

CALIFORNIA COASTAL COMMISSION

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Energy and Ocean Resources Unit

Staff Report: June 28, 1991
Hearing Date: July 16, 1991
Item Number: 4

Commission Action: Approved
Action Date: July 16, 1991
Commission Vote: 9 to 2

ADOPTED COASTAL COMMISSION RESOLUTION TO FURTHER CONDITION

PERMIT NO. 183-73

SAN ONOFRE NUCLEAR GENERATING STATION UNITS 2 AND 3

PERMITTEES: Southern California Edison Company and
San Diego Gas and Electric Company

PERMIT NO. 183-73

PROJECT DESCRIPTION: Adopted resolution to (1) further condition
permit for San Onofre Nuclear Generating Station
Units 2 and 3, in San Diego County, to address
substantial effects on the marine environment,
as identified by the Marine Review Committee;
and (2) make recommendations to the San Diego
Regional Board regarding NPDES permit monitoring.

SUBSTANTIVE FILE DOCUMENTS: See Appendix 4

EXECUTIVE SUMMARY

Coastal Commission's July 16, 1991 Action

On July 16, 1991, the Coastal Commission adopted a resolution to further condition Southern California Edison's (SCE) and San Diego Gas and Electric's (SDG&E) coastal permit (Permit 183-73) for Units 2 and 3 of the San Onofre Nuclear Generating Station (SONGS) in northern San Diego County. The new conditions require mitigation for impacts to the marine environment that the Marine Review Committee (MRC) found to be caused by the operations of Units 2 and 3 of SONGS.

The Commission also adopted a resolution to the San Diego Regional Water Quality Control Board (San Diego Regional Board) (Exhibit 7). This resolution recommends changes to the NPDES monitoring program and transmits MRC data regarding potential non-compliance with NPDES permit standards.

The Marine Review Committee Established by the Coastal Zone Conservation Commission as a Condition of the Coastal Permit for SONGS Units 2 and 3

In 1974, when the CZCC reviewed SCE's and San Diego Gas and Electric's (SDG&E) application for SONGS Units 2 and 3, there was very little reliable scientific information on the impacts SONGS would cause on the marine environment. Southern California Edison believed that SONGS would not cause substantial adverse impacts on the marine environment. Some scientists who testified predicted an "ecological desert." Others predicted large drops in phytoplankton and zooplankton populations. Others testified that the heated water would have significant impacts on the marine environment surrounding SONGS.

On February 20, 1974, (under the Coastal Zone Conservation Act of 1972 - "Proposition 20"), the CZCC approved Units 2 and 3 with the provision that a three member independent committee - the Marine Review Committee - would carry out a comprehensive field study of the impacts of SONGS on the marine environment, and with the commitment that SCE would make future changes in the SONGS cooling system (as extensive as cooling towers) to address impacts to the marine environment identified by the MRC.

The Membership of the Marine Review Committee

The MRC is composed of three scientists: one, the Chairman, appointed by the Commission; another by the applicants, SCE and SDG&E; and the third by the appellants, who are coordinated by the Friends of the Earth. The current membership of the MRC is the Chairman, Dr. William Murdoch, UC Santa Barbara (Commission's representative); Dr. Byron Mechals, SCE (applicant's representative); and Dr. Rimmon Fay, Pacific Bio-Marine Laboratory (appellant's representative).

The Coastal Zone Conservation Commission's Original Mandate to the Marine Review Committee

Coastal permit 183-73 directed the MRC to: (1) determine the effects of the cooling system of SONGS Unit 1 on the adjacent marine ecosystem; (2) predict the effects of SONGS Units 2 and 3; and (3) monitor the effects of Units 2 and 3. The aim was to obtain information that would allow the CZCC to decide whether or not changes in the cooling system should be required to prevent or reduce any significant effects that Units 2 and 3 cause to the marine environment.

Permit condition B.4 states that MRC shall be responsible for

"...recommending to the State Commission any changes it believes necessary in the cooling system for Units 2 and 3. The State Commission shall then further condition the permit accordingly."

Permit condition B.6 states:

"Should the study at any time indicate that the project will not comply with the regulatory requirements of State or Federal water quality agencies or that substantial adverse effects on the marine environment are likely to occur, or are occurring, through the operation of Units 1, 2, and 3, the applicants shall immediately undertake such modifications to the cooling system as may reasonably be required to reduce such effects or comply with such regulatory requirements (which can be made while construction is going on and could be as extensive as requiring cooling towers if that is the recommendation). The State Commission shall then further condition the permit accordingly."

In 1979 the Commission Directed the Marine Review Committee to Consider Mitigation

In November 1979, the Commission, as successor agency to the CZCC pursuant to PRC section 30331, recognized that some effects might be mitigated without requiring changes in the cooling system. It directed the MRC as follows:

"The Commission recognizes the difficulties in requiring major design changes to SONGS Units 2 and 3 after the NRC grants operating licenses and the units are generating electricity. Changes such as requiring cooling towers, extended diffusers or single point discharges could cost hundreds of millions of dollars and result in unit shutdown for a period of time. The Commission has the authority to impose such changes, however, if recommended by the MRC after unit operation in order to prevent significant environmental damage...The Commission also recognizes that operational changes or mitigation measures might adequately compensate for any marine life damages resulting from the operation of Units 2 and 3. The Commission, therefore, requests the MRC to study the feasibility and effects of selected promising mitigation measures, including construction of an artificial reef, as suggested by Southern California Edison. The MRC should recommend what measures might be taken to assure there would be no net adverse effect on the marine environment from operation of SONGS Units 2 and 3."

The Coastal Commission's Responsibility in the SONGS Permit

The coastal permit for SONGS Units 2 and 3 was granted by the California Coastal Zone Conservation Commission under the Coastal Act of 1972. The Coastal Act of 1976 superceded the Coastal Act of 1972. Section 30609 of the 1976 Coastal Act provides that permits granted under the 1972 law and any conditions thereto remain in full force and effect. In addition, the conditions are agreements in the nature of a contract between the applicant and the Commission. For both of these reasons, such conditions must be complied with.

In the case of the SONGS permit, SCE made commitments to fund MRC's work and to address impacts to the marine environment identified by the MRC as being caused by SONGS.

The Commission's area of responsibility in this action is to:

- 1) review the permit for condition compliance; and
- 2) condition the permit further to address the SONGS-caused marine resource impacts identified by the Marine Review Committee; and
- 3) forward recommendations to the San Diego Regional Water Quality Control Board (San Diego Regional Board) and the State Water Resources Control Board on the findings of the MRC regarding water quality and NPDES permit monitoring.

The Marine Review Committee's Results and Recommendations

The Marine Review Committee's summary of its principal conclusions and recommendations are quoted below: (Source MRC Final Report)

- o The plant kills large numbers of organisms in its intake cooling water, and sometimes moves turbid water into the San Onofre kelp bed (SOK).
- o The MRC has measured adverse effects on the kelp community in San Onofre kelp bed, including giant kelp, fish, and large benthic invertebrates. These effects, although local, are deemed substantial because kelp is a valuable and limited habitat.
- o The MRC calculates that there is a substantial impact on the standing stock of a number of fish populations in the Southern California Bight. The reductions in standing stocks of these species are probably between one and ten percent. Because the effects can occur over large populations, we conclude they are substantial.
- o The MRC has also measured a reduction in the local abundance of some midwater fish populations. Each year, SONGS takes in 45 tons of fish and kills at least 21 tons of fish per year in its intake system. This estimate was made in a period of depressed fish abundance, and over the long term the amount killed will be about 56 tons per year.

- o The MRC analyzed a range of options for preventing, reducing, or mitigating these impacts, and presents two sets of options to the Commission. Option 1a is cooling towers; the majority of the MRC (Mechalas and Murdoch) recommends rejection of this option, Dr. Fay recommends its acceptance. Option 1b is moving the discharges; the MRC recommends against this option.

The MRC recommends acceptance of Option 2, which involves creating an kelp bed artificial reef, upgrading the existing systems at SONGS that are designed to exclude fish from the plant or to return them to the ocean, and selection of one or a combination of three techniques: (1) reduction of flow of cooling water through SONGS or other SCE coastal power plants; (2) construction of a high-relief artificial reef designed to maximize fish production; and/or (3) restoration of a wetland.

The MRC also recommends that the State Thermal Plan be amended to remove restrictions on the allowable across-the-condenser temperature rise for open coastal power plants, to facilitate reducing the flow of cooling water.

- o Other parts of the community that were studied and in which no substantial adverse effects were found are: the plankton, a range of animals associated with the sandy bottom, including invertebrates living in or on the soft sediments (these are called the "soft benthos"), certain mysids, bottom-dwelling fish, and intertidal sand crabs. The soft benthos, mysids and bottom-dwelling fish increased in abundance in the SONGS' area as a result of the plant's activities (Dr. Fay disagrees with these conclusions).
- o The MRC concludes that SONGS is not in compliance with certain water quality regulations. The level of natural light at the bottom, downcoast from SONGS, was 6-16% lower than it would have been without SONGS. There were significant reductions in local populations of midwater fish, and of kelp, fish and invertebrates in the San Onofre kelp bed.

The Marine Review Committee Submitted its Final Report to the Commission in 1989

The Marine Review Committee submitted its Final Report to the Coastal Commission in August of 1989. In December of 1989, the Marine Review Committee scientists presented a workshop to the Commission. During the workshop, the MRC presented slides and a detailed description of SONGS' impacts to the marine environment. The workshop was videotaped and the tapes are available on loan from the Commission's Energy and Ocean Resources Unit. Copies of the MRC Final Report and the Mitigation Technical Report have been sent previously to the Commission.

The Coastal Commission staff worked with the MRC scientists, SCE, environmental groups, fish and wildlife agencies, the Coastal Conservancy, the San Diego Regional Board, the State Water Resources Control Board, wetlands and kelp scientists and others to develop a recommendation to the

Commission. The goal of the staff was to develop a set of findings and conditions for the Commission's consideration that followed MRC's recommendations and addressed existing Coastal Commission and wildlife agencies practices and policies.

Coastal Permit Conditions Require Mitigation for Marine Resource Impacts Caused by SONGS

Commission staff spent considerable time reviewing the issues, past Commission efforts and practices, and the experience of others in various locations around the country relative to how habitat creation and restoration projects should and should not be formulated and implemented. The goal was to devise a program that would maximize opportunities for long-term success. The Commission's adopted program is on the cutting edge of what is known and being done in this field.

A. Mitigation for Fish Losses

The Commission evaluated the three options recommended unanimously by the MRC for mitigating bightwide fish losses, as well as an option that was rejected by the MRC (fish hatchery). The Commission first considered the two options that involve preventing impacts through modification of the cooling system operations--rescheduling SONGS operations or reducing the cooling water inflow during times of high fish larval abundances. The Commission believes that the costs of these options, relative to the benefits that would be derived, do not warrant their implementation.

From among the remaining mitigation options, the Commission selected the coastal wetlands restoration for several reasons. Coastal wetlands provide valuable habitats for fish, including many of the species affected by SONGS as well as other economically important species, such as halibut. In addition, wetlands restoration provides numerous other marine and coastal resource benefits, such as providing habitats for a variety of marine organisms, including many rare and endangered species, and migrating birds. The wetlands restoration is required to be 150 acres in size, the upper end of the range recommended by the MRC. The Commission required that at least 150 acres be restored because the MRC estimate is conservative and there is uncertainty over the actual values produced by and the potential for success of any wetland restoration project.

Condition A sets forth a process through which a wetland site will be selected and a preliminary restoration plan developed to mitigate for bightwide fish losses and provide maximum marine and coastal resource benefits. The permittee will evaluate five potential wetland restoration sites using a list of standards and objectives included in the permit condition that reflect these overall goals. The Commission will review and approve the proposed site and preliminary plan. The condition includes performance standards to measure the success of the restored wetland.

In addition to the wetlands restoration to mitigate for fish losses, the Commission required the permittee to install behavioral barrier devices (Condition B). Behavioral barriers have the potential to reduce fish losses by diverting fish from entering the intakes or to guide entrapped fish into the fish return system.

B. Mitigation for Impacts to San Onofre Kelp Bed

To mitigate for the impacts from SONGS discharge plume on the San Onofre Kelp reef, the the Commission required construction of a 300 acre artificial kelp reef, as recommended by the MRC. The Commission evaluated other alternatives such as moving the discharge, but determined that the artificial reef had the greatest potential for effectively mitigating the impacts and providing the greatest overall benefits.

Condition C sets forth a process through which a 300 acre artificial kelp reef would be sited and designed in such a manner as to have a high likelihood of successfully replacing the lost resources.

C. Resolution to the San Diego Regional Water Board

Based on the MRC findings on water quality compliance, the Commission adopted a resolution (Exhibit 7) recommending that the San Diego Regional Board amend its NPDES permits for Units 2 and 3 to (1) require monitoring of the effects to midwater fish and kelp bed biota; (2) require measurement of light reduction by total irradiance rather than light transmissivity, and (3) specify guidelines for sampling design and statistical procedures that distinguish SONGS-induced effects from natural fluctuations.

The Full Mitigation, Monitoring, and Remediation Package is Needed to Offset Impacts Caused by SONGS

The Coastal Acts (1972 and 1976) have strong policies for the protection of the marine environment. It has typically been the Commission's practice to require changes in a project to prevent impacts rather than to allow impacts to occur and then provide mitigation.

MRC's recommendations included mitigation measures (kelp bed reef, wetland restoration) and potential changes to the power plant to prevent or reduce impacts. The MRC Final Report gave options for the Commission to select between mitigation measures or changes to the plant or a combination of approaches.

In reviewing MRC's recommendations, the Coastal Commission made prevention of impacts to the marine environment the top priority. After an exhaustive review of the feasible prevention alternatives, the Commission believes that the prevention alternatives that involved changes to the plant or operational changes (example: flow reduction) are not warranted because of high costs, technical constraints, and environmental impacts. These environmental impacts include increased use of other coastal power plants resulting in increased losses of fish at those locations and increases in air emissions.

The adopted conditions which set up a mitigation, monitoring, and remediation program is viewed as a minimum package. The Commission believes that the only way that SCE should be allowed to mitigate impacts rather than make extensive SONGS cooling system and operational changes to prevent impacts is through the full adopted mitigation package. This package was recommended by MRC and refined and specified through the staff recommendation. A lesser mitigation package would not fully address the impacts caused by SONGS and would not be in compliance with the coastal permit conditions.

The MRC - An Innovative Program

When the Coastal Commission established the independent MRC in 1974, it set up an innovative and bold process to collect sound scientific data on the impacts of SONGS on the marine environment. The Commission knew there was not agreement among experts as to what impacts SONGS would cause. Therefore, the MRC was purposefully composed of three scientists representing divergent points of view - Southern California Edison, the appellants (a consortium of environmental groups) and the Coastal Commission.

The MRC process brought together the scientists representing different views to design the methods of data collection and analysis and to decide the focus and scope of the study. During the entire MRC process the three MRC members debated the scope and methods of the study and the interpretation of the results. The MRC process necessitated a lot of give and take in order to accommodate the divergent scientific opinions. This process resulted in a balanced interpretation of the data.

MRC's findings on the marine resource impacts and its recommendation on mitigation measures are supported by strong, defensible scientific data. MRC's findings on the marine resource impacts and MRC's package of recommended mitigation measures are conservative and not inflated in any way. All three MRC members signed the Final Report, although Dr. Fay did highlight the sections of the Final Report with which he did not agree and he submitted a minority report.

Cooling towers are the only prevention technique that would result in essentially full marine resource protection. One MRC member, Dr. Rim Fay, believes that cooling towers should be the preferred alternative. The other two MRC members rejected this alternative because of its extreme costs and the fact that it would cause other impacts to coastal resources such as visual intrusion, fog inducement, noise, and destruction of coastal bluffs.

Overall Benefits of MRC Program

The MRC program was a success in the following ways:

The MRC Accomplished Its Mandates

- o The MRC completed its mandate to design and carry out a comprehensive study of the effects of SONGS on the marine environment.

MRC Scientists Developed New, More Accurate Environmental Assessment Techniques

- o The MRC developed new, innovative techniques for studying impacts on the marine environment. For example, the Before/After Control-Impact Paired (BACIP) technique developed by MRC scientists allowed researchers to sort out the natural variability in the ocean from the impacts caused by SONGS. This technique broke new ground. New MRC approaches are already being applied in the assessment of environmental impacts in California and elsewhere in the United States.

MRC Data Document Significant Impacts to Kelp Bed and Fish Populations

- o The MRC identified substantial adverse impacts caused by SONGS including significant damage to the kelp bed from reduced light and increased sedimentation, and fish losses due to entrainment and impingement.

MRC Found Impacts to Regional Fish Populations

- o The MRC was able to estimate the permanent reduction in standing stock of fish in the Southern California Bight resulting from SONGS. This shows that SONGS and other coastal seawater-cooled power plants have significant regional impacts on marine fish populations.

MRC Found that SONGS Does Not Cause Some of the Impacts Originally Predicted

- o The MRC found that some of the impacts that were predicted to occur ("ecological deserts," huge drops in plankton populations, significant marine resource damage due to heated water) were not significant problems.

MRC Data Will Improve the Design of Future Power Plants

- o The data MRC collected and published will be extremely useful to design future power plants to have less impact on the marine environment, and to more accurately assess the impacts of future power plants and the retrofitting of existing plants.

MRC Found that Multi-Port Diffuser Systems May Not Be Best Approach for Cooling Water Discharges to Open Coastal Waters

- o The MRC studies showed that the multi-port diffuser system designed to reduce heated water discharge to meet the State Thermal Plan may actually cause more impacts than it prevents. One of the most substantial impacts found by the MRC resulted from the turbid plume caused by the multi-port diffuser system.

MRC Recommended Thermal Plan Changes

- o The MRC recommended the State Water Resources Control Board consider amending the State Thermal Plan to remove restrictions on the allowable across the condenser temperature rise for open coastal power plants, to facilitate reducing the flow of cooling water. Reducing the flow would reduce the impacts on fish populations by minimizing the number of fish larvae killed in power plant cooling systems.

Independent Third-Party Monitoring Preferable to Self-Monitoring

- o The independent MRC studies identified impacts to the marine environment that were not detected in the NPDES permit SCE self-monitoring required by the San Diego Regional Board. The MRC used different techniques and a more rigorous scientific approach. MRC's results suggest that monitoring and reporting by an independent third party will be more likely to detect non-compliance than self-monitoring. This points to the need to consider revising many of the ongoing regulatory monitoring programs.

MRC Studies Provide Extremely Valuable Information on Southern California Coastal Waters

- o MRC scientists greatly expanded the knowledge of the physical, chemical, and biological environment in southern California coastal waters, including ocean currents, light regimes, and the distribution and abundance of plankton, fish, and kelp forest species. This information is contained in MRC reports, carefully documented MRC computerized data bases, and in papers published in scientific journals. These data will be extremely valuable in future coastal and ocean resource management decisions.

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EXHIBITS

- Exhibit 1: Map of San Onofre Area
- Exhibit 2: San Onofre Nuclear Generating Station
- Exhibit 3: Schematic of Velocity Cap over Intake Pipe
- Exhibit 4: Layout of SONGS Intakes and Diffusers
- Exhibit 5: Estimated Reduction Adult Fish Recruitment and Standing Stock
- Exhibit 6: SONGS Units 2 and 3 Screenwell Area
- Exhibit 7: Resolution to San Diego Regional Board

APPENDICES

- Appendix 1: California Coastal Commission Permit 183-73
- Appendix 2: Staff Recommendation on radiological discharge monitoring and conditions to be added to Permit 183-73 and Direction to the MRC regarding Mitigation
- Appendix 3: Summary - Minority Report on the Final Report of the MRC
- Appendix 4: Substantive File Documents

ADOPTED RESOLUTION

Pursuant to the provisions of Conditions B-4 and B-6 of Permit 183-73, the Commission hereby adopts the following additional conditions (Section II) to be added to Permit 183-73, for the reasons stated in the Findings and Declarations hereinbelow set forth (Section III).

SECTION I: INTRODUCTION AND REPORT STRUCTURE

This report consists of the new permit conditions and supporting findings for Permit 183-73 to address the substantial adverse effects of SONGS Units 2 and 3 on the marine environment.

The following section, Section II, contains the new permit conditions.

Section III, Findings and Declarations, consists of six subsections. Section A provides background on the Marine Review Committee and its studies of SONGS impacts. Section B contains a description of SONGS substantial adverse effects on the marine environment. Section C contains the findings on the mitigation package required to address the substantial adverse effects. Section D summarizes the effects not found to be substantial. Section E contains a summary of the MRC's findings on water quality compliance and includes a recommendation to the San Diego Regional Water Quality Control Board for changes to the National Pollutant Discharge Elimination System permit to address these findings.

SECTION II: ADOPTED PERMIT CONDITIONS

This section consists of five permit conditions. Condition A consists of a requirement for a wetland restoration project to mitigate for fish losses. Condition B consists of a requirement for the installation of behavioral barrier devices to divert fish from the cooling water intake areas. Condition C consists of a requirement for a artificial kelp reef to mitigate impacts to the San Onofre Kelp reef. Condition D describes an administrative structure to provided oversight and independent monitoring of the mitigation projects. Condition E addresses the issue of the maintenance and storage of the data collected by MRC.

CONDITION A: WETLAND RESTORATION MITIGATION

The permittee shall develop, implement and fund a wetland restoration project that compensates for past, present and future fish impacts from SONGS Units 2 and 3, as identified by the Marine Review Committee.

1.0 SITE SELECTION AND PRELIMINARY PLAN

In consultation with Commission staff, the permittee shall select a wetland restoration site and develop a preliminary plan in accordance with the following process and terms.

Within 9 months of the effective date of this permit, the permittee shall submit the proposed site and preliminary wetland restoration plan to the Commission for its review and approval or disapproval.

1.1 Site Selection

The location of the wetland restoration project shall be within the Southern California Bight. The permittee shall evaluate and select from sites including, but not limited to, the following eight sites: Tijuana Estuary in San Diego County, San Dieguito River Valley in San Diego County, Huntington Beach Wetland in Orange County, Anaheim Bay in Orange County, Santa Ana River in Orange County, Los Cerritos Wetland in Los Angeles County, Ballona Wetland in Los Angeles County, and Ormond Beach in Ventura County. Other sites proposed by the permittee may be added to this list with the Executive Director's approval.

The basis for the selection shall be an evaluation of the sites against the minimum standards and objectives set forth in subsections 1.3 and 1.4 below. The permittee shall take into account and give serious consideration to the advice and recommendations of an interagency Wetland Advisory Panel, established and convened by the Executive Director. The permittee shall select the site that meets the minimum standards and best meets the objectives.

1.2 Preliminary Restoration Plan

In consultation with Commission staff, the permittee shall develop a preliminary wetland restoration plan for the wetland site identified through the site selection process. The preliminary wetland restoration plan shall meet the minimum standards and incorporate as many as possible of the objectives in subsections 1.3 and 1.4, respectively.

The preliminary wetland restoration plan shall include the following elements:

- a. Review of existing physical, biological, and hydrological conditions; ownership, land use and regulation.
- b. Site-specific and regional restoration goals and compatibility with the goal of mitigating for SONGS impact to fish.
- c. Identification of site opportunities and constraints.
- d. Conceptual restoration design, including:
 1. Proposed grading and excavation; water control structures; planting; integration of public access, if feasible; buffers and transition areas; management and maintenance requirements.
 2. Proposed habitat types (including approximate size and location).
 3. Preliminary assessment of significant impacts of design (especially on existing habitat values) and net habitat benefits.
 4. Evaluation of steps for implementation e.g. permits and approvals, development agreements, acquisition of property interests.
 5. A graphic depiction of proposed plan.

1.3 Minimum Standards

The wetland restoration project site and preliminary plan must meet the following minimum standards:

- a. Location within Southern California Bight.
- b. Potential for restoration as tidal wetland, with extensive intertidal and subtidal areas;
- c. Creates or substantially restores a minimum of 150 acres (60 hectares) of wetlands, excluding buffer zone and upland transition area;
- d. Provides a buffer zone of a size adequate to ensure protection of wetland values, and not less than at least 100 feet wide, as measured from the upland edge of the transition area.

- e. Any existing site contamination problems would be controlled or remediated and would not hinder restoration.
- f. Site preservation is guaranteed in perpetuity (through appropriate public agency or nonprofit ownership, or other means approved by the Executive Director), to protect against future degradation or incompatible land use.
- g. Feasible methods are available to protect the longterm wetland values on the site, in perpetuity.
- h. Does not result in loss of existing wetlands.
- i. Does not result in impact on endangered species.

1.4 Objectives

The following objectives represent the factors that will contribute to the overall value of the wetland. The selected site shall be that with the best potential to achieve these objectives. These objectives shall also guide preparation of the restoration plan.

- a. Provides maximum overall ecosystem benefits e.g. maximum upland buffer, enhancement of downstream fish values, provides regionally scarce habitat, potential for local ecosystem diversity.
- b. Provides substantial fish habitat compatible with other wetland values at the site.
- c. Provides a buffer zone of an average of at least 300 feet wide, and not less than 100 feet wide, as measured from the upland edge of the transition area.
- d. Provides maximum upland transition areas (in addition to buffer zones);
- e. Restoration involves minimum adverse impacts on existing functioning wetlands and other sensitive habitats.
- f. Site selection and restoration plan reflect a consideration of site specific and regional wetland restoration goals.
- g. Restoration design is that most likely to produce and support wetland-dependent resources.
- h. Provides rare or endangered species habitat.
- i. Provides for restoration of reproductively isolated populations of native California species.

- j. Results in an increase in the aggregate acreage of wetland in the Southern California Bight.
- k. Requires minimum maintenance.
- l. Restoration project can be accomplished in a timely fashion.
- m. Site is in proximity to SONGS.

1.6 Restrictions

(a) The permittee may propose a wetland restoration project larger than the minimum necessary size specified in subsection 1.3(c) above, if biologically appropriate for the site, but the additional acreage must (1) be clearly identified, and (2) must not be the portion of the project best satisfying the standards and objectives listed above.

(b) If the permittee jointly enters into a restoration project with another party: (1) the permittee's portion of the project must be clearly specified, (2) any other party involved cannot gain mitigation credit for the permittee's portion of the project, and (3) the permittee may not receive mitigation credit for the other party's portion of the project.

(c) The permittee may propose to divide the mitigation requirement between a maximum of two wetland restoration sites, unless there is a compelling argument, approved by the Executive Director, that the standards and objectives of subsections 1.3 and 1.4 will be better met at more than two sites.

2.0 FINAL PLAN AND PLAN IMPLEMENTATION

2.1 Final Restoration Plan

Within 12 months following the Commission's approval of a site selection and preliminary restoration plan, the permittee shall submit a final restoration plan along with CEQA documentation generated in connection with local or other state agency approvals, to the Executive Director of the Coastal Commission for review and approval. The final restoration plan shall substantially conform to the approved preliminary restoration plan as originally submitted or as amended by the Commission pursuant to a request by the permittee. The final restoration plan shall include, but not be limited to the following elements:

- a. Detailed review of existing physical, biological, and hydrological conditions; ownership, land use and regulation.
- b. Evaluation of site-specific and regional restoration goals and compatibility with the goal of mitigating for SONGS impacts to fish.

