

Southern California Edison Company (SCE) has provided joint frequency distributions of wind speed and direction by atmospheric stability class, based on the vertical temperature gradient, collected onsite during the period January 25, 1973 to January 25, 1976. The distributions were for wind speed and direction measured at both the 10- and 40-m (33- and 131-ft) levels with the vertical temperature difference between the 6.1- and 36.6-m (20- and 120-ft) levels. SCE has also conducted a tracer test program to assess the atmospheric dispersion in the landward directions at the San Onofre site. Section 6.2.5 describes the onsite meteorological program and the tracer test program.

The staff has made reasonable estimates of average atmospheric dispersion conditions for SONGS 2 & 3 using an atmospheric dispersion model for long-term releases; this model is based on the "Straight-Line Trajectory Model" described in Regulatory Guide 1.111. The onsite tracer tests showed that ground-level relative concentrations normalized by windspeed were similar whether the source of release was elevated or ground level; thus it was assumed that all plant releases were from ground level. The calculations also include considerations of intermittent releases during more adverse atmospheric dispersion conditions than indicated by an annual average calculation as a function of total duration of release. The calculations include an estimate based on the criteria outlined in Regulatory Guide 1.111 of maximum increase in calculated relative concentration and deposition due to the spatial and temporal variation of the airflow not considered in the straight-line trajectory model. Radioactive decay of effluents and depletion of the effluent plume were also considered as described in Regulatory Guide 1.111.

In the evaluation, we used meteorological data collected onsite between January 25, 1973 and January 24, 1976. All releases were evaluated using joint frequency distributions of wind speed and direction measured at the 10-m (33-ft) level by atmospheric stability [defined by the temperature difference between the 36.6- and 6.1-m (120- and 20-ft) levels]. Data recovery for this time period was 88%.

Table 5.1 presents the calculated values of relative concentration (χ/Q) and relative deposition (D/Q) for specific points of interest.

2.5 SITE ECOLOGY

2.5.1 Terrestrial ecology

The FES-CP describes the terrestrial ecology of the San Onofre site (FES-CP, Sect. 2.8.1). Field work for this description, however, was conducted only during November 1971 and contained very little quantitative data. Consequently, the issuance of the construction permit was subject to the applicant's expansion of its current environmental monitoring program "to determine environmental effects which may occur as a result of site preparation and construction of Units 2 and 3, and to establish an adequate preoperational baseline by which the operational effects of Units 2 and 3 may be judged" (FES-CP, p. iv). In response, the applicant conducted terrestrial ecological studies for a period of 1 year on a 0.61-ha (1.5-acre) quadrat located immediately south of Units 2 and 3 construction site (ER, Appendix 2A). This monitoring program documented seasonal changes in the biotic communities over a 1-year time span and fulfilled the recommendations of NRC Regulatory Guide 4.11.

About 80% of the study area is in a natural plant community of coastal sage scrub, and the remaining 20% has been disturbed by man-related activities. Total cover on the study area ranged from 81 to 98%. The greatest cover was found in February, decreasing toward midsummer. Vegetative diversity in the coastal sage scrub community was relatively low; California sagebrush (*Artemesia californica*) was the dominant species (65% relative cover). Coyote bush (*Baccharis pilularis*) ranked second in the study area (9% relative cover) but had higher relative cover in the disturbed areas than in the climax stand. The applicant's survey suggests that surface disturbances significantly alter the composition of the coastal sage scrub community by encouraging the invasion of exotic perennial and annual plant species, especially mustards and grasses. Establishment of these plants occurred only in areas that have been disturbed (ER, Appendix 2A). As expected for this very small study area (0.61 ha), no endangered plant species were observed.

Fauna observed within the study area included 5 species of reptiles, 12 species of mammals, and 36 species of birds; no amphibians were sighted. None of the species observed in the study area are threatened or endangered as defined by the U.S. Department of the Interior[16] (ER, Sect. 2.2.1.2).

The endangered animal species[16] whose ranges include the vicinity of the plant and associated transmission lines are listed in Table 2.4. Two of these species have been observed by the applicant. The California brown pelican has occurred several times on the beach adjacent to the construction area (ER, Sect. 2.2.1.2), and the California least tern has a nesting colony located near the Del Mar Boat Basin, a facility used by the applicant to move heavy components (see Sect. 2.2.2).

Examination of the geographical distributions[17,18] of the 266 endangered plant species in California[19] indicates that 26 of these species occur in those counties (Orange and/or San Diego) traversed by the transmission lines (Table 2.5). No endangered plant species, however, were observed during the applicant's biological study of the San Onofre-Santiago transmission line route.[20] Biological surveys of the other transmission line routes have not been conducted, but no habitats adjacent to or within the transmission line right-of-way have been classified by state or Federal authorities as being critical to any endangered species (ER, Suppl. 1, Item 22).

2.5.2 Aquatic ecology

The aquatic ecology of the site was described in the FES-CP issued in March 1973, and was based on descriptive data obtained from literature concerning the southern California coast. The FES-CP site description contained minimal baseline information on spatial and temporal differences in species occurrences and population densities. The data obtained since issuance of the FES-CP is primarily from three sources: (1) a thermal effects study performed jointly by Environmental Quality Analysts, Inc., and Marine Biological Consultants, Inc., in 1973 using data and results obtained from 1964-72 by Bendix Marine Advisers, Inc., and Intersea Research Corporation.[21] (2) the SONGS 1 Environmental Technical Specifications (ETS) monitoring program begun in November 1974, conducted by the Lockheed Aircraft Service Company's Department of Marine biology,[22-27]

Table 2.4. Endangered animal species[a] whose ranges include Orange and San Diego counties, California

Common name	Scientific name	Habitat	Reason for decline
California brown pelican	*Pelecanus occidentalis californicus*	Pacific coast from Canada to Mexico	Egg shell thinning due to pollutants such as DDT
California least tern	*Sterna albifrons brownii*	Pacific coast from S. San Francisco Bay, California, to S. Baja, California	Loss of nesting habitat (sandy beaches) due to increased human activity
American peregrine falcon	*Falco peregrinus anatum*	Coast and higher mountains inland	Egg shell thinning due to DDT; human disturbance
Southern bald eagle	*Haliaeetus leucocephalus leucocephalus*	Estuarine areas and inland around large lakes, reservoirs, and wetlands	Disturbance of nesting birds; illegal shooting; loss of nest trees; contamination of food chain by persistent pesticides
Light-footed clapper rail	*Rallus longirostris levipes*	Coastal salt marshes	Destruction of its natural habitat by filling for housing and industrial use, marine development, and water pollution destroying food species and/or habitat

[a]U.S. Department of the Interior, "Endangered and Threatened Wildlife and Plants," 41 F.R. 47180–47198.

Table 2.5. Endangered plant species of Orange and San Diego counties, California

Plant name[a]		Habitat and geography[a]
Scientific	Vernacular	
Acanthomintha ilicifolia	San Diego thornmint	Clay depressions on mesas and slopes; coastal sage scrub, chaparral; SW San Diego County
Arctostaphylos glandulosa var. *crassifolia*	Thickleaf manzantia	Sandy mesas and bluffs; chaparral; coast of San Diego County
Aster chilensis		Dry banks, grassy fields, etc., sea level to 5000 ft; many plant communities; mountains of San Diego County to Santa Barbara County
Astragalus tener titi	Coastal dunes rattleweed	Sandy places near the coast; coastal strand; near San Diego
Berberis nevinii	Nevin's bayberry	Sandy and gravelly places below 2000 ft; coastal sage scrub, chaparral; San Diego County
Brodiaea filifolia	Thread-leaved brodiaea	Heavy clay soil below 2000 ft; coastal sage scrub, chaparral; San Diego County
Brodiaea orcuttii	Orcutt's brodiaea	Near streams and around vernal pools and seeps, up to 5500 ft; chaparral; Yellow Pine Forest, San Diego County
Chorizanthe orcuttiana	Orcutt's chorizanthe	Sandy places; coastal sage scrub; San Diego County
Cordylanthus maritimus ssp. *maritimus*	Salt marsh bird's beak	Coastal salt marsh; Lower California to Oregon
Dicentra ochroleuca	Yellow dicentra	Occasional in dry disturbed places below 3000 ft; chaparral; Santa Ana and Santa Ynez mountains
Dichonda occidentalis	Western dichondra	Mostly dry sandy banks in brush or under trees; coastal sage scrub, chaparral, southern oak woodland; coastal San Diego and Orange counties
Dudleya multicaulis	Many-stemmed dudleya	Dry stony places below 2000 ft; coastal sage scrub, chaparral; San Onofre Mountain, Orange and San Diego counties
Dudleya stolonifera	Laguna Beach dudleya	Cliffs in coastal sage scrub; canyons near Laguna Beach, Orange County
Eryngium aristulatum var. *parishii*	San Diego coyote-thistle	Vernal pools; chaparral; San Diego region
Ferocactus viridescens	San Diego barrel cactus	Dry hills; coastal sage scrub, valley grassland; around San Diego, NW Lower California
Galium angustifolium ssp. *borregoense*		Creosote bush scrub; Borrego Valley, E. San Diego County
Githopsis filicaulis (last reported in 1884)	Mission Canyon blue-cup	Mission Canyon, San Diego
Hemizonia conjugans	Otay tarweed	Mesas; coastal sage scrub; SW San Diego County
Hemizonia floribunda	Tecate tarweed	Dry slopes and valleys below 3500 ft; coastal sage scrub, chaparral; S. San Diego County, N. Lower California
Limnathes gracilis var. *parishii*	Parish slender meadow-foam	Moist lake shores and wet places from 4500 to 5000 ft; Yellow Pine Forest; Cuyamaca and Laguna mountains
Monardella linoides ssp. *viminea*		Rocky washes below 1000 ft; coastal sage scrub, chaparral; SW San Diego County
Monardella macrantha var. *halli*	Hall's monardella	San Gabriel and San Bernardino mountains to Cuyamaca and Santa Ana mountains
Nolina interrata	San Diego nolina	Dry slope; chaparral; W. of Dehesa School, 8 miles east of El Cajon, San Diego County
Orcuttia californica var. *californica*	California orcuttia	Drying mud flats; valley grassland; San Diego County
Poa atropurpurea	San Bernardino bluegrass	Meadows and grassy slopes from 6000 to 7000 ft; Montane Coniferous Forest; San Diego County
Pogogyne abramsii	San Diego pogogyne	Beds of dried pools; chaparral, coastal sage scrub; mesas from San Diego to Miramar

[a]Nomenclature, habitat, and geography from P. A. Munz, *A Flora of Southern California*, University of California Press, Berkeley, Calif., 1974; and W. R. Powell, Ed., *Inventory of Rare and Endangered Vascular Plants of California*, Special Publication No. 1, Berkeley, Calif., 1974.

Source: U.S. Department of the Interior, "Endangered and Threatened Species, Plants," 41 F.R. 24542–24572.

(To convert ft to m, multiply by 0.3048.)

and (3) the Annual Report to the California Coastal Commission, August 1976-1977, by the Marine Review Committee,[28] a special study group established by the California Coastal Commission to estimate the consequences of operating SONGS 2 & 3. Because the ETS program contains the most recent data, included seasonal fluctuations in species occurrences and population densities, and evaluated the effects of SONGS 1 operation on the local marine environment, the description of the site aquatic ecology that follows is based on these data (obtained from November 1974 through December 1976). SONGS 2 & 3 are adjacent to SONGS 1, on the same site. Additionally, the effects of SONGS 1 operation are now a part of the environment of SONGS 2 & 3 and should therefore be included in a complete description of the site ecology.

The biotic communities relevant to an adequate description of the site ecology are the plankton, nekton, benthic, kelp, and intertidal communities.

2.5.2.1 Plankton

Bimonthly plankton sampling was conducted four times in 1975 and six times in 1976 at seven stations along the 10-m (33-ft) contour from 2.4 km (1.5 miles) upcoast to 6.7 km (4.2 miles) downcoast of the SONGS 1 intake/ discharge line (Fig. 2.3).

