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

SUBMITTED

TO THE

CALIFORNIA COASTAL COMMISSION

by

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OCTOBER 1990

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I. 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 value of 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 SONGS.

Southern California Edison (SCE) agreed to the MRC's Final Report (signed by Dr. Byron Mechalas, as SCE's representative) accepting the significance of the findings and the appropriateness of the mitigation measures recommended by the majority of the MRC. Even with complete availability of the MRC data throughout the program, SCE is now questioning the accuracy of the MRC findings and procedures, e.g., estimated bight-wide fish losses, the

appropriateness of the control sites for the kelp studies and the mitigation recommendations (SCE communications, Hertel 1990, Palmer 1990). This is inconsistent with the participation of SCE in every step of the MRC program. If irrelevant studies and erroneous analyses were performed, SCE should have pointed this out during the course of the studies. If an inappropriate control site was studied, a suitable location should have been suggested.

This member of the MRC agrees with the significance of the majority of the MRC findings. I am concerned that SCE's consultants are reaching different conclusions based on less intensive and systematic studies while ignoring the significance of the MRC data. I find this disturbing because this is the exact situation which the MRC was created to avoid. The MRC was formed with SCE's support to determine if unequivocal adverse impacts upon the marine environment attributable SONGS' Units 2 and 3 have occurred as measured with statistical confidence. In this member's opinion, however, 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, microzooplankton and some kelp bed invertebrates). The study was, in the majority of aspects, the best possible under the circumstances given time and budget constraints. The purpose of this minority report and of my criticisms is to alert the CCC to the strong possibility 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) <u>Under Estimation of Effects</u>. Limitations in the study design resulted in under estimation of 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 concluded. SONGS' impacts were not necessarily measured at a site of maximum impact. All of the impacts resulting from the operation of the SONGS could not be evaluated; therefore, only a few possible impacts were studied because of time and budget constraints in the program.

2) Inconsistency in Zooplankton Sampling. Impacts on zooplankton, including 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. Samples were collected upstream from the SONGS' discharge and the presence of impact at the sampling site assumed on the basis of the direction of the current as measured at another location at the time of sampling. There was no determination of the concentration of the plume at the time and site of the sampling of zooplankton to estimate the impact of discharged wastes and suspended sediments on these organisms. Absent an unequivocal measure of the concentration of the discharge plume at the time and location of the sampling, the presence of the plume and measurement of an effect on the zooplankton cannot be assumed. Because of the asymmetry in the distribution of the discharge plume alongshore (Figure 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 accomplished.

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 observed increases in mysids, bottom fish and soft benthos. There is no direct evidence to support this conclusion because the MRC did not estimate the amount of organic

matter discharged from the SONGS nor how this potential "food" was partitioned among various consumers in the environment.

4) Impacts of Suspended Sediments. Redistribution of fine sediments offshore from 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 off San Onofre (SDG 1989). This is difficult to resolve with the fact that the SONGS has superimposed an unnatural change in the flow of water in the near shore zone including the redistribution of fine sediments offshore which occurred after SONGS Units 2 and 3 began operation.

5) Impact on 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 SONGS Units 2 and 3, the MRC did document adverse impacts upon sand crabs which correlated with the presence of radioactivity and metals. In this members opinion, it is impossible to exclude the adverse biological effects of these substances in the environment near SONGS. These impacts should be added to the other effects on the organisms that are already stressed in the area affected by 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, this member recommends the following:

1) Strenghten Mitigation. In this member's opinion, the only reasonable mitigation measure which will prevent the present and continuing damage to the marine environment is the retrofitting of cooling towers to all three units at the SONGS. Cooling towers are also recommended to achieve restoration of the native biota upon decommissioning of the SONGS. 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 1990, this is 21 years in the case of Unit 1, 7 years for Unit 2, and 6 years for Unit 3 (MRC Technical Report O, see Appendix).

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 appropirate 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 the monitoring programs for releases of radioactivity and metals be reviewed and more rigorous monitoring programs 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 mitigation option of prevention of damage to the environment.

II. DETAILED RECOMMENDATIONS

1. Strengthened Mitigation

The only mitigation measure which will prevent the continuing damage to the marine environment as a result of the operation of SONGS Units 1, 2 and 3 is the retrofitting of cooling towers to all three Units (MRC Final Report, p. 288). Since Unit 1 is exempt from the terms of California Coastal Zone Conservation (CCZCC) Permit 183-73, the California Coastal Commission (CCC) cannot require Southern California Edison (SCE) to modify this Unit. Abatement of the adverse impacts of Unit 1 can be required by the Regional Water Quality Control Board in any way that provides a resolution of the problems resulting from the operation of this Unit that is acceptable to the Board. The CCC is able to further condition permit 183-73 for Units 2 and 3 to require the installation of cooling towers.

Cooling towers are required at all inland and some coastal nuclear fueled power plants. While the proposal for cooling towers is untried on this scale (comment provided by SCE), the scale-up is not very great. Cooling towers are the only measure which assures the maximum potential for the prevention of the losses of marine resources documented in the MRC Final Report. It is thus consistent with all applicable law and regulation for prevention of losses of marine resources resulting from the operation of the SONGS.

SCE represents that it does not have the land upon which to place cooling towers. Original projections by SCE were to build additional Units (Units 4 and 5) south of Units 2 and 3 on land to which they no longer claim to have access; this is, at the least, inconsistent. The MRC received estimates of cost and the effect upon generating capacity at SONGS and in the SCE system from SCE;

these should be subjected to independent verification. The MRC has reviewed the potential environmental impacts of the operation of the cooling towers (MRC Final Report, p. 288). These projections should be subject to independent review and assessment.

The other methods of mitigation (in-like, in-kind and off-site) discussed in the MRC Final Report should be qualified by a comment that each of the mitigative alternatives is untried and unproved in scale for the attainment of specific objectives relative to the impacts resulting from the operation of the SONGS (MRC Final Report, Ch. 19, MRC Technical Report H). The majority of the measures suggested offer potential replacement of the resources lost or endangered with other resources in-kind. Only the low level kelp reef would be designed to replace kelp bed resources in part and in-like but this proposed action is untried on the scale suggested and, so far, such artificial reefs have not been successful in supporting perennial kelp beds (MRC Final Report, p. 292, 298).

Ultimately, upon decommissioning of the SONGS, establishment of biological populations composed of species in-kind during the operating life-span of the SONGS, will result in an imbalanced biota which will complicate the ultimate restoration of the original resources lost during the operating life span of the SONGS. Provisions should be made to restore these original resources once the SONGS is decommissioned.