- c. Identification of site opportunities and constraints.
- d. Schematic restoration design, including:
 - 1. Proposed cut and fill, water control structures, control measures for stormwater, buffers and transition areas, management and maintenance requirements.
 - 2. Planting Program, including removal of exotic species, sources of plants and or seeds (local, if possible), protection of existing salt marsh plants, methods for preserving top soil and augmenting soils with nitrogen and other necessary soil amendments before planting, timing of planting, plans for irrigation until established, and location of planting and elevations on the topographic drawings.
 - 3. Proposed habitat types (including approximate size and location).
 - 4. Assessment of significant impacts of design (especially on existing habitat values) and net habitat benefits.
 - 5. Location, alignment and specifications for public access facilities, if feasible.
 - 6. Evaluation of steps for implementation e.g. permits and approvals, development agreements, acquisition of property rights.
 - 7. Cost estimates.
 - 8. Topographic drawings for final restoration plan at 1" = 100 foot scale, one foot contour interval.
 - 9. Drawings shall be directly translatable into final working drawings.

2.2 Wetland Construction Phase

Within 6 months of approval of the final restoration plan, subject to the permittee's obtaining the necessary permits, the permittee shall commence the construction phase of the wetland restoration project. The permittee shall be responsible for ensuring that construction is carried out in accordance with the specifications and within the timeframes specified in the approved final restoration plan and shall be responsible for any remedial work or other intervention necessary to comply with final plan requirements.

2.3 Timeframe for Resubmittal of Project Elements

If the Commission does not approve any element of the project (i.e site selection, restoration plan), the Commission will specify the time limits for compliance relative to selection of another site or revisions to the restoration plan.

3.0 WETLAND MONITORING, MANAGEMENT AND REMEDIATION

Monitoring, management (including maintenance), and remediation shall be conducted over the "full operating life" of SONGS Units 2 and 3. "Full operating life" as defined in this permit includes past and future years of operation of SONGS units 2 and 3 including the decommissioning period to the extent there are continuing discharges. The number of past operating years at the time the wetland is ultimately constructed, shall be added to the number of future operating years and decommission period, to determine the length of the monitoring, management and remediation requirement.

The following section describes the basic tasks required for monitoring, management and remediation. Condition II-D specifies the administrative structure for carrying out these tasks, including the roles of the permittee and Commission staff.

3.1 Monitoring and Management Plan

A monitoring and management plan will be developed in consultation with the permittee and appropriate wildlife agencies, concurrently with the preparation of the restoration plan, to provide an overall framework to guide the monitoring work. It will include an overall description of the studies to be conducted over the course of the monitoring program and a description of management tasks that are anticipated, such as trash removal. Details of the monitoring studies and management tasks will be set forth in a work program (see Section II-D).

3.2 Pre-restoration site monitoring

Pre-restoration site monitoring shall be conducted to collect baseline data on the wetland attributes to be monitored. This information will be incorporated into and may result in modification to the overall monitoring plan.

3.3 Construction Monitoring

Monitoring shall be conducted during and immediately after each stage of construction of the wetland restoration project to ensure that the work is conducted according to plans.

3.4 Post-Restoration Monitoring and Remediation

Upon completion of construction of the wetland, monitoring shall be conducted to measure the success of the wetland in achieving stated restoration goals (as specified in restoration plan) and in achieving performance standards, specified below. The permittee shall be fully responsible for any failure to meet these goals and standards during the full operational years of SONGS Units 2 and 3. Upon determining that the goals or standards are not achieved, the Executive Director shall prescribe remedial measures, after consultation with the permittee, which shall be immediately implemented by the permittee with Commission staff direction. If the permittee does not agree that remediation is necessary, the matter may be set for hearing and disposition by the Commission.

Successful achievement of the performance standards shall (in some cases) be measured relative to approximately four reference sites, which shall be relatively undisturbed, natural tidal wetlands within the Southern California Bight. The Executive Director shall select the reference sites. The standard of comparison i.e. the measure of similarity to be used (e.g. within the range, or within the 95% confidence interval) shall be specified in the work program.

In measuring the performance of the wetland project, the following physical and biological performance standards will be utilized:

- a. Longterm Physical Standards. The following longterm standards shall be maintained over the full operative life of SONGS Units 2 and 3.
 - 1) Topography. The wetland shall not undergo major topographic degradation (such as excessive erosion or sedimentation).
 - 2) Water Quality. Water quality variables [to be specified] shall be similar to reference wetlands.
 - 3) Tidal prism. The designed tidal prism shall be maintained, and tidal flushing shall not be interrupted.
 - 4) Habitat Areas. The area of different habitats shall not vary by more than 10% from the areas indicated in the final restoration plan.

- b. Biological Performance Standards. The following biological performance standards shall be used to determine whether the restoration project is successful. Table 1, below, indicates suggested sampling locations for each of the following biological attributes; actual locations will be specified in the work program.
 - 1) Biological Communities. Within 4 years of construction, the total densities and number of species of fish, macroinvertebrates and birds (see table 1) shall be similar to the densities and number of species in similar habitats in the reference wetlands.
 - 2) Vegetation. The proportion of total vegetation cover and open space in the marsh shall be similar to those proportions found in the reference sites. The percent cover of algae shall be similar to the percent cover found in the reference sites.
 - 3) Spartina Canopy Architecture. The restored wetland shall have a canopy architecture that is similar in distribution to the reference sites, with an equivalent proportion of stems over 3 feet tall.
 - 4) Reproductive Success. Certain plant species, as specified by in the work program, shall have demonstrated reproduction (i.e. seed set) at least once in three years.

- 5) Food Chain Support. The food chain support provided to birds shall be similar to that provided by the reference sites, as determined by feeding activity of the birds.
- 6) Exotics. The important functions of the wetland shall not be impaired by exotic species.

TABLE 1: Suggested Sampling Locations

	Salt Marsh			Open Water		Mudflat	Tidal Creeks
	Spartina	Salicornia	Upper	Lagoon	Eelgrass		
1) Density/spp:							
Fish				X	X	X	X
Macroinverts				X	X	X	X
Birds	X	X	X	X		X	X
2) % Cover							
Vegetation	X	X	X		X		
algae	X	X				X	
3) Spar. arch.	X						
4) Repro. suc.	X	X	X				
5) Bird feeding				X		X	X
6) Exotics	X	X	X	X	X	X	X

CONDITION B: BEHAVIORAL BARRIER MITIGATION

The permittee shall install and maintain behavioral barriers including but not limited to mercury lights and sonic devices at SONGS Units 2 and 3 to reduce midwater fish impingement losses. Within 6 months of the effective date of this permit amendment, the permittee shall submit a plan for installation of behavioral barrier devices to the Executive Director for review and approval. Within 3 months of the Executive Director's approval, the permittee shall install the required devices.

In consultation with the permittee, the Commission staff will monitor the effectiveness of the behavioral barrier devices. If the Executive Director determines that the installed devices are not sufficiently effective to warrant continued use, the Executive Director may require removal and installation of alternative behavioral barrier devices.

CONDITON C: KELP REEF MITIGATION

The permittee shall, in consultation with the Executive Director, select a site and construct an artificial reef as mitigation for the resource losses at the San Onofre Kelp Bed (SOK) caused by the San Onofre Nuclear Generating Station (SONGS). The reef shall be designed to replace the lost and damaged resources at the San Onofre Kelp Bed Reef and produce a persistent giant kelp forest and associated ecosystem. The reef shall be located in the vicinity of the SONGS, but outside the influence of the SONGS discharge plume and water intake.

After selecting potential sites, and conducting a pre-construction site assessment at these potential sites, the permittee shall select a site and design a reef which meets the standards and objectives listed below. The permittee shall submit the final reef plan to the Commission for its review and approval.

1.0 SITE SELECTION

Three or more potential reef sites shall be selected based on, but not limited to, the following criteria:

- 1) Location as near as possible to the San Onofre Kelp Bed, and preferably between Dana Point (Orange Co.) and the Pendleton Artificial Reef (San Diego Co.), but outside the influence of the SONGS discharge plume and water intake;
- 2) Minimal disruption of natural reef or cobble habitats and sensitive or rare biotic communities;
- 3) Suitable substrate with low mud and/or silt content (e.g. hard-packed fine to coarse grain sand, exposed cobble or bedrock without an established biological community, or cobble or bedrock covered with a thin layer of sand);
- 4) Location at a depth locally suitable for kelp growth and recruitment;
- 5) Location near a persistent natural kelp bed;
- 6) Location away from sites of major sediment deposition;
- 7) Minimal interference with uses such as vessel traffic, vessel anchorages, commercial fishing, mariculture, mineral resource extraction, cable or pipeline corridors;
- 8) Location away from power plant discharges, waste discharges, and dredge spoil deposition sites;

- 9) Location that will not interfere with or adversely affect resources of historical or cultural significance such as shipwrecks and archeological sites.

1.1 Preconstruction Site Assessment

The permittee shall obtain site-specific field information, over a period of one year, at each of the three or more potential reef sites which best meet the above criteria. This field information shall be used in both the site selection and design of the reef. Field information shall: (1) include a description of existing biota at the site, (2) provide a reasonable prediction of the likelihood that a healthy kelp bed will be established and persist, (3) provide a reasonable prediction of the extent of rock burial due to sediment deposition and/or sinking into soft sediment, and (4) provide a prediction of the effect of the reef on local sand transport and local beaches.

The specific field information to be gathered, and the methods for gathering and analyzing it, shall be approved by the Executive Director. At the conclusion of this pre-construction assessment, the permittee shall select the most suitable site to build the reef, subject to the review and approval of the Executive Director, in consultation with the resource agencies. The site shall be submitted to the Coastal Commission, for its review and approval, as part of the artificial reef plan described in Condition C-2 below.

2.0 REEF DESIGN AND FINAL PLAN

Following the preconstruction site assessment, and within 18 months of the effective date of this condition, the permittee shall submit to the Commission, for review and approval, an artificial reef plan, designed to: (1) replace the damaged resources (as identified by the MRC) at the San Onofre Kelp Reef and (2) produce a persistent, healthy giant kelp forest and associated ecosystem. If the Executive Director determines that specific information is needed to evaluate whether the reef design will meet the goals and standards set forth in this condition, the Executive Director may direct the permittee to provide this information. The Executive Director, in evaluating the reef design, will consult with the resource agencies.

The primary goals of the reef shall be to provide: (1) stable rock surfaces and rock configurations that produce a community of algae and invertebrates similar in composition, diversity and abundance to SOK; (2) adequate conditions for giant kelp recruitment, growth, and reproduction, and (3) adequate conditions for a community of reef-associated biota similar in composition, abundance and diversity to SOK. This design shall meet the following standards:

- 1) The reef shall be constructed of rock determined to be suitable to sustain a kelp forest and a community of reef associated biota similar in composition, abundance and diversity to SOK. Additional devices may also be used to anchor kelp.
- 2) The total areal extent of the kelp reef shall be no less than 300 acres (120 hectares).

- 3) The 300 acre reef shall be covered by at least 200 acres (80 ha) of exposed rock substrate. Should the Executive Director determine that more rock coverage is necessary to meet the above goals, the Executive Director may require that the design include the additional coverage recommended.
- 4) The reef design shall take into account sediment deposition characteristics of the site, so that 200 acres of exposed stable rock substrate will be permanently present, be sufficiently free of scouring to support a diverse and stable community of attached biota, and allow kelp to become established and persist.

3.0 KELP REEF CONSTRUCTION

The reef shall be constructed in two phases. The first phase shall cover an area large enough to represent the important processes affecting a large 300 acre (120 ha) reef, but no larger than necessary in the event there are major problems with the initial design. The proposed size of the first phase reef shall be included in the reef plan submitted to the Commission. This phase shall be monitored for at least 3 years to determine if the design is likely to meet the goals and standards set forth in this condition, and determine that the reef does not interfere with local sand transport. Management techniques shall be tested during this phase to determine if such techniques will better ensure that the goals and standards will be met. At the conclusion of this initial monitoring period, the permittee shall submit any recommendations for changes to the design to the Coastal Commission for its review and approval. Construction of the remaining portion of the reef shall be completed no later than 6 years after the effective date of this condition.

The artificial reef shall be constructed according to the approved design, including location, depth, overall rock coverage, rock size, dispersion of rocks, and rock relief. A post-construction survey shall be carried out to demonstrate that the reef was built to approved specifications. If the Executive Director determines that the reef was not built to specifications, the permittee shall modify the reef to meet the approved specifications.

4.0 MONITORING AND REMEDIATION

The permittee is fully responsible for any failure to meet the standards and goals set forth in this condition during the full operational years of SONGS units 2 and 3 as defined in Condition II-A-3.0. Should the Executive Director find that the goals and standards set forth in this condition have not been met, the permittee must immediately undertake necessary modifications to the reef design or other remediation determined by the Executive Director to be necessary to meet the standards and goals. If the permittee does not agree that the standards and goals have not been met, the matter may be set for hearing and disposition by the Commission.

4.1 Monitoring

Monitoring shall be implemented as described in Condition II-D to: (1) insure that the performance standards of this condition are met, (2) determine if the mitigation successfully replaces the lost and damaged resources in the San Onofre Kelp Bed Reef, and (3) determine the reasons why standards have not been met, so that remediation will be successful. The monitoring program shall be designed to assess whether the performance standards listed below have been met.

4.2 Performance Standards

- a. Substrate. At least 90% of the 200 acres (80 ha) of exposed rock substrate must remain available for attachment by reef biota. If, at any time, more than 10% of the reef should become covered by sediment, or become unsuitable for growth of attached biota due to scouring, and there is no sign of recovery within 3 years, as determined by the Executive Director, more rock shall be added to the reef to replace the substrate lost. Surveys to monitor exposed rock substrate availability shall begin immediately after construction is complete and shall continue for the full operational life of SONGS units 2 and 3.

- b. Kelp Bed. Kelp recruitment experiments to determine the best method of establishing kelp on the reef shall be carried out in the first phase. The experiments shall provide a basis for future kelp establishment efforts should adequate natural recruitment fail to occur. Within 3 years of construction of the second phase, the Executive Director shall evaluate the status of kelp on the artificial reef. If 60% of the reef is not covered with a self-sustaining medium to high density kelp bed (defined as more than 4 adult plants/100 m² of substrate), the reason for failure of the kelp bed to become established shall be determined, and an effort begun to establish or augment kelp on the reef. The experimental method determined by the Executive Director to be most likely to be successful and reliable shall be employed until kelp coverage meets the above standard, or until 5 years after establishment or augmentation is first attempted. If oceanographic conditions are unfavorable to kelp during part of this period, the Executive Director may direct the permittee to defer the effort to establish kelp.

The reef shall sustain an average kelp coverage of 60% for the full operational life of SONGS units 2 and 3. If the long-term average kelp coverage does not meet this standard, the permittee shall undertake feasible corrective action, as identified by the Executive Director, to restore the kelp coverage to 60%. This may entail adding more rock to the reef. If, during the period of time of the full operational life of SONGS units 2 and 3, coverage of medium to high density kelp falls below 30% of the reef for two consecutive years, the Commission staff will, at the permittee's expense,

evaluate the general state of kelp in the region. If the decline is region-wide, no attempt to correct the situation shall be required. If the decline is confined to the artificial reef, the permittee shall undertake feasible corrective action, as identified by the Executive Director, to restore the kelp coverage to 60%

- c. Fish. Within 10 years of reef construction, the standing stock of fish at the reef shall be at least 28 tons. The MRC determined that this amount of reduction in the kelp bed fish biomass was caused by the operation of SONGS. The fish biota shall demonstrate the following characteristics:
- 1) The resident fish assemblage shall have a total density and number of species similar to natural reefs within the region.
 - 2) Fish reproductive rates shall be similar to natural reefs within the region.
 - 3) The total density and number of species of young-of-year fish (fish in the first year after settling) shall be similar to natural reefs within the region.
 - 4) Fish production shall be similar to natural reefs within the region.
- d. Benthos. Within 10 years of reef completion, the benthic community shall demonstrate the following characteristics:
- 1) The benthic community (both algae and macroinvertebrates) shall have a total density and number of species similar to natural reefs within the region.
 - 2) The benthic community shall provide food-chain support for fish similar to natural reefs within the region.
 - 3) The important functions of the reef shall not be impaired by undesirable or invasive benthic species (e.g. urchins, Cryptoarachnidium).

Samples taken at reference natural kelp reef sites shall be used to determine the similarity of each variable listed above for natural reefs within the region. The standard of comparison, i.e. the measure of similarity to be used, shall be specified in the work program (see Condition D). If the fish and benthos standards listed above are not met within 10 years after reef construction, the permittee shall be responsible for any corrective action the Executive Director deems appropriate and feasible.

CONDITION D: ADMINISTRATIVE STRUCTURE

1.0 ADMINISTRATION

Personnel with appropriate scientific or technical training and skills will, under the direction of the Executive Director, oversee the mitigation and monitoring functions identified and required by conditions II-A through C. The Executive Director will retain approximately two scientists and one administrative support staff to perform this function.

This technical staff will oversee the preconstruction and post-construction site assessments, mitigation project design and implementation (conducted by permittee), and monitoring activities (including plan preparation); the field work will be done by contractors under the Executive Director's direction. The contractors will be responsible for collecting the data, analyzing and interpreting it, and reporting to the Executive Director.

The Executive Director shall convene a scientific advisory panel to provide the Executive Director with scientific advice on the design, implementation and monitoring of the wetland restoration and artificial reef. The panel shall consist of recognized scientists, including a marine biologist, an ecologist, a statistician and a physical scientist.

2.0 BUDGET AND WORK PROGRAM

The funding necessary for the Commission and the Executive Director to perform their responsibilities pursuant to these conditions will be provided by the permittee in a form and manner determined by the Executive Director to be consistent with requirements of State law, and which will ensure efficiency and minimize total costs to the permittee. The amount of funding will be determined by the Commission on a biennial basis and will be based on a proposed budget and work program, which will be prepared by the Executive Director in consultation with the permittee, and reviewed and approved by the Commission. If the permittee and the Executive Director cannot agree on the budget or work program, the disagreement will be submitted to the Commission for resolution.

The budget to be funded by the permittee will be for the purpose of reasonable and necessary costs to retain personnel with appropriate scientific or technical training and skills needed to assist the Commission and the Executive Director in carrying out the mitigation and lost resource compensation conditions (II-A through C) approved as part of this permit action. In addition, reasonable funding will be included in this budget for necessary support personnel, equipment, overhead, consultants, the retention of contractors needed to conduct identified studies, and to defray the costs of members of any scientific advisory panel(s) convened by the Executive Director for the purpose of implementing these conditions.

Costs for participation on any advisory panel shall be limited to travel, per diem, meeting time and reasonable preparation time and shall only be paid to the extent the participant is not otherwise entitled to reimbursement for such

participation and preparation. Total costs for such advisory panel shall not exceed \$100,000 per year adjusted annually by any increase in the consumer price index applicable to California.

The work program will include:

- a. A description of the studies to be conducted over the subsequent two year period, including the number and distribution of sampling stations and samples per station, methodology and statistical analysis (including the standard of comparison to be used in comparing the mitigation projects to the reference sites.)
- b. A description of the status of the mitigation projects, and a summary of the results of the monitoring studies to that point.
- c. A description of the performance standards that have been met, and those that have yet to be achieved.
- d. A description of remedial measures or other necessary site interventions.
- e. A description of staffing and contracting requirements.
- f. A description of the Scientific Advisory Panel's role and time requirements in the two year period.

The Executive Director may amend the work program at any time, subject to appeal to the Commission.

3.0 ANNUAL REVIEW

A duly noticed public workshop will be convened and conducted by the Executive Director or the Commission each year to review the status of the mitigation projects. The meeting will be attended by the contractors who are conducting the monitoring, appropriate members of the Scientific Advisory Panel, the permittee, Commission staff, representatives of the resource agencies (CDFG, NMFS, USFWS), and the public. Commission staff and the contractors will give presentations on the previous year's activities, overall status of the mitigation projects, identify problems and make recommendations for solving them, and review the next year's program. The permittee shall report on the status of the behavioral barrier devices.

The public review will include discussions on whether the artificial reef and wetland mitigation projects have met the performance standards, identified problems, and recommendations relative to corrective measures necessary to meet the performance standards. The Executive Director will utilize information presented at the annual public review, as well as any other relevant information, to determine whether any or all of the performance standards have been met, whether revisions to the standards are necessary, and whether remediation is required. Major revisions shall be subject to the Commission's review and approval.

The mitigation projects will be successful when all performance standards have been met each year for a three year period. The Executive Director shall report to the Commission upon determining that all of the performance standards have been met for three years and that the project is deemed successful. If the Commission determines that the performance standards have been met and the project is successful, the monitoring program will be scaled down, as recommended by the Executive Director and approved by the Commission. A public review shall thereafter occur every five years, or sooner if called for by the Executive Director. The work program shall reflect the lower level of monitoring required. If subsequent monitoring shows that a standard is no longer being met, monitoring may be increased to previous levels, as determined necessary by the Executive Director.

The Executive Director may make a determination on the success or failure to meet the performance standards or necessary remediation and related monitoring at any time, not just at the time of the annual public review.

CONDITION E: MRC DATA MAINTENANCE

The scientific data collected by the MRC will be stored in the Commission library in San Francisco, and at the Los Angeles County Museum of Natural Science, or at an alternative location in Southern California, as determined by the Executive Director; and will be made available for public use. The permittee shall purchase the necessary computer equipment for the Commission and the Southern California location to store and retrieve the data, and shall fund appropriate staff training on data storage and retrieval at both locations.

SECTION IV: PROPOSED FINDINGS AND DECLARATIONS

A. BACKGROUND

The California Coastal Zone Conservation Commission, (now, the California Coastal Commission), authorized construction of Units 2 and 3 of the San Onofre Nuclear Generating Station (SONGS) in 1974. At the time of the approval, the Commission lacked sufficient information on the nature and extent of the impact of the power plant operations on the marine environment. To address this lack of information, the permit (No. 183-73, see Appendix 1) established the Marine Review Committee (MRC), and directed it to study the effects of Units 2 and 3 on the marine environment, and if necessary to recommend changes to the cooling system to reduce or prevent such effects. The studies and recommendations would provide a basis for the Commission to further condition the permit to address the impacts.

Specifically, the permit directs the MRC to: (1) determine the effects of the cooling system of SONGS Unit 1 on the adjacent marine ecosystem; (2) predict the effects of SONGS Units 2 and 3; and (3) monitor the effects of Units 2 and 3. The permit states that MRC shall be responsible for "... recommending to the State Commission any changes it believes necessary in the cooling system for Units 2 and 3. The State Commission shall then further condition the permit accordingly (Condition B-4)."

Additional guidance is provided by Permit Condition B-6, which states as follows:

Should the study at any time indicate that the project will not comply with the regulatory requirements of State or Federal water quality agencies or that substantial adverse effects on the marine environment are likely to occur, or are occurring, through the operation of Units 1, 2, and 3, the applicants shall immediately undertake such modifications to the cooling system as may reasonably be required to reduce such effects or comply with such regulatory requirements (which can be made while construction is going on and could be as extensive as requiring cooling towers if that is the recommendation). The State Commission shall then further condition the permit accordingly.

In November 1979, the Commission recognized that some effects might be mitigated without requiring changes in the cooling system (see Appendix 2, pp. 4-5). It directed the MRC as follows:

The Commission recognizes the difficulties in requiring major design changes to SONGS Units 2 and 3 after the NRC [Nuclear Regulatory Commission] grants operating licenses and the units are generating electricity. Changes such as requiring cooling towers, extended diffusers or single

point discharges could cost hundreds of millions of dollars and result in unit shutdown for a period of time. The Commission has the authority to impose such changes, however, if recommended by the MRC after unit operation, in order to prevent significant environmental damage

The Commission also recognizes that operational changes or mitigation measures might adequately compensate for any marine life damages resulting from the operation of Units 2 and 3. The Commission, therefore, requests the MRC to study the feasibility and effects of selected promising mitigation measures, including construction of an artificial reef, as suggested by Southern California Edison. The MRC should recommend what measures might be taken to assure there would be no net adverse effect on the marine environment from operation of SONGS Units 2 and 3.

The MRC is composed of three scientists: one appointed by the Commission; another appointed by the permit applicants, Southern California Edison Co. and San Diego Gas & Electric Co.; and the third appointed by the appellants, who are coordinated by the Friends of the Earth. The current membership of the MRC is the Chairman, Dr. William Murdoch, UC Santa Barbara (Commission's representative); Dr. Byron Mechals, Southern California Edison (applicant's representative); and Dr. Rimmon Fay, Pacific Bio-Marine Laboratory (appellant's representative).

The permit requires the MRC to report to the Commission semiannually. The long-standing practice of the Commission has been to receive these reports, generally with a brief transmitting staff report, and after discussion of the report in a public hearing, to provide the MRC with some response. This response has taken the form of resolutions of comment, recommendations, and in one case, adoption of two new permit conditions (B-9 and B-10) recommended by the MRC. These permit conditions (B-9 and B-10) address the use of chemicals in SONGS' cooling water and condenser systems.

1.0 THE POWER PLANT

The San Onofre Nuclear Generating Station is located in north San Diego County (see Exhibit 1). SONGS Unit 1 has been operating since 1968 and generates 436 megawatts (MW) of electric power. Unit 1 draws in almost 150 billion gallons of seawater per year, or 320,000 gallons per minute, to cool the condenser. The construction of SONGS Units 2 and 3 began in 1974 and was completed in 1981 (see Exhibit 2). These units can generate 1,100 MW of electric power each. They each can draw in seawater at a rate of 830,000 gallons per minute, which results in an estimated flow of almost 700 billion gallons per year. All three units operating together can take in and discharge each day a volume of water measuring one square mile and 14 feet deep.

The intake for Unit 1 is a vertical pipe that extends about 3,000 feet from shore, with a velocity cap to cause the water to flow horizontally into the

pipe and make it easier for fish to avoid entrapment (see Exhibit 3). The discharge is a vertical pipe that extends about 2,500 feet from shore. Units 2 and 3 have single intake pipes that are 18 feet in diameter and terminate 3,400 feet offshore. The discharge pipes taper from 18 feet to 10-14 feet in diameter. The discharge pipe for Unit 2 terminates 8,500 feet offshore, and for Unit 3 it extends 6,150 feet offshore (see Exhibit 4).

The last 2,500 feet of Unit 2 and 3's discharge pipes is a multiport diffuser that rapidly mixes the cooling water with the surrounding water. The diffusers contain 63 discharge ports angled offshore that increase the velocity of the discharge. The discharge water is 19°F above the intake water temperature. To cool the discharge water, the diffusers draw in seawater at a rate about ten times the discharge flow and mix it with the discharge water. The surrounding water is swept up along with sediments and organisms and transported offshore at various distances, depending on the prevailing currents. (The MRC has measured these currents, and SCE has produced a physical model of SONGS' water movement.)

The intakes are covered with 3/8" screens to keep some of the fish and other objects from entering. Units 2 and 3 have a fish return system, which diverts fish to a holding bay, and from there to a conduit extending 1,900 feet into the ocean.

2.0 MRC BUDGET

Under the permit, the MRC is an independent body that designs its own study program and advises the Commission. The MRC is an incorporated entity, with a chairman, a business manager, and about five staff. Most studies are conducted, after competitive bidding, by private companies and university scientists.