Phytoplankton

1975 Data. The 84 phytoplankton taxa recorded in the 1975 surveys are similar to those found in previous studies.[25] The phytoplankton was dominated numerically by dinoflagellates. Prorocentrum micans was the most abundant species, constituting 30 to 90% of the samples.[22] Other abundant organisms included Prorocentrum spp., Ceratium sp. A, and Ceratium sp. B. Several species of Peridinium and Dinophysis were also present. The number of taxa per station within each survey was relatively uniform. A complete list of phytoplankton taxa recorded during 1975 is given by station and survey in Appendix VIII, Table 2, p. 217 of ref. 25.

Chlorophyll α concentrations ranged from 0.24 to 2.32 mg/m^3 (0.004 to 0.04 grains/250,000 gal) during the four 1975 surveys.[25] Differences in chlorophyll α concentrations between stations were not significant. Differences were significant, however, between depths and between surveys; chlorophyll α concentrations were significantly greater at the 8-m (26-ft) depth, and the mean concentrations of September were significantly greater than those of the other survey months - May, July, and November.

Phaeopigment concentrations ranged from 0.08 to 1.23 mg/m^3 (0.076 to 0.174 grains/250,000 gal) during the four 1975 surveys.[25] Station differences were not significant, but differences in mean concentrations between surveys and between depths were significant. As with chlorophyll α, phaeopigment concentrations were greater at 8 m (26 ft) than at 1 m (3.3 ft), and the September survey showed the highest phaeopigment concentrations of all four surveys.

1976 Data. In 1976, 128 species or higher taxa of phytoplankton were reported from the six surveys conducted (Table II-2, pp. 11-13 of ref. 26). These taxa consisted of species when identifiable and higher taxa (genera, families, etc.) when identification to the species level could not be made. The taxa representing greater than 30% of any given sample by number were Nitzschia spp. (March and November), an unidentified pennate diatom (January, March, July, September, and November), Gonyaulax spp. (January and March), and Prorocentrum micans (May).[27]

Normal vertical distribution patterns were observed in 1976, as in 1975, with higher concentrations of chlorophyll α and phaeopigments again measured in the lower half of the 10-m (33 ft) water column. However, relatively high values of chlorophyll α were found during the January and May surveys in 1976, whereas in 1975, chlorophyll α concentrations were moderate in May and high in September. Also in contrast to 1975, there was no consistent vertical separation of diatoms from dinoflagellates.

Slightly higher surface temperatures at plankton stations nearest SONGS 1 during some surveys had no apparent effect on the distribution and abundance of phytoplankton; rather, distribution and abundance were apparently the result of natural spatial and temporal variation.[27]

Zooplankton

1975 Data. Zooplankton species encountered in the four 1975 surveys were common to the neritic waters of southern California.[22] A master species list of zooplankton found in the surveys is presented in Appendix VIII, Table 2, p. VIII-30 of ref. 22. The most common group consisted of copepodids of Acartia spp., usually accounting for more than 50% of the total number of individuals sampled.[22] Other species that commonly occurred in the samples were Paracalanus parvus copepodids, Oikopleura spp., Evadne nordmanni, Labidocera trispinosa copepodids,

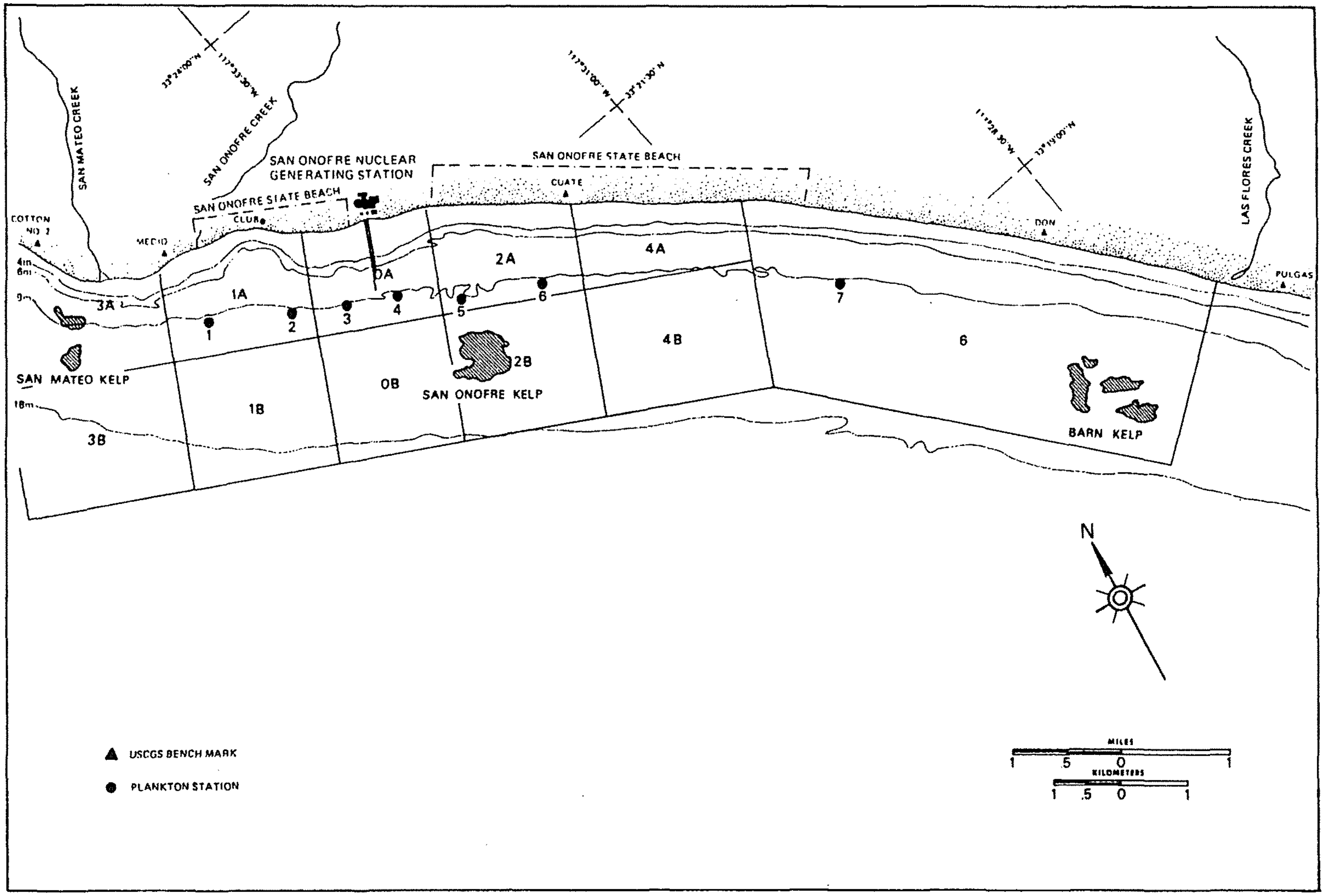

Fig. 2.3. Environmental Technical Specifications plankton station locations and environmental surveillance zones, San Onofre Nuclear Generating Station Unit 1. Source: Lockheed Center for Marine Research, *San Onofre Nuclear Generating Station Unit 1, Environmental Technical Specifications, Annual Operating Report, Vol. IV, Biological Data Analysis — 1976*, June 1977.

Sagitta euneritica, and Acartia tonsa. Less abundant species were adult Paracalanus parvus, cyphonautes larvae, Acartia clausi, and Clausocalanus spp. copepodids. Other species present usually accounted for less than 1% of any sample.[22]

Sampling stations were best differentiated by the distribution of five species: Sagitta euneritica, Corycaeus amazonicus, Oithona spp. copepodites, euphausiid larvae, and Podon polyphemoides. A clear separation of the stations, however, was not obtained, which suggests that no strong processes in the area acted to partition the environment.[25]

Total abundance per sampling station ranged from 600 to 10,900 per m^3 (568 to 10,322 per 250,000 gal) (Fig. 2.4), and total number of taxa ranged from 36 to 65 during the four surveys of 1975.[25] The number of taxa at station 4 near the SONGS 1 discharge was significantly higher than at all the other stations (Fig. 2.4).

1976 Data. In 1976, 115 species or higher taxa were reported from the six surveys performed (Table II-2, pp. 7-10 of ref. 26). Sixteen taxa were considered predominant because they were numerically dominant (number one in rank) during at least one survey, or because they represented more than 1% of the total number of individuals during the year.[27] These sixteen taxa constituted 90% of the total individuals recorded for the year.[27] The seasonal distribution of each of these taxa during the 1976 surveys is shown in Fig. 2.5. Significant differences were found among stations for all but five of the taxa, and significant differences were found between depths for all but six of them. All of these taxa exhibited significant differences among surveys.

Normal vertical distribution patterns were also observed in 1976, as in 1975, with higher concentrations of zooplankton observed in the lower half of the 10-m (33-ft) water column.

Although higher concentrations of zooplankton were measured near SONGS 1 in 1975, no effect of SONGS 1 was indicated by the 1976 studies. Even though water temperatures during the 1976 November survey (when SONGS 1 was off-line) were unusually warm for the season, the distribution and abundance of zooplankton, as with the phytoplankton, were apparently the result of natural spatial and temporal variation.[27]

2.5.2.2 Nekton

1975 Data

Quarterly nekton sampling was conducted in 1975 at six stations — three stations in the area of the SONGS 1 discharge (zone 0A) and three stations about 6706 m (22,000 ft) downcoast (zone 6) (Fig. 2.6). The downcoast stations (zone 6) acted as control areas not under the influence of the SONGS 1 discharge.

A total of 3206 individuals representing 49 species or higher taxa were taken during the four 1975 surveys.[25] The most abundant fish was the queenfish (Seriphus politus), which accounted for nearly twice the number of individuals in the year's catch than the second most abundant species. Other abundant fish were the walleye surfperch (Hyperprosopon argenteum), white croaker (Genyonemus lineatus), spotfin croaker (Roncador stearnsii), jacksmelt (Atherinopsis californiensis), and white surfperch (Phanerodon furcatus). Fourteen species were both abundant and common. Five of the 14 species displayed significant differences in their distributions between zones; four of these — jacksmelt, white seabass (Cynoscion nobilis), white croaker, and queenfish - were significantly more abundant in zone 0A, and the pile surfperch (Damalichthys vacca) was more abundant in zone 6.

The variability observed in abundance between zones was influenced significantly by the distribution of four species: white seabass, white croaker, white surfperch, and California corbina (Menticirrhus undulatus). The white seabass and white croaker were significantly more numerous in zone 0A, and the California corbina and white surfperch were significantly more numerous in zone 6.

The number of individuals and number of taxa also varied significantly among surveys. However, the degree of similarity of species composition within zones did not differ significantly from the degree of similarity between zones.