2. Form a Non-Profit Foundation to Monitor Effects

Form a non-profit foundation to continue the monitoring of the effects of SONGS on the marine environment. Program review and evaluation of results for compliance with applicable law and regulation should be performed by governmental bodies, e.g., Water Resources Control Board, California Department of Fish and Game, U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, and California Coastal Commission (CCC) with access to the public for review and comment throughout the program (Figure 2).

A Scientific Study Group (SSG) should be composed of members distinguished by their knowledge of the coastal ecology of southern California. They shall be five in number selected by SCE, the CCC, the oponents to the construction of the SONGS, one representing the State Resources Agency, and one representing the fishing industry (sport fisheries, commercial fisheries, kelp harvesting or aquaculture). The SSG shall set program goals and objectives develop monitoring programs, establish criteria for assuring the impacts of the SONGS are mitigated, that on-going mitigation programs are effective, and award contracts for monitoring and related studies. At appropriate intervals, e.g., no less than every three years, recommendations shall be put forth for changes in program structure, content or alterations in the operations of or structural changes to the SONGS as needed to implement appropriate mitigation. During the succeeding three years that follow the implementation of recommended changes in the operation or structure of the SONGS, the effectiveness of the modifications shall be monitored and reported upon on an annual basis. These annual reports shall suffice at least in part for the purposes of the requirements of the National Pollutant Discharge Elimination System (NPDES) permit issued to SCE by the Regional Water Quality Control Board for the SONGS.

The Board of Trustees shall be accountable for the budget of the trust, legal problems, personnel policies and practices, and an overview of the financial aspects of the foundation and trust fund management. The members may be appointed by SCE, a conservation organization (e.g., the Sierra Club), and a member of an environmental law firm. Members of the trust shall have professional competence in one or more of the following areas: financial management, environmental law, personnel, management and/or accounting. Appointees other than by SCE shall file a disclosure statement indicating that they have no conflicts of interest with serving on the Board. All meetings of the board of Trustees and SSG shall be open to the public following appropriate

notice to interested parties.

3. Future Monitoring for Chronic Effects and Evaluation of Mitigation Measures

Despite the thoroughness of those aspects of the MRC studies presented in the MRC Final Report, there is an imperative need for additional monitoring that is not met by the monitoring by SCE under the terms of the current NPDES pernit, e.g., see SCE Annual Monitoring Reports 1980-1989 (SCE 1980-1989). Considering that the SONGS Units 2 and 3 will be in operation for twenty or more years and that substantial impacts have been measured, increased long-term effects are probable.

It is also imperative that the CCC require monitoring of the effectiveness of mitigation measures. Monitoring for effects of the operation of the SONGS and restoration of lost resources should include two objectives: (a) to document chronic changes in water and habitat quality, (physical and chemical variables), and populations of organisms (fish, benthic algae, hard bottom invertebrates, and soft benthos) affected by the operation of the SONGS. Design of the monitoring studies will include the Impact/Control area comparison as begun with the MRC program. Adequate sampling shall be conducted to meet statistical criteria for confidence consistent with regulatory requirements in the results obtained. (b) To evaluate 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 Units 2 and 3. Monitoring of the mitigation efforts shall continue until lost and damaged resources are restored to pre-operational abundances. If the SONGS' Units continue to operate without abating the redistribution of sediments and other adverse impacts, they will be in continuing violation of applicable water quality regulations (MRC Technical Report, O).

I recommend that the monitoring programs for release of radioactivity and metals be reviewed and more rigorous monitoring

programs be implemented. At the present time only gamma emitting isotopes are measured in the organisms collected about the SONGS and analyzed for burden of radioactivity. The summary burden of gamma emitters is not reported, nor are burdens of beta emitters and alpha emitters reported, nor the total burden of radioactivity in organisms. The only comparison is one of burden of isotope by isotope with organisms from the area around San Onofre versus the same species of organisms from a control area assumed to be free of radioactive contamination. Burdens are reported as relative enrichment and range from 2 to more than 100 for specific isotopes (MRC Technical Report, E). The increase in burden of radioactivity at San Onofre can have no other source than from SONGS. Recent action (July 1990) by the Nuclear Regulatory Commission (NRC) to deregulate the disposal of low level radioactive wastes "below the level of regulatory concern" is especially alarming for the potential exists to increase the release of radioactive wastes at the SONGS. In the present situation, it is impossible to fully evaluate the environmental effects of those wastes now released to the ocean, increased release of such wastes could cause additional problems.

SONGS is only required to analyze for metals in its discharge twice per year when the Units are generating electricity. There is no requirement to report on the amounts of metals overboarded into the discharge nor is there a requirement to report on the mass balance of pollutants entering and leaving the facility. Absent an accounting for the disposal of hazardous wastes in approved facilities, it must be assumed that they are released into the ocean. High level radioactive wastes are stored on site until the intensity of radioactivity declines at which point they may be diluted and released to the ocean. This problem will increase in severity if the facilities for the safe disposal of high level radioactive wastes are not commissioned in the United States. At this writing, there is no resolution other than storage on site as a management option for containment of high level radioactive

wastes.

At a minimum, burdens of radioactive isotopes may be assumed to have a linear effect upon the health of the organisms so contaminated (MRC Final Report, Ch. 16). Metal pollutants may be expected to act in a similar manner. However, it is reasonable to expect synergistic actions with a mix of metallic, radioactive, and other pollutants such as is found in the environment at the SONGS and this aspect of the effects of the SONGS on the marine environment has not been examined.

In reviewing the monitoring reports on radioactivity in organisms at and about the SONGS, it is impossible to determine what period of time the organisms have been exposed or at what levels of radioactivity. In some cases, it is impossible to determine what the exact species, e.g., rock crab, that were collected and analyzed and the specific locations where they were collected.

4. Independent Review of MRC Results

Should the CCC have doubts about the substantiality of the effects identified by the MRC, and the high probability that the effects are in fact greater than the level reported by the MRC then the CCC should subject the MRC program and reports to a thorough review by an independent consultant to the CCC for the purposes of: (a) program content and direction, (b) reliability of the data obtained and the appropriateness of the recommendations developed, (c) evaluation of the MRC as a model for environmental studies for regulatory purposes and, (d) evaluation of the importance of preliminary data and sampling trials not in the official MRC data bases.

No one has examined the entire MRC program and data base to evaluate it with respect to the conclusions reached and reported to the CCC. Even though a selection was made of what data to analyze and report to the CCC, there is no indication that any of the unanalyzed data or unreported data contain information which

is inconsistent with the conclusions of the MRC. I believe that if an independent review of the whole of the MRC data were conducted, the recommendations of the MRC would be supported more fully and an examination of the findings would support the contention that the MRC estimates of damage to the marine environment are conservative by possibly as much as an order of magnitide too low.