Total expenditures in the 17 years from 1974 to 1991 are estimated at \$48 million. The MRC has been accurate in its budget projections and yearly expenditures have been at or below budget. Although the Commission does not have the responsibility for managing the MRC budget, during the study the Commission has made recommendations for budget revisions to reduce long-term costs. Furthermore, Commission staff has worked with the MRC Chairman to see that expenditures are reasonable and necessary for compliance with the permit condition.

Expenditures to date are reasonable in view of the breadth and detail required by the permit conditions. For scientists to provide the data required by the permit, extensive studies were essential. Studies in offshore waters are very costly. Trained scientists and divers must be hired; boats and modern equipment are expensive. Numerous samples must be taken and analyzed for the data to be statistically accurate.

3.0 THE PHASES OF THE MRC STUDY

Phase I - The Effects of Unit 1 (1975 to 1978)

Phase I of the study consisted of determining the effects of SONGS Unit 1 on the marine ecosystem. After an initial organizational period in which

contracts were awarded, field work on the project began in 1976. This work was confined close to shore, in the region around Unit 1. Reports to the Commission in 1977, 1978, and 1979 dealt with the effects of Unit 1. All issues raised about Unit 1 were resolved by 1979.

Phase II - Predictions (1975 to 1980)

Phase II of the study consisted of predicting the effects of Units 2 and 3 and making recommendations to the Coastal Commission on any needed design changes. In 1978 the MRC began studying the marine environment offshore of Unit 1. The first few months of this phase were spent determining the patterns of distributions of the various groups of organisms so that a sampling regime could be designed that would lead to predictions. The remainder of this phase was devoted to field studies, modeling, and analyses leading to predictions of the effects of Units 2 and 3.

In November 1978, the Commission directed the MRC to determine whether it recommended any changes to the plant at that time. In March 1979 the MRC submitted an interim report that contained the following recommendations: 1) the Commission should examine the engineering feasibility, economic costs, and legal aspects of mitigation measures that involve altering the diffusers; 2) the MRC should monitor the effects of Units 2 and 3 after they begin operating; and 3) the Commission should review state thermal requirements because the MRC was concerned that greater damage might result from meeting the thermal requirements with a long discharge pipe than from exceeding the thermal standards. The MRC also recommended against plant changes at that time but said that actual effects from Units 2 and 3 could only be determined with post-operational monitoring.

In November 1979, the Commission directed the MRC to study possible measures to mitigate the impacts from Units 2 and 3, including the construction of an artificial reef.

Phase III - Monitoring Effects of Units 2 and 3 (1979 to 1990)

The studies carried out for the predictions (Phase II), and the predictions themselves, provided the basis for designing the monitoring studies. Phase III of the study consisted of monitoring the effects of Units 2 and 3, which included both pre-operational and post-operational monitoring. Phase III studies began in 1979, with the operational period beginning in 1983.

These studies, in general, have a single basic design. The MRC established the pattern of distribution and the abundance of marine populations near SONGS (impact site) and at a control site distant from SONGS, before the operation of Units 2 and 3, and then after full operation of these two units began. This innovative research design is called BACIP (Before-After/Control-Impact Paired), and was developed by the MRC.

Most impact studies consider either the use of a control and impact site, or the use of before and after data. By combining both of these techniques, the BACIP research design avoids the following two problems that may result from

using only one or the other technique. First, the abundance of organisms varies naturally through time, so any change observed near SONGS between the pre-operational and operational periods might be unrelated to the plant. The control site accounted for the natural variability in conditions. The values for the control site were subtracted from the results for the impact site to calculate the average difference between the two locations. Second, there are always differences in the abundance of organisms between any two areas of the ocean, so observing a difference between an impact and a control station in the after period would not have meant conclusively that SONGS was the cause.

The BACIP method looked at the change, before and after plant operation, in differences in abundance between the two locations. Where possible, the MRC attempted to determine the mechanisms that lead to effects because that could be important in evaluating mitigation measures. For example, if the impact on kelp was a result of temperature increases, the mitigation measures recommended would be different than if the impacts were a result of reductions in light.

Most of the field work was completed by December 1986; follow-up work on kelp was completed in 1987. From 1987 to 1990, MRC scientists continued field investigations of the newly discovered muddy sediment. This sediment covers a portion of the San Onofre kelp bed substrate, smothering the biota it covers, and does not resemble other nearshore sediments in the area. One additional comprehensive field survey of the area affected by the cohesive sediment was completed between the Interim Report and the Final Report.

The MRC Interim Report was submitted to the Commission in May 1988. The Interim Report discusses the effects of SONGS on zooplankton, fish larvae, and midwater and soft-bottom fish. This interim report does not include any recommendations to the Commission.

MRC submitted its Final Report to the Commission in August 1989. This report includes results of all MRC studies, findings and recommendations, and extensive technical reports presenting the scientific basis for the recommendations.

4.0 MRC PROGRAMS

The MRC biological studies are concentrated under the following major programs, which are discussed in more detail in subsequent sections of this report: fish, larval fish, kelp, kelp invertebrates, plankton, mysids, and benthic organisms. All studies were designed to identify any significant impacts the power plant discharge may have on the marine environment surrounding SONGS. A separate mitigation program was designed to provide recommendations on possible measures to mitigate observed and estimated effects of SONGS on the marine environment.

Fish. Includes local benthic and mid-water fish, fish in kelp beds, and bight-wide fish populations, especially fish species fed on by larger fish (such as queenfish and white croaker).

Fish Larvae. Larvae are important because they constitute a critical stage for many marine fish species.

Kelp. The San Onofre Kelp (SOK) bed is largely southeast of the diffusers, about 1.2 miles offshore. SOK begins about 0.3 to 1.2 miles south of the diffusers and extends about 1.2-1.9 miles down coast. The SOK kelp bed links the more extensive kelp communities to the north and south. Prior to operation of SONGS Units 2 and 3 there were about 350 acres of kelp in SOK.

Kelp Invertebrates. Includes organisms that live on the kelp plants (e.g., sea urchins, snails) and large invertebrates (e.g., starfish and sea fans) that live on the bottom.

Plankton. The small plants and animals that drift in the water and are the basis of the marine fish production.

Mysid Shrimp. These organisms are shrimp-like crustaceans that are up to an inch long. They were selected as a target group because they are likely to show effects that occur and they are an important fish food.

Soft Benthos. Animals (e.g., worms, crustaceans, and mollusks) that live mainly in the sand and mud on the ocean floor and contribute to the production of bottom-dwelling fish.

Oceanography and Physical/Chemical Program. The inshore ocean currents and SONGS' effects on the local currents help to determine how the effects are spread. The physical conditions of the marine environment (e.g., bottom sediments, light and nutrient levels in the water) affect the biological populations and may be altered by SONGS.

5.0 CURRENT STATUS OF THE MARINE REVIEW COMMITTEE

The MRC has essentially completed its original mandate from the CZCC, but it is premature to disband the MRC. The San Diego RWQCB will be holding hearings on SCE's possible non-compliance with its NPDES permit. There is also an ongoing lawsuit in which Earth Island Institute is suing SCE under the federal Clean Water Act.

MRC's technical data will be critical evidence in both of these proceedings. The MRC must stay in existence at a level adequate to provide technical assistance and support services to the Coastal Commission until these proceedings are completed.

B. MARINE RESOURCES - SUBSTANTIAL ADVERSE EFFECTS

1.0 SUMMARY AND INTRODUCTION

This section describes the substantial adverse effects found by the Marine Resource Committee (MRC), and the Commission's findings and declarations regarding those impacts. The MRC found that the operation of SONGS Units 2 and 3 results in substantial adverse effects to the organisms in the San Onofre Kelp Bed, to the fish stocks in the Southern California Bight, and to local midwater fish populations (MRC 1989).

San Onofre Kelp Bed:

- o The discharge plume from SONGS Units 2 and 3 results in a substantial reduction in the abundance and density of kelp plants.
- o The discharge plume results in a substantial reduction in the abundance and biomass (total weight) of most of the kelp bed fish species that the MRC studied.
- o The discharge plume results in a substantial reduction in the abundance of large invertebrates inhabiting the kelp reef.

Fish stocks in the Southern California Bight:

- o Intake loss of immature fish is projected to cause substantial reductions in Bight-wide adult fish populations.

Local midwater fish populations:

- o Substantial reductions in local abundance of midwater fish populations were measured out to a distance of 3 km from SONGS.

2.0 SAN ONOFRE KELP BED REEF

The San Onofre Kelp Bed (SOK) is located about 1.2 miles offshore and extends from 0.3 to 1.2 miles south of SONGS' diffusers (See Exhibit 5). The substrate in the San Onofre Kelp Bed is unusual in that it is mainly composed of boulders and cobbles interspersed with coarse sand, whereas most kelp beds occur on consolidated rock reefs. Nonetheless, a rich and diverse biota occurs in the bed. Giant kelp is a valuable commercial resource, and kelp forests are ecologically important habitats that support hundreds of species of plants, fish and invertebrates, many of which are harvested by commercial or sports fishermen. The most conspicuous algae in SOK include giant kelp, which extends through the water column to form a canopy at the surface, and understory plants that include several species of brown and red algae. Conspicuous large invertebrates include red and white urchins, three species of gorgonians (soft corals), and a variety of molluscs (mostly snails). Common fish species in SOK include kelp bass, California sheephead, kelp perch, seniorita, white seaperch, black perch, rock wrasse, pile perch, blacksmith, black croaker, and barred sand bass.

2.1 GIANT KELP

The Marine Review committee's studies of giant kelp in the San Onofre Kelp Bed (SOK) and the San Mateo Kelp Bed (SMK, the control area) show that SONGS' operation has had a substantial adverse effect on a valuable kelp bed.

Adult kelp plants produce millions of microscopic spores that grow into microscopic plants. Over a period of about 12 months, these microscopic plants grow into adults 30 or more feet long. The median adult life span is about one year in the San Onofre area, so the kelp beds need to be replaced by recruitment of new adults every few years.

The MRC used a variety of methods to study giant kelp. The extent and density of kelp in SOK and SMK were measured by (1) counts by divers of plants that occurred along permanent transects, (2) down-looking sonar, and (3) side-scanning sonar. In addition, quadrats were sampled and a variety of experiments were performed to examine the effects of SONGS on the early life of stages of giant kelp.

Effects

The MRC's sonar and transect data indicate that the operation of SONGS reduced the area of kelp in SOK by about 60% relative to the control site (SMK). This reduction means that there would be, on average, about 200 acres more moderate to high density kelp (more than 4 plants per 100 m², or 59,000 more kelp plants, in the San Onofre Kelp Bed if SONGS were not operating.

The reduction in relative density of adult plants at SOK was largely caused by SONGS' effect on the production of new adult plants, and not by an increase in the death rate of existing adults in SOK. SONGS has affected kelp by increasing turbidity in SOK; the turbidity comes from the discharge plume, which frequently moves turbid water over the kelp bed. SONGS reduced the light reaching the bottom in SOK in the "After" period by about 26% when currents moved the plume over the bed, and the net reduction, regardless of current direction, was 16%. Seston flux increased by 48% in the upcoast portion of SOK and is likely to have increased in the downcoast position as well. The increased turbidity suppresses development of the microscopic stages of kelp.

In recent years there has been a general increase in the abundance of giant kelp in Southern California. However, the increase has been less at SOK because of the operation of SONGS. During years when there is little kelp recruitment anywhere (such as during severe El Ninos), SOK will probably decline at the same rate as other kelp beds, since SONGS does not appear to affect adult mortality. However, during marginal years for kelp, recovery would be expected at SMK but not at SOK. As a result, SOK is expected to have less kelp, on average, than it would have if Units 2 and 3 were not operating.

2.2 KELP BED FISH

The giant kelp forests provide food and shelter to a large number of fish species. The MRC contractors conducted studies to determine whether the

abundance of fish in SOK was affected relative to that of the control site, the San Mateo Kelp Bed (SMK), as a consequence of the operation of SONGS. The study estimated the actual number and biomass of fish lost and gained at SOK as a result of operation of the power plant.

The monitoring for this portion of the study was done during two pre-operational years, 1980 and 1981, and two operational years, 1985 and 1986. The MRC sampled at least 40 different species that were either directly dependent on the kelp or closely associated with it. Kelp bed fish live in and among the fronds of the giant kelp. Fish such as the kelp perch, the northern anchovy, the jack mackerel and the giant kelp fish are directly associated with the kelp plants. Some fish are associated with all types of reefs, including kelp reefs. These fish include kelp bass, seniorita, halfmoon, rock wrasse and California sheephead. The MRC grouped the fish by the type of habitat that they inhabit the majority of the time. Bottom fish spend most of their time within a few meters of the bottom. The water-column fish spend most of their time somewhere in the water column well above the bottom.

Effects

Eight out of ten species examined declined in abundance and biomass. The fish living close to the bottom (bottom fish) declined in abundance by 70% and in biomass by 73% relative to fish at the control site. The MRC estimates that the San Onofre Kelp Bed had almost 200,000 fewer bottom fish than would have been present if SONGS had not been operating. This number of fish represents a total weight of about 28 U.S. tons. Water-column fish showed a relative decline of about 17% in abundance and 33% in biomass. The MRC found that none of the results for the water-column fish were statistically significant but did show trends in the direction of decline.

The decline in fish was a result of the decline in kelp abundance. Operation of the plant may also have affected the abundance of fish by reducing the number of large invertebrates, and increasing the flux of particles through the water column. The seniorita and the halfmoon showed a substantial relative increase during this time, and some other species increased slightly. Two possible explanations for these increases are that 1) the fish crowded into the area that still had kelp after the kelp decline on other parts of the reef, and 2) the density of food particles, which some fish feed on, increased as a result of the plume.

2.3 INVERTEBRATES ON HARD SUBSTRATES IN KELP BEDS

Common invertebrates that inhabit the hard bottom areas include abalones, snails, sea urchins, sea stars and sea cucumbers. Thirty-seven species were chosen to represent the over 100 species of large invertebrates that commonly inhabit kelp beds. The species that were chosen could be counted easily and reliably by divers in the field under conditions of poor visibility. These species are typical of the large invertebrates that inhabit the kelp beds of

southern California. Invertebrates that could be most easily sampled were found to be snails, some sea urchins and one species of sea cucumber. Ten surveys were done before SONGS began operation and eight surveys were done after the plant began operation. The data were then analyzed using the BACIP design.

Effects

The MRC found SONGS Units 2 and 3 caused a decline in abundance of invertebrates in the San Onofre Kelp Bed. A major decline was seen in snail species. The declines in snails range from 60% to 80%, depending on the proximity of the sampling location to the diffusers. The range of decline for white sea urchins was from 40% to 76%. One species of sea cucumber was found to increase in abundance. The declines in large invertebrates is assumed to result from the increase in the flow of particles caused by the turbid plume from the SONGS discharge diffusers. The new fine grained sediments covered some areas of hard substrate, which some species of large invertebrates depend on for survival.

3.0 REDUCTION IN BIGHT-WIDE FISH STOCKS

Fish eggs, larvae and juveniles are drawn into the plant with the cooling water and killed. Because of the large amount of water used for cooling, the number of fish killed this way is very large; several billion fish each year.

Description of Affected Resource

Eggs and larvae of many fish species are planktonic, and move with the water currents. Other fish species deposit their eggs, and the larvae become planktonic when they hatch. If egg release or hatching occurs close to shore, these early life stages, while dispersing to some extent, often remain in ocean waters nearshore. They are thus susceptible to being drawn into SONGS with the cooling water. After metamorphosis from a larva to a juvenile (resembling the adult fish), some fish move immediately to other habitats, while others remain within the midwater nearshore ocean, and can also be drawn in with cooling water as juveniles. For many fish species, larval abundances in Southern California coastal waters are highly seasonal. This is reflected in the MRC larval fish catches. More than 50% of the larvae caught in MRC monthly surveys were caught in the 3 months of February, March, and April.

Study Methods

The number of eggs, larvae and juveniles of each species drawn into Units 2 and 3 of SONGS and entrapped was estimated from net samples taken in ocean water near the intakes. Three water strata were sampled: surface, mid-water, and near the bottom. For those fish eggs, larvae and juveniles drawn into the plant with the cooling water, mortality was assumed to be 100%.

The effect on fish populations could not be measured directly, since fish can move great distances, and consequently the effect is spread over a very wide area. Therefore, the MRC developed a method to estimate, or project, this loss, and express the loss as a percentage change in the abundance of species populations throughout the Southern California Bight.

First, from a series of samples taken at different depths offshore of the area near San Onofre, the MRC calculated a ratio of numbers entrapped to numbers in the Bight. This ratio is referred to as the "entrapment rate." Second, using this ratio, and an estimate of the length of time larvae and juveniles are susceptible to entrapment in the plant, the MRC projected the percent reduction in new adults entering (recruiting to) the Bight-wide adult fish population. This estimate, or projection, is termed "adult-equivalent loss" or "short-term loss" by the MRC. Third, the MRC projected the long-term effects of SONGS on Southern California Bight fish populations. A constant percentage loss each year would result in extinction of a fish species population unless there is "compensation" within the population, so that surviving individuals have better survival or increased reproduction, thus stabilizing population abundance. For this step, the MRC used mathematical models to analyze the effects of possible compensation mechanisms on the projections of adult-equivalent loss. This allowed the MRC to project long-term effects of SONGS on Southern California Bight fish populations. Finally, the MRC translated the long-term percentage reductions into the weight (in tons) of fish lost.

The MRC made conservative estimates at each of these four steps. First, for six species with juveniles that are killed in SONGS (see Exhibit 5), the estimated short-term (adult-equivalent) loss is known to be too low because the juvenile entrapment rate could not be estimated. Second, the MRC used a low to middle estimate of the adult-equivalent losses of queenfish and white croaker, although reasonable assumptions could have supported a higher estimate. Third, the models suggested that the long-term reductions would in general be greater than the short-term loss unless two or more compensatory mechanisms acted jointly, whereas the MRC assumed the long-term and short-term losses were the same. Finally, the estimated number of tons lost was adjusted by omitting northern anchovy losses and reducing the remaining losses by about 50%. The MRC chose the conservative option at each stage because the overall process contains much uncertainty that could have biased the estimates upward, and the MRC wished to develop strongly defensible estimates.

Biological Effects

The MRC has projected reductions in adult recruitment for 21 species of fish (Exhibit 5). Staff considers the 14 species with percent losses of greater than 1% subject to a substantial adverse environmental effect. Most of the fish affected by SONGS are species whose larvae (and, in many cases, juveniles) are confined to shallow nearshore ocean waters. When compensation is considered, and thus longer-term effects on the abundance (or standing stock) of fish are projected, the MRC concluded that: (1) it is unlikely that compensation prevents the abundance of adult fish from declining to a lower level; and (2) reasonable assumptions lead to

reductions equal to short-term projections (i.e. those percentages listed in Exhibit 5). In the case of white croaker, for example, the long-term reduction would equal 6% of the adult population, and represent about 3 1/2 million fish or 360 tons.

The substantial loss of fish from the Southern California Bight due to SONGS operation has a number of major consequences. Some of the most heavily affected fish (such as queenfish) are small species, and are fodder fish for larger predators. Even those fish big enough as adults to support fisheries are fodder at smaller sizes. Therefore, food chain effects are one of the major consequences of this loss.

Another major consequence is the loss to fisheries, mainly sport fisheries. White croaker, California grunion, black croaker, California corbina, and diamond turbot are all affected species sought by sport fishermen. Some of the species with substantial projected reductions, such as black croaker and California corbina, are protected from commercial take because of their limited range. There is a concern that population abundances of these species could not withstand both sport and commercial exploitation. These are the species of most concern.

The third major consequence is the loss of biota inhabiting important and rare Southern California habitats, including wetland, lagoon, and bay ecosystems and reefs. Many of the affected species spend part of their life cycle in these habitats. Species such as diamond turbot, cheekspot goby, shadow goby and arrow goby commonly live as adults in shallow water lagoon or wetland habitats, and their larvae are dispersed into the coastal shore zone. Still others, such as white croaker, jacksmelt, and queenfish, are commonly found in lagoon or bay systems, as well as in the nearshore coastal zone. Such species as giant kelpfish, reef finspot, and black croaker live on reefs.

4.0 LOCAL FISH POPULATIONS

Description of Affected Resource

Fish populations in the immediate area of SONGS can be grouped into three categories: midwater fish, bottom fish and kelp bed fish. SONGS effects on kelp bed fish are discussed in section III-B-2.2. Midwater fish are usually schooling fish moving through the water column. The larger midwater species are pelagic predatory fish such as Pacific and jack mackerel, and are more common in deeper water. Other species such as queenfish and white croaker are more common nearer shore. Larger adults of queenfish and white croaker are found closer to the bottom than are juveniles and small adults. Therefore adult queenfish and white croaker are categorized (along with such bottom-oriented fish as flatfish) as bottom fish, while juveniles and small adults prefer to be higher up in the water column.

Study Methods

The MRC hypothesized that changes to local fish populations might be expected to occur as a result of fish losses in the water intake system of

SONGS. Therefore, the MRC estimated intake loss and, in addition, measured changes in local density of fish. Intake loss includes fish impinged on screens, those diverted into the Fish Return System but not surviving, and those killed in heat treatments. Because of an El Nino during the years the MRC gathered intake loss data, fish population abundances in the vicinity of SONGS were lower than expected. The intake loss estimate was increased to reflect abundances before the El Nino. Local densities of midwater fish and bottom fish were analyzed separately. Changes were assessed using the BACIP method.

Biological Effects

The MRC estimated that an average of 122 tons of fish are entrapped each year by the intake system at SONGS, and 57 tons are killed. This estimate is for all three units. The three most abundant midwater species in the vicinity of songs (anchovy, queenfish and white croaker) are the fish species most commonly entrapped by Units 2 and 3 (97% by number; 54% by weight).

Local densities of two species of midwater fish were substantially reduced. Queenfish declined 50%-70% out to three kilometers from SONGS. White croaker declined 60% within one kilometer of SONGS, and 35% out to three kilometers from SONGS. In addition, there is a statistically significant general pattern of decreases for other midwater species in the vicinity of SONGS. Queenfish and white croaker are the most at risk from entrapment, and their survival is very poor if they do enter the intake system. However, the MRC was unable to conclude that the local population declines could be completely explained by intake loss.

The abundance of bottom fish generally tended to increase near SONGS. Older (and therefore larger) queenfish and white croaker were among 5 species showing statistically significant increases. In addition, the total weight of bottom fish increased relative to the control, and there was a statistically significant trend of increases as a general pattern for bottom fish species. The MRC believes that these increases may be related to an increase in biota living in the sediment near the SONGS discharges. Such biota are a major food source for bottom fish. The MRC attempted to compare gains and losses of queenfish and white croaker, but did not present the calculations in the MRC Final Report because reliable overall estimates could not be made.

5.0 CONCLUSION - SUBSTANTIAL ADVERSE MARINE RESOURCE IMPACTS

For the foregoing reasons, the Commission finds that the effect of SONGS Units 2 and 3 on (1) the kelp in the San Onofre Kelp Bed community - including giant kelp, kelp bed fish, and large invertebrates, and (2) Bight-wide fish stocks and local midwater fish, constitutes substantially adverse effects within the meaning of that term as it is used in Condition II-B-6 of Permit No. 186-73.

B. MITIGATION FOR SUBSTANTIAL ADVERSE EFFECTS

This section presents the Commission's findings and declarations on the mitigation package required to offset the substantial adverse effects of SONGS Units 2 and 3 on the marine environment.

1.0 SUMMARY

- o MRC Mitigation Recommendations. The MRC recommended a possible combination of three techniques to mitigate or prevent fish losses: modification of plant operations to reduce larval entrainment, construction of an artificial reef, and restoration of a wetland. The MRC also recommended installation of behavioral barriers to divert fish from the intake screens. To mitigate for the impacts to the kelp bed reef, the MRC recommended construction of an artificial kelp bed reef.
- o Adopted Mitigation Package. The Commission finds that a wetland restoration combined with installation of behavioral barriers would best mitigate Bight-wide and local fisheries impacts, and that a artificial kelp bed reef would best mitigate for the impacts to the San Onofre kelp bed reef community.

2.0 INTRODUCTION

Condition II-B of Permit No. 183-73 for Units 2 and 3 of SONGS states that should the MRC studies of the effect of SONGS on the marine environment indicate that substantial effects are occurring or are likely to occur, the permittee shall undertake modifications to the cooling system as may reasonably be required to reduce the effects. This condition reflects the need to consider preventative measures to address adverse impacts before considering compensatory measures, because prevention is the more certain way of protecting the marine environment. Mitigation projects aimed at replacing resources can result in a net loss of resources because of the uncertainty of success. However, the Commission also recognizes that, in some instances, prevention is infeasible. In 1979, the Commission directed the MRC to also evaluate promising mitigation measures, which could be required in lieu of changes to the plant, if deemed appropriate by the Commission.

As discussed in detail in Section III-B, the MRC found that the operation of SONGS has adversely affected the marine environment through the following mechanisms: (1) killing organisms, such as fish larvae, juvenile and adult fish, that are drawn into the plant with the cooling water; and (2) creating a turbid plume that adversely affects the San Onofre Kelp Bed (SOK).

The MRC studies revealed substantial adverse effects both on the local environment and on the regional marine environment. Locally, substantial adverse effects were found for a number of fish species populations near SONGS, and for a range of organisms in SOK, including giant kelp, fish and large invertebrate species. Regionally, substantial adverse effects were projected for a number of fish populations throughout the Southern California Bight.

The MRC evaluated an array of techniques to reduce or mitigate SONGS impacts. The MRC recommended a possible combination of four techniques for reducing or mitigating fish losses, and one technique for mitigating the impacts to the San Onofre kelp bed community.

3.0 MRC RECOMMENDED MITIGATION FOR FISH LOSSES

The MRC presented four techniques for preventing or compensating for fish losses: (1) modify plant operations to reduce larval entrainment; (2) construct an artificial reef; (3) restore a wetland; and (4) use behavioral barriers at the intakes in the Fish Return System to reduce the impingement of juvenile and adult fish. The MRC stated that a combination of one or more of the first three techniques could be used to mitigate for the Bight-wide fish losses, and that the fourth technique should be required if shown to be effective.

(1) Modify Operations to Reduce Larval Entrainment. The MRC discussed two techniques for reducing larval entrainment: scheduling SONGS not to operate during periods of highest larval abundances and/or reducing the flow of water during SONGS operations. The MRC further stated that employment of these techniques at other SCE coastal power plants could also constitute acceptable mitigation for SONGS.

(2) Artificial Reef. A high relief artificial reef would mitigate for fish losses by increasing the general production of fish. The MRC recommended a 150 acre (60 hectare) high relief artificial reef to offset all fish losses (except those occurring in SOK).

(3) Wetland Restoration. Coastal wetlands are rare and valuable habitat in California. They serve as fish nurseries, are productive, and provide habitat for rare and endangered species. The MRC recommended restoration of a 75 to 150 acre (30 to 60 hectare) wetland to mitigate SONGS impacts on fish. The MRC based this estimate of the wetland size on an estimate of loss of biomass of adult fish.

The MRC recommended implementation of any one of the above three techniques, or some combination of the techniques, e.g. partial mitigation with flow reduction or rescheduling operations and partial mitigation with wetland restoration or artificial reef construction.

(4) Behavioral Barriers. In addition to one or some combination of the above three techniques to mitigate for fish losses, the MRC recommended that two new techniques be employed to reduce the impingement of adult and juvenile fish be employed: mercury lights and sonic devices. The MRC recommended that these techniques be tested on an experimental basis, and implemented if they reduce impingement by at least 2 metric tons (MT) per year.