1976 Data

A taxonomic summary of the 1976 nekton sampling data by station and by survey can be found in Table III-4, pp. 17-18 of ref. 26. A total of 46 species was reported from these surveys. Seven species — queenfish, white croaker, white surfperch, walleye

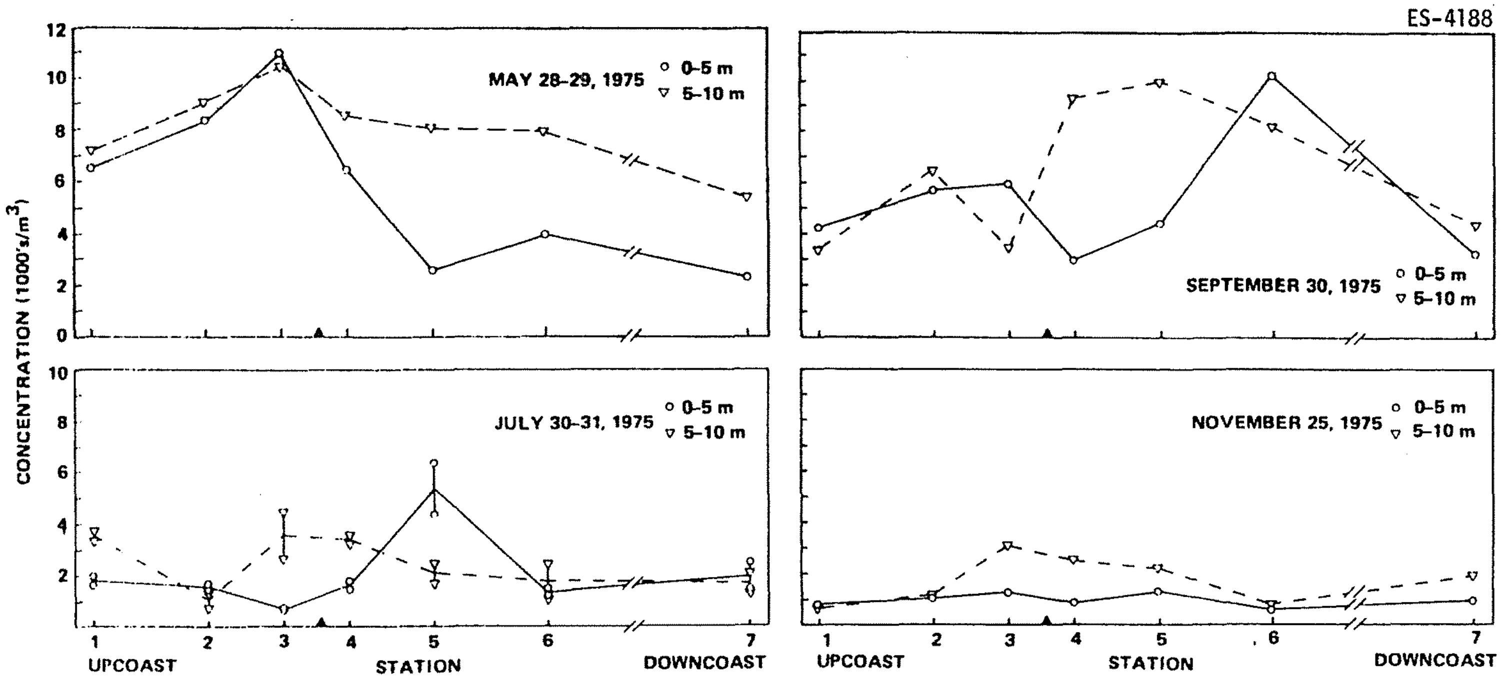

Fig. 2.4. Zooplankton concentrations from 1975 surveys. Open circles (o) and triangles (▽) indicate values from the upper and lower strata respectively. The relative distances of the plankton stations from SONGS 1 are shown. A solid triangle (▲) indicates the position of SONGS 1. A vertical bar connects the July replicates. Source: Lockheed Marine Biological Laboratory, *San Onofre Nuclear Generating Station Unit 1, Annual Analysis Report, Environmental Technical Specifications, January-December 1975*, 1976.

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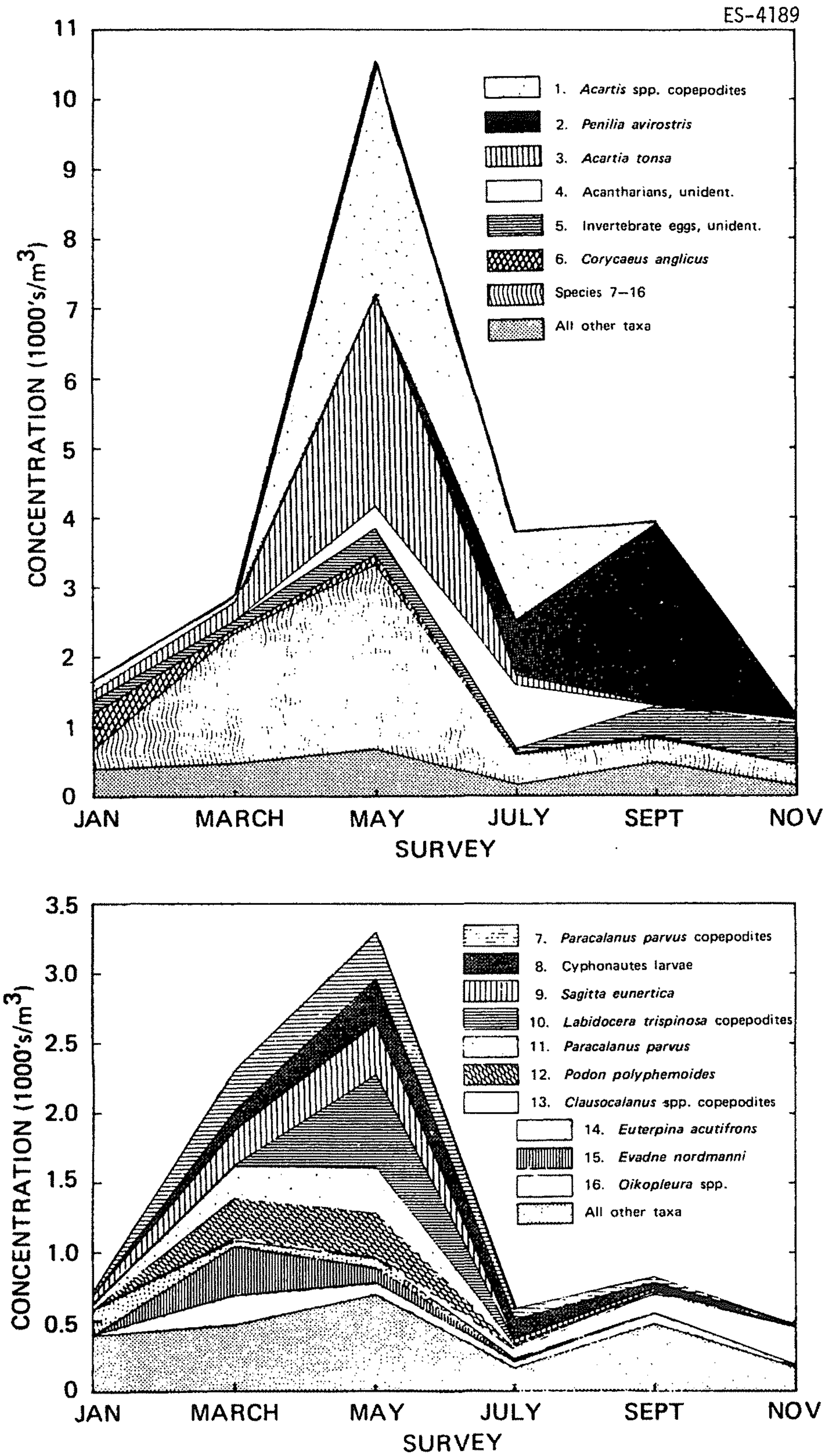

Fig. 2.5. Seasonal distribution of the 16 most abundant zooplankton taxa in 1976. Means of abundance during each survey are plotted. Source: Lockheed Center for Marine Research, *San Onofre Nuclear Generating Station Unit 1, Environmental Technical Specifications, Annual Operating Report, Vol. IV, Biological Data Analysis — 1976,* June 1977.

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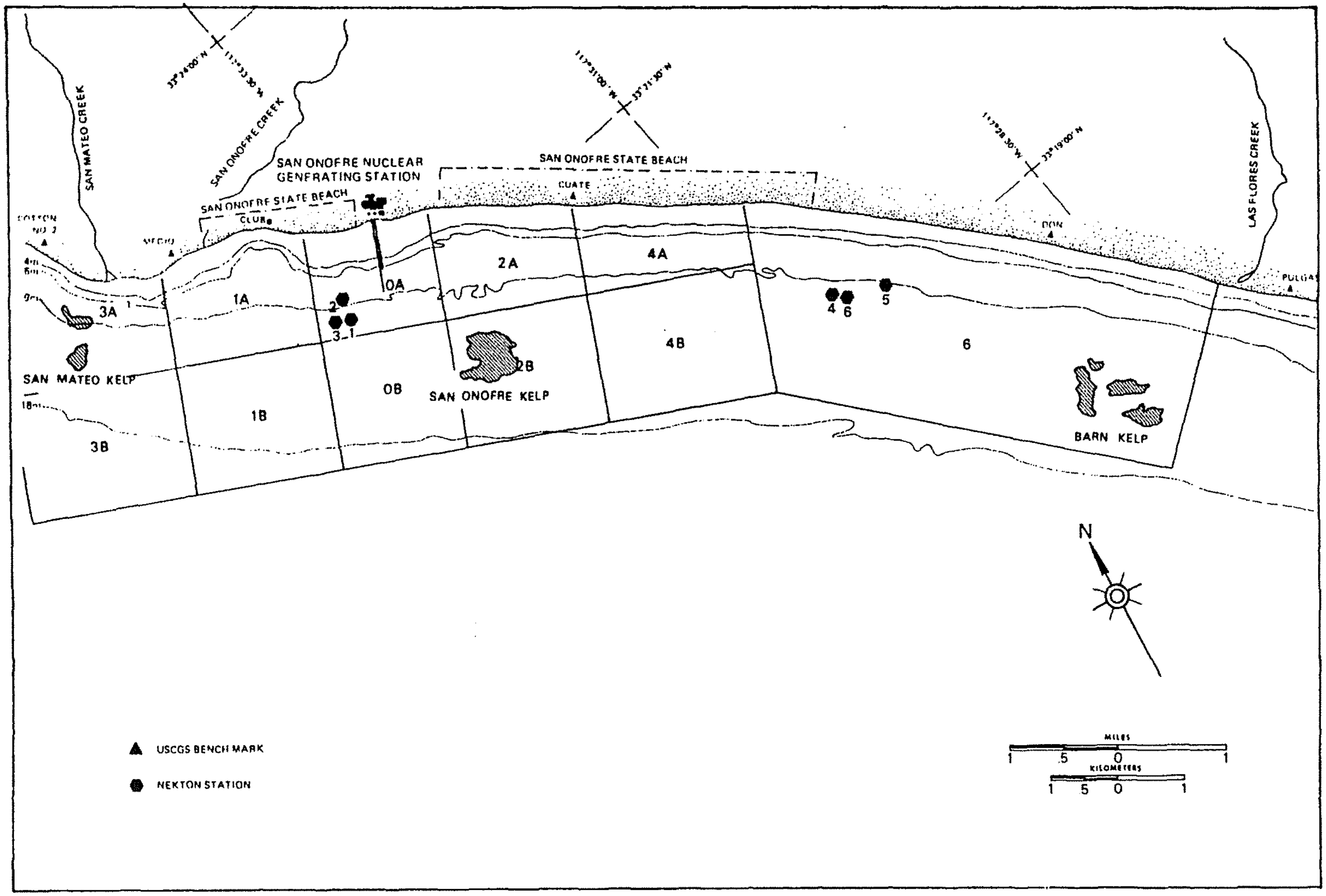

Fig. 2.6. Environmental Technical Specifications nekton station locations and environmental surveillance zones, San Onofre Nuclear Generating Station Unit 1. Source: Lockheed Center for Marine Research, *San Onofre Nuclear Generating Station Unit 1, Environmental Technical Specifications, Annual Operating Report, Vol. IV, Biological Data Analysis — 1976*, June 1977.

surfperch, black croaker (Chilotrema saturnum), spotfin croaker, and half moon (Medialuna californiensis) were captured in both zones.[27] As a group, these seven species accounted for 81.3% of the total catch for the year.[27] The first five of these species were tested for significant differences between zones and among surveys. Only the queenfish and white croaker showed a significant difference between zones, being significantly more abundant in zone 0A than in zone 6. The remaining three species did not differ significantly between zones.

In contrast, six predominant species in 1975 (bottom nets) contributed 82.3% of the individuals collected.[25] Of the predominant species netted in both years, only the queenfish and white croaker were significantly more abundant in zone 0A than in zone 6 during both years of the survey.

The spatial distribution of the queenfish, white croaker, and white surfperch differed significantly among the 1976 surveys. Temporally, the queenfish was found to be most abundant during the December survey and least abundant during the March survey. The white croaker was significantly more abundant during the December and March surveys than during the September and June surveys, and the white surfperch was significantly more abundant in the December catch than during all of the other 1976 surveys.

Significant differences were observed in the number of species between zones, with the number in zone 0A being significantly greater than the number in zone 6. Four species best discriminated between zones 0A and 6: white seabass, white croaker, yellowfin croaker (Umbrina roncador); and white surfperch.

There was also a significant difference among survey periods, with the number of species taken in March being significantly less than the number taken during all of the other surveys, which were not significantly different from each other.

The significant difference found in both number of individuals and number of species among surveys in 1976 was also found in 1975 although no obvious trend in species diversity was revealed (Fig. 2.7). On the other hand, a high similarity within zones existed during 1976; the 1975 data indicated similar but less distinct patterns.