III. BACKGROUND

In 1973, a commission composed of lay persons faced a decision under the California Coastal Zone Conservation (CCZC) Act of 1972 to approve or deny an application for the construction of Units 2 and 3 of the San Onofre Nuclear Generating Station (SONGS). Under the terms of the Act, the CCC could not approve of a development which would be an irretrievable, irreversible commitment of coastal resources unless the adverse impacts on the environment from the development were fully mitigated. The application was initially denied and then reconsidered and approved with conditions.

In the testimony before the California Coastal Zone Conservation Commission (originally the CCZCC which was succeeded by the California Coastal Commission (CCC)), the applicant, SCE, testified that the operation of the SONGS would result in a negligible impact upon the coastal resources at San Onofre. Opponents considered the huge volume of seawater needed to cool the reactors as well as the location of the diffusers through which this water would be returned to the ocean, and predicted that the operation of the SONGS Units 2 and 3 would cause the formation of a marine desert in the nearshore area off San Onofre (MRC Final Report, p. 3).

The regulatory agencies charged with protection of marine resources and water quality did not refute either the applicants or the opponents which left the CCZCC caught between the two extreme predictions. Thus arose one of the conditions for approval

for the construction of SONGS Units 2 and 3 that resulted in the formation of the Marine Review Committee (MRC) with the mandate to predict and then to assess, in a comprehensive manner, the effects of the SONGS Units 2 and 3 on the marine environment. In 1988, after the majority of the field work was completed, the MRC learned of its status as an advisory body to a state agency. As such, the MRC is subject to the Bagley-Keen Act and in 1988 members of the public were notified of their right to attend MRC meetings if they so wished. The MRC Final Report describes the findings of facts resulting from 12 years of multidisciplinary study of the effects of the SONGS on the marine environment. This Final Report is absent the review and comment of the public on the MRC program and studies during the course of the investigation.

Southern California has a rich and productive coastline with a diverse biota. About 1000 species of organisms have been identified in the region studied by the MRC (S. Schroeter personal communication). Most of these organisms are planktonic at some stage of their life cycle. Thus the permit issued by the CCZCC took special note for the MRC to examine, in the broadest manner, the plankton and all other organisms which might be affected by the SONGS (MRC Final Report, p. 331).

The MRC study program was designed as "an effects study", that is, to examine the properties of the water column and bottom sediments Near and Far from the point of discharge from the SONGS and compare these properties with the abundances of organisms through time from the two areas. The Near area is the Impact area where changes in properties or abundances caused by SONGS might be expected to be observed versus the Control (Far) areas where variations in properties or abundances were assumed to occur as a result of natural processes which affect both Near and Far sites to the same extent and in the same way.

It is crucial to note that the area subject to the inpact from the SONGS was assumed to be symetrical alone the shoreline, that is, equidistant along shore and offshore from a central point of

impact (the discharge points for Units 1,2 and 3). The MRC did not determine the maximum sites of impact for the various groups of organinsms sampled nor did the MRC directly measure of the discharge at the points of sampling of the biota. The criterion, which was fundamental to the study design, was to determine if there was a change in the abundance of 50% of the organisms sampled in the Impact area versus the same species or group in the Control area in the Before period of sampling versus the after (operational) period of sampling (BACI).

Dr. Peterson, a reviewer of many of the MRC reports called specific attention to measure the concentration of the discharge from the songs at the time and point of sampling. In addition, the U.S. E.P.A. specifically pointed to the importance of gradient sampling through a waste discharge to identify the location of the waste plume and for correlation of the concentration/length of impact (dose) with the changes in the biological components of the area impacted (U.S. E.P.A. 1982).

Every day SONGS Units 1, 2 and 3 circulate a maximum volume of water on the order of 1 mile square to a depth of 14 feet through the generating station for the principal purpose of condensing the steam that flows through the turbine generators. Subsequently, that portion discharged through the diffusers, initially mixes with about ten times its volume in order to meet the Thermal Plan requirements of the State Water Resources Control Board (MRC Final Report, p. 332). This daily volume of about 0.25 cubic miles of seawater then mixes and disperses at rates determined by the velocity of the currents in the inshore area. In this process, an amount of heat equivalent to the domestic consumption of 3.5 million residences housing a population of 10 million persons is released to the environment (SCE personal communication). Radioactive wastes and corrosion products from the SONGS are also released to the environment, however, the accounting for the amounts and composition of these releases together with the frequency of specific releases is not well known (MRC Technical

Report, O).

Intake and entrainment of water moved by the pumps of SONGS Units 2 and 3 have altered the pattern of movement of the inshore waters in the vicinity of the SONGS (MRC Final Report, p. 83). This has occurred because the flow of cooling waters through and discharged by the SONGS is continuous and at a mean rate of 325 cm/sec versus background mean flow of 3 cm/sec. Once this mass of water is set in motion, it tends to continue in the direction of motion that is determined by the predominant flow of the inshore waters which is to the southeast (downcoast) 60% of the time. One quarter of a cubic mile of water moving every day at any velocity has a momentum all of its own that can overcome weak natural reversals in current direction caused by tidal changes.

Most of the water passing through the cooling system of the SONGS comes from offshore and upcoast from the SONGS. When this water is discharged, a turbid plume may be observed downcoast from the diffusers accompanied by a measureable decrease in irradiance through the water column (mean irradiance decreases by about 16%, MRC Technical Report O). When the current flows upcoast, clear offshore water is drawn through the SONGS and entrained by the discharge. As a result, a non-turbid plume may flow upcoast (MRC data indicate an overall increase in irradiance upcoast of the diffusers (clearer water) and a decrease in irradiance downcoast (more turbid water)).

Thus, water discharged from the SONGS does not move in a symmetrical pattern about the diffusers. Movement downcoast is generally parallel to the shoreline. Movement upcoast is deflected inshore by the kelp growing on the upcoast side of the line of the diffusers. This asymmetrical pattern of water movement is represented in Figure 2. This representation of water movement differs from that illustrated in the Final Report (MRC Final Report, p. 92) which idealizes the dilution of the plume based upon mean current velocities directed upcoast and downcoast. The offshore downcoast distribution of the plume is limited to no

further from shore than about the 60 ft (20 m) isobath. Upcoast movement of the plume is parallel to and closer to the shoreline.