4.0 MITIGATION PACKAGE FOR FISH LOSSES

4.1 WETLAND RESTORATION

The Commission evaluated the three options presented by the MRC for mitigating Bight-wide fish losses, as well as an option that was evaluated and rejected by the MRC (fish hatchery). The Commission first considered the two options that involve preventing impacts by modifying the cooling system operations--rescheduling SONGS' operations or reducing the cooling water flow when fish larvae are abundant. However, the Commission found that the implementation of these techniques is not warranted because of technical constraints and costs that are high, relative to the benefits that would be derived (see subsection 6.0, below).

From among the remaining mitigation options, the Commission selected the option of restoring a coastal wetland for several reasons. Coastal wetlands provide valuable habitat for fish, including many of the species affected by SONGS and other economically important species, such as halibut. In addition to offsetting the impacts of SONGS on fish, restoration of coastal wetlands provides numerous other marine and coastal resource benefits.

Coastal wetlands provide habitat for a variety of marine organisms, including many rare and endangered species, and migrating birds. In addition, coastal wetlands are themselves rare. Less than 25% of the original wetlands remain in Southern California, and most of the remaining wetlands are degraded. Restoration opportunities could be lost or partially lost to development in the future. Finally, in addition to wildlife benefits, wetlands offer aesthetic benefits and provide flood control.

The Coastal Act supports the concept of restoration of marine resources and protection of sensitive areas. Section 30230 states "[M]arine resources shall be maintained, enhanced, and where feasible, restored. Special protection shall be given to areas and species of special biological or economic significance."

Standards and Objectives for Wetlands Restoration

The overall objective of the wetland restoration project is to mitigate for Bight-wide fish losses due to SONGS impacts within a valuable and balanced ecosystem. Condition II-A sets forth a process through which a wetland site shall be selected and a preliminary wetland restoration plan developed to meet this objective. The process requires the permittee to evaluate eight wetland restoration sites located within the Southern California Bight, the area in which the MRC found impacts to fish from SONGS. The permittee will use a list of minimum standards and objectives included in the permit condition to evaluate the different sites for their restoration potential, for their suitability in providing compensation for SONGS impacts to fish, and for the overall marine and coastal resource benefits that could be achieved through the restoration. This process will develop the information necessary to determine which potential site would both meet the minimum standards and best achieve the objectives outlined in Condition II-A. The standards and objectives will also guide the preparation of the restoration plan. The

permittee is required to obtain the Commission's approval of a proposed site and preliminary restoration plan, giving the Commission the final authority in determining the location and design of the wetland restoration project.

Compensation for SONGS Impacts

To some extent, the wetland restoration will directly compensate for the impacts of SONGS on Bight-wide fish by providing fish habitat. The standards required to be met in the condition address this goal by specifying that the location of the restoration project be within the Southern California Bight; by requiring that the wetland be a minimum of 150 acres (60 hectares), as recommended by the MRC; and by requiring that the wetland restoration project have potential for tidal restoration with extensive low and subtidal areas, with the objective of providing substantial fish habitat within a balanced ecosystem. The objective that the restoration project provide compensation as soon as possible is necessary because the impacts of SONGS are ongoing.

With respect to the wetland size requirement, 150 acres represents the upper end of the range identified by the MRC. The MRC stated that the wetland should be 75 to 150 acres, depending on the specific design of the restoration. The Commission finds that at least 150 wetland acres should be restored for the following reasons: (1) there is considerable uncertainty over the actual values produced by a wetland restoration project, and over the potential for success of any given project, and (2) the MRC estimate is conservative. Finding III-B-2.0 describes the MRC's conservative approach. While the Commission recognizes the value of this approach, there is a reasonable possibility that the losses are actually higher than estimated. To be most protective of resources, the Commission finds that the high end of the acreage range is appropriate. The Commission further finds that the 150 acre requirement pertains only to the wetland area and does not include the buffer zone and upland transition area.

Protection of Long-Term Wetland Values

Another goal of the restoration project is to achieve a wetland that will be successful in the long-term. In order to achieve long-term success, the Condition includes a requirement that feasible methods are available to protect long-term wetland values from problems such as sedimentation. The potential for long-term success is also advanced by the objective that the site require a minimum amount of human intervention to function (minimum maintenance requirement); by the requirement that any contamination problems be controlled or remediated; and by the requirement that preservation of the site be guaranteed in perpetuity, either through public or nonprofit ownership or other means approved by the Executive Director.

Maximum Marine and Coastal Resource Benefits

The goal that the wetland restoration project provide maximum marine and coastal resource benefits is advanced through a number of the standards and objectives stated in the permit condition. The first objective (1.4-a) reflects the general goal that the site and restoration plan provide maximum ecosystem benefits e.g. maximum upland buffer, enhancement of downstream fish

values, etc. Standard 1.3-d requires a buffer zone of a size necessary to protect wetland values, and not less than 100 feet wide, with the objective of a buffer zone averaging 300 feet wide. An adequate buffer zone is necessary to protect and enhance a diversity of wildlife values, to protect the wetland's water quality and to prevent sediment deposition.

Other objectives include providing adequate upland transition areas, rare or endangered species habitat, and habitat for reproductively isolated populations of native California species. In addition, the restoration should involve minimum adverse impacts to existing wetland and other sensitive habitat, be a design most likely to produce wetland-dependent resources and be compatible with site-specific and regional restoration goals. A final objective is that the project result in an increase in the aggregate acreage of wetland in the Southern California Bight.

Interagency Wetland Advisory Panel

At appropriate points in the planning process, the Executive Director will convene an interagency advisory panel to provide advice and comments on the wetland site selection, restoration and monitoring plans. The interagency panel will help ensure that the restoration project incorporates regional wetland restoration goals, and is developed in a manner consistent with federal and state law. The panel will include staff representatives of appropriate state and federal agencies such as California Department of Fish and Game, U.S. Fish and Wildlife Service, National Marine Fisheries Service, and the State Coastal Conservancy.

Performance Standards

Condition III-A includes two lists of standards that the restored wetland must meet: (1) longterm physical standards; and (2) biological performance standards. The purpose of these standards is to provide criteria for the success of the wetland and to provide an indication as to when remedial or management measures should be required. In this evaluation, the restored wetland will be compared to reference sites - relatively undisturbed, natural tidal wetlands.

4.2 BEHAVIORAL BARRIOR DEVICES

In addition to a wetland restoration project, the mitigation package for SONGS Units 2 and 3 fisheries impacts includes a requirement that the permittee install behavioral barriers to divert local midwater fish from the intakes. Although SONGS employs two techniques - velocity caps on the intakes and a Fish Return System - for reducing midwater fish losses, at least 20 metric tons (MT) of fish are still killed by the plant each year. The fish are impinged on traveling screens, killed during heat treatments (the fish apparently do not move to the Fish Return System before the water temperature in the screenwells becomes fatal), or unable to survive diversion through the Fish Return System (see Exhibit 6).

The MRC identifies two types of "behavioral barriers" - mercury lights and sonic devices - as economically feasible techniques that could potentially

reduce fish losses at SONGS. Behavioral barriers take advantage of fish behavior to reduce entrapment and impingement rates as discussed below.

- o Mercury lights have been shown to attract fish and could be placed in the Fish Return System chamber to guide entrapped fish out of the screenwells and into the Fish Return System collection area. This would be particularly important during heat treatments because the fish killed during heat treatments tend to be the largest and most economically important of those killed at SONGS Units 2 and 3. The MRC estimates that mercury lights (perhaps in conjunction with sonic devices) might be able to save up to 2.7 MT/year of these large fish at a cost of roughly \$100,000.
- o Sonic devices, such as pneumatic guns or "hammers," provide a high-energy acoustic output that can startle fish and alter their behavior near the device. These devices could be placed in the screenwell area and used to divert fish into the Fish Return System chamber, and/or they could be placed at or near the SONGS' intakes to scare schools of fish away from the intakes, thus reducing the number of fish entrapped. The MRC estimates that sonic devices in the screenwell area (perhaps in conjunction with mercury lights) might be able to save up to 3.0 MT/year of all species and sizes of fish at a cost of roughly \$100,000. Sonic devices at the intakes could reduce the entrapment of schooling fish by 50 percent, saving about 5.4 MT/year of smaller and younger fish species at a cost of roughly \$300,000.

Because the fish must actively swim towards the lights or away from the source of the sound to avoid entrapment, behavioral barriers have little effect on the entrainment of larvae.

The effectiveness of behavioral barriers in reducing fish impingement and entrainment losses has not been adequately tested. Fish behavior varies greatly among different species and lifestages of fish and is influenced by environmental and physiological conditions, making it difficult both to find a behavioral barrier that will work for all species at all times and to predict how effective a technique will be under particular circumstances. Nevertheless, behavioral barriers could be valuable mitigation techniques.

Therefore, in order to mitigate the impacts of SONGS on midwater fish populations, therefore, the Commission finds that SCE shall install and test behavioral barriers including, but not necessarily limited to, mercury lights and sonic devices at SONGS Units 2 and 3. The selected devices shall be monitored to evaluate the effectiveness of such barriers in reducing midwater fish losses.

5.0 MITIGATION FOR IMPACTS TO THE SAN ONOFRE KELP REEF

In the findings for Permit 183-73, the Commission stated that "substantial harm to the kelp bed could occur through excessive heat or turbidity." Condition II-C of the permit, which required that "no diffuser port shall be located within 1,900 feet of the area where the kelp bed south of the

diffusers is likely to expand," was designed to minimize the potential impacts of SONGS Units 2 and 3 on the kelp bed.

However, it is clear from the results of the MRC studies that Condition II-C did not protect the kelp bed from the effects of SONGS. The Commission was correct in their concern about the effects of turbidity. The MRC study found substantial adverse effects to giant kelp, kelp-bed fish, and kelp-bed invertebrates within the San Onofre kelp bed reef (SOK). The substantial adverse effects on SOK resulted from the turbid plume passing over the kelp reef, and were not a result of excessive heat.

Mitigation Methods for Reducing Impacts to SOK

Permit 183-73 contemplates changes to the cooling system if substantial adverse impacts are found. There are two changes to the cooling system which would prevent the impacts to SOK: (1) cooling towers; and (2) locating the discharge away from the kelp bed. However, the MRC recommended and the Commission finds that compensation for the kelp bed losses, in the form of an artificial reef, is preferable mitigation for the following reasons: (1) it is likely to replace the lost resources; and (2) the cooling system changes will cause additional impacts, have engineering problems, and are costly (as discussed in subsection 6.0, below).

Artificial Kelp Reef as Mitigation for SONGS Impacts to SOK

Condition II-C requires the permittee to construct an artificial reef that develops and maintains a kelp bed, and has a physical structure as similar as practicable to SOK's. Based on the kelp, kelp bed fish, and kelp bed invertebrate losses at SOK, the MRC recommended that a 300 acre (120 ha) reef be built. An estimated 200 acres (80 ha) of kelp was lost due to SONGS. The additional 100 acres (40 ha) was recommended because of the risks inherent in replacing a natural ecosystem with a designed ecosystem and because kelp might not cover the entire reef. The kelp and cobble/boulder community might not be as productive and diverse, and there may be substantial time delays in establishing kelp and other biota on the reef. The performance standards set forth in Condition II-C are designed to ensure that the artificial reef will replace the kelp bed reef resources lost at SOK.

The Commission has in the past been concerned about the biological value of artificial reefs and their use for mitigation. The performance standards in Condition II-C represent the important kelp reef biological values and functions. As a result of the reef monitoring, the Commission will be able to assess whether this artificial reef does, in fact, function like a natural reef such as SOK. If it does not, the Commission will be able to direct the permittee to change the reef to provide such functions more successfully.

The use of an artificial reef as mitigation for the effects of SONGS on the San Onofre Kelp Bed is distinguished from proposals to use artificial reefs to compensate for the loss of other kinds of habitat, such as semi-protected soft bottom habitat. Such proposals would lead to a net loss of an important habitat, and replacement with a completely different type of habitat, and may be inconsistent with the Commission's mandate to protect marine resources.

The mitigation reef for the impacts from SONGS will be larger than other artificial reefs built in California. Quarry rock artificial reefs recently built by the Department of Fish and Game have extended out to approximately 250 acres, but cover only approximately seven acres with rock because they were constructed of small rock piles with extensive areas of soft bottom in between. These reefs were not built for mitigation purposes.

Siting and Design of Mitigation Reef

Additional planning and field work will be necessary to determine how best to meet the goals and standards set forth in Condition II-C. The size of rocks, height above the ocean floor (or relief), extent of contiguous area of rock, and extent of scattered cobbles or boulders, are all design decisions which depend on the characteristics of the selected site, characteristics of the SOK reef, and the biological implications of various alternatives. Because the resources to be replaced are associated with both the kelp and the cobble reef itself, it will be important to build a reef that will replace the reef biota as well as the kelp. The necessary expertise to make the correct site and design decisions to meet the goals and standards will be available to the Commission and the permittee through the administrative structure set forth in Condition II-D.

The main design problems to be resolved are: (1) how to ensure that kelp will become established and persist, (2) how to configure the reef to replace as many as possible of the affected species in the SOK reef community, and (3) how to ensure that the reef rocks will not sink into the sand or be buried by sediment.

The MRC identified a number of factors affecting kelp bed stability and persistence. These factors are: location, proximity to existing beds, substrate, and size. The correct location is very important, and a siting study will be critical to the success of kelp bed establishment and persistence. Kelp will not grow well if light levels are too low near the ocean bottom. Water clarity and depth at the selected location will determine available light levels. Kelp beds can be damaged by storms, and this may be an important consideration in choosing a location. It may be possible to minimize this type of damage through reef design as well as location. Factors such as rock size and configuration may be important. Because individual kelp plants only survive a year or so in the San Onofre area, it will be important to have a nearby source for kelp recruitment to the reef, particularly for the initial stages of reef development. Therefore the artificial reef will need to be located as close as possible to an existing kelp bed. The large size of the reef should help protect kelp plants from decimation by herbivores, and loss of fronds from heavy coverage by epiphytes.

Because kelp beds have not persisted on many artificial reefs, the MRC recommended that techniques for establishing kelp be explored immediately after construction. The most effective technique would then be used if it was necessary to establish or augment kelp on the reef. Condition II-C establishes a performance standard for kelp coverage, and provides for recruitment experiments to determine the most effective technique.

SOK is a low cobble reef. Condition II-C requires the permittee to construct an artificial reef as similar as practicable to the damaged portion of SOK. However, it may not be possible to find a site where a cobble reef as low as SOK will persist. There is a concern that the rock substrate may become covered by sediment, and therefore be unavailable for attachment by small kelp plants and other biota. The reef configuration will have to be designed carefully, and take into account sediment characteristics of the site. The MRC recommended that larger rocks and occasional areas of somewhat higher relief be incorporated into the reef design to minimize the risk that a low-relief artificial reef will be inundated by sand. This recommendation can be incorporated during the design stage. Condition II-C requires that the reef be constructed so that rock remains exposed. In addition, Condition II-C requires that more rock be added if the substrate is unavailable for attachment by algae or other biota.

6.0 MITIGATION OPTIONS NOT SELECTED

This section describes several mitigation options that were evaluated by the Marine Review Committee, but that are not required by this permit, and discusses the reasons for rejecting those options.

Cooling System Modifications

Cooling Towers. Cooling towers would significantly reduce all of the adverse marine resource impacts by reducing the intake water flow by 90% or more. However, a majority of the MRC (Drs. Murdoch and Mechalis) rejected this option because of the high costs and other environmental impacts that could result from installation of cooling towers. The cost of constructing the towers is estimated to be \$300 million (PLG 1990) to \$1 billion (MRC Final Report 1989), plus reduced efficiency of up to 20% that would add an additional \$1 billion cost over the life of the plant.

According to the MRC, construction of cooling towers could have several adverse environmental impacts. The salt water used in the towers could result in salt drift, which could cause terrestrial impacts. The water discharged from the plant would have higher concentrations of toxic chemicals and other contaminants than under the present system. Construction of the cooling towers would require modifications to the coastal bluffs near the power plant, and would have visual impacts. Finally, plant capacity could be reduced, requiring additional electricity generation at other plants, with associated environmental impacts.

Moving the Discharge. One alternative for reducing the impacts to kelp is to move the discharge so that the plume does not pass over the San Onofre Kelp Bed. This would eliminate the impacts on the kelp bed reef, but would not reduce the adverse effects on Bight-wide and local fish populations caused by SONGS cooling water intake system. Moving the discharge location would be expensive (hundreds of millions of dollars), and the options for changing the location are limited by the plant's design. In addition, a new discharge location would result in new impacts on the marine environment, elsewhere.

Given these disadvantages and the likelihood that impacts to the kelp bed community could be adequately mitigated by an artificial reef at a much lower cost, the MRC rejected this option.

Rescheduling Operations. One of the techniques for reducing impacts to fish that was recommended by the MRC (as one of three options) was requiring SCE to reschedule operations at SONGS so that the downtime for the power plant occurred during March and April, the period of maximum abundance of fish larvae. If the downtime were during March and April, the MRC estimated that losses of fish larvae could be reduced by about 50%.

However, the MRC recognized that there could be problems implementing this recommendation. These difficulties were substantiated by SCE. According to SCE, it would not be possible to have a regular 12 or 24-month downtime cycle (PLG 1990). The reason is that the time at which maintenance and refueling occur is subject to a complex set of factors, including the variability of forced outages. Therefore, if SCE were required to shut down during the months of March and April, they contend that they would also have to shut the plant down during other times of the year to perform maintenance and refueling. When SONGS is shut down, the lost power must be made up, probably at fossil fuel burning power plants, which are more expensive to run and which also produce adverse environmental impacts. According to SCE, this option would cost in the hundreds of millions of dollar over the life of the plant as a result of higher replacement power costs (PLG 1990).

Flow Reduction. Another technique that the MRC recommended (as one of three options) was reducing the rate of intake water flow through SONGS. A reduction in the rate of water flow through SONGS would reduce both fish losses and turbidity caused by the discharge plume. Operating the plant at 67% flow for February through May (a period of high larval abundance) and full flow the rest of the year could reduce fish larval losses by 27% (MRC Technical Report H, p. 297).

However, a lowered pumping rate would lead to a reduction in the plant's thermal efficiency. The power lost would be discharged to the ocean as increased heat, requiring a waiver of the state thermal discharge standard. In addition, the power would have to be made up at other power plants, which are more expensive to run and which would also result in adverse environmental impacts. The permittee estimated the cost of this option as \$10 million in capital costs to install variable speed drives on existing pumps, and \$7 million per year in replacement power costs (PLG 1990).

Compensation Technique

Fish Hatcheries. The MRC rejected the option of construction and funding of a fish hatchery as mitigation for SONGS. Although a fish hatchery has the potential to provide replacement of fish resources, there are a number of problems with using a fish hatchery as a technique for mitigating SONGS impacts to fish. The existing (salmon) hatcheries have had varied success, in spite of substantial financial investments and extensive studies (MRC Technical Report H, p. 275). Little is known about the effectiveness of releasing hatchery reared marine fish in the wild, and enhancement of marine

populations through release of hatchery-reared fish has never been demonstrated. Unlike other mitigation options which at some point become self-sustaining, i.e. artificial reef and wetland, a fish hatchery requires a continuous outlay of money for operations and maintenance. For all of these reasons, the MRC did not recommend a fish hatchery as part of the mitigation program for SONGS.

7.0 MITIGATION TIMING

This permit requires the permittee to commence the planning process for the wetland restoration mitigation and artificial kelp reef immediately. With respect to the wetland, a proposed site selection and preliminary restoration plan is required to be brought before the Commission within nine months of approval of these conditions. Within 12 months of the approval of the site selection and preliminary restoration plan, the permittee must submit a final restoration plan to the Executive Director for review and approval. Within 6 months of approval of the final plan, construction must commence. The timetable for construction will be specified and approved in the final plan. With respect to the kelp reef, the permittee must submit a final design plan to the Commission for review and approval within 18 months of the effective date of the permit condition, and must complete reef construction within 6 years of the effective condition date.

The Commission finds that, as with any permittee, if the permittee believes that changed circumstances warrant modification to the Commission's mitigation requirement, the permittee may request such modification from the Commission. Furthermore, if the timing of the other regulatory agencies' action is such that when the permittee has completed the planning process necessary for the major components of the Commission's required mitigation program and is ready to begin construction, and the other agency(s) has not yet acted, the permittee may request an extension of the time allowed to complete the mitigation obligation from the Commission. However, the permittee must commence the planning process immediately, and may not await the outcome of the other regulatory processes to do so.

8.0 MITIGATION FOR CURRENT LIFE OF SONGS UNITS 2 AND 3

The mitigation program required by these permit conditions satisfies the permittee's mitigation obligations for the current projected life of SONGS Units 2 and 3. Modifications to extend the life of the power plant, such as repowering, would require a new permit and a new mitigation program. Units 2 and 3 began operation in 1983 and 1984, respectively, and the impacts to the marine environment have been ongoing. Therefore, the mitigation measures must compensate for these past impacts as well as the impacts for the remaining life of the Units. The Commission has taken into consideration the fact that both the wetland and the artificial reef are designed to persist beyond the life of the power plant in its determination that the required mitigation program compensates for the impacts to the marine environment from the existing Units 2 and 3.

The permittee's monitoring, management and remediation obligation extends over the "full operating life" of SONGS Units 2 and 3. Both the artificial kelp reef and the restored wetland must be maintained for the total number of years that the plant causes impacts to the San Onofre Kelp reef and to Bight-wide fish populations.

9.0 MITIGATION MONITORING AND ADAPTIVE MANAGEMENT

Many of the preventative measures for reducing SONGS impacts studied by the MRC, such as moving SONGS discharge, constructing cooling towers, or reducing the water inflow rate, offer relatively certain and measurable benefits. However, as described in subsection 6.0, these techniques also have serious cost and feasibility issues associated with them. With the exception of the behavioral barriers, the mitigation package required by these conditions is compensatory rather than preventative in nature. While the benefits of such measures are predicted to fully offset the identified impacts of SONGS, these benefits are uncertain. The monitoring, management and remediation program, required by Condition II-D, addresses this uncertainty by providing information on the success of mitigation projects, and by providing a mechanism for "adaptive management" of the created resource, i.e. improving the likelihood of success by monitoring and on the basis of the data collected, regularly reevaluating the management plan and determining necessary remedial steps.

For the wetland restoration there is uncertainty over whether the wetland will be successful in achieving the anticipated resource value. The monitoring and management program for the wetland project (see Condition II-A) will measure the performance of the wetland compared to natural reference wetlands, and based on the monitoring findings, prescribe remedial measures.

For the artificial kelp reef, there is uncertainty over whether a giant kelp bed of a size necessary to offset the impacts at San Onofre Kelp bed will successfully be established on the reef. There is also uncertainty over whether the community of fish, benthic algae and invertebrates will be similar to the community that would occur at San Onofre kelp bed in the absence of SONGS. As for the wetland, the monitoring and management program for the artificial kelp reef will indicate the success of the reef in achieving desired objectives and will prescribe remedial measures as necessary (see Condition II-C).

Behavioral barriers are a promising, but unproven technique for reducing fish impingement. Because the effectiveness of these devices has not been adequately tested, there is no guarantee that they will successfully provide mitigation benefits. However, the relatively low cost of these techniques warrant their installation. Monitoring the effectiveness of the techniques, as provided by Condition II-B, will enable Executive Director to determine if one or more device should be permanently installed and maintained.

Administrative Structure for Monitoring and Management

The most effective and reliable means of achieving the compensation objectives described in this permit is through independent, third party monitoring and adaptive management. In its Final Report, the MRC recommended that monitoring be "independent" (page 308). Condition II-D describes an administrative structure to accomplish independent, third party monitoring and adaptive management, with Commission staff oversight.

The MRC pointed out in its Final Report (Page 312) that "the specific design of each [monitoring] program and the analysis and interpretation of the data will be critical to the successful completion of the objectives of these recommendations." The scientific advisory panel and the annual review set forth in Condition II-D will help ensure that each aspect of the monitoring, management and remediation program is well designed and executed.

10.0 CONCLUSION - MITIGATION FOR SUBSTANTIAL ADVERSE IMPACTS

The Commission finds that the restoration, monitoring and remediation of a coastal wetland combined with installation and monitoring of behavioral barriers will provide full mitigation for the impacts of SONGS on Bight-wide and midwater fish (as identified by the MRC), consistent with the Coastal Act. The Commission finds that the process set forth in condition II-A and II-D will achieve the following: (1) result in the selection of a wetland site, and the development and implementation of a restoration plan that will best mitigate for the impacts of SONGS; and (2) provide maximum overall coastal and marine resource benefits. The monitoring, management and remediation program will ensure that the mitigation compensation values are achieved.

The Commission finds that the construction of an artificial reef will provide full mitigation for the impacts of SONGS on the San Onofre Kelp Bed (identified by MRC). The artificial reef will directly replace the resources lost and damaged in the San Onofre Kelp Bed, if it is successful. Condition II-C is designed to ensure that the artificial reef will provide: (1) stable rock surfaces and rock configurations for attachment of a community of algae and invertebrates similar in composition, diversity and abundance to SOK; (2) adequate conditions for giant kelp recruitment, growth, and reproduction; and (3) adequate conditions for a community of reef-associated biota similar in composition, abundance and diversity to SOK. The performance standards set forth in Condition II-C-4.0 will ensure that the above goals are met, and the artificial reef replaces the kelp reef values lost at SOK. In addition, the large size and habitat variety, physical structure resembling the SOK reef, additional acreage to account for differences between the mitigation reef and SOK reef, careful siting, and monitoring and remediation, should it be necessary, will all help insure replacement of lost resources.

D. MARINE RESOURCES - OTHER EFFECTS

1.0 SUMMARY AND INTRODUCTION

This section presents the Commission's findings on MRC studies that did not detect any substantial, adverse, SONGS-induced effects on the specific portion of the marine environment studied. Specific MRC studies discussed include: (1) releases of metals and radionuclides from SONGS Units 2 and 3; (2) deposition of muddy sediments in SOK; and (3) effects of SONGS' operations on bottom dwelling (benthic) fish, plankton, certain species of mysids, soft benthos, and intertidal sand crabs.