The data suggest that the areas sampled in the two zones may support somewhat different nekton communities. Physical differences between the zones which may also affect the nekton results include the presence of the intake and discharge structures at SONGS 1 and riprap material in zone 0A, general differences in substrate type and composition between the zones, turbidity, and the presence of a dense stand of the phaeophyte Cystoseria spp. in the area of the zone 0A nekton stations. Temperature data collected during bimonthly cruises and nekton surveys revealed no obvious differences between zones, which indicates that temperature is not an important factor.

Fisheries statistics

Commercial and sport fisheries catch data for 1974 from the California Department of Fish and Game statistical blocks in the vicinity of SONGS 1 (Fig. 2.8) revealed that the number of fish per block ranged from 16,601 in block 737 to 123,246 in block 756.[27] With the exception of block 801, all of the blocks examined measured an increase in catch per unit effort between 1973 and 1974. However, the magnitude of the increase was small in comparison to the decrease shown by all of the blocks over the past 13 years.

The 1974 commercial catch reported a total of 46 taxa from the five blocks surrounding San Onofre.[27] The only taxon common to all five blocks was the Pacific bonito (Sarda chiliensis). Each of the five blocks yielded catches at about the expected level, based on the size of the blocks and the amount of coastline encompassed.[27]

2.5.2.3 Benthos

1975 Data

Three surveys conducted in 1975 at 11 benthic stations (Fig. 2.9) revealed a total of 160 species or higher taxa of epibenthic macrobiota (Tables X-1 to X-11, pp. X-12 to X-43 of ref. 22). The taxa represented members of 11 major taxonomic groups. Within zones not associated with kelp beds (zones 0A and 6), the flora was dominated by rhodophyte taxa throughout the year. Mollusks were the dominant fauna during April and October, whereas molluscan and chordate taxa occurred in similar numbers during the July sampling period. Rhodophytes were also the dominant floral component and mollusks were the dominant faunal component of the kelp bed biota at all kelp bed stations during all survey periods.

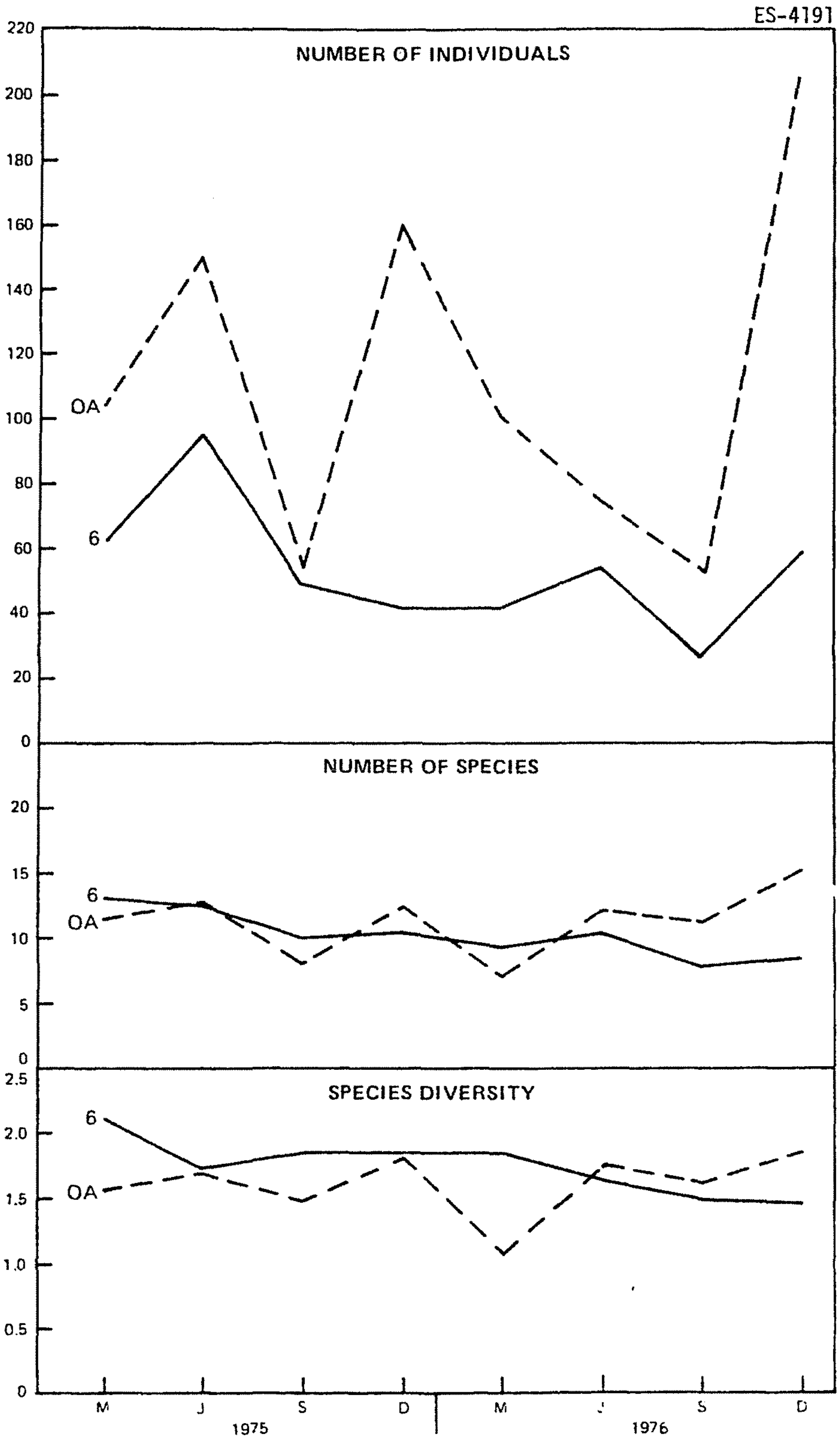

Fig. 2.7. The mean number of individuals and species per net by zone and species diversity of zones OA and 6 by survey during 1975 and 1976. Source: Lockheed Center for Marine Research, *San Onofre Nuclear Generating Station Unit 1, Environmental Technical Specifications, Annual Operating Report, Vol. IV, Biological Data Analysis — 1976*, June 1977.

The species whose distribution best discriminated between zones 0A and 6 were the anthozoan Muricea californica, which occurred mostly in zone 6; the rhodophyte Prionitis spp., which was absent from zone 6; the holothuroid Parastichopus parvimensis, which occurred only in zone 6; and the gastropod Astrea undosa, which was observed only in zone 0A.

The trophic composition based on the number of taxa of the two zones not associated with kelp beds (zones 0A and 6) was similar among these zones and was dominated by suspension feeders and by primary producers during all surveys (Table 2.6).

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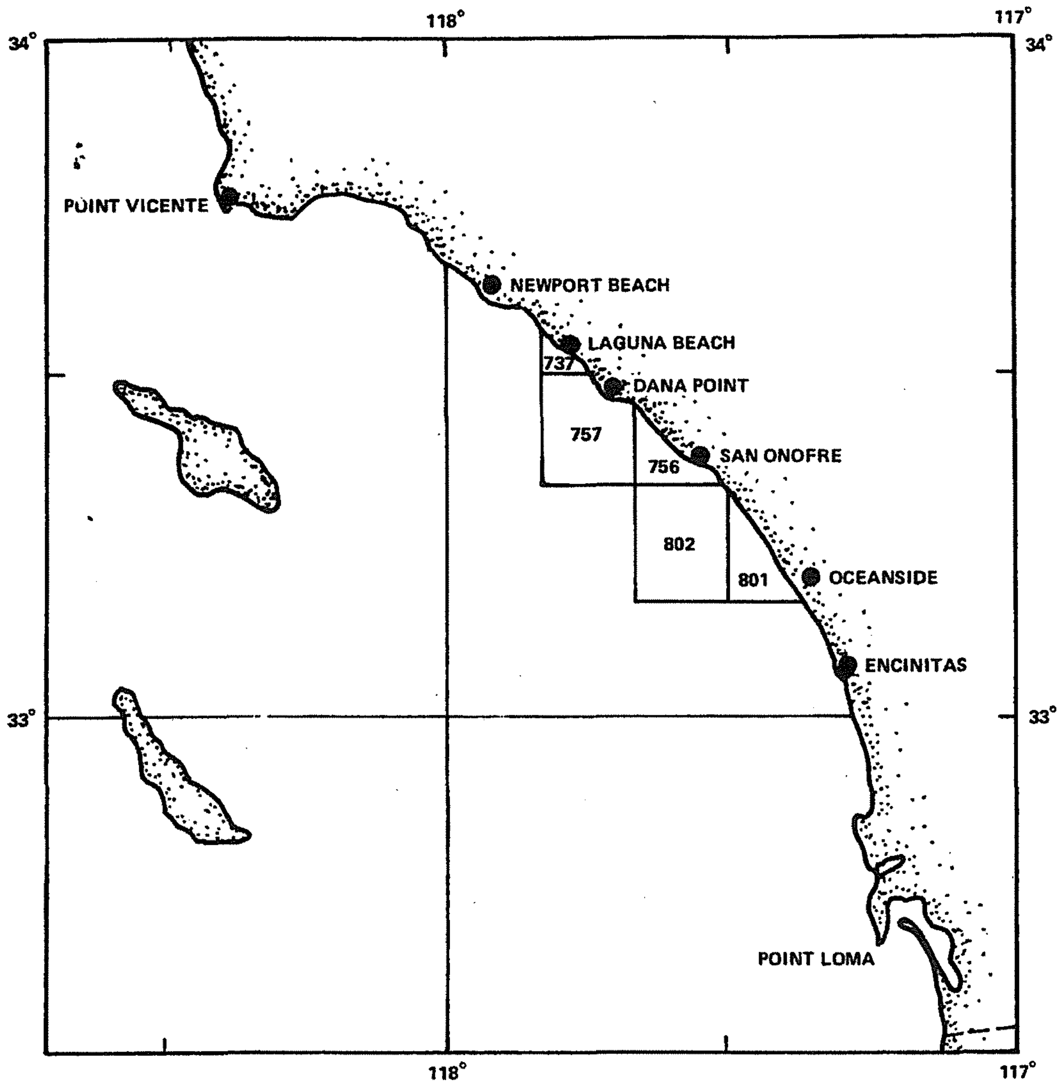

Fig. 2.8. California Department of Fish and Game catch statistic blocks in the vicinity of San Onofre. Source: Lockheed Center for Marine Research, *San Onofre Nuclear Generating Station Unit 1, Environmental Technical Specifications, Annual Operating Report, Vol. IV, Biological Data Analysis — 1976*, June 1977.