Some documented losses from the biota impacted by the SONGS results from entrainment in the flow of cooling water of a daily volume on the order of one mile square to a depth of 14 feet (this is greater than the whole of the volume of the inshore waters of southern California taken on an annual basis). This entrainment results in measurable losses of eggs, larvae, juvenile, and adult marine organisms. It is also possible to estimate the adult equivalent losses resulting from the death of eggs and larvae (estimates of adult equivalent losses resulting from the death of juveniles could not be calculated) (MRC Final Report pp. 155,186,194). Some of these losses are expressed in terms of estimations of reduced stocks of fishes distributed throughout the southern California Bight (Table 2). Estimated losses are logarithmic, i.e., a percentage of the population is lost each year. Absence of biological compensation for these losses, the standing stocks of the species most vulnerable to withdrawal through the SONGS must decline in abundance to some lower level throughout the southern California Bight (the potential for complete biological compensation of the losses resulting from the operation of the SONGS is discussed for fishes in the MRC Technical Report, M). No hard evidence or theoretical modeling supports complete compensation for fish or any other organism lost as a result of the operation of the SONGS. Thus, the prediction is supportable that the abundances of fishes vulnerable to loss in power plant cooling waters will be unnaturally lower than in the absence of this impact.

IV. MINORITY VIEWS ON MAJOR ISSUES

Conclusions regarding most of the effects of SONGS on the marine environment were reached unanimously by the MRC as were recommendations for measures to abate or mitigate the damage. SCE maintains that cooling towers are too costly and therefore are

unreasonable. It is on the issue of reasonability where there is disagreement within the MRC. This is a different issue than the one assumed by the SCE's consultants when they choose to ignore the available data and facts in order to reach different conclusions than those reported by the MRC. This is the exact situation which the MRC was created to avoid. It does a disservice to the CCC to provide it with a conflicting set of poorly documented opinions as a critique of an extensive, thoroughly documented study of the biological effects resulting from the operation of the SONGS Units 1, 2 and 3.

This member has expressed disagreement with the following issues throughout his period of tenure on the MRC. This does not mean that the study was not done well but rather that it had limitations with which I could not agree or accept. Thus it is my conviction that the adverse impacts caused by the SONGS may have been greater than estimated by the MRC.

1. Under Estimatation of the Effects of SONGS

SONGS has severe impact upon nearshore fishes, kelp beds, zooplankton, mysids and benthic invertebrates. Estimates of the annual extent of these impacts as reported by the MRC are conservative because: (1) the point of measurement of the impact was not qualified as the point of maximum impact, (2) the monitoring studies were over too short a period of time (2 years), and (3) SONGS operated at a lower level during the monitoring period of the studies than during subsequent years of operation (ca 50+% vs 80+%).

Adverse impacts resulting from the operation of the SONGS are expected to increase as chronic affects become established and additional imbalances in the indigenous biota result. Part of this increase in severity of effect may result from the discharge of increased amounts of radioactivity and corrosion products as the Units age (Riccio & Murphy 1988).

At least three independent variables are available as tags of the distribution of the discharge from the SONGS: (1) radioactivity, (2) a salinity-temperature anomaly, and (3) sedimentation and/or irradiance. Radioactivity may be determined in the water column for both gamma and beta emitters as well as in the sediments or concentrated in the tissues of out-planted organisms (out-planting may be necessary as a result of the loss of much of the sessile biota under the plume from the SONGS).

The plume may be recognizable as a difference in density between the surrounding waters and the mixed waters of the discharge. This difference may be more apparent at the offshore border than in the dynamically mixing waters of the shoreline. An abundance of evidence points to the importance of the concentration of the plume through time (dose) at a given location to correlate with biological observations in the area of the impact.

Expanded collection of physical data to correlate with biological observations is important to the mitigation program. It will be necessary to establish that the physical environment of the Impact area is restored to a quality equal to that found at the Control stations in order to evaluate the effectiveness of preventive measures.

2. Inconsistency in Zooplankton Sampling

Zooplankton, including meroplankton, was not sampled consistently in the discharge plume from the SONGS. Samples were collected upstream from the SONGS' discharge and only slightly significant differences in the abundance of zooplankton between the Impact versus Control samples were observed. A small but significant difference in the After period between the Impact and Control area for meroplankton as represented by barnacle larvae was observed. This is inconsistent with the observation that the invertebrates living in the kelp bed declined in abundance (MRC Final Report, p. 143). It is not logical to expect an increase in the abundance of the progeny of an adult population that is

declining in abundance when production of progeny is density dependent on the abundance of adults.

Sampling of zooplankton upstream from the SONGS should have been qualified by gradient sampling correlated with the concentration of the plume discharged from the SONGS, but this was not done.

It was noted that when the currents flowed upcoast, irradiance on the bottom increased because clear offshore water entered the intake and surrounded the diffusers. In contrast, when currents flowed downcoast, irradiance on the bottom decreased (MRC Technical Report O) because turbid water entered the intake and surrounded the diffusers. At least at the irradiance station(s), there is no evidence for a turbid plume from the SONGS impacting the nearshore area upcoast of the diffusers and presumably at or near the sites where the zooplankton were sampled, that is, the evidence is lacking for the presence of the discharge of SONGS where and when the zooplankton were sampled.

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 remains to be accomplished.

3. Importance of Organic Matter as Food Supply

More than 12,000 tons of organic matter (as living organisms) annually enters the cooling systems of the SONGS (Table 1). A portion of this organic matter is removed by the community of fouling organisms that live on the inside of the intake and discharge pipes. Some of the organic matter passes through the power plant and is returned to the environment largely as small, cooked fragments of animal and plant tissue. Many of the organisms in the water column can consume or mineralize this particulate matter, i.e., bacteria, protozoans, non-specific grazers (e.g., copepods, mysids, larval fish and invertebrates), juvenile and adult fish (e.g., anchovy and sardines). If rocky areas are present, these habitats are covered with suspension feeding

invertebrates (e.g., sponges, cnidarians, bryozoans, mollusks, arthropods and tunicates). They are adapted to remove dissolved and particulate organic matter from the water column. Unconsolidated bottoms (muddy to sandy bottoms) are inhabited, in part, by another suite of organisms specialized for feeding on small bits of organic material. Regrettably, the MRC did not estimate the amount of organic matter discharged from the SONGS nor how this "food" was partitioned among various consumers in the environment.

It is suggested in the MRC report that the broadcasting of the remains of organisms in the discharge from the SONGS might explain the observed increases in mysids, bottom fish and soft benthos (MRC Final Report. pp. 226, 181, 217 respectively). This member feels that there is no good evidence for "enhancement" of popuations of all these groups as discussed below.

a. Mysids

The data indicate an increase in the abundance of semi-planktonic mysids about 2 miles downstream from the SONGS despite the estimated 14 tons lost per year in the cooling system (MRC Final Report, p. 224). This apparent increase might be explained by a number of factors including increased availability of food, decreased net avoidance in turbid waters, decreased predation as a result of decreases in the stocks of white croaker and queenfish, and increased concentration caused by a postulated vertical circulation cell (EPA Report). Possibly all four factors are affecting the estimates of their abundance, but this member does not believe it is likely to be caused by the rain of organic matter.