- o Metals and Radiation. SONGS Units 2 and 3 discharge both metals and radioactive nuclides to the marine environment. Although the MRC conducted its own long-term field research program to study the potential impact of these emissions on sand crabs, the MRC reviewed other available evidence and concluded that the amounts of metals or radionuclides released from SONGS are unlikely to cause substantial adverse ecological impacts to the marine community near SONGS.
- o Muddy Sediments. MRC contractors discovered new deposits of muddy sediments in San Onofre Kelp Bed (SOK) sampling sites downcoast of SONGS' diffusers in October 1985. The sediments, which covered 71 acres of SOK in 1987 (about 15 percent) and 22 acres of SOK in 1989 (about 4.5 percent), cover and kill marine organisms that normally grow on the hard substrate of kelp beds. The MRC theorized that SONGS' operations contribute to the appearance and presence of muddy sediments in SOK. The MRC technical report stated, however, that the data collected are inadequate to establish this linkage. The Commission finds that construction of a kelp reef outside the influence of SONGS' discharges (see Condition II-C) would also mitigate impacts to kelp bed biota attributable to sediment deposition at SOK.
- o Unimpacted Marine Biota. MRC studies of discharges from SONGS Units 2 and 3 did not detect any substantial adverse effects to the following marine organisms: bottom dwelling (benthic) fish, plankton, certain species of mysids, soft benthos, and intertidal sand crabs. A majority of the MRC (Drs. Mechalas and Murdoch) concluded that SONGS' operations contribute to an increase in abundance in the SONGS' area of benthic fish, meroplankton, mysids, and soft benthos. Dr. Fay, however, found that "there is no good evidence for the enhancement of these populations." (Draft Minority Report on the Final Report of the MRC, October 1990, p. 22; hereinafter, Draft Minority Report)

2.0 METALS AND RADIATION

Both radioactive and non-radioactive effluents (including metals released during corrosion of metal-containing structures in the SONGS' cooling water system) enter the marine environment after being discharged into the seawater

that passes through SONGS. The MRC examined the potential impacts of these emissions by conducting a long-term study of sand crabs, and reviewing available evidence from a number of sources, including (1) Southern California Edison's (SCE) National Pollution Discharge Elimination System (NPDES) reports to the San Diego Regional Water Quality Control Board (San Diego Regional Board) and (2) data collected from other state and federal monitoring programs (e.g., the State Mussel Watch Program). Impacts were determined by measuring concentrations of metals and radionuclides in receiving waters, not discharge waters, since the main task of the MRC was to assess the ecological consequences of the SONGS' cooling system, not to monitor substances discharged. The MRC did not study health and safety issues related to the release of radiation, since the Commission has limited review capabilities over radiological discharges. (The health and safety aspects of radiological monitoring fall under the authority of the federal Nuclear Regulatory Commission.)

The MRC reached the following conclusions from the available evidence:

Metals. Data indicate that SONGS releases metals into the marine environment. However, the data do not indicate that SONGS releases enough metals to increase substantially their concentration in the marine environment near SONGS.

Radiation. Data indicate that SONGS releases radioactive nuclides into the marine environment at rates sufficient to lead to detectable, but low, concentrations in local marine organisms and occasionally in nearby sediments. These concentrations are only slightly above background levels, and are far below the levels known to cause physiological impairment to marine organisms.

The Commission agrees with the MRC's findings that metals and radionuclides released from SONGS Units 2 and 3 have not adversely affected either the local marine biota or the physical environment near SONGS. Given the available data and the Commission's limited review capabilities over radiological discharges, the Commission finds, therefore, that current releases of metals and radiation from SONGS Units 2 and 3 require neither mitigation nor modification to the SONGS' cooling system.

3.0 MUDDY SEDIMENTS

The MRC has studied the hard bottom habitat at SOK and San Mateo Kelp bed (SMK) since October 1980. In October 1985, MRC contractors diving on sampling sites in SOK discovered portions of the stations covered with six to 12 inches of muddy sediments. These sediments, which had covered and killed marine organisms on the hard substrate of the kelp bed, had not been detected in any MRC studies conducted at SOK before SONGS Units 2 and 3 began commercial operations.

The MRC technical report (B) concluded that SONGS' operations may have contributed to the appearance and persistent presence of the sediments for the following reasons:

1. MRC contractors did not sight deposits of muddy sediments at SOK prior to 1985. Between 1985 and 1989, however, the contractors sighted deposits of similar sediments at SOK over 100 times. During this same time period, similar sediments were sighted at locations outside SOK only five times.
2. The gross ("bulk"), physical, and chemical characteristics of the muddy sediments found at SOK differ from the characteristics of surrounding sediments. This suggests that the sediments are transported to SOK. The MRC theorized that fine sediments near SONGS are entrained in the SONGS' cooling water discharge plume, mixed with organic material derived from plankton killed by the plant, and subsequently carried over SOK in the discharge plume. Ocean current studies using dye tracers show that sediments could be deposited at various points in SOK where water movement over the kelp bed is greatly reduced as a result of altered water flow and its encounter with the kelp bed.
3. The sites in SOK where muddy sediments have been deposited are concentrated along the upcoast and offshore edge of the kelp bed immediately downcoast of the diffusers. These areas coincide with the areas where the SONGS' discharge plume encounters the kelp bed.

The MRC technical report concluded that the timing and appearance of muddy sediments in SOK suggest that SONGS' operations contribute to sediment deposition in the kelp bed. However, the report concluded that the data collected do not establish SONGS' role in either the presence or the deposition of muddy sediments in SOK.

The Commission believes that construction of a new kelp reef as mitigation for other SONGS-induced impacts to kelp would also mitigate impacts caused by deposition of muddy sediments on the hard substrate in SOK. The Commission finds, therefore, that the observed adverse effects of sediment deposition at SOK require neither additional mitigation nor modification to the SONGS' cooling system.

4.0 BOTTOM DWELLING (BENTHIC) FISH

The benthic fish community in the vicinity of SONGS includes many species of sport and commercial fish (e.g., halibut, turbot and sanddabs) together with larger bottom-oriented individuals (e.g., white croaker and queenfish). Benthic fish species such as white croaker and queenfish feed primarily on crustaceans, worms, clams, and other detritus-feeding invertebrates. Other species, such as halibut, eat anchovies and other small fish. Turbot and sanddabs feed on both invertebrates and small fish.

The MRC studied benthic fish populations by sampling 68 species of bottom fish for two years before SONGS Units 2 and 3 became operational and for three years afterwards. Benthic fish were sampled in shallow (18 m) water and in deep (30 m) water at both impact and control sites.

MRC studies indicate that the relative abundance of benthic fish tended to increase after SONGS Units 2 and 3 became operational. Five fish species (including queenfish and white croaker, the most abundant species) increased in abundance, while three species decreased in abundance. In addition, total weight of bottom fish at both the shallow and deep water impact sites increased relative to total weight of bottom fish at the control sites. The MRC theorizes that (1) benthic fish increased in abundance because discharges of organic matter from SONGS (organisms entrained in the SONGS' cooling water system are killed and subsequently discharged as organic detritus) attract detritus-feeding invertebrates and other fish species upon which benthic fish feed and (2) the density of benthic fish increased because the fish did not emigrate from the local area. Dr. Fay finds, however, that the data collected at the 30 m station do not support the conclusion that SONGS' operations increase benthic fish abundance or density at the deep water station. (Draft Minority Report, pp. 24-5.)

Given the available data, the Commission agrees with the MRC's findings that SONGS Units 2 and 3 have not adversely affected benthic fish species in the marine environment near SONGS. The Commission finds, therefore, that the effects on benthic fish from current operations of SONGS Units 2 and 3 require neither mitigation nor modification to the SONGS' cooling system.

5.0 PLANKTON

The term "plankton" encompasses both small marine plants ("phytoplankton," the basis of the marine food web) and small marine animals ("zooplankton") that float or drift in the water column. Zooplankton are subdivided into three groups: (1) "holoplankton" (organisms that spend their lives as plankton); (2) "meroplankton" (early stages of species such as barnacles and clams whose adult stages live on the ocean floor); and (3) the larvae of many fish species. Zooplankton feed on either phytoplankton or other zooplankton, and are fed upon in turn by the fish and the other organisms that "ultimately support most of the sport and commercial fish species in the ocean." (MRC Final Report, p. 185.) Due to their size and inability to maneuver effectively in currents, plankton are vulnerable to being entrained and killed in the SONGS' cooling water system or to being transported by the SONGS's discharge plume away from the SONGS' area. A decrease in local plankton abundance could in turn cause a decline in local abundance of both the fish and the other organisms that feed on plankton.

The MRC plankton monitoring program at SONGS was conducted for five years before SONGS Units 2 and 3 became operational and for three years afterwards. This section of the report examines SONGS' effects on phytoplankton, holoplankton and meroplankton, because the MRC obtained different results for SONGS' effects on larvae than it obtained for effects on the other categories of plankton. Effects on fish larvae are discussed in Section III-B.

The MRC reached the following conclusions from the data collected:

Phytoplankton. MRC studies did not detect a statistically significant decrease in local phytoplankton abundance.

Zooplankton. An estimated 1350 tons dry weight of zooplankton are taken into the SONGS Units 2 and 3 intakes each year. The majority of the MRC (Drs. Mechals and Murdoch) found that (1) this loss does not cause a local reduction in zooplankton abundance and (2) the data indicate that the local abundance of meroplankton increased as a result of SONGS' operations. Dr. Fay, however, found that "The charge to the MRC . . . to sample the plankton and assess the impact of the SONGS on this group of organisms was not accomplished." (Draft Minority Report, p. 5.)

Given the available data, the Commission agrees with the MRC's findings that SONGS Units 2 and 3 have not caused substantial adverse effects to plankton in the marine environment near SONGS. The Commission finds, therefore, that the effects on plankton from current operations of SONGS Units 2 and 3 require neither mitigation nor modification to the SONGS' cooling system.

6.0 MYSIDS

"Mysids" are small (up to an inch long) shrimp-like crustaceans. Many mysids live near the ocean floor during the day and move throughout the water column at night. Organisms that exhibit this form of behavior are called "semi-planktonic." SONGS kills large numbers of mysids by drawing these organisms into the cooling system along with the cooling water. Because mysids and other semiplanktonic organisms are an important food source for fish that live in the vicinity of SONGS--including midwater fish such as queenfish and benthic fish such as sanddabs--any adverse impact of SONGS' operations on mysids could also adversely effect those species that feed upon mysids.

The mysids monitoring program at SONGS was conducted from 1979 to 1986. The program was designed to determine (1) whether operations of Units 2 and 3 cause a detectable reduction in abundance of mysids within several kilometers of the discharge structures, (2) whether nearshore mysids are moved offshore (into presumably unsuitable habitats) with the water entrained by the diffuser outakes, and (3) how many mysids are killed each year by withdrawal into the cooling system of Units 2 and 3. Because mysids are the most abundant of the semiplanktonic organisms in the vicinity of SONGS, the MRC chose certain species of mysids to represent all semiplanktonic organisms in the vicinity of SONGS. The MRC program also studied only semiplanktonic varieties of mysids and not those species of mysids associated with kelp canopy.

MRC studies showed that SONGS entrains and kills about 6.5 billion mysids (14 tons) per year. Despite these losses, MRC data indicate an increase in relative abundance of mysids about two miles (1.25 km) downstream from SONGS. The MRC found that the observed increases in mysid abundance may arise from either an increase in organic material present in the SONGS' discharge plume or as a result of decreases in the stocks of midwater fish which feed upon mysids. Dr. Fay suggested a number of other possible factors including increased mysid concentration caused by a vertical circulation cell. (Draft Minority Report, p. 22.) MRC studies did not show evidence of mysid losses resulting from offshore transport.

Given the available data, the Commission agrees with the MRC's findings that SONGS Units 2 and 3 have not caused substantial adverse effects to certain species of mysids in the marine environment near SONGS. The Commission finds, therefore, that the effects on certain species of mysids from current operations of SONGS Units 2 and 3 require neither mitigation nor modification to the SONGS' cooling system.

7.0 SOFT BENTHOS

The "soft benthos" refers to the large and varied assemblage of invertebrates that live in and on the soft sediments of the ocean floor. This assemblage is diverse taxonomically, exhibits a large array of different feeding habits and patterns of habitat utilization, and represents the largest faunal group (in number of species) potentially impacted by SONGS. Because the soft benthos is a principal food source for benthic fish such as turbot, any adverse impacts of SONGS' operations on the soft benthos could also affect species that feed upon the soft benthos.

The soft benthos monitoring program at SONGS was conducted from 1977 to 1986. MRC studies identified over 600 species of soft benthos organisms, including worms (polychaetes), crustaceans, and molluscs (primarily clams).

MRC studies indicate that widespread increases in the abundance of soft benthos occurred near SONGS. The MRC theorized that the soft benthos increased in abundance because the amount of organic matter on which the soft benthos feed increased as other organisms were entrained in the SONGS' cooling water system, killed, and subsequently discharged as detritus.

Given the available data, the Commission agrees with the MRC's findings that SONGS Units 2 and 3 have not adversely affected soft benthos organisms in the marine environment near SONGS. The Commission finds, therefore, that the effects on the soft benthos from current operations of SONGS Units 2 and 3 require neither mitigation nor modification to the SONGS' cooling system.

8.0 INTERTIDAL SAND CRABS

MRC studies on intertidal sand crabs represent the only investigations into the potential impacts of SONGS on marine organisms that reside in the intertidal zone. Data from an early (1976 to 1978) MRC study of sand crab populations near SONGS suggested that SONGS Unit 1 had adversely affected local sand crab populations up to ten miles (16 km) from SONGS. This early study suggested that sand crabs near SONGS Unit 1 may be smaller than sand crabs elsewhere, and may also exhibit poorer reproductive capacity.

The MRC studies examined spatial and temporal patterns in the biology of sand crabs based on data collected intermittently from 1976 through 1986. The studies looked for effects on sand crab abundance, reproduction, size, and growth. Additional data on metal concentrations in sand crab tissues were collected twice in 1983 and once in 1986. Radionuclide activity in sand crabs was evaluated once in 1986. Both the growth of individual sand crabs and the size distribution of a sand crab population can be influenced by a variety of

natural factors, including the physical characteristics of the beaches on which sand crabs live (e.g., the proportion of sand to cobbles on the beach). Consequently, samples were collected at a number of beaches varying in distance from SONGS to distinguish "location effects" from "SONGS-induced effects." The MRC, however, could not utilize the BACIP sampling approach used in other MRC studies, because SONGS Unit 1 (which began commercial operation in 1968) may have already affected sand crabs. (The BACIP approach requires sampling before the plant begins operation in order to isolate impacts that occur after the plant begins to operate.)

The MRC studies showed that intertidal sand crabs at beaches near SONGS often have characteristics that are different from sand crabs at more distant beaches. For example, in contrast to sand crabs farther from SONGS, sand crabs near SONGS tended to be smaller and to have poorer egg development. Other differences--such as the size of egg-bearing females and the fraction of the number of females bearing eggs--were also noted on occasion. A majority of the MRC (Drs. Mechalis and Murdoch) concludes that (1) the observed spatial patterns and other differences in sand crab characteristics may be attributable to the physical characteristics of the beaches near and far from SONGS, and not to operations at SONGS Units 2 and 3 (i.e., observed differences occur because the beaches in the SONGS' area have a high proportion of cobble and a corresponding low proportion of sand) and (2) the data do not provide evidence that the biological differences between sand crabs near and far from SONGS are related to releases of metals and radionuclides from SONGS. Dr. Fay, however, finds that "the MRC did document adverse impacts upon sand crabs as a result of the operation of Units 1, 2, and 3 correlated with the presence of radioactivity and metals (MRC Final Report, p. 227)." (Draft Minority Report, p. 28.)

Given the available data, the Commission agrees with the MRC's findings that SONGS Units 2 and 3 have not adversely affected intertidal sand crabs in the marine environment near SONGS. The Commission finds, therefore, that the effects on sand crabs from current operations of SONGS Units 2 and 3 require neither mitigation nor modification to the SONGS' cooling system.

9.0 CONCLUSION - NO SUBSTANTIAL ADVERSE EFFECTS

The Commission finds that the MRC studies of bottom dwelling (benthic) fish, plankton, mysids, soft benthos, and intertidal sand crabs discussed in this section do not establish SONGS-induced impacts to the specific parts of the marine environment studied by the MRC. Consequently, the Commission finds that neither additional mitigation nor modification to the SONGS' cooling system is required for releases of metals and radiation from SONGS Units 2 and 3, for the appearance and presence of muddy sediments in SOK, and for the effects of SONGS' operations on bottom dwelling (benthic) fish, plankton, certain species of mysids, soft benthos, and intertidal sand crabs.

E. WATER QUALITY COMPLIANCE

1.0 SUMMARY AND INTRODUCTION

In issuing Permit No. 183-73, the California Coastal Zone Conservation Commission directed the Marine Review Committee (MRC) to study the compliance of SONGS Units 2 and 3 with the regulatory requirements of State and Federal water quality agencies. In accordance with this directive, the MRC collected data on several water quality indicators, including temperature, metals, sediments, natural light, and effect on marine biota. The data were assessed to determine if SONGS is in compliance with (1) the National Pollutant Discharge Elimination System (NPDES) permits for Units 2 and 3 issued by the San Diego Regional Water Quality Control Board (San Diego Regional Board) and (2) the regulatory requirements of other state and Federal water quality agencies. The MRC then compared its findings with the findings reported in Southern California Edison's (SCE's) annual NPDES monitoring reports to the San Diego Regional Board. Results of MRC studies suggest the following:

1. Temperature. SONGS meets the permit limit for water temperature.
2. Metals. SONGS meets the permit limits for discharges of metals.
3. Sediments. Data collected on sediment deposition in the San Onofre Kelp Bed (SOK) downcoast of SONGS are inconclusive regarding SONGS compliance with regulations for sediments.
4. Natural Light. SONGS does not meet the NPDES permit limitations governing natural light levels in the receiving waters. MRC data show that discharges from SONGS Units 2 and 3 significantly reduce light intensity in receiving waters. Natural light levels at the ocean bottom in SOK were six to 16 percent lower than they would have been in the absence of SONGS.
5. Marine Organisms. SONGS does not meet the NPDES regulations regarding plants and animals in the ocean near SONGS. MRC data show statistically significant reductions in populations of midwater fish near SONGS and populations of giant kelp, kelp-bed invertebrates and kelp-bed fish in SOK.

The MRC's determination of SONGS' noncompliance with water quality standards for natural light and effects on marine biota differ from SCE's findings of compliance for the following reasons: (1) the MRC used a more powerful sampling program to monitor natural light levels near SONGS; (2) SCE does not regularly monitor some of the marine biota populations that the MRC found to be affected by SONGS; and (3) the MRC and SCE used different approaches to analyze the data collected.

Based on the findings of the MRC, the Commission recommends that the San Diego Regional Board amend the SONGS Units 2 and 3 NPDES permits to:

- o Require that the effects of Units 2 and 3 on midwater fish, kelp-bed fish and kelp-bed invertebrates be regularly monitored to assess whether SONGS-induced effects diminish or accumulate through time.
- o Require that SONGS' effects on natural light levels in receiving waters near SONGS be determined by measuring "total irradiance" continuously instead of transmissivity, since "irradiance is a more direct measure of the light available to plants for photosynthesis" (MRC Final Report, p. 283). The existing NPDES permits allow SCE to measure transmissivity or total irradiance or both.
- o Require that ocean currents be measured continuously at the stations established for continuous irradiance measurements so that the position of the SONGS' discharge plume can be taken into account when testing for SONGS' effects.
- o Establish specific guidelines for the sampling designs and statistical procedures used by SCE for its NPDES monitoring reports that will ensure that SCE monitoring studies can adequately distinguish between SONGS-induced effects and changes attributable to natural events.

This section of the Commission's report on SONGS: (1) discusses relevant water quality regulations and the federal and state agencies responsible for implementing the regulations in the California coastal zone; (2) describes the NPDES permit requirements for SONGS; (3) examines the MRC's findings relating to the impact of SONGS Units 2 and 3 on the marine environment; and (4) based on the MRC's finding, makes recommendations in the form of a resolution to the San Diego Regional Board.

2.0 RELEVANT WATER QUALITY REGULATIONS AND REGULATORY AGENCIES

Regulation of marine water quality along the California coast is shared by several agencies at both the federal and state levels. The agencies with the most comprehensive regulatory authority are the United States Environmental Protection Agency (EPA) and the California State Water Resources Control Board (State Board). Authority held by the State Department of Fish and Game (DFG) and the Coastal Commission relates to marine resource protection.

The federal and state programs for regulating marine water quality are independent, but interrelated. EPA's authority derives from the Clean Water Act (CWA), as amended (the Federal Water Pollution Control Act Amendments of 1972 and 1987; 33 U.S.C. secs. 1251, et seq.). The CWA authorizes EPA to establish and administer the NPDES permit program, which requires municipal and industrial dischargers to (1) obtain an NPDES permit before discharging into navigable waters, (2) monitor the physical and biological characteristics in the vicinity of the discharge, and (3) report regularly on compliance with the water quality limits and conditions imposed in the NPDES permit.

States obtain authority to issue NPDES permits by submitting a water quality control plan to the EPA that contains effluent limitations and standards that are at least as stringent as those in the CWA. Upon EPA approval of the plan, the state agency developing the plan becomes the regulatory authority within

the state for discharges into state waters (marine waters out to three miles from shore). In California, the EPA has designated the State Board as the water pollution control agency responsible for all purposes stated in the CWA. The Porter-Cologne Act (Water Code secs. 13000, et seq.) establishes the regulatory framework for the State's program. In addition, the State Board has prepared two water quality control plans for California. These are the:

Thermal Plan ("The Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Water and Enclosed Bays and Estuaries of California") which (1) sets standards for maximum temperature differences between discharged waters and receiving waters and (2) prohibits discharge of heated waste near areas of special biological significance; and

Ocean Plan ("The Water Quality Control Plan for Ocean Waters of California") which (1) establishes water quality objectives for receiving waters in order to protect the quality of the ocean waters for use and enjoyment by the people of the state and (2) prohibits degradation of marine biota. The existing NPDES permits for SONGS Units 2 and 3 (issued in 1985) are subject to the regulations contained in the 1983 Ocean Plan.

NPDES permit review and enforcement is conducted for the State Board by nine Regional Water Quality Control Boards (Regional Boards). The Regional Boards have primary responsibility for (1) developing and adopting waste discharge requirements (limits on waste discharges to state waters), (2) administering monitoring programs (used to determine compliance with permit requirements), and (3) renewing NPDES permits every five years. In preparing and reviewing NPDES permits, the Regional Boards must consider all applicable federal and state water quality criteria, regulations and laws.

Both the DFG and the Coastal Commission are authorized to protect marine resources. Relevant DFG regulations are:

- o Prohibit discharges detrimental to fish, plant or bird life (DFG Code 5650);
- o Require cleanup and removal of illegally discharged pollutants (DFG Code 12015); and
- o Require restoration of marine habitats or communities that are damaged by a discharge of a substance that is not regulated by an NPDES permit (DFG Code 12016).

The Coastal Commission protects marine resources under the California Coastal Act of 1976. The Coastal Act contains policies establishing standards to which coastal development must conform (Chapter 3, Sections 30200 through 30264). For example, Section 30231 states:

The biological productivity and the quality of coastal waters, streams, wetlands, estuaries, and lakes appropriate to maintain optimum populations of marine organisms and for the protection of human health shall be maintained and, where feasible, restored through, among other means, minimizing adverse effects of waste water discharges and entrainment....

In addition, Coastal Act Section 30404 authorizes the Commission to submit recommendations to the State or Regional Board that encourage the agency to carry out its functions in a manner consistent with the Coastal Act. These recommendations may include proposed changes in NPDES permits.

3.0 NPDES PERMIT REQUIREMENTS FOR SONGS

The San Diego Regional Board writes and administers the NPDES permits for all three units at SONGS. The NPDES permits for SONGS Units 2 and 3 (CA0108073 and CA0108181, respectively) are separate but virtually identical - the only differences concern total volume of water discharged at each unit. Both NPDES permits were last renewed in 1985.

The NPDES permits for Units 2 and 3 impose water quality regulations through limits on constituents contained in the discharge water, and regulations that refer to the characteristics of the receiving water. The water quality objectives of the Thermal Plan and the Ocean Plan are incorporated into receiving water limitations. The permits also specify the monitoring requirements and programs that SCE (the discharger) must use to determine if SONGS' discharges are in compliance with the NPDES permit provisions.

Discharge Limitations

The NPDES permits covering discharges from SONGS Units 2 and 3 prohibit ocean discharge of materials such as high-level radioactive wastes, polychlorinated biphenyl compounds (PCBs), municipal and industrial sludge, and untreated wastes; discharge of total residual chlorine from any unit is limited, except in certain specific circumstances, to less than two hours per day (Requirements A.1 through A.6.). Other permit regulations are expressed as:

- o General policies. For example: (1) "SONGS... discharge of elevated temperature wastes to the Pacific Ocean shall comply with limitations necessary to assure protection of beneficial uses and designated areas of special biological significance" (Req. B.8); and (2) "SONGS... waste management systems that discharge to the ocean shall be designed and operated in a manner that will maintain the indigenous marine life and a healthy and diverse marine community" (Req. B.5.).
- o General limitations. For example: (1) during normal operations the daily average of the difference in temperature between discharge and intake waters must not exceed 20°F (Req. B.9); (2) the pH of the discharge must remain between 6.0 and 9.0 (Req. B.10); and (3) SONGS' discharges should not contain substances that "form sediments which degrade benthic communities or other aquatic life," that are "toxic to marine life due to increases in concentrations in marine waters or sediments," or that "significantly decrease the natural light of benthic communities and other marine life" (Reqs. B.4(b),(c),(d)).
- o Standards (for the maximum concentrations of specific constituents that may be present in the discharge water). For example: after November 19, 1985, the combined discharge of total residual chlorine from SONGS Unit 2 or Unit 3 may not exceed 192 lbs/day (Req. B.3).

Receiving Water Limitations

NPDES receiving water regulations are most pertinent to the MRC's directive to measure SONGS' effects on the marine environment. These regulations address the cumulative impacts of the discharge, and apply to the thermal, physical, chemical, biological, and bacteriological characteristics of receiving waters. In general, NPDES receiving water regulations prohibit degradation of marine biota. In particular, the regulations limit or prohibit the following changes to receiving water quality: (1) an increase in natural water temperature in excess of 4°F (Req. D.1(a)); (2) a statistically significant reduction in natural light transmittance outside the Units 2 and 3 discharge zone (Req. D.1(c)(3)); and (3) degradation of benthic communities as a result of increased sedimentation (Req. D.1(e)(1)). Degradation is determined by "analysis of the effects of waste discharge on species diversity, population density, contamination, growth anomalies, debility, or supplanting of normal species by undesirable plant and animal species" (Ocean Plan 1983, p. 12).

Monitoring Program Design

The NPDES permits for SONGS Units 2 and 3 require that SONGS' effects be assessed by comparisons of characteristics at impact sites (monitoring stations close to SONGS where potential effects are likely to occur) and control or reference sites (stations far from SONGS where potential effects are not likely to occur). In order to determine if the data collected at the two sites are significantly different, statistical tests should be used to compare impact and control sites. Such comparisons should also distinguish between effects attributable to SONGS' discharges and effects attributable to natural spatial and temporal variation.

4.0 MRC FINDINGS ON WATER QUALITY

To measure the effect of SONGS Units 2 and 3 on marine water quality, the MRC collected data on the following water quality indicators for receiving waters: temperature, metals, sediments, natural light levels, and effect on marine biota. Each of these indicators is regulated by the NPDES permits for Units 2 and 3. The MRC then compared its results with the permit limits established in the respective NPDES water quality regulation. The MRC found as follows:

1. Temperature. SONGS Units 2 and 3 are in compliance with NPDES permit limits for temperature. NPDES regulations require that elevated temperature wastes shall not result in increases in the natural water temperature exceeding 4°F at the shoreline, at the surface of the ocean substrate, or at the ocean surface beyond 1000 feet from the discharge system (Req. D.1(a)). The MRC found the temperature increases in receiving waters to be within these limitations.
2. Metals Concentrations. SONGS Units 2 and 3 are in compliance with NPDES permit limits for discharges of metals. The NPDES criteria for metals require that (1) the discharges do not contain substances that accumulate in water or sediments to levels that are toxic to marine life and (2) the concentrations of certain substances do not increase

to levels that would degrade indigenous biota. The MRC found that the concentrations of metals in the tissues of marine organisms, sediments and seawater near SONGS were similar to the concentrations in organisms at "clean" reference sites.