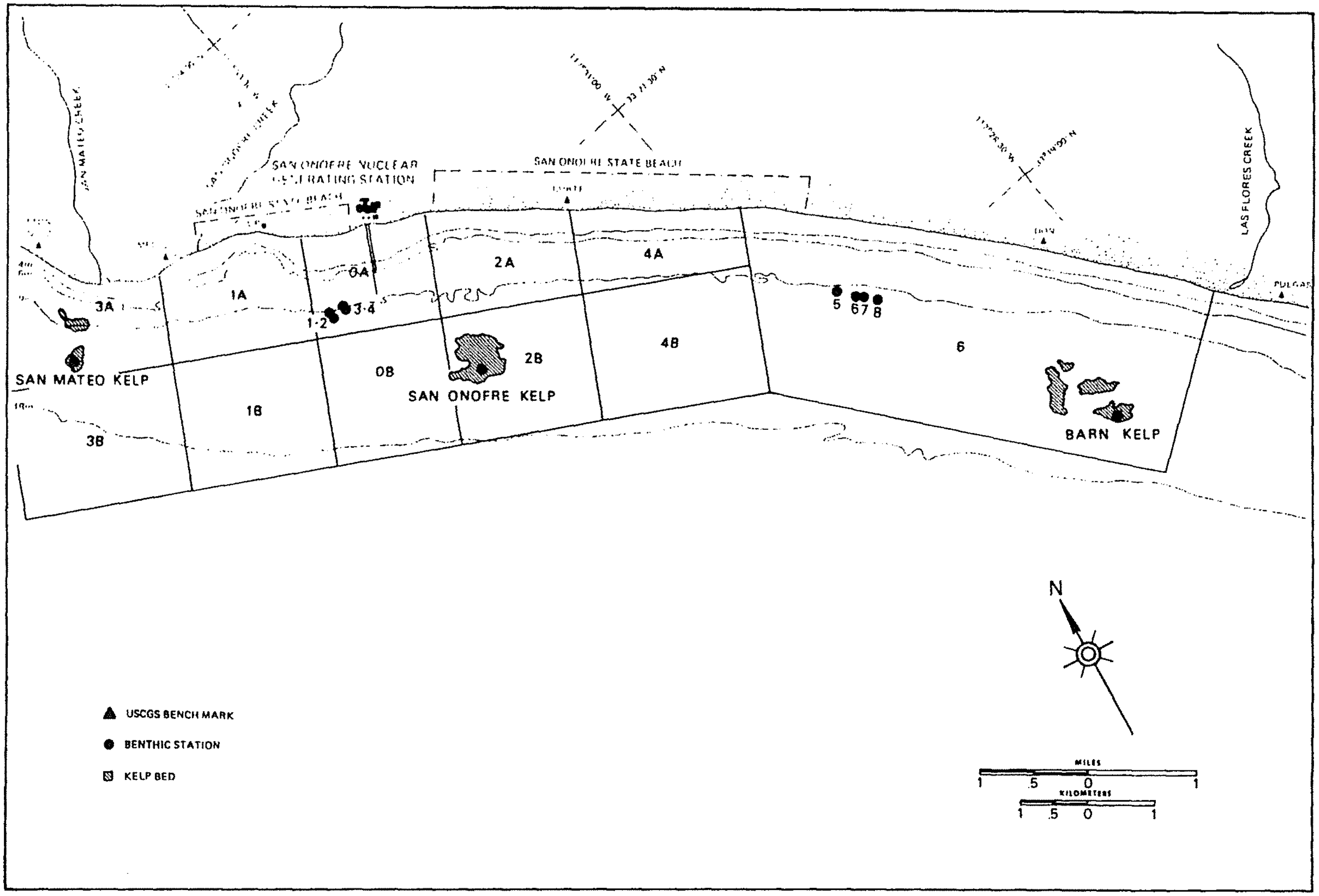

Fig. 2.9. Environmental Technical Specifications environmental surveillance zones, benthic station locations, San Onofre Nuclear Generating Station Unit 1. Source: Lockheed Center for Marine Research, *San Onofre Nuclear Generating Station Unit 1, Environmental Technical Specifications, Annual Operating Report, Vol. IV, Biological Data Analysis — 1976*, June 1977.

Table 2.6. Trophic composition (percent) of benthic taxa at discharge (zone 0A) and control (zone 6) based on the number of taxa of each trophic type present during 1975

	April 10–18		July 15–18		October 13–17	
Trophic types	Zone 0A	Zone 6	Zone 0A	Zone 6	Zone 0A	Zone 6
Primary producers	23	18	35	40	30	29
Suspension feeders	34	43	35	42	33	37
Grazers	10	3	12		12	5
Scavengers	13	13	7	10	12	11
Predators	20	22	12	7	13	18

Source: Lockheed Marine Biological Laboratory, *San Onofre Nuclear Generating Station Unit 1, Annual Analysis Report, Environmental Technical Specifications, January – December 1975*, 1976.

Kelp bed stations were best distinguished by four taxa: the gastropod *Cypraea spadicea*, which occurred only at San Onofre Kelp Bed; the anthozoan *Corynactis* spp., which occurred predominately at San Mateo and Barn kelp beds; the annelid *Spiochaetopterus costarum*, which did not occur at San Onofre Kelp Bed; and the white abalone, *Haliotis sorenseni*, which occurred only at San Onofre Kelp Bed. Twelve taxa were considered predominant at kelp bed stations: *Chelyosoma productum*, *Conus californicus*, *Corallina/Haliptylon*, *Corynactis* spp., Crustose corallines (unident.), *Dioptra* spp., *Leucilla nuttingi*, *Lytechinus pictus*, *Mitrella carinata*, *Muricea californica*, Pagurids (unident.), and *Rhodymenia* spp.

Trophic composition based on the number of taxa at the kelp bed stations was similar among stations and was dominated by suspension feeders (e.g., barnacles, which feed by filtering out suspended material) and primary producers (algae) during all surveys (Table 2.7).

Table 2.7. Trophic composition (percent) of benthic taxa at San Mateo (SMK), San Onofre (SOK), and Barn (BK) kelp beds based on the number of taxa of each trophic type present during 1975

	April 10–18			July 15–18			October 13–17		
Trophic types	SMK	SOK	BK	SMK	SOK	BK	SMK	SOK	BK
Primary producers	22	19	24	26	21	25	30	18	26
Suspension feeders	49	36	41	38	36	59	43	38	45
Grazers	2	17	9	8	12		7	10	4
Scavengers	12	12	9	12	12	9	7	12	10
Predators	15	17	17	16	18	6	12	22	16

Source: Lockheed Marine Biological Laboratory, *San Onofre Nuclear Generating Station Unit 1, Annual Analysis Report, Environmental Technical Specifications, January – December 1975*, 1976.

1976 Data

Diving surveys of the epibenthic macrobiota were conducted quarterly during 1976 at the same 11 benthic stations. A total of 159 species or higher taxa, which were members of 11 major taxonomic groups, were identified during the four surveys.[27] A taxonomic summary of these data by station and by survey is presented in Tables IV-1 and IV-2, pp. 21-28 of ref. 26. Zones 0A and 6 contained twelve predominant taxa whose combined abundance accounted for 84.3% of the total percent cover and 65.1% of the total enumerated individuals.[27] Seven of the twelve predominant taxa consisted of large taxonomic categories that were not field identifiable to a lower taxon. These seven taxa included parvosilvosa, unidentified ectoprocts, unidentified crustose coralline algae, and unidentified hydroids, rhodophytes, pelecypod siphons, and pagurids. These large taxonomic groups totaled 72% of the total percent cover and 20% of the total enumerated individuals for the entire year's data.[27] The magnitude of the abundances of these large taxonomic groups may be somewhat misleading, however, because each of these categories can contain members of several different species.[27]

The predominant taxa identified to at least the generic level consisted of *Rhodymenia* spp., *Bryopsis hypnoides, Diopatra ornata, Muricea californica,* and *Patiria miniata.* The distribution of these taxa among zones and stations is presented in Table V-12, p. 68 of ref. 27. The abundance of all of these taxa differed significantly between zones; *Rhodymenia* spp. and *Patiria miniata* were significantly more abundant in zone 0A, whereas *Bryopsis hypnoides, Diopatra ornata,* and *Muricea californica* were significantly more abundant in zone 6. None of these taxa differed significantly among surveys.

A greater degree of similarity in both species composition and abundance was found within zones than between zones. Distribution of the anthozoan *Murica californica* and the rhodophyte *Prionitis* spp. contributed the greatest to the differences between zones 0A and 6 in both years. Also in both 1975 and 1976, *M. californica* and the polychaete *Diopatra ornata* were significantly more abundant in zone 6. Species composition of the San Onofre Kelp Station was generally more similar to zone 0A stations than to the other kelp bed stations; this is much the same as the 1975 survey data.

No significant differences existed between zones or kelp bed stations in the distribution of taxa among trophic levels during 1975 or 1976.

Aerial infrared kelp survey

An aerial infrared kelp survey revealed that both Barn and San Onofre kelp beds showed a slight increase in total area during 1975 (Fig. 2.10). All of the kelp beds increased in size between February and May 1976 (Fig. 2.10). During the period May to September 1976, Barn and San Onofre kelp beds underwent an 80 and 92% decrease respectively.[27] At the time of the November 1976 survey, Barn Kelp Bed had increased to 77% of the area it had covered during the May survey, whereas San Onofre Kelp Bed again underwent a slight decrease.[27] San Mateo Kelp Bed remained essentially the same. The same general trends were encountered during mapping of the kelp beds by electronic positioning during 1975 and 1976 as part of the construction surveillance program for SONGS 2 & 3.

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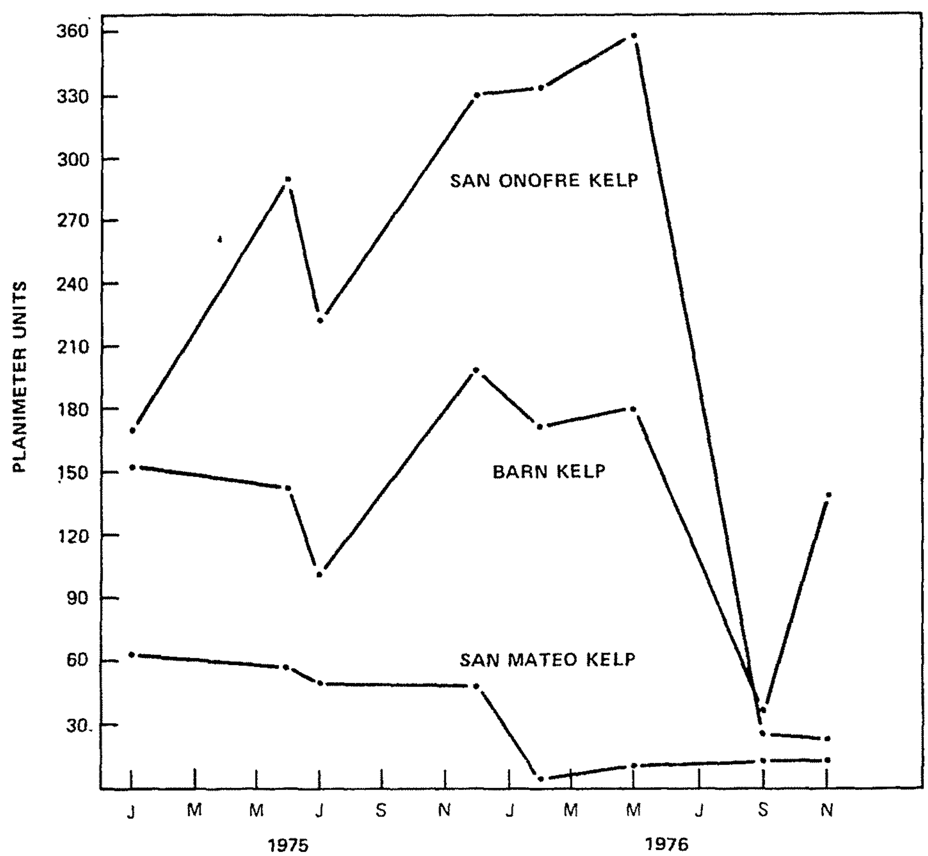

Fig. 2.10. Estimated relative total canopy area of San Mateo, San Onofre, and Barn kelp beds during 1975 and 1976, based on planimeter integration of aerial infrared photographs. Source: Lockheed Center for Marine Research, *San Onofre Nuclear Generating Station Unit 1, Environmental Technical Specifications, Annual Operating Report, Vol. IV, Biological Data Analysis — 1976,* June 1977.

Historical accounts of changes in kelp bed canopy areas throughout southern California have shown changes in magnitude equal to or much greater than those observed during this study, often over a short period of time.[27]

2.5.2.4 Intertidal community

1975 Data

During four intertidal surveys in 1975, 106 species or higher taxa representing 12 major taxonomic groups were observed at the five intertidal stations (Fig. 2.11).[25] These taxa are listed in Appendix XII, Tables 1 and 2, p. 246-52 of ref. 25. A comparison of the data collected in 1975 with historical data indicates that the fauna and flora encountered are typical inhabitants of this geographical area.[25] Phaeophytes, rhodophytes, and mollusks consistently exhibited the greatest number of taxa throughout the year at all stations. The distribution of five taxa were found to contribute significantly to the variability among stations: the rhodophytes *Corallina/Haliptylon*, *Pterocladia/Gelidium*, *Laurencia* spp.; the spermatophyte *Phyllospadix* spp.; and the anthozoan *Anthophleura* spp. Seventeen taxa, the majority of which were algae, were both common and abundant. The most abundant of these seventeen taxa were *Corallina/Haliptylon*, *Ulva* spp., and *Zonaria farolwii*.

