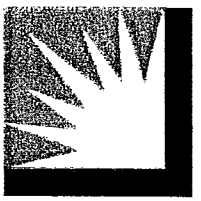
Comprehensive Demonstration Study for Southern California Edison's San Onofre Nuclear Generating Station

Final Report, January 2008



SOUTHERN CALIFORNIA
EDISON

An *EDISON INTERNATIONAL* Company
San Onofre Nuclear Generating Station

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EXECUTIVE SUMMARY

This Comprehensive Demonstration Study (CDS) is submitted by Southern California Edison (SCE) in compliance with the San Onofre Nuclear Generating Station (SONGS) NPDES Permits (Permit numbers CA0108073 and CA0108181). The permit requirements for Best Technology Available (BTA) were based on the Federal Phase II §316(b) Rule issued in 2004. The Federal Rule authorized use of five different compliance alternatives and a number of compliance options.

SONGS has existing technologies currently in place that reduce impingement mortality by an estimated 94.2% in terms of finfish numbers and 97.7% by weight. These reductions are at the high end of the 80%-95% reduction range required by the Phase II Rule. Impingement mortality reduction is achieved through the use of an offshore intake with a velocity cap combined with an on-shore fish return system (FRS). In addition to modifications to the intake structures, SCE has committed to restore 150 acres of coastal wetland, costing $86 million. This acreage was determined by the California Coastal Commission (CCC) to be sufficient to offset entrainment losses of Units 2 and 3. The Second Circuit §316(b) ruling stated that restoration measures could not be used for compliance, therefore the SCE CDS does not include a Restoration Plan. However, a restoration plan has been developed and approved by the CCC in compliance with conditions stated in the Coastal Development Permit for the facility.

Alden Research Laboratory, Inc. (Alden) identified six potential structural and/or operational alternatives for more detailed evaluation to meet the entrainment reduction performance standard (i.e. 60%-90% reduction) of Federal Phase II Rule. Three of these alternatives were identified as infeasible for the following reasons:

- Reduced Cooling Water Pump Use – This option was determined not to be feasible because SONGS is a baseloaded facility with cooling water pumps in operation on an almost continuous basis. Times that flow reduction could occur are extremely limited and at unpredictable times.

- Aquatic Filter Barrier – Due to the amount of filter fabric material that would be needed and the harsh hydraulic conditions that occur in the California Coastal Pacific Ocean, especially during storm events, this option was determined to be infeasible for structural reasons.

- Relocation of the Cooling Water Intake Structure – The option was determined to be infeasible for a number of reasons that included lack of a clear entrainment reduction benefit and associated benthic habitat impacts. The SONGS Marine Review Committee

(MRC), an independent scientific review committee, reached the same conclusion in their evaluation of this option.

Cursory review suggested three technologies and operational measures that were potentially feasible and warranted further evaluation. In the context of this study, feasibility was determined based on the ability to engineer and theoretically apply such technologies. Numerous assumptions were made on the complete feasibility of these technologies. The study did not include the potential for environmental impacts, impacts to the California power system, or permitting and regulatory issues. SCE believes that these issues would likely affect the overall feasibility of the technologies. For purposes of this document, the estimated biological performance and cost associated with these alternatives are summarized as follows:

- Fine-mesh Traveling Screens – This was the lowest cost technology with an estimated capital cost of approximately $11 million and an annual operation and maintenance (O&M) cost of $663,000/yr. However, this option also had the lowest entrainment reduction benefit estimated to be less than 16%.

- Narrow-slot Wedgewire Screens – This technology had an estimated capital cost of $59 million and an O&M cost of approximately $1.5 million/yr. This option would automatically meet the Federal Phase II Rule impingement mortality reduction standard by reducing the through-screen velocity to less than 0.5 fps. The estimated reduction in entrainment is approximately 76%.

- Retrofit with Closed-cycle Cooling – This alternative had the highest cost with an estimated capital cost of $676 million and an annual O&M cost of $46 million/yr. However, this alternative would meet the performance standards for both impingement mortality and entrainment reduction.

Based on this analysis, SCE elected to comply with the permit using a combination of Compliance Alternative 2 (i.e., demonstrating existing measures in place) for impingement and Compliance Alternative 5 (use of site-specific standards) for entrainment. For impingement, SCE has provided the necessary CDS documents to demonstrate that the combination of the offshore velocity cap combined with the fish return system (FRS) meet the impingement mortality reduction performance standard for Units 2&3. For entrainment, SCE is demonstrating that based on technically sound site-specific cost estimates, the costs of potentially feasible entrainment reduction alternatives are significantly greater than those considered by EPA. The necessary CDS documents for use of Site-specific Standards using the cost-cost test are provided for reducing entrainment for Units 2&3. Additionally, the Impingement Mortality and Entrainment Report, as well as past studies, suggest that the off-shore, mid-water intake offers some degrees of reduction. This value is proposed to be quantified at a later date. However, based on the cost-cost test results and the suggested evidence of entrainment reduction, the existing cooling water intake structure should be determined to represent the Best Technology Available (BTA) for minimizing environmental effects of the cooling water intake structure (CWIS).