At a radius of 2 miles from the point of discharge, the dilution of the discharge is greater than 1:100 and it seems implausible that the increase in mysids can be fully explained by the slight increase in organic detritus in the discharge of the cooling waters. In fact, the MRC observed a consistent decline of

30% in the abundance of filter feeding anchovy larvae in the area impacted by the plume from the SONGS. This loss of these larvae is greater than what can be accounted for as a result of entrainment of cooling waters through the SONGS and dilution of the discharge. The question is, does the plume from the SONGS weaken or kill anchovy larvae and thus provide an increase in the food supply for mysids which may be attracted to this unnatural situation.

Another group of mysid species is found in the kelp bed. The MRC final Report observed that it is likely that, to the extent that the kelp bed was reduced in coverage and abundance, these mysids were also lost. It was impossible to determine the relative changes in the two populations of mysids because those in the kelp bed were not examined quantitatively. Thus, the MRC cannot state unequivocally that mysids overall increased in abundance as a result of the operation of the SONGS nor establish a reason for this change in abundance in the semi-planktonic portion of this population of organisms. It is possible to state that there was a change in community structure evidenced by the change in rank order of abundance of semi-planktonic mysids from the Before to the After period and in the Impact area versus the Control area and this constitutes evidence for a change from a "Balanced Indigenous Population of Organisms" (BIP) caused by the operation of the SONGS. Those mysids associated with the kelp bed declined in abundance to an unknown but significant extent. This is a definite adverse change in the Balanced Indigenous Population of the benthic mysids of the kelp bed.

b. Soft Benthos

Disruption of community structure of all biotic groups was evident at all locations impacted by the SONGS with the most extensive changes observed closer to the diffusers (MRC Final Report). The changes in community structure tended to moderate with distance from the diffusers. If the rain of postulated

organic carbon is important to the benefit of the soft benthos, enhancement should have been greatest, all other things being equal, closer to the diffusers. But this is not what was observed for all groups. Instead, abundance of the surface feeders, (including crustaceans) of the soft benthos increased with distance from the diffusers (MRC Final Report, Ch. 14).

Changes in the soft benthos did not correlate well with any of the physical measurements made at the depths surveyed in the After period. Other data point to the change in the composition of the sediments with respect to grain size and organic burden that do relate in time to the operation of the SONGS but do not correlate with the overall abundance and species composition of the organisms categorized as the soft benthos (MRC Final Report, p. 201).

c. Benthic Fishes

Increases in the abundance of bottom fishes were found at a sampling depth of 90 feet (30 m). The MRC Final Report suggested that this might be caused by an increase in soft benthic organisms and organic debris falling on the bottom, but there is no direct evidence that this is the cause. Fishes may have increased in concentration to avoid the turbid plume from the SONGS but this possibility was not examined by comparing decreases in abundance in more shallow water with increases in abundance at 90 ft (30 m). Thus there is no explanation of why the fishes increased in abundance at the putative but not qualified Impact site at a depth of 90 feet in the After period related to the operation of the SONGS.

Fishes associated with the kelp bed decreased in abundance with the loss of the kelp bed and the depths where the plume from the SONGS was shown to be present based on studies of irradiance and sedimentation. For the most part, however, the benthic fishes sampled at a depth of 90 feet were not the same species found in the kelp bed at depths of 30-50 feet. So the increase in the

abundance of fishes at 90 feet cannot be explained by the decline of fishes with the loss of the kelp plants.

4. Impacts of Suspended Sediments

SONGS is sited on an eroding (retrograding) shoreline where the uplands, beaches, and seafloor are burdened with predominantly terrigenous sediments that include significant portions of silt and clay. Periodically, this coastline is impacted by episodes of large waves which place substantial amounts of sediments into suspension in the inshore water column. These sediments are subsequently moved and redistributed by currents. The smallest particles may remain in suspension for prolonged periods of time depending upon the turbulent state of the water column. Additional loadings of fine sediments may arrive in the nearshore area as a result of episodes of run-off from the land. SONGS adds another influence upon the suspended sediments by artificially redistributing them offshore. This occurs both directly as suspended sediments are entrained in the flow of cooling water that passes through the plant followed by discharge through the diffusers offshore and by vertical entrainment of suspended sediments with the discharge of cooling water at the site of the diffusers.

Adverse effects upon the environment that result from this redistribution of suspended sediments offshore include the following: (1) A decrease in the penetration of light through the water column. This shadowing effect degrades conditions necessary for the reproduction and sustenance of plants. The decline in plants in terms of abundance and hardiness impairs conditions necessary for the existence of those animals dependent upon the many species of phytoplankton and benthic algae. Herbivores are reduced in abundance and carnivores preying upon the herbivores decline in abundance. (2) Increased flux of suspended sediments may adversely impact the larvae of fish and invertebrates, e.g., anchovy, because they reduce the acceptability of the habitat for

recruitment and clog the feeding apparatus and gills of benthic invertebrates and fishes. (3) Accumulations of fine sediment will bury sessile organisms, weakly motile organisms, areas of coarse sediments and hard substrates (rocks). Many of the invertebrates are adapted to coarse sediments or intertidal habitats and cannot colonize the sediments in which the grain size of the bottom deposits become too fine.

Redistribution of fine sediments offshore has resulted in the loss of an estimated 59,000 kelp plants, together with associated fish, invertebrates and benthic algae (MRC Final Report, Ch. 7,8).

The MRC was advised by some contractors working in this area early in its history (1979, 1980) that suspended sediments redistributed offshore would be a problem. Yet when anomalous sediments were first observed by divers in 1985 (MRC Technical Report B), they were treated as an unanticipated surprise which has not yet been thoroughly investigated and reported upon. SCE considers the problem of redistribution of sediments as part of the natural flux of sediments in the area of San Onofre (SDG 1989). This is difficult to resolve with the fact that the SONGS has superimposed an unnatural change in the flow of water in the near shore zone including the redistribution of fine sediments offshore (MRC Technical Report B) that occurred after SONGS Units 2 & 3 began operation.

It was predicted that the increase in turbidity would result in a change in the composition of the community of fouling organisms from the Before period to the After period in the Impact area (Osman, communication 1980). This prediction was not examined in the After period, possibly for reasons of difficulty in quantifying the change in community structure as estimated by outplanting of settling plates. Nevertheless, changes in community composition associated with decreases in irradiance and seston flux are well recognized in aquatic environments even though the precise extent of change in the community may not be closely correlated with the changes in the physical variables or predicted with high

precision.