Six predominant taxa exhibited distributions that varied significantly among stations, but no patterns that interrelated these differences were obvious. These six taxa were the anemone *Anthopleura* spp.; the rhodophytes *Corallina/Haliptylon*, *Lithothrix aspergillum*, *Pterocladia/Gelidium*; and the phaeophytes *Sargassum* spp. and *Zonaria farlowii*.

1976 Data

Quarterly intertidal sampling was also conducted in 1976. A taxonomic summary of these data by survey and station is presented in Table VI-1, pp. 35-38 of ref. 26.

Predominant taxa identified to at least the generic level were *Sargassum* spp., *Mitrella carinata*, *Macron lividus*, *Anthopleura elegantissima*, *Corallina/Haliptylon*, *Zonaria farlowii*, and *Dictyota/Pachydictyon*. The distribution of the abundance of these organisms for each station and for each survey is presented in Table VII-11, p. 104 of ref. 27. No significant differences were found in the abundance of *Dictyota/Pachydictyon*, *Macron lividus*, and *Mitrella carinata* among stations. The distribution of four taxa — *Corallina/Haliptylon*, *Zonaria farlowii*, *Sargassum* spp., and *Anthopleura elegantissima* — displayed statistically significant differences in abundance among stations. *Corallina/Haliptylon* was most abundant at station 5, *Zonaria farlowii* at stations 2 and 4, and *Sargassum* spp. was at station 3. The greatest number of *A. elegantissima* was observed at stations 1, 4, and 5.

The rhodophyte *Corallina/Haliptylon* contributed the most to the differences among stations during both 1975 and 1976 and was also predominant both years. During both years this taxon was more abundant at the station farthest downcoast of the SONGS 1 discharge and least abundant at the two stations upcoast of the discharge. Three other predominant taxa, *Sargassum* spp., *Zonaria farlowii*, and *Anthopleura elegantissima* exhibited statistically significant differences in abundance among stations during both 1975 and 1976. *Dictyota/Pachydictyon* exhibited no statistically significant differences in abundance among stations during either year.

No statistically significant difference in the distribution of taxa among trophic types existed among intertidal stations during either year. During both years, the intertidal communities of all stations were dominated by primary producers (algae).

The study area is accessible to considerable human intervention in the form of organism collecting in the tide pools, clam digging, surfing, and walking through intertidal cobble beds. Because of their accessibility via public roads, the stations nearest and upcoast of the generating station receive the heaviest use; the other stations receive less use because they are accessible only via hiking trail or the beach. Overall beach use in the study area is indicated by the San Onofre Beach State Park (which includes the study area) estimates of park use for 1976, which indicate that 378,483 people used the beach in the study area. The study area is also used heavily by clam diggers collecting littleneck clams, because this area is probably one of the most extensive and productive in the state. The large excavations and overturned cobble that result from clam digging may have considerable effect on the intertidal biota by disturbing habitats and interfering with mating activities.

Aerial infrared survey data on three occasions in 1976 revealed possible shore impingement of the 0.6°C (1°F) elevated temperature field at the four stations nearest the generating station. The 2°C (4°F) elevated field appeared to contact the shore immediately upcoast of the generating station but did not impinge on any intertidal cobble stations. Shore impingement of the elevated temperature field was not indicated in 1975.

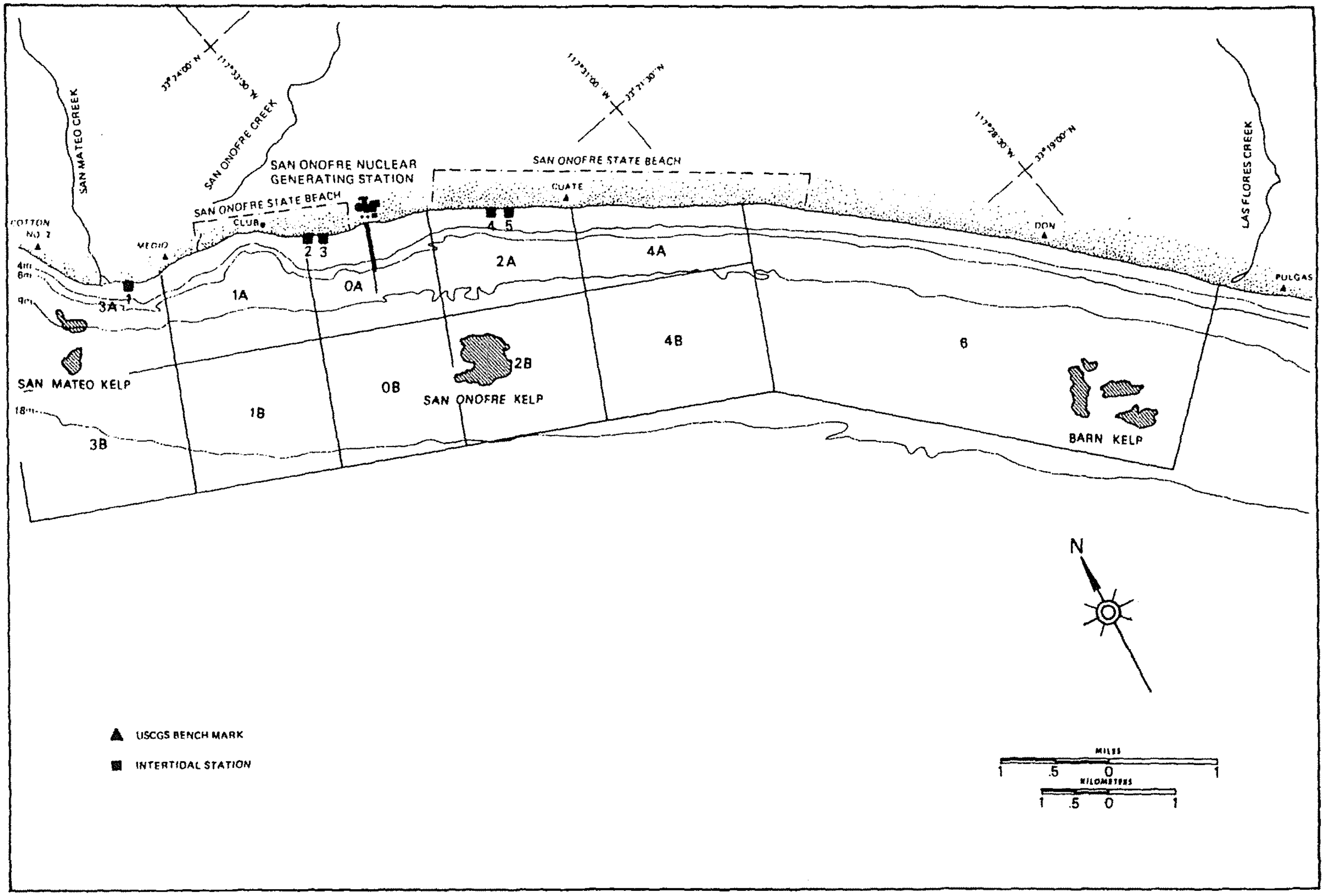

Fig. 2.11. Environmental Technical Specifications intertidal station locations and environmental surveillance zones, San Onofre Nuclear Generating Station Unit 1. <u>Source</u>: Lockheed Center for Marine Research, *San Onofre Nuclear Generating Station Unit 1, Environmental Technical Specifications, Annual Operating Report, Vol. IV, Biological Data Analysis — 1976*, June 1977.

Based on a comparison of the abundance of predominant taxa among stations and the similarity of stations during the study, the intertidal communities under study did not display a great deal of temporal variation during either 1975 or 1976. Minimal differences were detected among surveys with respect to the abundance of predominant taxa. These differences did not appear related to the offline condition of the generating station which occurred during two of four surveys.

2.6 BACKGROUND RADIOLOGICAL CHARACTERISTICS

The Environmental Protection Agency[29] has reported average background radiation dose equivalents for California as 96.6 millirems per person per year. The average background for San Diego is 104.6 millirems per person per year. (This is higher than the state average because of natural radioactivity in granitic rocks in the area.) Of the total for California, 42.2 millirems per person per year was attributed to cosmic radiation. Of this total external gamma radiation (primarily from K-40 and the decay products of the uranium and thorium series) was estimated at 36.4 millirems per person per year. The remainder of the whole body dose is due to internal radiation (mostly H-3, C-14, K-40, Ra-225, and Ra-228 and their decay products), which was estimated to average 18 millirems per person per year.

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3. THE PLANT

3.1 RESUME

The domestic water supply and service water system will now be supplied by the Tri-Cities Municipal Water District rather than obtained from flash boilers as previously contemplated (Sect. 3.2.1). The major design changes that have environmental effects relate to the heat dissipation system. The revised heat dissipation system is described in Sect. 3.2.2. These revisions and others result in a change in the chemical effluents and are discussed in Sect. 3.2.4.1. Changes in the radioactive waste treatment systems are described in Sect. 3.2.3. Significant changes have occurred in the transmission lines; the revised transmission line system is described in Sect. 3.2.5.

3.2 DESIGN AND OTHER SIGNIFICANT CHANGES

3.2.1 Plant water use

Both fresh water and seawater will be used at SONGS 2 & 3. About 0.05 m^3/sec (1.65 cfs) of fresh water will be supplied by the Tri-Cities Municipal Water District for the domestic water supply system and service water system. The major portion of the domestic water requirement will be used for landscaping and associated functions. The service water system will provide water to miscellaneous systems and equipment throughout the operating areas. A large amount of this fresh water will be used at the intake screenwell area for cooling of pump bearings.

The source of seawater is the Pacific Ocean. Cooling water will be withdrawn from the ocean at a rate of 53.5 m^3/sec (1887 cfs). This water will be used for turbine plant cooling, component cooling, main condenser cooling, and for the fish handling system. The turbine plant and component cooling water systems are closed-cycle systems. Heat is transferred to the seawater by heat exchangers.

Further details of the plant water use are given in Fig. 3.1.

3.2.2 Heat dissipation system

Plant waste heat will be dissipated by means of a separate once-through cooling system for each unit. About 53.5 m^3/sec (1887 cfs) of seawater per unit is withdrawn from the ocean through a velocity-cap-type submerged intake, located about 975 m (3200 ft) from shore. The velocity cap is circular with a 15-m (50-ft) diameter. The lower lip of the cap is 2.7 m (9 ft) from the ocean bottom, and the interior separation of the upper and lower lip is 2.1 m (7 ft). The intake velocity will be about 0.5 m/sec (1.7 fps). The total water depth at the intake region is 9.1 m (30 ft). The intake structure is illustrated in Fig. 3.2.

Each unit has a Seismic Category I auxiliary intake structure to provide emergency core cooling. These structures are located approximately 32 m (100 ft) shoreward of the primary intake structures. Each structure has a 3.66 m (4-ft) ID vertical riser that extends upward from the intake conduit and is equipped with a velocity cap that is similar in design to that of the primary system. During normal operating conditions, water is estimated to enter the structure at 0.38 m/sec (1.3 fps). Details of these structures are shown in Fig. 3.2.

After passing through the intake, the cooling water for each unit will travel to the plant via a 5.5-m (18-ft) ID pipe that becomes a 4.9-m (16-ft) square box conduit at the shoreline. Here, water is delivered to a forebay leading to the intake structure screenwell. The water will then pass through a series of baffles as the channel widens to about 12.5 m (41 ft). At this point, the channel narrows and the main volume of water turns through an angle of 70°, where it passes through six adjacent sets of traveling bars and screens. A small volume of water does not turn towards these bars and screens but continues along the narrowing channel and enters the fish collection chamber.