3. Sediments. The data collected on sediment deposition in SOK are inconclusive regarding SONGS compliance with NPDES permit limits for sediments. Although the available evidence suggests that the operation of SONGS Units 2 and 3 may contribute to the appearance and continued presence of muddy sediments in SOK, the data do not conclusively support this hypothesis. The NPDES permits require that (1) the rate of deposition of inert solids in ocean sediments should not be changed in a way that would degrade benthic communities, and (2) organic materials in sediments should not increase to levels that degrade marine life (Reqs. D.1(c)(2)) and D.1(d)(5)).
4. Natural Light Penetration (Turbidity). SONGS Units 2 and 3 are not in compliance with NPDES permit limits governing levels of natural light in receiving waters. The NPDES permits prohibit discharges that significantly reduce the transmittance of natural light (which is a necessary element of photosynthesis) at any point outside the the area where initial mixing of discharged and receiving waters occurs (Req. D.1(c)(3)). The MRC found that the level of natural light at the ocean bottom in SOK was six to 16 percent lower than it would have been in the absence of SONGS (MRC Final Report, p. 2).
5. Marine Organisms. SONGS Units 2 and 3 are not in compliance with NPDES regulations governing impacts to marine life. The NPDES permits require that SONGS' discharges be "designed and operated in a manner that will maintain the indigenous marine life and a healthy and diverse marine community," and that marine plant, vertebrate, and invertebrate communities are not degraded. (Reqs. B.5 and D.1(e)). The MRC found statistically significant SONGS-induced declines in populations of giant kelp (60 percent decline), kelp-bed fish (70 percent), kelp-bed invertebrates (30-90 percent), and some midwater fish species (as large as 70 percent). (MRC Final Report O, pp. 7-9.)

5.0 COMPARISON OF MRC FINDINGS WITH SCE NPDES MONITORING STUDIES

SCE submits annual NPDES monitoring reports of Units 2 and 3 discharges to the San Diego Regional Board each July. These reports describe the results of monitoring studies SCE had conducted during the previous calendar year. The basic monitoring requirements of the NPDES permits include monitoring of fish entrainment, the cooling water intake, the in-plant waste stream, the combined discharge (out-plant), the fish handling system, and the receiving water. SCE has complied with the monitoring requirements established by the NPDES permit.

Beginning with SCE's first report in 1984 (on 1983 date), SCE has found that (1) effects of SONGS' operation on the marine communities and resources of the San Onofre region were minimal and localized, (2) no significant adverse effects on the beneficial uses of the receiving waters were detected by the

SCE sampling program, and (3) discharges from Units 2 and 3 are in compliance with the NPDES permit requirements. (SCE 1984, 1985, 1986, 1987, 1988; MRC Technical Report 0.)

In contrast to SCE's findings of compliance, the MRC's analyses indicate that SONGS does not comply with some NPDES permit limits. The MRC's findings differ from SCE's for the following reasons. The MRC's sampling program utilized a more powerful design that enabled it to distinguish effects of SONGS from effects attributable to natural spatial and temporal variation. The MRC measured irradiance directly, whereas SCE measured transmissivity. The NPDES permits for SONGS do not require that SCE monitor some of the marine biota that the MRC found to be affected by SONGS. The MRC used a more quantitative, statistical approach to evaluating its data than did SCE. More detailed explanations for the differences between SCE's and the MRC's findings can be found in the MRC's Final Report (pp. 275-283) and the MRC's Technical Report 0.

6.0 RECOMMENDATION TO THE SAN DIEGO REGIONAL WATER BOARD

The California Coastal Act recognizes that the State Water Resources Control Board (SWRCB) and the California regional water quality control boards are the state agencies with primary responsibility for the coordination and control of water quality (Section 30412 (b)). Under Section 30412 (b), the Commission is prohibited from taking any action in conflict with a determination by the State Board or a regional board in matters relating to water quality.

The Commission, however, finds that the results of the MRC's studies raise significant questions concerning the protection of marine resources in the vicinity of SONGS Units 2 and 3. The Commission also finds that the MRC's findings provide important guidance to the San Diego Regional Board. Therefore, the Commission adopts a resolution recommending the following (see Exhibit 7 for text of the resolution):

Based on the findings of the Marine Review Committee, the Commission recommends that the San Diego Regional Board amend the SONGS Units 2 and 3 NPDES permits to:

- o Require that Southern California Edison regularly monitor the effects of Units 2 and 3 on midwater fish, kelp bed fish and kelp bed invertebrates;
- o Require that natural light levels in receiving waters near SONGS be determined by measuring total irradiance continuously (or by measuring both total irradiance and light transmissivity);
- o Require that ocean currents be measured continuously at the stations established for continuous irradiance measurements so that the position of the SONGS' discharge plume can be determined from the data collected; and

TABLE 2: NPDES and MRC Natural Light Monitoring Studies

	<u>SCE NPDES STUDIES</u>	<u>MRC STUDIES</u>
TYPE OF STUDY	Transmissivity Aerial Photography	Irradiance
FREQUENCY OF STUDY	<u>Transmissivity:</u> - Bimonthly from 1964 to 1981; - Unmeasured from 1982 to 1984; - Seven times during 1985; - Quarterly since 1985. <u>Aerial Photography:</u> - Quarterly since 1975.	<u>Irradiance:</u> - Continuously sampled for at least 175 days from mid-1981 to April 1983, and for more than 1000 days from May 1983 to December 1986.
ANALYTIC METHOD	Generally descriptive comparisons of impact and control sites; data variations often compared to natural events such as storms	Before-After/Control Impact Pairs (BACIP) program.
OTHER CONSIDERATIONS	Natural variation due to storms, El Nino events, etc. not factored out. Current direction and position of the SONGS' discharge plume not measured.	Natural variation factored out. Discharge plume direction and location measured.
FINDINGS RE SCE COMPLIANCE WITH NPDES PERMITS	Yes	No

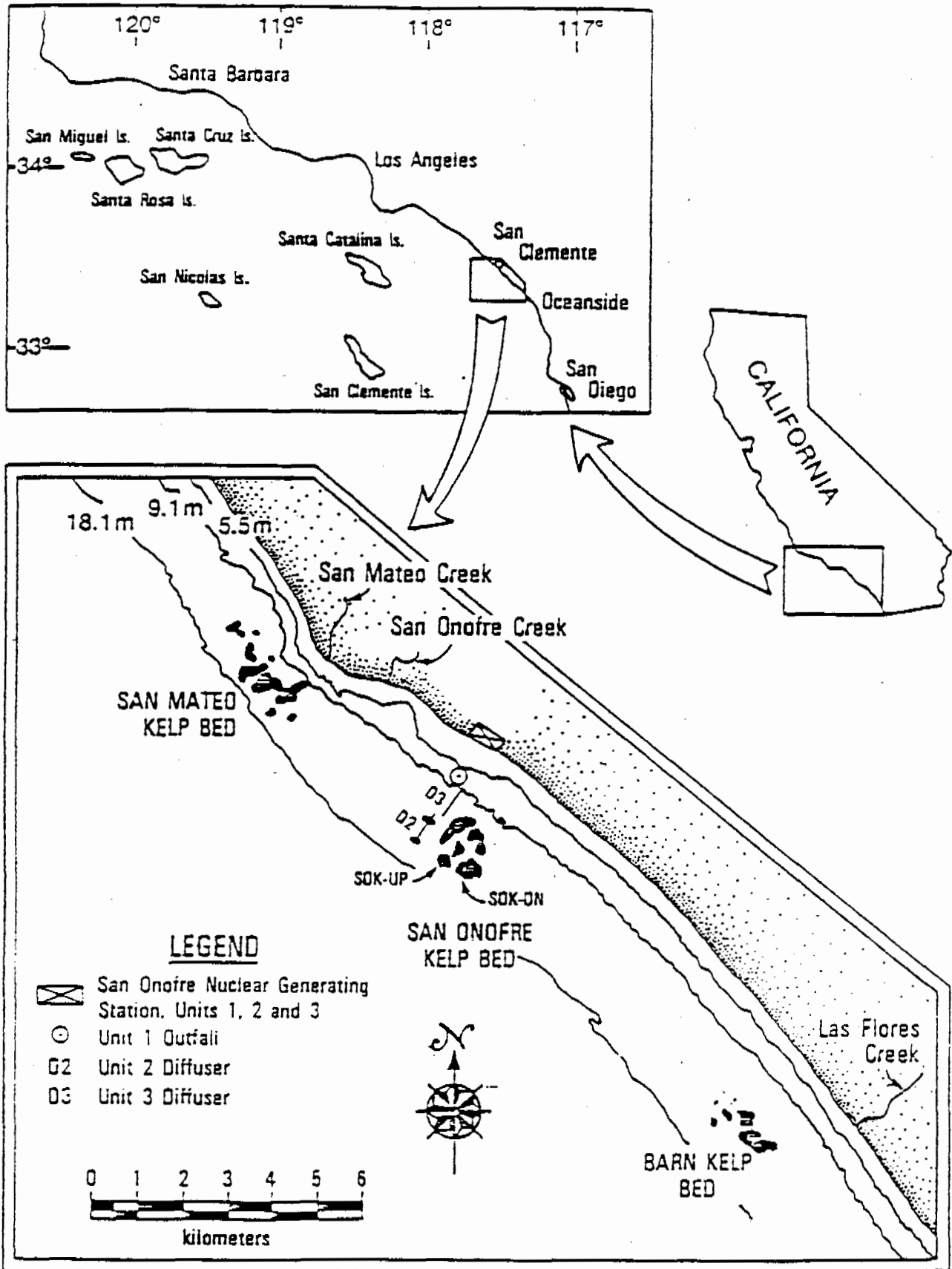


EXHIBIT NO. 1 Map of San Onofre Area

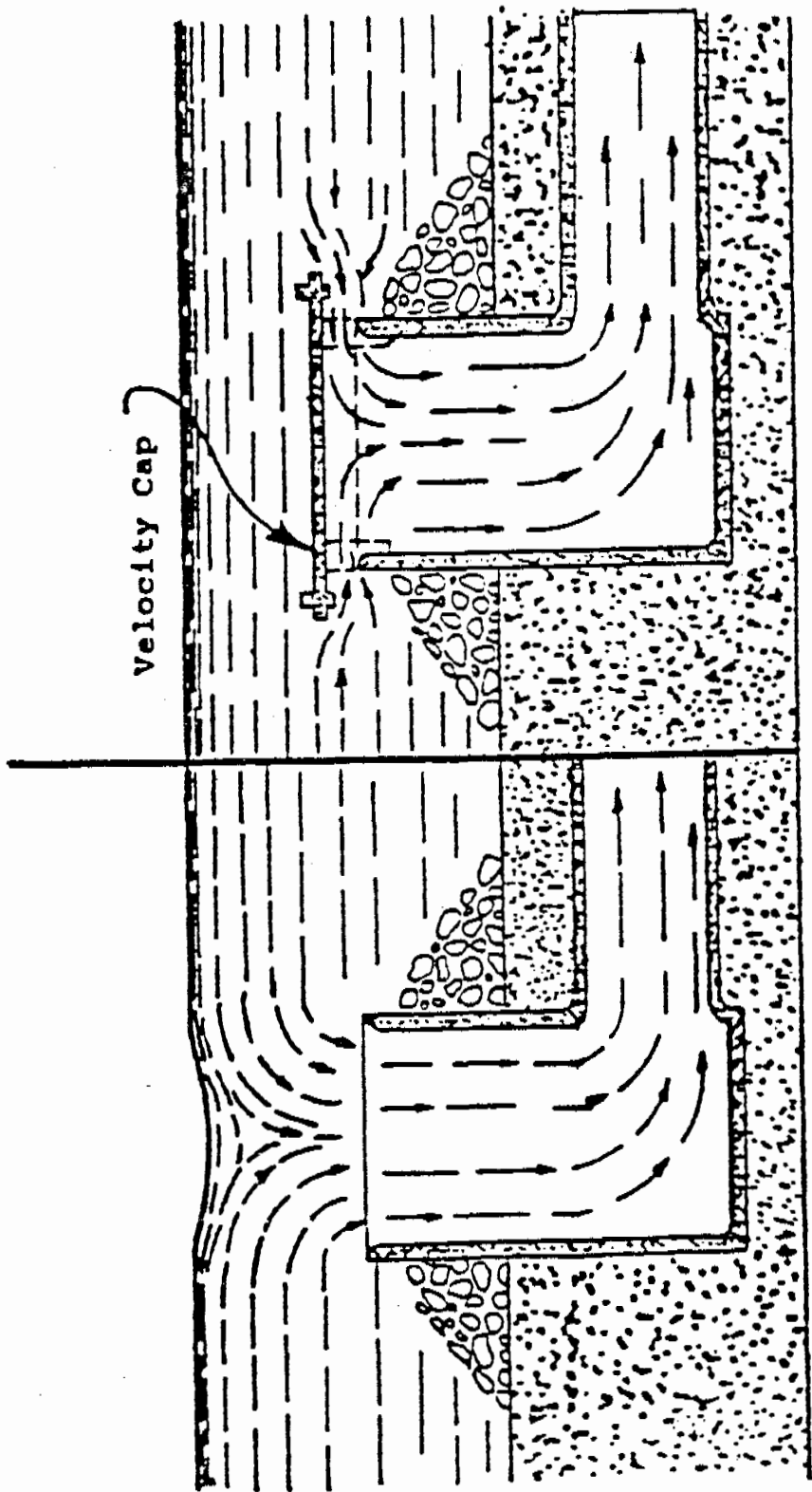
Source: MRC Final Report 1989, p. 38.



EXHIBIT NO. 2

San Onofre Nuclear Generating Station Units 2 and 3.

Source: BC Newsletter July-September, 1979.



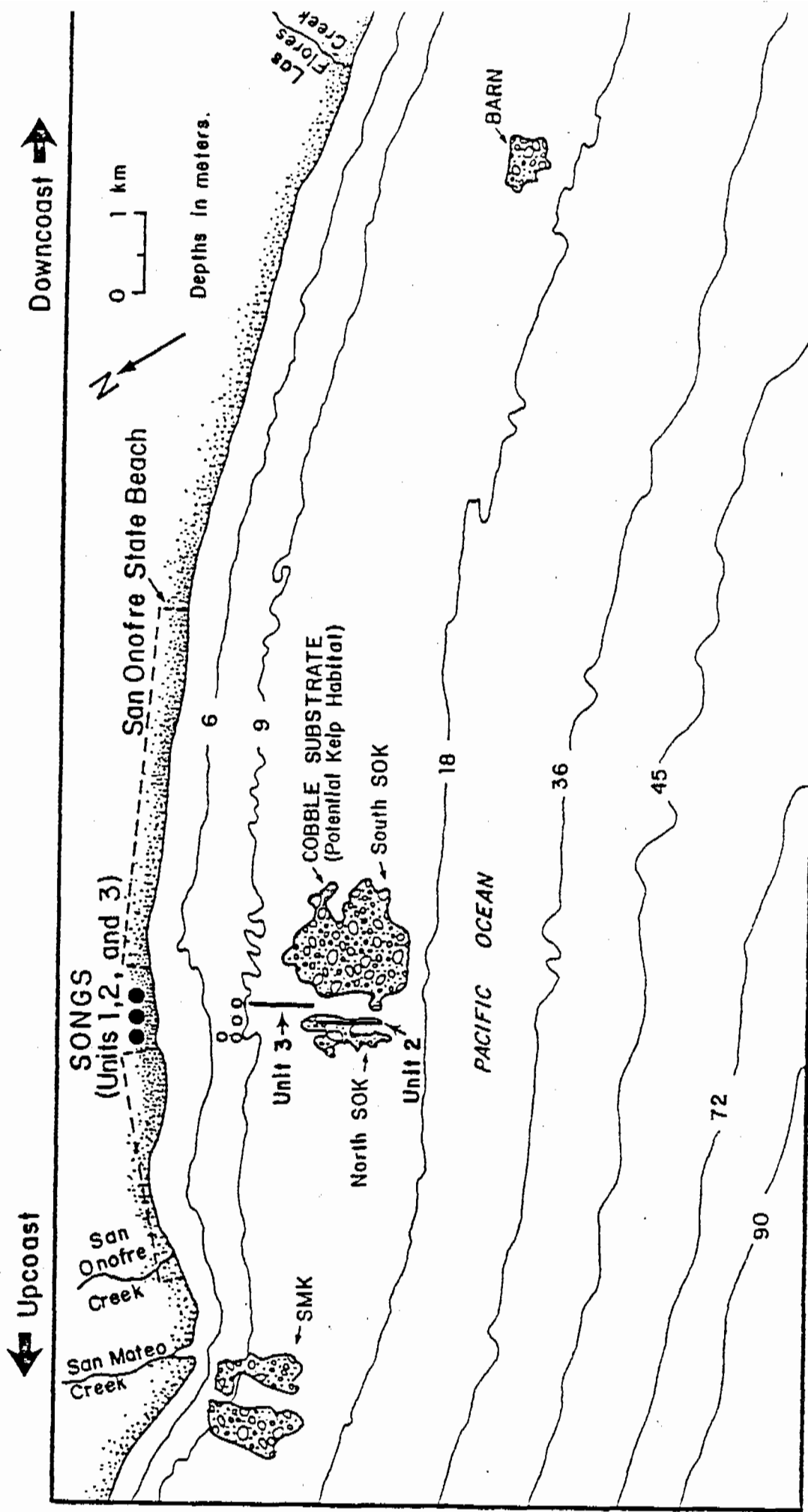
Velocity Distribution Without Cap

Velocity Distribution With Cap

EXHIBIT NO. 3

Schematic showing the change in flow pattern of the intake current when a velocity cap is placed over the intake pipe. Arrows indicate the direction of the current.

Source: MRC Technical Report H Mitigation 1990, p. 26.



○○○ = UNITS 1, 2, & 3 INTAKES
 ○ = UNIT 1 DISCHARGE
 — = DIFFUSER LINES

EXHIBIT NO. 4 Layout of SONGS intakes and diffusers relative to the shore and the cobble beds that provide kelp habitat.

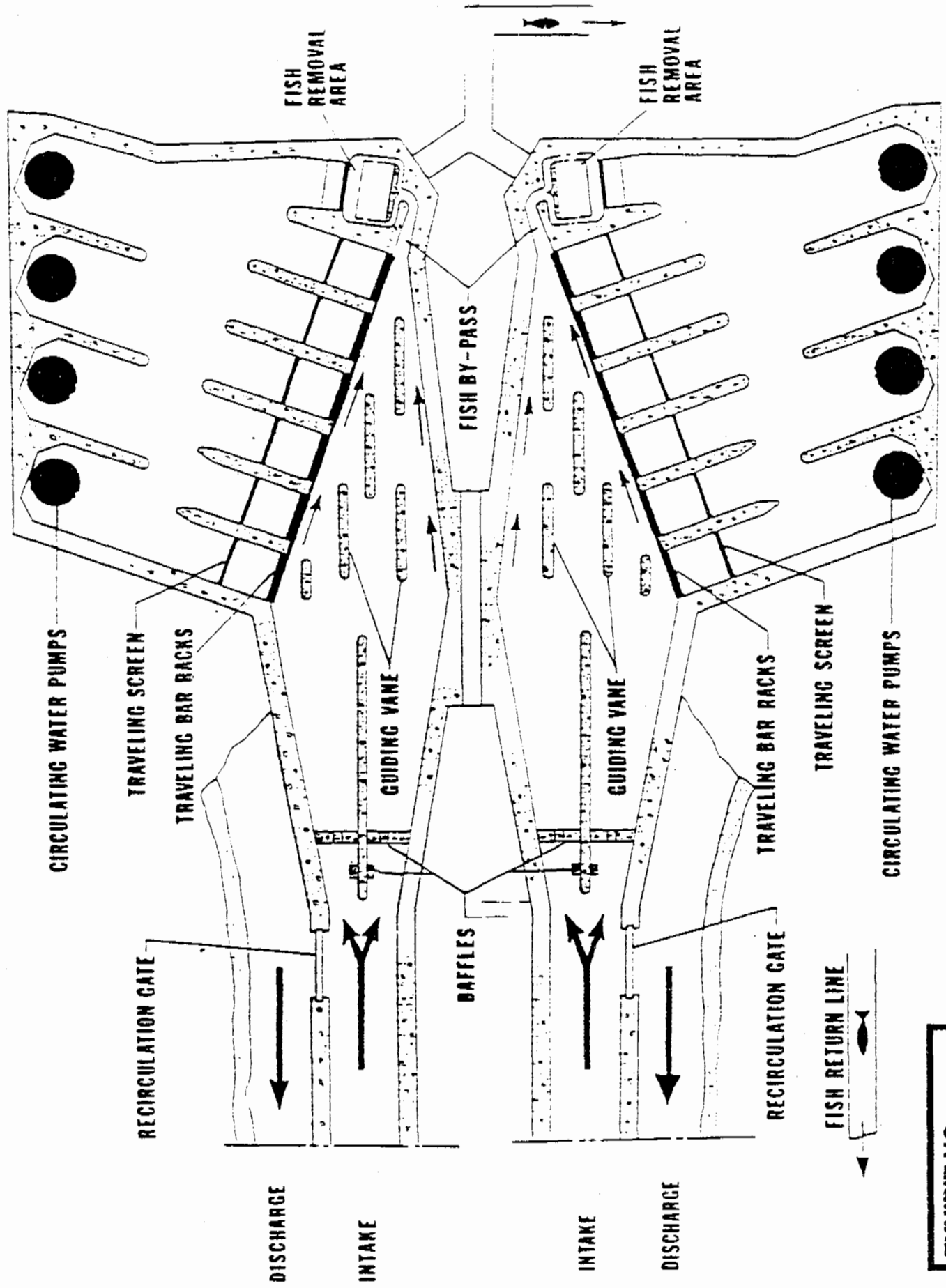
Estimated reduction in adult recruitment and adult standing stock in the Southern California Bight as a result of SONGS' operation.

COMMON NAME	PERCENT
<u>TAXA WHOSE JUVENILES ARE ENTRAPPED</u>	
* Queenfish	13
* White croaker ^s	6
* California grunion ^s	5
* Black croaker ^s	4
* California corbina ^s	4
* Jacksmelt	3
Salema	0.4
Kelp and barred sand bass ^s	0.1
Northern anchovy ^c	<0.1
<u>TAXA WHOSE JUVENILES ARE NOT ENTRAPPED</u>	
COMMON NAME	PERCENT
* Giant kelpfish	6.9
* Kelpfish (unid.)	5.0
Cheekspot goby	3.0
Reef finspot	2.9
Arrow goby	2.6
Diamond turbot ^s	2.1
Shadow goby	2.1
California clingfish	1.4
Blenny (unid.)	0.1
California halibut ^{s, c}	0.1
Hornyhead turbot	0.1
Pacific mackerel ^c	0.1

EXHIBIT NO. 5

Source: MRC Final Report (Table 10.1) 1989, p. 157.

SAN ONOFRE UNITS 2 & 3 SCREEN WELL



Source: MRC Technical Report C - Entrapment of Juvenile and Adult Fish at SONGS. 1989

EXHIBIT NO. 6

CALIFORNIA COASTAL COMMISSION

45 FREMONT, SUITE 2000
SAN FRANCISCO, CA 94105-2219
VOICE AND TDD (415) 904-5200

**CALIFORNIA COASTAL COMMISSION****RESOLUTION CONCERNING THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
(NPDES) PERMITS ISSUED FOR SAN ONOFRE NUCLEAR GENERATING STATION UNITS 2 AND 3**

July 16, 1991

The California Coastal Commission resolves as follows:

WHEREAS, on February 20, 1974, the California Coastal Zone Conservation Commission created the Marine Review Committee (MRC) as a condition of approval of Permit No. 183-73 for the construction of Units 2 and 3 of the San Onofre Nuclear Generating Station (SONGS); and

WHEREAS, the Commission directed the MRC to measure the effects of SONGS Units 2 and 3 on the marine environment and to determine if SONGS is in compliance with the regulatory requirements of State and Federal water quality agencies; and

WHEREAS, the MRC has provided substantial evidence that SONGS may not be in compliance with the Units 2 and 3 National Pollutant Discharge Elimination System (NPDES) permit regulations for natural light levels and effects on marine organisms; and the Commission staff has transmitted this information to the San Diego Regional Water Quality Control Board (San Diego Board) and it is in the San Diego Regional Board's purview to make a determination with respect to NPDES compliance; and

WHEREAS, the MRC has specifically found that the SONGS' turbid discharge plume when over the San Onofre Kelp Bed, caused a reduction of 26% in natural light levels near the ocean bottom in the San Onofre Kelp bed (SOK) downcoast from SONGS and significant reductions in local populations of midwater fish and in kelp, invertebrates and fish in SOK, effects that were not detected in the NPDES monitoring studies conducted by Southern California Edison (SCE); and

WHEREAS, the Coastal Commission has further conditioned SCE's coastal permit to require mitigation that will offset marine resource impacts due to SONGS, as identified by the MRC; and

WHEREAS, the San Diego Regional Water Quality Control Board (San Diego Regional Board) writes and administers the NPDES permits for SONGS Units 2 and 3 (CA0108073 and CA0108181, respectively) under the authority of the California State Water Resources Control Board (State Board) and the Federal Environmental Protection Agency (EPA); and

EXHIBIT NO. 7

APPENDIX 1

CALIFORNIA COASTAL COMMISSION PERMIT 183-73

February 1974

CALIFORNIA COASTAL ZONE CONSERVATION COMMISSION

20 MARKET STREET, 2nd FLOOR
 SAN FRANCISCO, CALIFORNIA 94102
 (415) 557-1001

RECEIVED

RONALD REAGAN, Governor

JUL 7 1978

CALIFORNIA
COASTAL COMMISSION

February 28, 1974

PERMIT NO. 183-73

Southern California Edison Company
 P. O. Box 800
 2244 Walnut Grove Avenue
 Rosemead, California 91770



STATE OF CALIFORNIA

San Diego Gas and Electric Company
 P. O. Box 1831
 San Diego, California 92112

Gentlemen:

On February 20, 1974, by a vote of 10 in favor, 2 against, the California Coastal Zone Conservation Commission adopted the resolution below that, subject to the conditions noted below, authorizes the construction of Units 2 and 3 at the San Onofre nuclear generating station, as described in your application.

Resolution of Approval

I. Approval of Modified Proposal. The California Coastal Zone Conservation Commission hereby approves a permit for the proposed development as modified by the conditions below, on grounds that, as conditioned, the proposed development would not have any substantial adverse environmental or ecological effects and would be consistent with the findings, declarations, and objectives of the California Coastal Zone Conservation Act of 1972.

II. ConditionsA. Public Access Around Construction Site

1. The applicants shall provide public access between the two parts of the San Onofre State Beach, around the construction site, from 8 a.m. to sunset on Saturdays, Sundays, and National Holidays in the months of June, July, August, and September, beginning in the year 1975 and continuing through the construction period.
2. The access shall be provided by means of a walkway no less than 6 feet wide.
3. Signs shall be posted by the applicants at both ends of the walkway to provide reasonable notice to the public of the existence of the walkway and of the days and hours it will be open.
4. Public use of the walkway may be interrupted for a maximum of one hour per day, with each interruption to last no more than 15 minutes, to allow the movement of construction equipment or workmen.