5. Anchovy Larvae

As noted in the MRC Final Report, changes in the abundance of anchovy larvae at the location of sampling of ichthyoplankton 0.5 or 2 miles downstream from the diffusers was consistent throughout the After period. Anchovy larvae are the most abundant of the ichthyoplankters. Both the pre-flexion and post-flexion anchovy larvae were reduced in abundance on the order of 30%. One sampling cruise was made to see if a gradient of abundance of anchovy larvae versus distance from the SONGS diffusers could be detected and it was found.

The abundance of anchovy eggs doubled in the After period versus the control, but they are considered less valuable than the older larval stages because rates of mortality decrease as the larvae increase in age, i.e., older larvae have a better chance of survival than the eggs have. However, localized doubling in concentration of anchovy eggs in the Impact area is suggestive of a mechanism involving the SONGS and consistent with the observations reported by Barnett et al. (1984).

6. Radioactivity and Metals

Efforts to correlate impaired biological attributes of sand crabs with the operational status of the SONGS have produced various results (MRC Final Report, Ch. 16, 17). Efforts to document the SONGS as a source of metal pollution in the environment has also produced variable results (MRC Final Report, Ch. 17). Among the mix of observations are the following : sand crabs at San Onofre are smaller, tend to mature at a smaller size, do not live as long, and tend to abort their eggs versus sand crabs on other beaches (MRC Technical Report A). At San Onofre, the problem of impaired maturation of eggs can be correlated with body burdens of radioactivity and metals associated with the SONGS (MRC Final Report, p. 243). These observations may not be reproducible

through time. Accumulation of radioactive elements in marine organisms in the vicinity of the SONGS has been consistently documented although several aspects of the radiological monitoring program are inadequate for the purposes of assessing the importance of the release of radioactivity on the environment and the health of marine organisms (MRC Final Report, Ch. 17). Part of this problem arises from the fact that SCE is not required to report when releases of radioactivity or pollutants will occur. The MRC learned, in 1985, rather late in the history of its program that releases of metals and radioactivity are most common when nuclear plants are in the start-up phase, or when they are off-line for maintenance and repairs. Still later, it was learned that the potential for releases of metals and radiation from nuclear plants increases as the facility ages and maintenance intensifies as a problem (Riccio & Murphy 1988).

Unit 1 corroded severely and required extensive repair and refitting followed by an unresolved law suit against the builder of the unit, Westinghouse Electric (Appendix A). There is no doubt in the opinion of this member of the MRC that the corrosion products from Unit 1 were released to the ocean and could have been responsible for the impairment of biological attributes of sand crabs collected from near and about San Onofre (MRC Final Report, Ch. 16). There is a question therefore, of the environmental significance of and effects upon the environment caused by Units 2 and 3 as they age. While the MRC final report could not find substantial evidence for adverse impacts upon the environment as a result of the release of radioactivity and metals from SONGS Units 2 and 3, 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). It is impossible to exclude the adverse effects of the presence of these substances in the environment. This impact must be added to other effects on the organisms that are already stressed in the area affected by the discharge by the SONGS.

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TABLE 1. Estimated annual losses of organisms entrained by the SONGS.

ORGANISM	LOSSES (Weight in Tons)
Phytoplankton	10,000*
Zooplankton	1,350
Mysids	14
Icthyoplankton	4 billion larvae***
Juvenile and adult fish	51

* Approximately 10 times the amount of zooplankton entrained
** Holoplankton and meroplankton excluding fish
*** No exact weight estimate available

TABLE 2. Estimate of annual bight wide reduction in adult fish stocks due to entrainment of eggs, larvae, juveniles and adults in SONGS. The three taxa that represent 70% of all entrained fishes are presented.

TAXA	# Fish lost	Biomass (Tons)
Queenfish	18,000,000	551
White croaker	4,100,000	349
N. Anchovy	89,000,000	1,340
Other		960