Each screenwell is outfitted with traveling bar racks behind which are 1-cm (3/8-in.) mesh traveling screens. In the forebay behind the traveling screens are four 1/4-capacity vertical, wet pit,

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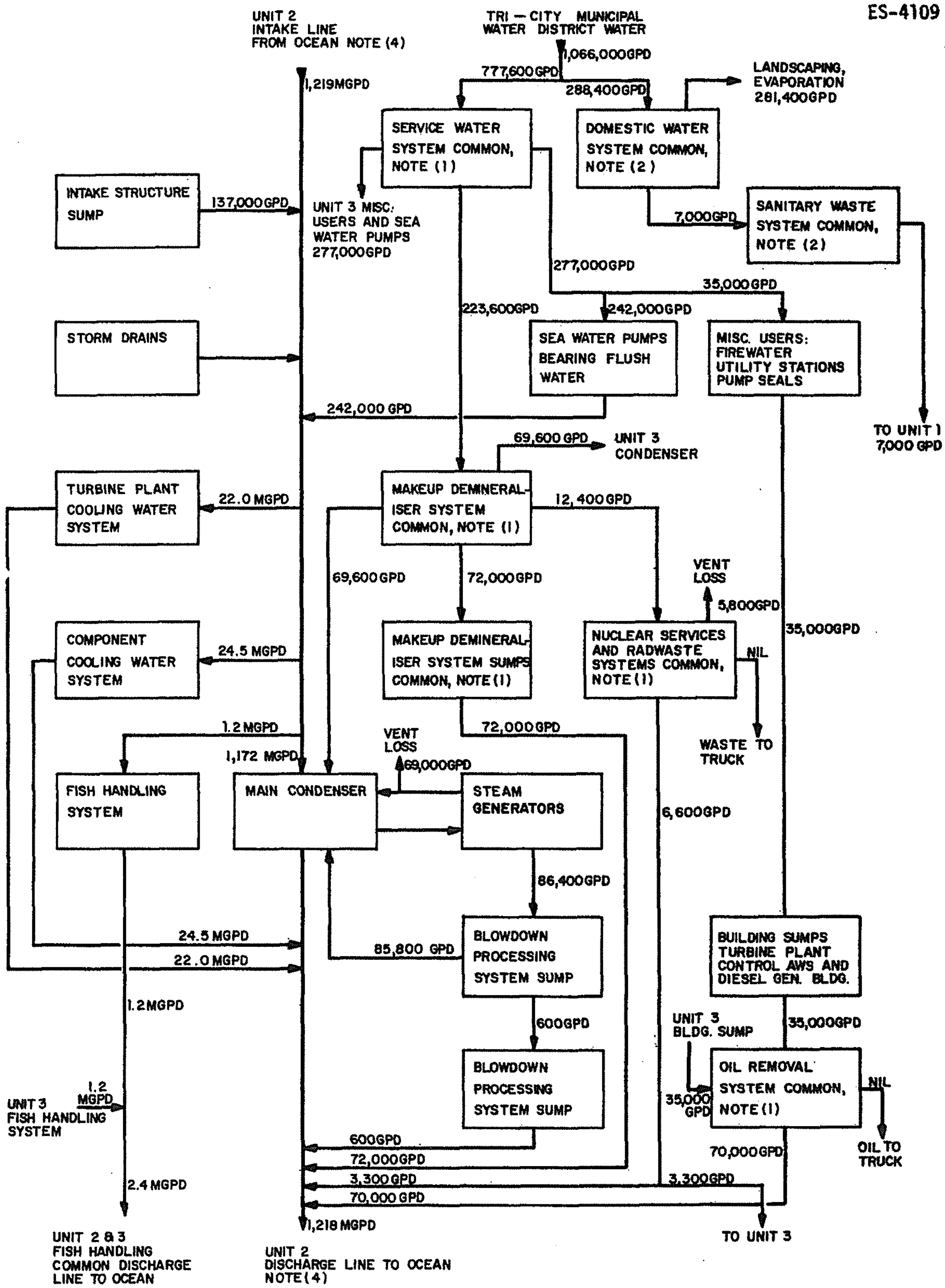

Notes: (1) Common system, serves Units 2&3
(2) Common system, serves Units 2&3, AWS bldg
(3) MGPD, millions of gallons per day
(4) Unit 3 flows are same as Unit 2
(5) To convert GPD to liters per day, multiply by 3.7854

Fig. 3.1. Plant water use. Source: ER, Fig. 3.3-1.

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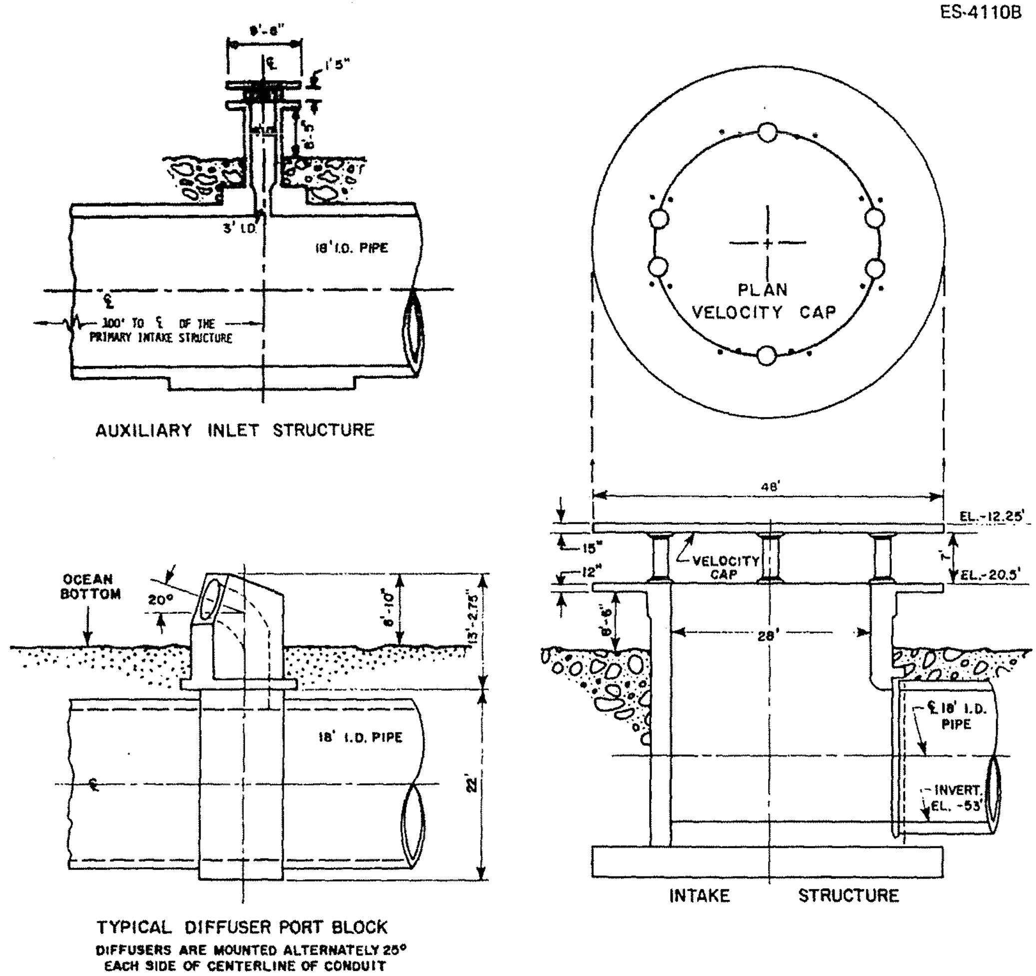

Fig. 3.2. Design details of the velocity-cap intake structure and typical diffuser port. Source: ER, Fig. 3.4-2.
(To convert ft to m, multiply by 0.3048.)

circulating water pumps. These pumps provide 50.3 m^3/sec (1775 cfs) of water to a two-shelled condenser. This water experiences an 11.1°C (20°F) temperature rise across the condenser. About 2.1 m^3/sec (75.8 cfs) of water is withdrawn prior to reaching the condenser for use in the turbine plant cooling loop and the fish return systems. Details of the intake screenwell structure are shown in Fig. 3.3.

After passing through the condenser, the heated water will pass through the Amertap strainer, which collects the Amertap balls used for cleaning the condenser tubes. Subsequently, this heated water is supplemented by 1.1 m^3/sec (37.9 cfs) of water from the turbine plant cooling system and screenwashing. The water then passes into a seal well weir chamber designed to ensure proper siphon flow through the condenser. This chamber terminates into a 4.9-m (16-ft) square box conduit to which 1.1 m^3/sec (37.9 cfs) of nuclear component cooling water flow is added. At the shoreline, this square conduit joins a 5.5-m (18-ft) ID buried pipe that conveys the heated water to the diffuser.

The diffuser for each unit is about 762 m (2500 ft) in length, and each diffuser has 63 ports spaced 12 m (40 ft) apart. Each port extends 1.8 m (6 ft) from the bottom and is oriented from the horizontal at an angle of 20°. The ports are alternately aligned at angles of ±25° from the offshore direction. The port throat diameter will vary from 56 cm (22 in.) to 61 cm (24 in.), and the maximum discharge velocity from any port will be 4 m/sec (13 fps). The Unit 3 diffuser begins about 1150 m (3800 ft) from shore, and the Unit 2 diffuser begins about 1950 m (6400 ft) from shore. The Unit 2 diffuser is located about 220 m (722 ft) upcoast of the Unit 3 diffuser.

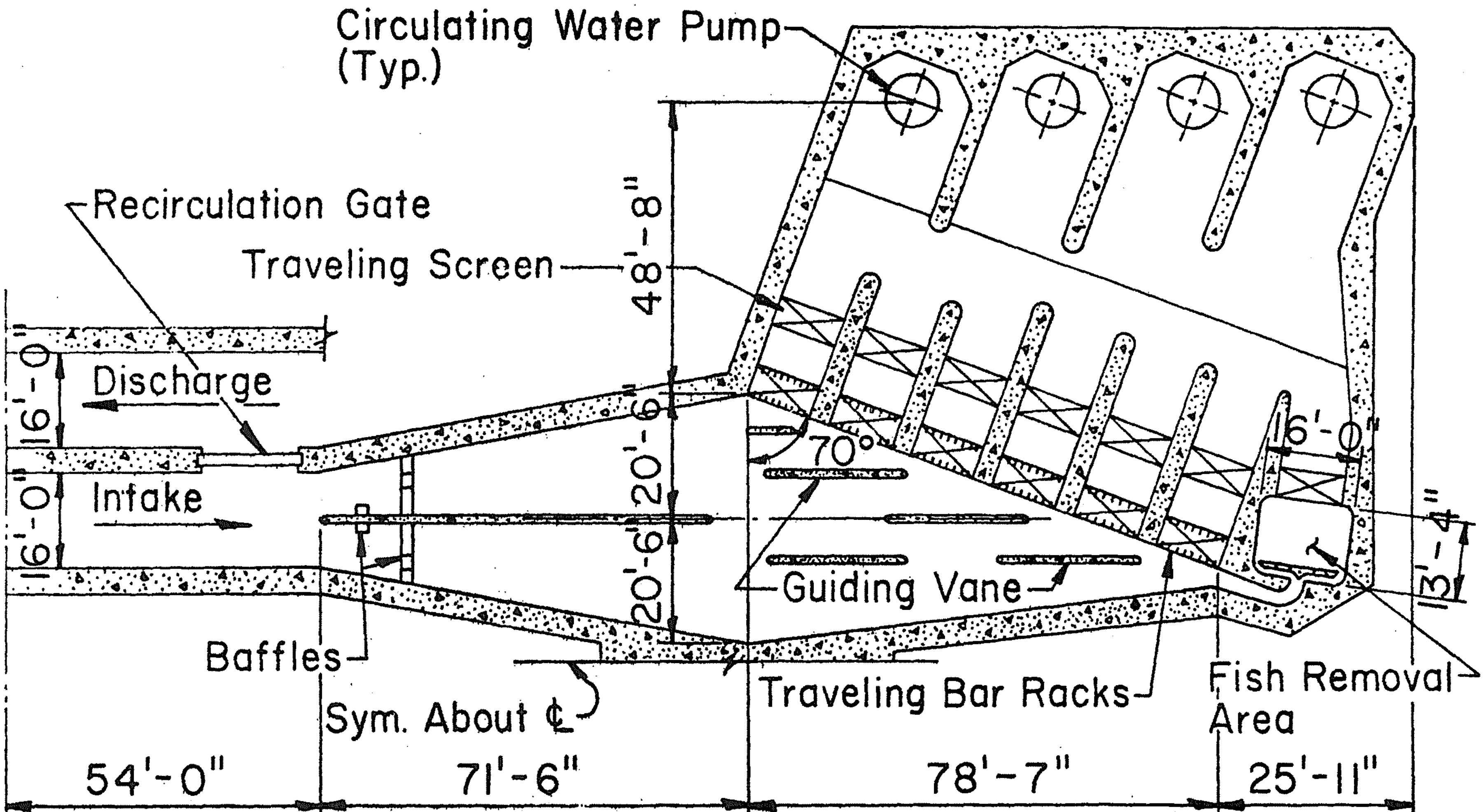

Fig. 3.3. Design details of the intake screenwell area. Source: ER, Fig. 3.4-3. (To convert ft to m, multiply to 0.3048; to convert in. to mm, multiply by 25.4.)