B. Marine Environment

1. Immediately upon approval of this permit, a comprehensive and continuing study of the marine environment offshore from San Onofre shall be begun to predict, and later to measure, the effects of San Onofre Units 2 and 3 on the marine environment, with emphasis on (a) the effects of the new units on zooplankton and larval organisms, and (b) compliance with the regulatory requirements of State and Federal water quality agencies. This study shall be in addition to any other study programs affecting the marine environment, but this and other studies may be combined or otherwise conducted in a manner that will result in the broadest possible consideration of the effects of Units 1, 2, and 3 on the entire marine environment in the vicinity of San Onofre.

2. The study program shall be designed and conducted under the direction of a Review Committee consisting of 3 persons with professional experience in marine biology and knowledge of the issues involved; one to be chosen by the applicants, one to be chosen by the appellants, and one to be chosen by the State Commission (to serve at the pleasure of the Commission) from a list submitted by the Executive Director of the State Commission (hereinafter referred to as "staff"). The members of the Review Committee shall be designated within 30 days of the date of State Commission action on this permit. If a member is not chosen within that period, and the name transmitted to the staff, that member's place on the Review Committee shall be promptly filled by a member chosen by the State Commission in the manner provided above.

3. All costs of the study, including any special reviews necessary to evaluate study data, shall be borne by the applicants.

4. The Review Committee shall be responsible for determining the design of the study program, reviewing the data collected, interpreting the results of the studies, and recommending to the State Commission any changes it believes necessary in the cooling system for Units 2 and 3. The State Commission shall then further condition the permit accordingly.

5. The Review Committee shall make reports to the State Commission at least semi-annually as to the status, findings, and recommendations of the study.

6. Should the study at any time indicate that the project will not comply with the regulatory requirements of State or Federal water quality agencies, or that substantial adverse effects on the marine environment are likely to occur, or are occurring, through the operation of Units 1, 2, and 3, the applicants shall immediately undertake such modifications to the cooling system as may reasonably be required to reduce such effects or comply with such regulatory requirements (which can be made while construction is going on and could be as extensive as requiring cooling towers if that is the recommendation). The State Commission shall then further condition the permit accordingly.

7. If at any time the State Commission, the Review Committee, and the applicants cannot reach agreement on (a) the scope, form, and methodology of the study; (b) the results of the study, i.e., whether the study shows that operation

of Units 2 and 3 would or would not have, or is or is not having, a substantial adverse environmental effect; or (c) the steps necessary to deal with any substantial adverse environmental effects shown by the study, a 3-member board of arbitration shall be selected to resolve the matter in dispute. The board shall consist of 3 persons with professional knowledge of the issues involved, one to be chosen by the State Commission, one by the applicants, and the third by the first two. The decision of the board of arbitration shall be binding on both the State Commission and the applicants.

8. Compliance with the conditions in Section B, Marine Environment, shall be monitored and enforced by the State Commission or by its successor, and if there is no successor, then by the State Water Resources Control Board, or, if that body so designates, the San Diego Regional Water Quality Control Board.

C. Kelp

No diffuser port shall be located within 1,900 feet of the area where the kelp bed to the south of the diffusers is likely to expand. This area shall be determined by a marine biologist of the State Department of Fish and Game or the U. S. Bureau of Sport Fisheries and Wildlife prior to July 1, 1974.

D. Use of Project Site

1. Prior to commencement of construction, the applicants shall guarantee the protection, in their natural condition, of the areas shown in Exhibit 1, designated as "Bluff Area (unexcavated) (approx. 5 acres)" and also an area extending north from the "Bluff Area (unexcavated) (approx. 5 acres)" for .10 mile and bounded by the mean high tide line and a line 100 feet east of the top edge of the bluff. The property immediately east of the areas to remain undisturbed may be graded and filled for use as a level site for construction equipment; such leveling and grading shall be to an elevation of approximately one hundred (100) feet in the area east of the "Bluff Area (unexcavated) (approx. 5 acres)" and shall be to an elevation of not less than forty-five (45) feet in the area east of the above described one-tenth (1/10) mile area, except for grading necessary to provide an access road to the construction site for Units 2 and 3 (Exhibit 1A, revised 2/26/74).

2. As part of the construction of Units 2 and 3, the applicants shall institute a program to prevent erosion and to stabilize the bluff-canyon area in its present condition.

3. Upon completion of the erosion control and canyon stabilization program described in paragraph 2 above, the applicants shall allow full and uninterrupted public access to the beach, bluff, and canyon area that is to remain in its present condition.

4. The guarantee required by this condition shall be for the duration of applicants' site easement (expiration date, May 1, 2023) and shall be satisfied by means of a duly executed instrument submitted to and approved, for form and content by the Executive Director and the Attorney General to assure conformance with the intent of this condition, and which instrument shall be duly recorded. The intent of this condition is to assure that, through the Commission's planning program and other means, this area, which is the most scenic part of the project site, will be provided permanent protection.

5. Compliance with the conditions in Section D, Use of Project Site, shall be monitored and enforced by the Commission or by its successor, and if there is no successor, then by the State Parks and Recreation Commission.

E. Plant Reliability

In order to insure that these units will provide a reliable source of power, particularly in light of present reliability performance of nuclear units in general, the applicants will establish a reliability organization. This organization shall report at a vice presidential position which is separate from, but an equal level with, vice presidential positions of organizations responsible for engineering, construction, procurement and operation of these units. This reliability organization shall have the authority and organizational freedom to (a) identify reliability problems; (b) initiate, recommend, or provide solutions to these problems; (c) verify implementation of solutions; (d) control further processing, delivery or installation of problem items until proper dispositioning of the deficiency or unsatisfactory conditions has been agreed.

This organization shall prepare and file reports with the California Public Utilities Commission on a semi-annual basis. These reports shall describe the activities of the reliability organization including specific measures implemented to insure reliability of these units.

F. Regional Commission Conditions

All conditions imposed by the Regional Commission and not modified above shall remain in effect.

G. Acceptance of Conditions

No construction shall take place until the applicants have acknowledged in writing that they understand all the conditions imposed herein and agree to abide by all of them.

III. Findings and Declarations. The Commission finds and declares as follows:

A. Summary. Unlike most developments proposed for the coastal zone, the addition of Units 2 and 3 at San Onofre would have an impact on all 3 parts of man's physical environment—air, land, and water.

The impact on the air would be beneficial, in that the generation of electric power by nuclear means would not pollute the air as would the generation of the same amount of power by burning fossil fuels. Many of the oil-burning power plants are in the coastal zone, and thus they affect the quality of the coastal environment.

The impact on the land would be adverse, in that about .51 mile of coastal bluffs would be destroyed. But, as provided by Condition D above, the most important and most scenic area of canyons and bluffs, about .31 mile long, would be protected for the duration of the site easement.

The impact on the offshore ocean waters is not yet sufficiently known. But, as provided by Condition B above, a detailed study of the possible effects of Units 1, 2, and 3 on the ocean waters will be undertaken, with emphasis on the plankton and larval forms that are the basis of the ocean food chain and thus of the ocean's sport and commercial fisheries. The conditions provide for modifying the plant's

cooling system if the study shows that there are substantial adverse effects on the offshore waters.

For these reasons, the Commission finds that, overall, the proposed development would not have a substantial adverse environmental effect and that a permit may be approved under the California Coastal Zone Conservation Act of 1972.

B. Nuclear Hazard Not a Factor in Decision

The Commission, in reaching its decision on this application, has been advised by its legal counsel, the Attorney General, that the Federal Government appears to have exclusive authority to regulate and control radiation hazards posed by nuclear power plants. Accordingly, the Commission expresses no opinion and makes no finding with regard to nuclear safety, and declares that questions of nuclear safety have played no part in its decision.

C. Marine Environment

1. Introduction. Although most public attention has focused on thermal pollution from power plants, it appears likely that the most significant adverse impacts on the marine environment at San Onofre would occur through entrainment of marine organisms in the plant's cooling system. Water would be drawn through Units 2 and 3 at a rate of 1.6 million gallons per minute, equivalent to a body of water about 1 mile square and 11 feet deep every day. When Unit 1 is operating together with Units 2 and 3, the amount of water directly entrained will amount to 1.95 million gallons per minute or about a square mile 14 feet deep every day. The total amount of water affected will undoubtedly be much greater because about 2/3 of the heat generated by the reactors is dissipated in the ocean (1.5×10^{10} BTU per hour from Units 2 and 3) and currents may be induced in the area from the vast quantities of water forced through the system.

2. Plankton Entrainment. The potentially most significant environmental effect of the proposed project, destruction of the nearshore plankton population, has been the subject of the least reliable studies. Plankton represent the main source of food for most organisms in the nearshore environment and include the immature stages of most nearshore marine animals such as clams and mussels and many fish. Plankton sampling studies were made for the applicants between 1965 and 1971, but their quality is a matter of dispute, and further information is clearly needed.

At issue are two possible effects of the plant's operation on plankton: the massive transporting of plankton from nearshore waters to an offshore area, caused by the cycling of ocean water through the power plant, and the killing of plankton as they are entrained in the plant's cooling system, and afterward if they are returned to the ocean in an unhealthy condition.

3. Entrainment and Mortality of Fish During Normal Plant Operation. Fish as well as plankton will be entrained in the cooling system. If not removed and returned to the ocean in a healthy condition, they too will be killed. The Atomic Energy Commission estimated that between 25,000 and 142,000 lbs. of fish would be killed per year from the normal operation of Units 2 and 3, depending upon the effectiveness of the fish return system. No fish return system is operating or

planned for Unit 1 and the Atomic Energy Commission has estimated that 30,000 lbs. of fish per year are being killed by that unit. The applicants contend, on the basis of small-scale experiments (e.g., use of a flume measuring 50' x 6' x 4' to model the intake structures that are 3,500 feet long) conducted at another generating station, that the effectiveness of the fish return system can be estimated at 70-80%. Although not conclusive, the results are promising.

4. Entrainment and Mortality of Fish During Heat Treatment. Every 5 or 6 weeks, the applicants propose to heat the water in the cooling system to 125°F to remove marine organisms growing within the system. These elevated temperatures will kill virtually everything entrained within the system. It is expected that between 11,000 and 28,000 lbs. of fish may be killed per year in this manner. The procedure does not comply with the general standards established by the State's Thermal Plan and an exception from these standards was requested by the applicants. An exception was granted, but with a condition that studies be conducted over the next 3 years to determine whether the heat treatment proposed is the least environmentally destructive method of controlling marine growths within the cooling system, or whether the system should be redesigned to permit lower-temperature or less-frequent treatment. Until these studies are completed, no finding can be made as to the least destructive method.

5. Thermal Discharges. Changes in the design of the cooling system of the proposed operation of the plant may be needed to meet both Federal and State standards with regard to the discharge of heated water into the ocean (thermal pollution). In issuing a permit at this time, the Commission makes no finding as to the adequacy of the present proposal to meet the standards of the State Water Resources Control Board or the Federal Environmental Protection Agency. The facts regarding State and Federal standards are as follows:

a. State Standards. The State Thermal Plan adopted by the State Water Resources Control Board and accepted by EPA establishes minimum thermal discharge standards that must be met by the project. Among the standards imposed is a requirement that the temperature of the discharge water not exceed the temperature of the "receiving" waters by more than 20°F. However, due to the fact that the intake point for the cooling system is located offshore at a depth of 20 feet and the diffuser ports are at depths of 20 to 40 feet, there may be a difference in temperature of about 6°F between the ocean water at the intake and portions of the diffuser. Because the applicants plan to operate the plant with a 20°F increase in temperature across the condensers, the temperature of the discharge waters may therefore be 26°F higher than the receiving waters. Therefore, no finding can be made that the project as proposed will meet the requirements of the State Water Resources Control Board.

b. Federal Thermal Standards. The 1972 Amendments to the Federal Water Pollution Control Act (PL 92-500) require effluent limitations "which shall require the application of the best practicable control technology currently available" to minimize thermal discharges. It would appear that this may require the use of closed-cycle cooling towers, because they are presently in use, they minimize thermal discharge, and a consultant to EPA has recommended this solution. The proposed project at San Onofre would not use this cooling system but instead would use single-pass cooling, which does not minimize thermal discharges.

The Federal Water Pollution Control Act does contain an exception procedure, provided the discharger can show that the proposed non-complying discharge will "assure the protection and propagation of a balanced, indigenous population of shellfish, fish and wildlife in and on that body of water" into which the thermal discharge will occur. Although EPA has not yet issued its regulations interpreting the provisions, the AEC concluded that "the heated water will result in changes in the species composition in the vicinity of the outfall; but no general ecological changes are expected" (AEC EIS, p. 1). Regardless of the fact that "no general ecological changes are expected" according to the AEC, the language of the statute would appear to preclude any changes in the characteristics of the existing indigenous species. If such an interpretation is adopted by EPA, it would mean that the proposed cooling system would not comply with Federal water quality standards and the project could not be constructed as proposed because there is insufficient acreage at the proposed site for closed-cycle cooling systems, such as cooling towers or spray ponds.

Thus conformity with the provisions of the Federal Water Pollution Control Act cannot be definitively resolved until EPA issues its regulations.

6. Impact on Kelp. A kelp bed has re-established itself to the south of the diffusers of the project during the past 2 years. Because many kelp beds have deteriorated, the growth of this bed is of particular scientific value. It is also a marine resource that is commercially harvestable and that provides a valuable habitat for various fish and other marine organisms. Substantial harm to the kelp bed could occur through excessive heat or turbidity. Condition C will insure that the effects of Units 2 and 3 on the kelp beds are not substantial.

D. Project Site

1. Bluffs and Canyons. Although motorists cannot see it from Interstate 5, the project site possesses a unique beauty. The narrow, twisting canyons, formed by erosion, and the bluffs towering more than 100 feet over the sand beach, combine to create a particularly scenic area.

Under the application before the Commission, the entire .51 mile of this unique site would be leveled for construction of Units 2 and 3. Under Condition D, however, construction of Units 2 and 3 will take about .21 mile of the bluffs and the most spectacular part of the site—the southernmost .31 mile—will be protected for the duration of the site easement. This will allow time for the Commission and others concerned about this important area to provide for its permanent protection.

2. Beach Access. Under the application before the Commission, about 1,000 feet of the San Onofre beach would be closed to the public during the entire 6-year construction period. Under Condition A, however, the beach area will be completely closed off only until June, 1975, and lateral access around the construction site will be provided by means of a walkway on summer weekends and holidays for the remainder of the construction period, except for brief intervals to permit the movement of construction crews and equipment.

Southern California Edison Company
San Diego Gas and Electric Company
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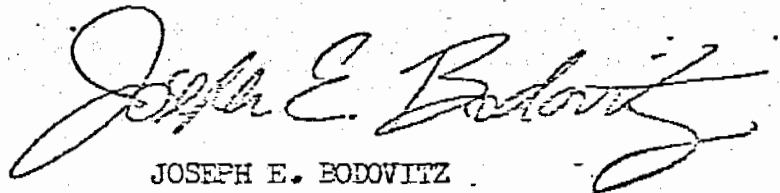
E. Total Environmental Effect

A finding that this project conforms to the provisions of the California Coastal Zone Conservation Act of 1972 requires consideration of the positive environmental effects of the project on air pollution along with the adverse effects of the project on the bluffs and the uncertainty of the extent of its adverse effects on the marine environment. All the conditions are required to permit a finding that the project, as conditioned, conforms to the provisions of the Act.

IV. Acknowledgment of Conditions

Before any activity authorized by the permit is to take place, you must return to this office and to the San Diego Coast Regional Commission office copies of this statement with your signature acknowledging that you have received it and understand its contents.

Yours very truly,



JOSEPH E. BODOVITZ
Executive Director

Attachment
cc: San Diego Coast Regional Commission

The undersigned permittees acknowledge receipt of the California Coastal Zone Conservation Commission Permit No. 183-73, and fully understand its contents, including all conditions imposed.

Date

For Southern California Edison Company

Date

For San Diego Gas and Electric Company

APPENDIX 2

STAFF RECOMMENDATION ON RADIOLOGICAL DISCHARGE
MONITORING AND CONDITIONS TO BE ADDED TO PERMIT 183-73 FOR
THE SAN ONOFRE NUCLEAR POWER PLANT

and

DIRECTION TO THE MRC REGARDING MITIGATION

November 1979

CALIFORNIA COASTAL COMMISSION
631 Howard Street, San Francisco 94105 — (415) 543-8555



November 9, 1979

TO: STATE COMMISSIONERS

FROM: MICHAEL L. FISCHER, EXECUTIVE DIRECTOR

SUBJECT: STAFF RECOMMENDATION ON RADIOLOGICAL DISCHARGE MONITORING AND CONDITIONS TO BE ADDED TO PERMIT A 183-73 FOR THE SAN ONOFRE NUCLEAR POWER PLANT (For Commission consideration at the November 19-21, 1979 meeting in Los Angeles.)

SYNOPSIS

Following their August 15, 1979 public hearing on the findings of the San Onofre Marine Review Committee (MRC), the Commission asked the MRC to evaluate the radiological discharge monitoring program at the San Onofre Nuclear Generating Station (SONGS). The MRC reports the program, conducted by Southern California Edison, is "grossly inadequate" and "makes it impossible to determine with accuracy the amounts of radioactive material being released by SONGS." Staff therefore recommends that the Commission inform the Nuclear Regulatory Commission (NRC) of the inadequacy of the design and implementation of SCE's monitoring program and ask Edison to immediately develop an independent and accurate monitoring program. If Edison does not, staff recommends the Commission formally intervene in the NRC operating license proceedings for SONGS. The NRC has exclusive authority to regulate radiological discharges from nuclear power plants.

Staff also recommends the Commission adopt two new conditions for SONGS that were recommended by the MRC: minimal use of chlorine and other biocides in the SONGS cooling water system and use of non-corrosive titanium alloy in the SONGS condensers. Because it may be difficult to require major design changes such as cooling towers or extended diffusers after the units are licensed and operating, the Commission should direct the MRC to determine if such changes are warranted prior to the conclusion of the Nuclear Regulatory Commission's operating license proceedings. The Commission should also request the MRC to evaluate possible mitigation measures, including an artificial reef suggested by Edison. The Commission could add such measures to the SONGS permit in lieu of or in addition to plant design or operational changes, if the MRC monitoring determines fish, kelp or plankton will be damaged by operation of the SONGS cooling water systems.

Also, in response to Commission request, the MRC has focused and reduced its project research expenditures from a 1979 projected cost of nearly \$5 million to 1980 projected cost of \$3.2 million.

PURPOSE OF REPORT

At their meeting of August 15, 1979, the Commission held a public hearing on a staff recommendation to review the status of the San Onofre Marine Review Committee (MRC) and the March 1979 Interim Report of the MRC. In response to staff's recommendation and to testimony received at the hearing, the Commission then adopted the following statement:

The Commission requests the MRC to more closely focus its study and monitoring program on kelp bed effects, effectiveness of the fish return system and effects of transport to deeper water on nearshore species and to modify five study program which the staff evaluation concludes are not likely to develop decision-making information. The MRC should study the ecological effects of extending the diffusers beyond the kelp bed. The MRC should also evaluate the adequacy of Nuclear Regulatory Commission and California Department of Health monitoring of radiological discharges from the plant and should evaluate recently published reports which conclude such discharges are not a threat to the marine environment. The MRC is requested to include this evaluation and their recommendations to the Commission on whether to initiate a radiological monitoring program as part of their revised study program to be submitted to the Commission.

The attached MRC report entitled, "Radiological Discharges from Nuclear Power Plants - An Evaluation of Present Monitoring at SONGS, of the Ecological Effects of Radionuclides, and a Recommendation for an Independent Program of Monitoring", and the attached letter to the Chairman of the Commission on "Future Plans of the MRC" respond to the above request.

The staff recommendation which follows includes recommendations from the MRC on radiological monitoring for the San Onofre plant, several conditions on the operation of the plant submitted by the Committee and requests for additional analysis from the MRC which will guide the Commission in making further decisions.

STAFF RECOMMENDATION

Staff recommends the Commission adopt the following resolution:

I. Monitoring of Radiological Discharges. The Commission finds that the current radiological discharges monitoring program being conducted by Southern California Edison Company at the San Onofre Nuclear Generating Station is grossly inadequate. The Marine Review Committee created pursuant to the Coastal Zone Conservation Commission permit for SONGS Units 2 and 3 has determined that the present monitoring program makes it "impossible to determine with accuracy the amounts of radioactive material being released by SONGS" into the marine environment (p. 5, MRC October 9, 1979 report, Radiological Discharges from Nuclear Power Plants).

The ecological effects of such discharges from nuclear power plants cannot be judged at this time due to lack of studies on such effects. But the MRC notes that the doses of such discharges from nuclear power plants are lower than discharges from other activities such as nuclear fuel reprocessing and hydrogen bomb blasts. Nevertheless, the Commission finds it is important for protection of public health and safety in addition to protection of the marine environment to accurately determine the level of radionuclide discharges from SONGS Units 1 and from Units 2 and 3 if they become operational.

Therefore, the Commission hereby resolves:

1. That staff shall inform the NRC of the inadequacy of the design and implementation of SCE's radiological monitoring program.
2. That Southern California Edison should immediately retain a completely independent contractor, as recommended by the MRC, to develop and implement an improved radiological discharge monitoring program that exceeds the Nuclear Regulatory Commission's minimum standards. The program should reflect the recommendations of the MRC.
3. That if Southern California Edison does not make such a commitment, the Coastal Commission will formally intervene in the NRC proceedings on operating licenses for SONGS Units 2 and 3. The Commission will request the NRC to exert its jurisdictional authority to require a comprehensive and accurate radiological discharge monitoring program as part of the operating licenses, if they are granted.
4. That if the NRC does not make such a requirement, the Commission directs staff to work with representatives of the Resources Agency and the Department of Health Services in exploring the feasibility of using the Commission's Coastal Energy Impact Program funds to carry out the independent monitoring program recommended by the Marine Review Committee.

II. Added Permit Conditions

Pursuant to the provisions of Conditions B-4 and B-6 of Permit A 183-73, the Commission hereby adopts the following additional conditions to be added to Permit A 183-73:

B-9. Chlorine, other oxidants, or biocides shall not be used in the cooling water system at SONGS Units 1, 2, and 3, except in the event of failure of the physical cleaning system when minimal application rates of biocides should be used. Such rates should be determined by the MRC.

B-10. Only highly corrosion resistant titanium alloy shall be used where determined by the MRC to be essential in the condenser system of SONGS Units 2 and 3, and the existing copper-nickel alloy condensers of Units 1 shall be replaced with titanium alloy condenser tubing.

FINDINGS AND DECLARATIONS:

The Commission finds and declares as follows:

1. Permit A 183-73. Within the terms of this permit granted under Proposition 20, marine life offshore of the San Onofre Power Plant would be protected by a continuing surveillance program to be conducted by the independent Marine Review Committee. That permit also empowered the MRC to design a study program, review the data collected, interpret the results of the studies, determine if adverse effects were occurring and recommend to the State Commission any changes it believed necessary in the cooling system for Units 2 and 3 (Condition B-4 and B-6).

COMPARISON OF SCE AND MRC FINDINGS:SCEPLANKTON - EFFECTS OF UNIT 1MRC

No patterns were observed that could be related to operation of SONGS Unit 1 (SCE, Annual Operating Report, 1978, Vol. IV).

The usual distribution is disrupted out to 500 yards...some species increased 20-fold, a few species reduced by 100-fold. Mysid shrimps are more abundant at about 200 yards than at stations closer to or further from the plant (MRC, Interim Report, 1979).

FISH - EFFECTS OF UNIT 1

The fish community offshore does not appear to be adversely affected by the discharge of Unit 1 cooling water (SCE, Annual Operating Report, 1978, Vol. IV).

About 75% of the fish entrained by Unit 1 (are queenfish). Although there is no detectable difference in the density of this fish species near the Plant and elsewhere, there is a much lower proportion of immature fish within 500 yards of the plant compared with other areas (MRC, Interim Report, 1979).

PLANKTON - PREDICTIONS OF EFFECT

SCE, p. viii: It is unlikely that the effect will be other than local and insignificant when compared to the processes in the southern California coastal region (SCE Thermal Effects Study, 1973).

Mortality will be increased in species that live largely in a band within 2.5 miles of shore. This will be equivalent to imposing an additional 1 - 10% mortality per day over an area of about 30 square miles during slow current regimes. The maximal rate would be roughly the same as the natural mortality rate and may be great enough to cause a reduction in plankton density around the Plant. A similar effect may occur with mysid shrimps. Within a similar-sized area, the numbers of planktonic larvae of benthic animals available for settlement will also be reduced to a greater degree than are the other zooplankton (MRC, Interim Report, 1979).

FISH - PREDICTIONS OF EFFECT

SCE, p. ix: Generating station operations likely have had no adverse effect on regional fish communities (SCE Thermal Effects Study, 1973).

If the fish return system is ineffective, the amount of fishes killed will be almost 5 times that of Unit 1, which would result in loss equivalent to about 1% of the queenfish living along 27 miles of coastline near SONGS. If part or all of the San Onofre kelp bed is destroyed, the loss of this habitat will probably reduce the abundance of certain sport fish in the area. The density of fish larvae may be reduced in an area at least as large as the area of reduction of zooplankton (MRC, Interim Report, 1979).

2. MRC Recommendation. Under the authority vested in them by Permit A 183-73 the majority of the MRC forwarded Conditions B-9 and B-10 to the Commission based on the following resolutions:

- a. The MRC recognizes that chlorine has been widely identified as a major cause of mortality of organisms at power plants employing single pass cooling water systems. Further, recent studies have demonstrated undesirable synergistic interactions among chlorine, heavy metals and marine sediments, and consequent effects on marine organisms. The MRC is aware that other power plants such as the Calvert Cliffs Nuclear Facility in Maryland, have operated successfully in marine environments with physical cleaning methods rather than with biocides.
- b. The MRC recognizes that a number of coastal power plants employing single pass cooling water systems have had undesirable effects due to corrosion of tubing and leaching of heavy metals, such as copper, from the condenser system into the environment.

3. Protection of Marine Life. Under the Coastal Act, the adverse effects of waste water discharge and entrainment must be minimized in order to protect the quality and productivity of coastal waters. Section 30230 states:

Marine resources shall be maintained, enhanced, and where feasible, restored. Special protection shall be given to areas and species of special biological or economic significance. Uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and that will maintain healthy populations of all species of marine organisms adequate for long-term commercial, recreational, scientific, and educational purposes.

Section 30231 states in part:

The biological productivity and the quality of coastal waters, streams, wetlands, estuaries, and lakes appropriate to maintain optimum populations of marine organisms and for the protection of human health shall be maintained and, where feasible, restored through, among other means, minimizing adverse effects of waste water discharges and entrainment, ...

The Commission finds that the conditions set forth above are necessary to protect marine life offshore of the San Onofre plant complex.

III. Direction to the Marine Review Committee

Because the MRC was created to conduct research oriented toward possible actions by the Commission and, if necessary, to add conditions to the SONGS permit to further protect the marine environment, the Commission makes the following requests of the MRC:

1. Major Cooling System Design Changes. The Commission recognizes the difficulties in requiring major design changes to SONGS Units 2 and 3 after the NRC grants operating licenses and the units are generating electricity. Changes such as requiring cooling towers, extended diffusers or single point discharges could cost hundreds of millions of dollars and result in unit shutdown for a period of time.