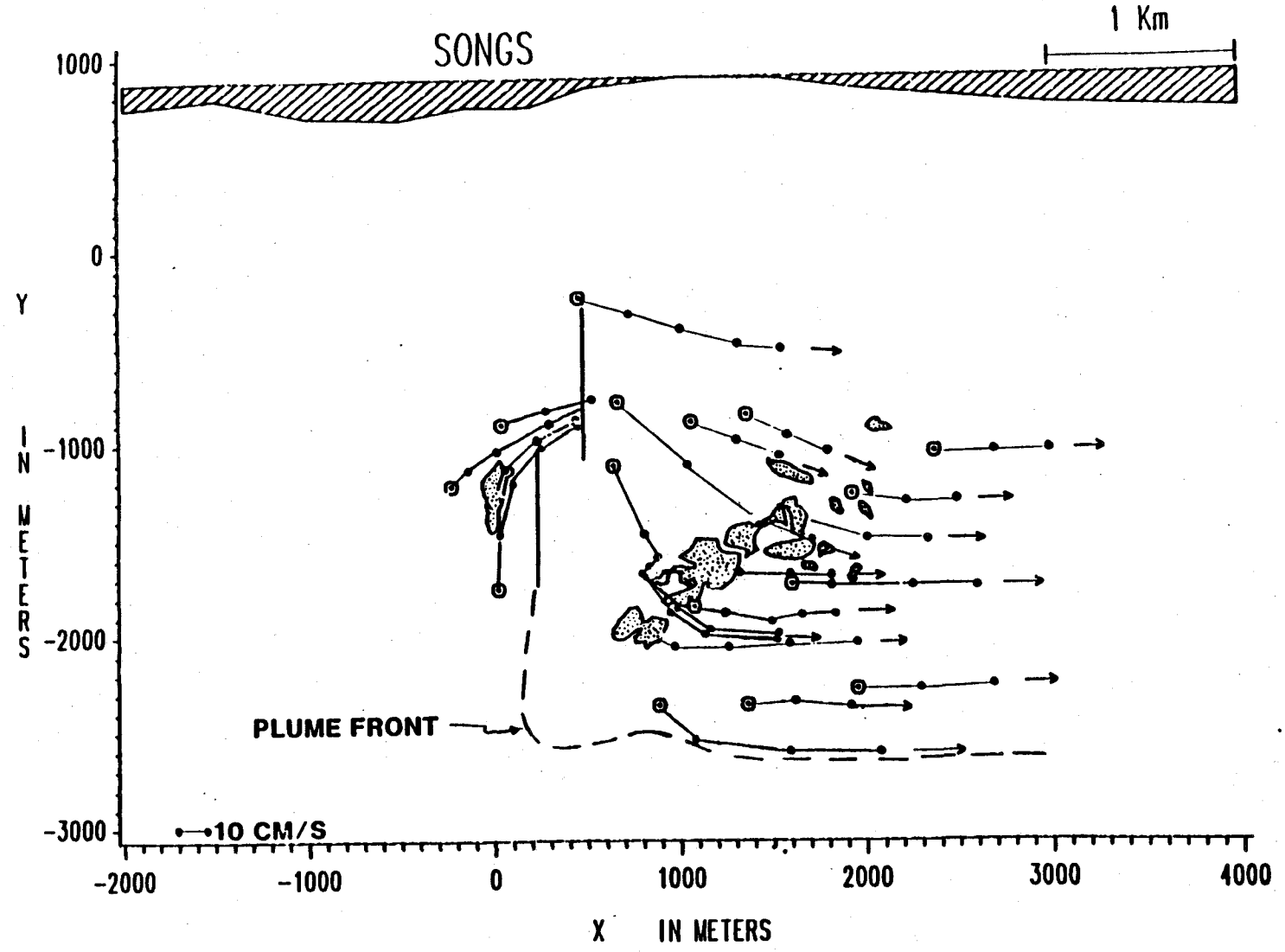
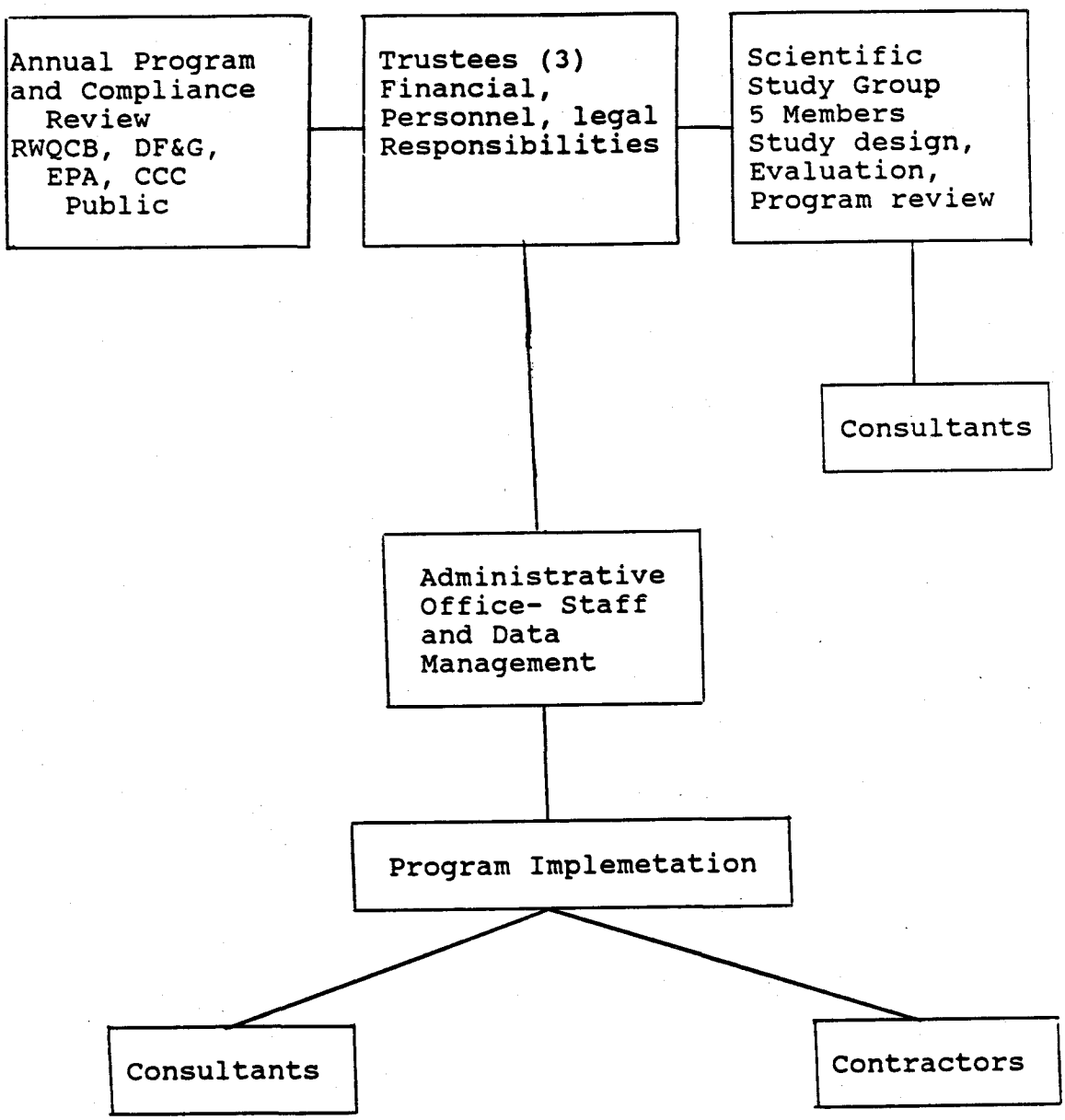


Fig. 1. Diagram of the asymmetrical pattern of water movement in the area around Units 2 & 3 difussers. Stippled areas represent kelp.

Figure 2. Proposed San Onofre Marine Monitoring Foundation.



APPENDIX A

San Onofre Nuclear Generating Station: Chronology

Compiled by Nuclear Information and Resource Services, Washington D.C.

20 December 1989

1/ /63 - Unit 1 ordered

3/ /64 - Unit 1 receives construction permit

3/27/67 - Unit 1 receives Provisional Operating License (POL)

6/14/67 - Unit 1 goes critical

6/16/67 - Unit 1 achieves first electrical generation

1/ 1/68 - Unit 1 goes into commercial operation

7/ 8/68 - AEC grants amendment no. 15 extending Unit 1 POL through March 27, 1970

2/18/70 - AEC grants amendment no. 17 extending Unit 1 POL through March 27, 1971

7/28/70 - SCE applies for full-term operating license

3/18/71 - Amendment no. 21 extends Unit 1 POL 18 months to September 27, 1972

8/ 7/72 - AEC informs SCE that under 10 CFR 2.109, POL will not expire because facility applied for full-term operating license thus no need to extend POL.
NOTE: UNIT 1 HAS NEVER RECEIVED A FULL-TERM LICENSE.

11/22/77- SCE discovers Unit 2 reactor vessel installed in April is BACKWARDS!

4/ /80 - Unit 1 shutdown for Steam Generator Tube repairs.

1981

5/13/81 - NRC staff says SCE need not consider the possibility of an earthquake of greater magnitude than the Safe Shutdown Earthquake in emergency plans.

6/21/81 - Unit 1 ends 14 month outage: 7000 Tubes sleeved at a cost of $67 Million.

6/28/81 - Worker claims SGT sleeving just not done.

7/17/81 - Unit 1 shut down due to fire in back-up generator.

8/17/81 - Unit 1 resumes operation after generator fire.