To control biofouling, the circulating water system is designed to allow heated water to reach all portions of the system. To accomplish this, an intake/discharge crossover gate allows seawater to be drawn into the plant through the diffusers and the heated water to be discharged via the intake. To achieve the temperature required to control biofouling, each unit has a recirculation and crossover gate. This system allows the cooling water requirement to be reduced by recirculating a portion of the heated water through the condenser. The temperature rise will be proportional to the degree of recirculation. During diffuser heat treatment, the circulating water follows the normal path but with recirculation. Intake heat treatment is performed by opening the intake/discharge crossover gate to reverse the flow direction, as well as to allow recirculation. Circulating water flow paths for the various plant operations are shown in Fig. 3.4.

A fish return system minimizes the mortality of fish that have reached the intake screenwell area. The louvered bar racks are designed and oriented in such a way that the fish are encouraged to follow a narrowing channel terminating at a fish holding chamber. This chamber is equipped with a vertical elevator basket that periodically rises slowly from the bottom to capture the fish in the chamber. Subsequently, the fish are flushed from the basket with seawater into a 1.2-m (48-in.) diameter pipe, which returns them to the ocean via an offshore submarine outfall.

3.2.3 Radioactive waste systems

During the operation of SONGS 2 & 3 radioactive material will be produced by fission and by neutron activation of corrosion products in the reactor coolant system. From the radioactive material produced, small amounts of gaseous and liquid radioactive wastes will enter the waste streams. These streams will be processed and monitored within the station to minimize the quantity of radioactive nuclides ultimately released to the atmosphere and to the Pacific Ocean.

The waste handling and treatment systems to be installed at the station are discussed in the applicant's Final Safety Analysis Report (FSAR) and in the ER. Information submitted to meet the requirements of Appendix I to 10 CFR Part 50 is contained in both the FSAR and ER. In these documents, the applicant has presented an analysis of the radioactive waste treatment systems and has estimated the annual release of radioactive waste materials in liquid and gaseous effluents resulting from normal operation.

In the following paragraphs, the radioactive waste treatment systems are described, and an analysis is given based on the staff's model of the applicant's proposed radioactive waste treatment systems. The staff's model has been developed from a review of available data from operating nuclear power plants, adjusted to apply over a 30-year operating life. The reactor coolant activities and flow rates used in the staff's analyses are based on experience and data from operating reactors. As a result, the parameters used in the model and the calculated releases vary somewhat from those used in the applicant's evaluation.

On April 30, 1975, the NRC announced its decision in the rulemaking proceeding (RM 50-2) concerning numerical guides for design objectives and limiting conditions for operation to meet the criterion "as low as is reasonably achievable" for radioactive material in light-water-cooled nuclear power reactor effluents. This decision is implemented in the form of Appendix I to 10 CFR 50.[1] To effectively implement the requirements of Appendix I, the NRC staff has reassessed the parameters and mathematical models used in calculating releases of radioactive materials in liquid and gaseous effluents in order to comply with the Commission's guidance.

This guidance directed that current operating data, applicable to proposed radwaste treatment and effluent control systems for a facility, be considered in the assessment of the input parameters. These parameters, models, and their bases are given in NUREG-0017.[2]

By letter of February 25, 1976, the applicant was requested to submit additional information concerning the means proposed to keep levels of radioactive materials in effluents from SONGS 2 & 3 to unrestricted areas "as low as is reasonably achievable," in conformance with the requirements of Appendix I to 10 CFR 50. The applicant was also given the option of providing either a detailed cost benefit analysis or demonstrating conformance to the guidelines given in the September 4, 1975, Annex to Appendix I. The applicant chose to perform the cost-benefit analysis required by Sect. II.D of Appendix I to 10 CFR Part 50.

The staff performed an independent evaluation of the applicant's proposed methods to meet the requirements of Appendix I. The evaluation consisted of (1) a review of the information provided by the applicant, (2) a review of the applicant's proposed radwaste treatment and effluent control systems, (3) the calculation of new source terms based on models and parameters as given in NUREG-0017,[2] and (4) a cost-benefit analysis to determine the cost-effectiveness of proposed augments to the liquid and gaseous radwaste treatment systems.

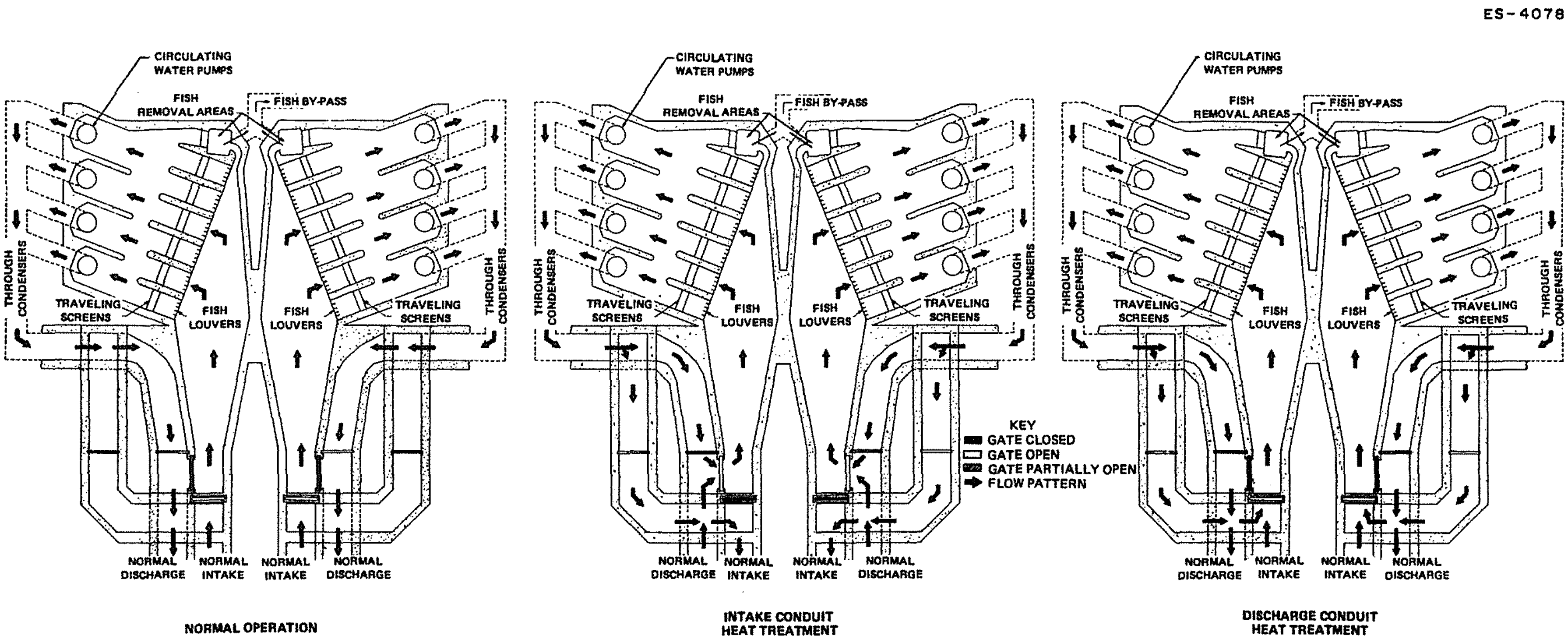

Fig. 3.4. Circulating water flow paths for normal plant operation, intake heat treatment, and discharge heat treatment. Source: Fig. 2-9 of *Thermal Effects Study Final Summary Report, San Onofre Generating Station Units 2 & 3 Volume 1*; Environmental Quality Analysts and Marine Biological Consultants, September 1973.

On the basis of the following evaluation, the staff concludes that the liquid and gaseous radio-active waste treatment systems for SONGS 2 & 3 are capable of maintaining releases of radioactive materials in liquid and gaseous effluents to "as low as is reasonably achievable" levels in accordance with 10 CFR Part 50.34a, and meet the requirements of Sect. II.A, II.B, II.C, and II.D of Appendix I to 10 CFR Part 50.[1]

3.2.3.1 Liquid radioactive waste treatment system

The liquid radioactive waste treatment system, which is shared by Units 2 and 3, will consist of equipment and instrumentation necessary to collect, process, monitor, recycle, or dispose of potentially radioactive liquid wastes generated during normal operation including anticipated operational occurrences. Liquid radioactive waste will be processed on a batch basis to permit optimum control of releases. Prior to release, samples will be analyzed to determine the types and amounts of radioactivity present; on the basis of the results, the waste will be recycled for reuse in the plant, retained for further processing, or discharged under controlled conditions to the Pacific Ocean via the circulating water outfall. A radiation monitor will automatically terminate liquid waste discharge if radiation measurements exceed a predetermined level in the discharge line. A schematic diagram of the liquid radioactive waste treatment system is given in Fig. 3.5.

The liquid radioactive waste treatment system will consist of the coolant radwaste (boron recovery) system, the miscellaneous (aerated) waste system, and the chemical waste system. The plant does not have a separate laundry and hot shower system; this function is combined in the aerated waste system.

The coolant radwaste system is shared by Units 2 and 3 and will process shim bleed and equipment drain wastes collected inside the reactor containment. The principal system components will be a gas stripper, four primary coolant radwaste holdup tanks, two preholdup demineralizers, two intermediate holdup tanks, two evaporator feed demineralizers, one evaporator, two polishing demineralizers, and two makeup storage tanks.

The miscellaneous liquid waste system will process non-reactor-grade liquid wastes, including floor drains, equipment drains containing non-reactor-grade water, and building sumps. After treatment these wastes will be transferred to the waste monitor tanks for reuse in the plant or for discharge to the Pacific Ocean via the circulating water outfall. The principal miscellaneous liquid waste system components will consist of one collection tank, four demineralizers, an optional evaporator, and two recycle monitor tanks. The liquid process stream may be routed through the optional evaporator if additional treatment is indicated.

The chemical waste system will process non-reactor-grade liquid wastes with high chemical content, including demineralizer regenerant solutions and laboratory drains. After treatment, these wastes will be transferred to the waste monitor tanks for reuse in the plant or for discharge to the Pacific Ocean via the circulating water outfall. The principal chemical waste system components will consist of one collection tank, an evaporator, two demineralizers, and two recycle monitor tanks.

The steam generator blowdown will be processed continually through a flash tank, with the liquid being cooled in a heat exchanger before passing through a filter and two demineralizers in series. The processed liquid is piped to the main condenser. The flashed steam is routed to the third point heater. The processed water will be reused in the plant, but may be discharged to the circulating water outfall under certain circumstances provided that radioactivity concentrations are below predetermined values.

Coolant radwaste system

Primary coolant will be withdrawn from the reactor coolant system at about 151 liters/min (40 gpm) and processed through the chemical and volume control system (CVCS). The letdown stream will be cooled, reduced in pressure, filtered, and processed through one of two mixed bed demineralizers. At the end of core cycle life this letdown stream will be passed through an anion demineralizer to remove boron when the feed and bleed mode of operation is not practicable. Radionuclide removal by the CVCS was evaluated by assuming 151-liters/min (40-gpm) letdown flow at primary coolant activity (PCA) through one mixed bed demineralizer (Li_3BO_3 form), and a continuous 30-liters/min (8-gpm) flow through one mixed bed demineralizer (H_3BO_3 form) for lithium control. The CVSC will be used to control the primary coolant boron concentration by diverting a side stream of about 3,785 liters/day (1000 gpd) per reactor of the treated letdown stream to the shared coolant radwaste system as shim bleed.

The shim bleed from the letdown stream will be processed through two mixed bed demineralizers (Li_3BO_3 form) in series, through a gas stripper, and routed to one of four 227,124-liter (60,000-gal) radwaste primary holdup tanks. Valve leakoffs and equipment drain wastes in the