The Commission has the authority to impose such changes, however, if recommended by the MRC after unit operation in order to prevent significant environmental damage. The MRC has not made such a recommendation to date. In order to permit the Commission to decide upon the necessity for design changes prior to operation if possible, the Commission requests the MRC to report to the Commission by June 1, 1980, prior to the completion of NRC operating license hearings, whether the Commission should consider and impose any major design changes on the cooling water systems for Units 2 and 3.

2. Mitigation Alternatives to Design Changes. The Commission also recognizes that operational changes or mitigation measures might adequately compensate for any marine life damages resulting from the operation of Units 2 and 3. The Commission, therefore, requests the MRC to study the feasibility and effects of selected promising mitigation measures, including construction of an artificial reef, as suggested by Southern California Edison. The MRC should recommend what measures might be taken to assure there would be no net adverse effect on the marine environment from operation of SONGS Units 2 and 3.

3. MRC Program and Budget. The Commission appreciates the MRC's efforts to focus and reduce the MRC research program and budget to those subjects given priority by the Commission. These subjects include predicting and later measuring effects on the San Onofre kelp bed, studying the offshore transport of larvae, and evaluating the effectiveness of the fish return system. The Commission requests that the MRC attempt to conduct the mitigation measures research program within the limits of the projected 1980 expenditures of \$3.2 million. The Commission also requests the MRC to work with Commission staff in assessing the need for selected research program areas where already completed research seems adequate for decision-making purposes or where the level of effort may not be needed for decision-making purposes. Areas to be further assessed include: hard benthos, subtidal soft benthos, zooplankton, ichthyoplankton, oceanography and data management.

BACKGROUND AND STAFF ANALYSIS

The California Coastal Zone Conservation Commission established the Marine Review Committee (MRC) in 1974 as a condition of Permit A 183-73 for Units 2 and 3 of the San Onofre Nuclear Generating Station. The MRC is composed of three scientists: one appointed by the Commission, another by the applicants, Southern California Edison Company and San Diego Gas & Electric Company, and the third by the appellants, who are coordinated by the Friends of the Earth.

The purpose of the MRC is to study the effects of the existing Unit 1 cooling water system on marine life, to predict and later to monitor the effects of Units 2 and 3, and to recommend to the Commission new conditions on Unit 2 and 3 cooling system design and operation to prevent significant damage to marine resources. The same permit condition enables the Commission to impose new cooling water system requirements on the permittee, based on MRC recommendations, at any time.

At their meeting of November 14, 1978, the Commission requested the Marine Review Committee to prepare an interim report which would begin to reach conclusions about the effects of the cooling system of the San Onofre Nuclear Generating Station and develop recommendations to protect marine life offshore of the plans. On March 12, 1979, the MRC submitted a report indicating that future monitoring might confirm predictions of damage to the San Onofre Kelp Bed, ineffectiveness of the fish return

system, and extensive mortality of small inshore marine organisms that are transported offshore by the system's diffusers. But the report recommended no design changes until predictions were confirmed by operational monitoring. The report suggested that the Commission consider recommending that the MRC evaluate the current radiological discharge monitoring issue, the added conditions and the state of MRC findings on impacts of SONGS on marine life, and the future MRC research program.

ISSUES

1. Radiological Discharge Monitoring. The accompanying MRC report, "Radiological Discharges from Nuclear Power Plants" responds to the Commission's August 15, 1978, request for such an evaluation.

The findings of the MRC (majority) as a result of that investigation are highly critical of the current self-monitoring program being conducted at San Onofre by SCE. According to the Committee, because of the inadequacy of the monitoring program, it is impossible to determine with accuracy the amounts of radioactive material being released by SONGS in the marine environment. Further, the annual reports by SCE to the Nuclear Regulatory Commission (NRC) contain many gross errors. In particular, the average values are calculated in such a way as to underestimate many of the concentrations of radioactive materials being discharged from SONGS.

While the MRC criticized the utility for not using their "good professional judgment in the development of the surveillance program", as recommended in the EPA monitoring program guidelines, they found the basic problem arose with the NRC regulations which do not require adequate replication or independent monitoring. Overall, the MRC found the present monitoring and reporting of radiological discharges at SONGS "grossly inadequate," and they believe that adequate monitoring can be assured only if it is done by an agency that is independent of the power companies. Though a strong case is made for independent monitoring, the MRC does not feel it should take over the responsibility for radiological monitoring at SONGS. It has been clearly established that radiation affects the health and survival of individual marine organisms and studies have indicated that certain species do have higher concentrations of certain radionuclides nearer SONGS than further away. However, the main task of the MRC is not to monitor substances discharged, but to assess the ecological consequences of the cooling system of SONGS. Although the evidence is sparse, MRC review of past studies of the ecological effects of radiological discharges suggests that such effects are to be expected mainly with high rates of discharge, much higher than have been measured from nuclear power plants. Therefore, they conclude that the ecological impacts of radiological discharges from SONGS is probably of less consequence than the ecological impact of other factors which they have been predicting from past studies. They suggest that if the Coastal Commission or some other State agency wants to know the probable ecological effects of radionuclides in the marine environment, it would be better to fund a study that examined an ecosystem subjected to the highest radionuclide levels that can be found and to combine this with experimental laboratory radiation studies.

Recommendation Course of Action

The MRC does offer assistance to the State Department of Health Services, which, they suggest, is the most logical agency to carry out a complete program of radiological monitoring. At present, the California Department of Health Services (DOHS) analyzes some samples, but these are collected by the contractor for the power companies (SCE and SDGE) that operate SONGS. To extend the DOHS program to include the collection

of the samples would be the best way to achieve a completely independent monitoring program. The MRC recommendation that the ECHS expand its program in this way supports a similar recommendation made in the recent March 1979 State Resources Agency report "Radioactive Materials in California".

As the MRC points out, additional funding would be necessary to support the collecting itself and to analyze the greater number of samples required for an adequate program. They have given a preliminary estimate of these costs (attached).

It is important that funding be obtained for such a program. The Resources Agency in "Radioactive Materials in California" recommends that the NRC fund expanded State auditing of nuclear power plant environmental surveillance programs. To date, such funding has not been forthcoming from the NRC.

To improve the radiological monitoring program staff recommends the Commission adopt a resolution with a number of stages, after informing the NRC of the program's shortcomings. First, SCE itself should develop a credible, objective and comprehensive monitoring program along the lines recommended by the MRC. The program should involve independent review of the design of the program, independent collection and analysis of samples, and full documentation of methods and results. The program should reflect prudent and responsible "judgment" well beyond that required by the minimal EPA guidelines on establishing such a program. If SCE refuses to develop and fund such a program, the second step of the recommended resolution is for the Commission to formally intervene in the Nuclear Regulatory Commission's operating license proceedings on SONGS Units 2 and 3. The objective of the intervention would be for the NRC to require a detailed, step-by-step independent monitoring program as part of the operating licenses for Units 2 and 3, if they are granted. Under federal law the NRC has sole authority to regulate radionuclide discharges. But the State can monitor the discharges. So if the NRC does not make more detailed monitoring program requirements part of the operating licenses, it seems important enough to accurately know what the discharges are to justify Commission consideration of using the Limited Coastal Energy Impact Program funds to conduct some independent monitoring. This would be considered as a last resort because the annual cost would be \$200-300,000 for the program suggested by the MRC (attached).

2. MRC Recommended Conditions. The MRC recommended three conditions to the Commission to be added to the SONGS permit. Two of the conditions, on minimizing use of chlorine and other biocides in the cooling water system and on use of corrosion resistant titanium alloy in the condenser are included in the staff recommended resolution. The third MRC recommended condition was: "B-11. A thorough and independent study shall be undertaken to evaluate the adequacy of the fish return system's design and operation and, further, if this new design proves ineffective, appropriate design changes shall be developed to reduce damage to the fin fish populations." This condition is more appropriate as Commission direction to the MRC rather than as a formal condition to add to the permit. The condition does not bind the application to an action. The MRC can undertake this evaluation task on its own, and the Commission has indicated it is a high priority.

3. Major Design Changes. The MRC has not recommended that the Commission require any major design changes to the SONGS cooling systems at this time. Condition B.6. of the SONGS permit states:

Should the study (MRC study) at any time indicate that ... substantial adverse effects on the marine environment are likely to occur, or are occurring, through the operation of Units 1, 2, and 3, the applicants shall immediately undertake such modification to the cooling system as may reasonably be required to reduce such effects or comply with such regulatory requirements (which can be made while construction is going on and could be as extensive as requiring cooling towers if that is the recommendation). The State Commission shall then further condition the permit accordingly.

Because the MRC has not been able to determine whether design changes should be required at this time, SCE faces a major uncertainty. Design changes such as cooling towers, extending the diffusers hundreds of feet or converting the discharges to single point discharges could cost hundreds of millions of dollars and, if required after unit operation could result in temporary removal from operation until the design changes are completed. Staff scenarios of possible "worst case" damage to fish, kelp and smaller marine organisms based upon MRC predictions indicate that there would probably have to be massive unexpected additional damage to marine life to require cooling towers after Units 2 and 3 begin operating. The fish return system, the locations of the intake and outfall and the diffusers, however, are areas where design changes should be more closely studied.

The MRC operating license proceedings are just beginning and as currently scheduled will probably end in early fall of 1980. The MRC should provide the Commission with its best scientific judgment prior to the conclusion of those proceedings as to whether the Commission should impose major design changes on the Units 2 and 3 cooling systems. Therefore, staff recommends the Commission direct the MRC to make that evaluation for submission to the Commission prior to June 1, 1980. Staff has deleted a condition recommended in its August 3, 1979 report that would have required extending the diffusers if the diffusers if the MRC finds 25% of the San Onofre kelp bed is being destroyed. Such a condition is not supported by MRC recommendations at this time, and as explained above would be difficult to implement after the plants begin operating.

4. Mitigation Alternatives to Design Changes. While there is no disagreement that there are measurable effects from Unit 1 and there will be effects from the operation of Units 2 and 3, both in kind and degree, the controversy arises over the exact nature and significance of the impacts. As can be seen from the comparison of SCE conclusions and MRC conclusions on the following chart, there is a clear disagreement over the significance and the actual existence of impacts. However, the MRC does indicate that post-operational monitoring could discover kelp, fish and plankton damage resulting from the cooling water systems. The MRC suggested that possible conditions to prevent such damage might involve engineering changes such as extending the diffusers well beyond the kelp bed or plant operating changes. SCE in its testimony to the Commission suggested that mitigation measures might be appropriate, at much less cost, if such damage is predicted with confidence or discovered through monitoring. The attached letter from SCE recommends that the Commission direct the MRC to evaluate promising mitigation measures, particularly the artificial reef concept that SCE believes may provide a net increase in marine life productivity in the area. (Some reef designs only attract marine life without increasing overall productivity.) Staff is recommending the Commission provide such direction to the MRC, including MRC evaluation of other promising mitigation measures if they can be identified. The results would provide the Commission with mitigation alternatives that might be imposed as conditions of the SONGS permit.

5. Future MRC Research Program and Budget. The MRC responded to the Commission's August 15, 1979 request "to more closely focus its study and monitoring program on kelp bed effects, effectiveness of the fish return system and effects of transport to deeper water on nearshore species" with the attached letter (October 27, 1979) from Dr. Joe Connell, MRC Chairman to Chairman Dorill Wright. The projected 1980 expenditures indicate about a one-third reduction in rate of expenditures from the project 1979 rate. Staff has not yet had time to evaluate the changes or to assess the contractor work programs and budgets in light of the Commission's direction. The Commission has also requested modification of five study programs which do not seem likely to develop additional decision-making information. Therefore, staff intends to evaluate some of the research programs with the MRC and to report back to the Commission on the evaluation. The programs include hard and subtidal soft benthos, zooplankton, ichthyoplankton, oceanography and data management.

Further budget assessments will also be necessary because the recommended research program on mitigation measures may be quite costly. Staff is recommending the mitigation research program be conducted within a \$3.2 million ceiling because staff had anticipated in its August 3, 1979 report that MRC expenditures might be reduced to a rate of about \$2 million a year. The revised MRC budget goes a long way in the direction of meeting the Commission's concerns about high cost and lack of focus of the research program.

APPENDIX 3

SUMMARY

MINORITY REPORT ON THE FINAL REPORT
OF THE MARINE REVIEW COMMITTEE (MRC)

SUBMITTED
TO THE
CALIFORNIA COASTAL COMMISSION

by

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SUMMARY

The Marine Review Committee (MRC) broke new ground in practical environmental research. Much of the information obtained is new knowledge for science and will result in a better understanding of the ecology of the inshore area of southern California. In part, the contribution of the MRC accrues from the study design, intensity and continuity of multidisciplinary investigations over a period of ten years, and the rigor of the statistical analyses performed.

Substantive agreement exists between the members of the MRC on the mechanisms of environmental impact resulting from the operation of the San Onofre Nuclear Generating Station (SONGS) in the following areas: (1) the loss of nearly all of the eggs, larvae, juvenile and adult marine organisms entering the SONGS with the flow of cooling water (Table 1) and, (2) the artificial transport of sediments from inshore to offshore together with the entrainment of suspended sediments offshore as a result of the circulation and discharge of cooling water. This process of circulation and discharge results in a plume of suspended sediments when the currents are flowing downcoast. This turbid plume causes a reduction in the penetration of light through the water column and adverse impacts by the sediments on organisms located on the bottom or in the water column (MRC Final Report, p. 93). These adverse impacts have resulted in a significant loss of fishes and invertebrates from the nearshore area, and a loss of 59,000 plants (80 ha) of the kelp bed community near the SONGS.

I agree with the chairman of the MRC in that the measured impacts are reported as conservative estimates of the SONGS' effects. In addition, there were many impacts that were not measured by this study (e.g., effects on benthic algae other than kelp, microzooplankton and some kelp bed invertebrates. This study was, in the majority of aspects, the best under the circumstances given time and budget constraints. The purpose of this minority report and of my criticisms is to emphasize to the CCC that the findings of the MRC present a conservative estimate of the effects of the SONGS on the marine environment, and that as a result, more appropriate mitigation should be required than has been recommended by the majority membership of the MRC.

Therefore, this minority report discusses the following aspects of the MRC Final Report where there are disagreements with the majority:

1) Under Estimation of Effects. Limitations in the study design resulted in under estimation of the effects for the following reasons. Operational effects of the SONGS were assessed for a period of only two years; this is too

short a period for the observation of chronic impacts. SONGS operated at a substantially lower level during the MRC monitoring studies compared to the period after the studies were completed. SONGS' impacts were not necessarily measured at a site of maximum impact. All of the impacts resulting from the operations of the SONGS could not be evaluated; therefore, selected impacts were studied because of time and budget constraints in the program.

2) Inconsistency in Zooplankton Sampling. Impacts on zooplankton, including the meroplankton, caused by the SONGS were considered to be instantaneous as compared with effects on populations of fishes. However, zooplankton was not sampled consistently in the discharge plume from the SONGS because samples were collected upstream from the SONGS. There was no determination of the concentration of the plume at the time and site of the sampling of zooplankton to evaluate the impact of discharged wastes and suspended sediments on these organisms. Because of the asymmetry in the distribution of the discharge plume along shore (Fig. 1), it is probable that the zooplankton were not impacted by the discharge when sampled in the MRC program. The charge to the MRC in the CCZCC permit 183-73 to sample the plankton and assess the impact of the SONGS on this group of organisms was not completed. Only estimates of the mass of zooplankton entrained by the power plant were measured and of two estimates obtained, the lower value was reported.

3.) Organic Matter. The MRC Final Report suggests that the broadcasting of the remains of organisms in the discharge from the SONGS might explain the increases in mysids, bottom fish and soft benthos. There is no direct evidence to support this hypothesis because the MRC did not estimate the amount of organic matter discharged from the SONGS nor how this potential "food" was partitioned among the various consumers in the environment.

4.) Impacts of Suspended Sediments. Redistribution of fine sediments offshore from the SONGS has resulted in the loss of an estimated 59,000 kelp plants, together with associated fish, invertebrates and benthic algae. SCE considers the problem of redistribution of sediments as part of the natural flux of sediments in the area of San Onofre (SDG 1989). Despite the fact that the SONGS has superimposed an unnatural change in the flow of water in the nearshore zone including the redistribution of fine sediments offshore which occurred after SONGS Units 2 and 3 began operation.

5.) Impact of Anchovy Larvae. The mechanisms responsible for the measured reduction of 30% in abundance of anchovy larvae should have been investigated.

6.) Radioactivity and Metals. While the MRC did not find substantial evidence for adverse impacts upon the environment as a result of the release of radioactivity and metals from the SONGS Units 2 and 3, the MRC did document adverse impacts upon sand crabs which correlated with the presence of radioactivity and metals. In my opinion, it is impossible to exclude the adverse biological effects of the substances in the environment near the SONGS. These impacts should be added to the other effects on the organisms subjected to the SONGS' discharge.

This report offers recommendations to assure that: (1) the full, long-term impact resulting from the operation of the SONGS Units 2 and 3 will be measured, (2) adverse impacts will be prevented in the future and will be mitigated, and (3) preventative and mitigative measures will be evaluated for their effectiveness, and strengthened where and when necessary. Specifically, I recommend the following:

1.) Strengthened Mitigation. The only mitigation measure which will prevent the present and continuing damage to the marine environment is the retrofitting of cooling towers to all three Units of SONGS. Cooling towers are also recommended to permit restoration of the native biota area impacted by the SONGS' discharge. Suggestions for lesser remedial measures than cooling towers are, at the least, inconsistent with applicable law.

2.) Ensure Compliance With Water Quality Standards. The CCC must ensure that the SONGS is in compliance with water quality standards. SONGS Units 1, 2 and 3 have failed to comply with water quality regulations with respect to penetration of light through the water column, accumulation of sediments on the seafloor and disruption of balanced indigenous populations (BIP) of marine organisms since these units became operational. As of 1991, this is 22 years for Unit 1, 8 years for Unit 2 and 7 years for Unit 3 (MRC Technical Report 0).

3.) Future Monitoring for Chronic Effects and to Evaluate Mitigation Measures. It is imperative that the CCC require additional monitoring to document chronic changes in water quality and populations of organisms affected by the operation of the SONGS. Future monitoring should also include an evaluation of the effectiveness of mitigation measures appropriate to prevent additional damage to marine resources and to restore the in-like resources destroyed or damaged by the operation of the SONGS. I recommend that monitoring programs for releases of radioactivity and metals be reviewed and more rigorous monitoring programs for these substances be implemented.

4.) Form a Non-profit Foundation to Monitor Effects.

Monitoring of changes in water quality and effects on marine organisms should continue under the auspices of a non-profit foundation.

5.) Independent Review of MRC Results.

An independent consultant to the CCC should review the results of the MRC studies. This member believes that estimates of damage are too conservative and that a thorough review of all of the MRC studies will support the recommendation to retrofit the SONGS with cooling towers in order to comply with the California Coastal Zone Conservation Act of 1972.

Table 1. Summary of the estimated losses of organisms in the San Onofre area as a result of the operation of the SONGS. These losses represent conservative estimates of the actual losses.

SONGS

SUMMARY OF LOSSES

Population	Loss
Kelp plants	59,000 plants, 80 ha 60% reduction
ENTRAINMENT LOSSES	
Phytoplankton*	10,000 tons/yr
Zooplankton**	1,350 tons/yr
Ichthyoplankton	4 billion larvae/yr***
Juvenile and Adult Fish	51 tons/yr
Mysids (semi-planktonic)	14 tons/yr
RELATIVE ABUNDANCE LOSSES	
Kelp Bed Fish (bottom)	Declined 70%
Kelp Bed Fish (water column)	Declined 17%
Hard Bottom Kelp Bed Invertebrates (15 species of snails) (sea urchins)	Declined 80% Declined 76%

* Estimated to be approximately 10 times the amount of zooplankton.

**Holoplankton and meroplankton excluding fish.

***No exact weight estimate available.

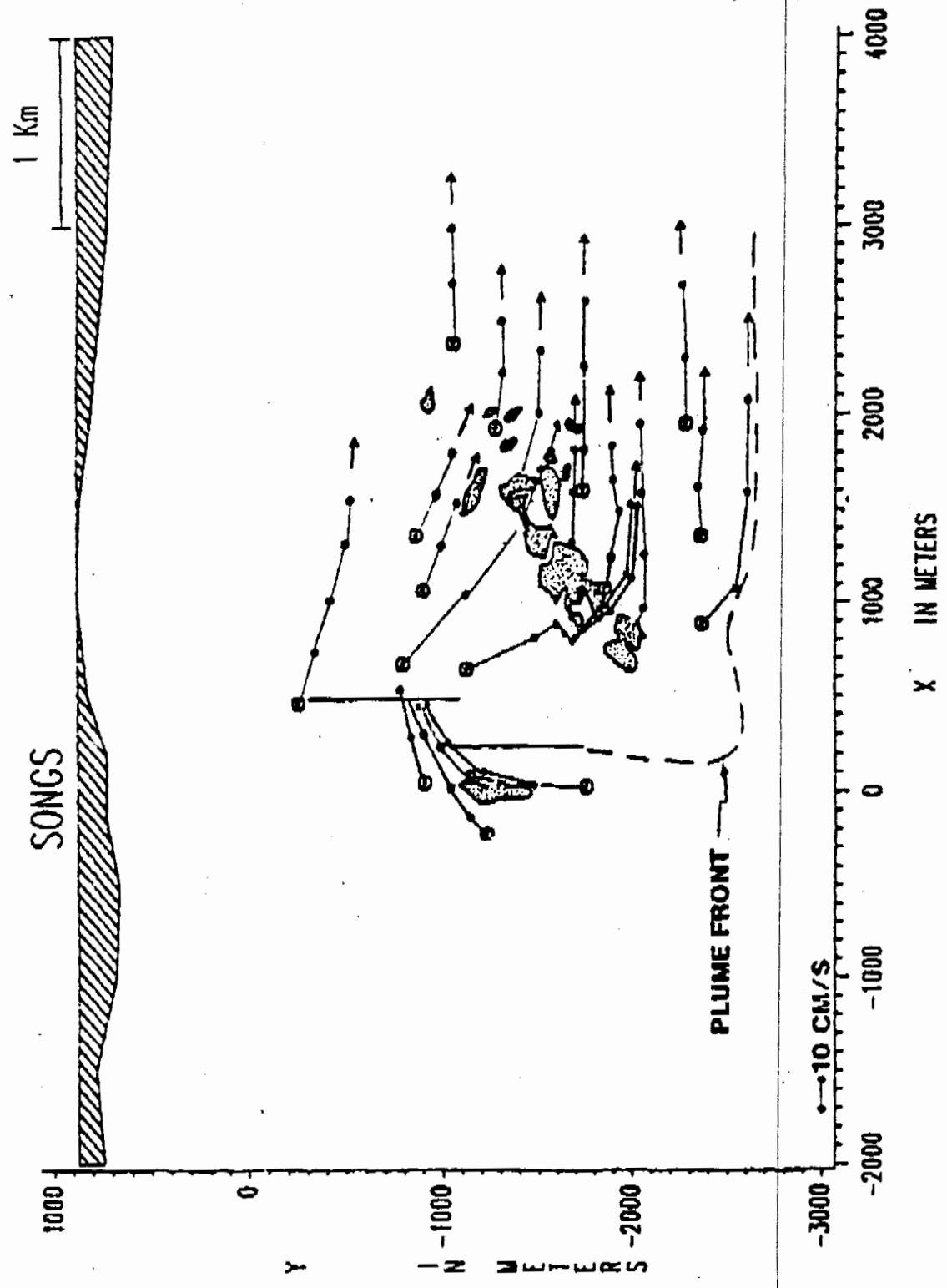


Fig. 1. Diagram of the asymmetrical pattern of water movement in the area around Units 2 & 3 diffusers. Stippled areas represent kelp.

Appendix 4: SUBSTANTIVE FILE DOCUMENTS

Documents and Studies

Marine Review Committee Interim Technical Reports:

1. Interim Report of the Marine Review Committee to the California Coastal Commission, April 18, 1988, MRC Document No. 88-05A.
2. Interim Technical Report to the California Coastal Commission: 1. Plant Description and Operating History and 2. Sampling Design and Analytical Procedures (BACIP). MRC, March 31, 1988.
3. Interim Technical Report to the California Coastal Commission: 3. Midwater and Benthic Fish. MRC, April 4, 1988.
4. Interim Technical Report to the California Coastal Commission: 4. Plankton. MRC, April 1, 1988.
5. Interim Technical Report to the California Coastal Commission: 5. Fish Larvae and Eggs. MRC, March 30, 1988.
6. Minority Report to the Commission on the Interim Report of the Marine Review Committee to the Coastal Commission, prepared and submitted by Dr. Rimmon Fay, June 1, 1988.

Marine Review Committee Final Report and Final Technical Reports:

7. Final Report - August 1989
8. Final Technical Report A. Sand Crabs, Volume I - May 1989
9. A. Sand Crabs, Volume II, Appendices - May 1989
10. B. Anomalous Sediments in the San Onofre Kelp Forest - February 19, 1991
11. C. Entrapment of Juvenile and Adult Fish at SONGS (San Onofre Nuclear Generating Station) - July 1989
12. D. Adult-Equivalent Loss - October 1989
13. E. Metals and Radiation - June 1989
14. F. Kelp Forest Invertebrates - April 1989
15. G. Mysids - July 1989
16. H. Mitigation - February 1990
17. I. Soft Bottom Benthos - July 1989
18. J. Kelp Bed Fish - July 1989

19. K. Giant Kelp - June 1989
20. L. Physical and Chemical Oceanography - July 1989
21. M. Bight-Wide Effects on Fish: Compensation - February 1990
22. N. Integration of Local Depression and Increases in Fish Stocks with Inplant Losses - July 1989
23. O. Water Quality Compliance - February 1990
24. Draft Minority Report on the Final Report of the MRC to the Coastal Commission, prepared and submitted by Dr. Rimmon C. Fay, Pacific Biomarine Laboratory, Inc., October 1990.
25. Pacific Estuarine Research Laboratory (PERL) 1990. A Manual for Assessing Restored and Natural Wetlands with Examples from Southern California. Biology Department, San Diego State University, a Publication of the California Sea Grant College.
26. Dykes, A. A., Read, J. W., Woodard, K., Buttemer, D. R. February 1990. Assessment of Marine Review Committee Recommendations for SONGS Units 2 and 3. Prepared for Southern California Edison Company, Rosemead, California.
27. PLG, Inc., October 1990. Use of Fuel Design Flexibility to Minimize Larvae Entrainment at San Onofre Units 2 and 3. NSCE1N0011.070990
28. Brown, Mark T., 1990. Buffer Zones for Water, Wetlands and Wildlife in East Central Florida. Center for Wetlands, University of Florida.
29. Southern California Edison Company, June 1, 1990. San Onofre Nuclear Generating Station: Compliance with NPDES Permit Conditions - Testimony to the California Regional California Regional Water Quality Control Board, San Diego Region.

Letters and Memos

1. Letter from Don May, Friends of the Earth, to Susan Hansch, California Coastal Commission, August 18, 1988.
2. Memo from Mary Hudson, staff counsel, CCC, to Susan Hansch, California Coastal Commission, concerning San Onofre Nuclear Generating Station - Marine Review Committee: Response to Legal Questions, August 22, 1988.
3. Letter from Frank L. Melone, Southern California Edison Company, to Susan Hansch, California Coastal Commission, October 17, 1990.