9/ 5/81 - Unit 1 closed for 7 weeks due to defects in Emergency Core Cooling System valves

11/18/81- 16 of 18 applicants fail reactor operator exam: indicates weakness in SCE training

1982

1/11/82 - Unit 2 issued low-power license by Atomic Safety & Licensing Board (ASLB)

2/16/82 - NRC ok's fuel loading and low-power tests at Unit 2

3/26/82 - Unit 1 experiences Steam Generator Tube leak

4/26/82 - Atomic licensing Appeal Board (ALAB) denies Intervenor's request to stay of Unit 2 low-power license

4/30/82 - Unit 2 declares Unusual Event due to leaking valves in the primary coolant system

5/ 4/82 - Unit 2 suspends low-power testing due to leak

5/10/82 - NRC analyst questions Unit 1's ability to withstand earthquake

5/15/82 - ASLB ok's Units 2 & 3 for full-power

5/23/82 - NRC determines Unit 1 can't meet seismic specifications

6/30/82 - NRC denies application for stay of Unit 2's low-power license

7/28/82 - NRC votes to allow full-power operations at Unit 2

9/ 7/82 - Unit 2 gets full-term license from Staff

9/24/82 - NRC allows full power pending hearing on "medical services"

10/14/82- NRC probes whistleblower claims that Units 2 & 3 welds defective or nonexistent.

11/9/82- Unit 2 experiences excessive cooldown transient dropping 128 degrees in 4.5 minutes

11/15/82- NRC ok's fuel loading & low-power tests at Unit 3

1983

2/ 1/83 - NRC allows full power operation of Unit 2 for six months from 3/17

4/ 1/83 - SCE sues Westinghouse over Unit 1 Steam Generators seeks $180 million

6/20/83 - NRC has been leaking inspection reports to licensees; prerelease allows SCE to avoid $20,000 fine

6/22/83 - Government Accountability Project accuses NRC of destroying UNIT 1 whistleblower records and of leaking inspection reports to Bechtel

8/ 8/83 - Unit 2 placed in commercial operation

8/10/83 - 21 security guards at SONGS fail drug tests

8/29/83 - Unit 3 begins low-power testing

9/ 4/83 - Unit 2 scrams due to turbine trip

9/16/83 - Unit 3 gets full-power authorization

9/22/83 - PUC sets performance indicators for SONGS; bonus if capacity factor > 80% but penalty if factor < 55%

9/24/83 - NRC order certifies "medical services issue"

9/30/83 - Unit 3 trips 3 times since full power granted

9/31/83 - Unit 3 trips due to salt water leak in condenser

1984

3/17/84 - Unit 3 discovers valves in containment cooling system were closed during 13 days of operation in violation of NRC regs.

4/ 1/84 - Unit 3 placed in commercial operation

5/17/84 - NRC proposes to fine SCE $250,000 because the valve failure went unnoticed

8/24/84 - Unit 3 closes due to salt water leak

9/17/84 - Federal Appeals Court affirms NRC finding of "adequate protection" re: earthquakes

9/25/84 - NRC lowers fine by $100,000 due to SCE mitigating circumstances

11/29/84- NRC allows Unit 1 to restart although seismic upgrade not completed. Primary & Containment systems brought up to .67 g, however, not all auxiliary systems meet .5 g. Staff says plant is safer than original design basis.

1985

2/29/85 - Sierra Club, Alliance for Survival & Tim Carpenter file for safety restart

4/10/85 - Hydrogen fire in generator causes reactor to trip from 100% power

11/22/85- Unit 1 trips due to loss of off-site power, leak in steam generator feed lines and other equipment problems. Unit without power for 4 minutes.

1986

1/22/86 - NRC releases NUREG on Unit 1 Waterhammer caused by failure of 5 safety-related check valves.

3/ 1/86 - NRC may reclassify Waterhammer as more serious

4/13/86 - Unit 1 accidently goes critical!

8/28/86 - NRC gives level III violation but cuts required fine in half due to SCE's previously good record

9/12/86 - NRC issues remand order establishing ASLB re: Medical Services Issue

1987

1/ 8/87 - NRC issues Final Safety Assessment of Unit 1 under Systematic Evaluation Program

1/13/87 - ASLB sets April 1 deadline for implementation of "medical services"

6/22/87 - Unit 3 trips due to sharp reduction of flow to steam generators

6/26/87 - NRC proposes $100,000 fine for Unit 3 violation of radiation safety standards:
* worker receives 512 REMS to hand
* particle of irradiated fuel found imbedded in worker's shoe when entering plant
* no radiation dose testing of areas
* worker set off alarms but survey not conducted

10/ 1/87 - Earthquake in Whittier, CA

10/ 4/87 - Unit 1 actuated by 5.5 r aftershock, Units 2 & 3 not affected

10/ 8/87 - Unit 1 identifies 7 potential single mode failures

11/19/87 - FEMA & NRC director of Radiation Protection says Emergency plan ok.

11/23/87 - Earthquake registering 6.0 hits 120 miles form SONGS

11/24/87 - Another quake of 6.3 r hits Westmoreland, CA

12/ 8/87 - 9 security officers & 2 supervisors were playing cards in Central Alarm Station or knew of it, while Unit 1 was at 92% power and Unit 3 was at 100%.

1988

1/19/88 - Unit 3 shutdown > 48 hours due to hydrogen leak

2/11/88 - Earthquake in Whittier Ca registers 4.7 r

2/19/88 - Unit 3 shutdown > 48 hours due to inadvertent safety system injection

6/14/88 - SCE agrees to pay $150,000 because 62 components did not meet standards

6/17/88 - Operator license suspended after testing positive for marijuana

6/27/88 - Earthquake in Whittier CC, registers 4.7 richter.

8/22/88 - Unit 2 declares unusual event due to unplanned shutdown caused by actuation of safety injection relief valves.

10/13/88- Ocean floor "GOOP" at SONGS triples in 3 years.

11/19/88- Earthquake 30 miles west of SONGS registers 4.6 r.

11/28/88- Unit 1 closes for refueling and maintenance

1989

1/ 6/89 - Unit 3 trips due to interruption of electrical supply and resultant problems in flow to Steam generators. Essentially the same event as 6/22/87.

1/11/89 - Unit 2 shutdown due to inoperable motor driven auxiliary feedwater pump.

1/23/89 - Reactor operator tests positive for drug use.

2/ 9/89 - Unit 2 trips due to inoperable core protection calculators.

3/17/89 - Reactor operator assigned to Units 2 & 3 tests positive for drug use.

5/11/89 - NRC will allow Unit 1 to restart despite damage to thermal shield bolts

5/20/89 - Unit 1 closed for steam generator tube repairs, delays restart due to problems in new instrumentation system.