The Second Circuit Court Decision on the §316(b) Phase II Rule on January 25, 2007, remanded to the EPA the use of the cost-cost test, as well as other key elements of the rule. As a result,

EPA has withdrawn the Phase II Rule in its entirety. EPA then issued a Federal Register Notice that until a revised final Rule is issued, §316(b) should be administered in individual NPDES permits on a Best Professional Judgment (BPJ) basis. SCE believes it is important that the final decision regarding requirements for any additional fish protection technologies for SONGS should be consistent with both the California State Policy and the revised Federal Phase II Rule. Work is currently in progress at both agencies to issue a proposed Rule/Policy in 2008. An interim BPJ decision for no additional structural or operational requirements is supported by:

- Consistency with previous NPDES §316(b) determinations issued for SONGS.
- SONGS is currently reducing impingement mortality sufficient to meet the upper end of the performance standard range and restoration measures are being implemented to offset entrainment losses for Units 2&3.
- It is currently unclear what technology(ies) will be considered BTA. Based on estimates, only two potentially feasible entrainment reduction technologies can meet the original performance standard range: narrow-slot wedgewire screens and closed-cycle cooling. While closed-cycle cooling achieves a higher level of entrainment reduction, it has not yet been determined if it will be identified as BTA in the revised Rule/Policy. It has an estimated cost of $676 million and a number of potential feasibility issues including the resulting environmental and permitting issues, social impacts, impacts to the California electrical system, and space constraints. In addition, wedgewire screens are unproven in California for use in an open ocean environment and have never been deployed in a high biofouling open ocean environment.
- Both EPA and the California State Water Resources Control Board (SWRCB) are working on a revised §316(b) draft Regulation/Policy for issuance in 2008.
- Petitions have been filed to the Supreme Court to review the Second Circuit Court Decision.

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1 INTRODUCTION

1.1 CDS Submittal Objectives

Although the 316(b) Rule has been suspended, the Comprehensive Demonstration Study (CDS) documents are being submitted for two key purposes:

1. To satisfy the requirements of Special Provisions 1(a)(ii) of Order Nos. R9-2005-05 and R9-2005-006 of NPDES Permit Numbers CA0108073 and CA0108181 for SONGS Units 2 and 3 respectively, and
2. To inform regulators in compliance decision making under Best Professional Judgment (BPJ).

The rationale for these dual objectives is based on the original Phase II Rule, the SONGS NPDES permit, the Second Circuit Court Decision, EPA's withdrawal of the Rule and the California State Water Resource Control Board's (SWRCB) efforts to develop a State §316(b) Policy.

1.2 The Phase II Rule Regulatory Requirements

EPA signed into regulation new requirements for existing electric power generating facilities for compliance with Section 316(b) of the Clean Water Act on July 9, 2004 (the Rule). These regulations became effective on September 7, 2004 and were based on numeric performance standards[1]. The Rule at 125.94(a) (1-5) provided facilities with compliance flexibility by incorporating five compliance alternatives as follows:

1. *A facility can demonstrate it has or will reduce cooling water flow commensurate with wet closed-cycle cooling and be determined to be in compliance with all applicable performance standards. A facility can also demonstrate it has or will reduce the maximum design through-screen velocity to less than 0.5 ft/s in which case it is deemed in compliance with the impingement mortality (IM) performance standard (the entrainment standard still applies).*
2. *A facility can demonstrate that it has in place technologies and/or operational measures and/or restoration measures in place that will meet the applicable performance standards.*
3. *A facility can propose to install new technologies and/or operational measures and/or restoration measures to meet applicable performance standards.*

[1] Performance standards are found at 125.94(b)

4. *A facility can propose to install, operate and maintain an approved design and construction technology.*

5. *A facility can request a site-specific determination of BTA [Best Technology Available] by demonstrating that either the cost of installing technologies and/or operational measures and/or restoration measures are significantly greater than the cost for the facility listed in Appendix A of the rule or that the cost is significantly greater than the benefits of complying with the applicable performance standards.*

All facilities that use compliance alternatives 2, 3, and 4 were required to demonstrate a minimum reduction in impingement mortality (IM) of 80% (125.94(b) (1)). Facilities with a capacity factor that is greater than 15% that are located on oceans, estuaries or the Great Lakes or on rivers and have a design intake flow that exceeds more than 5% of the mean annual flow must also reduce entrainment by 60% to 90% (125.94(b)(2)).

The Rule further required that facilities using compliance alternatives 2, 3, and 5 prepare a Comprehensive Demonstration Study (CDS) as described at 125.95(b) of the Rule. There were seven components of the CDS:

1. Proposal for Information Collection (PIC),
2. Source Waterbody Information (required only if facility is located on a river or reservoir),
3. Impingement Mortality and Entrainment Characterization Study
4. Technology and Compliance Assessment Information (consists of a Design and Construction Technology Plan and a Technology Installation and Operation Plan)
5. Restoration Plan
6. Information to Support Site-Specific Determination of BTA
7. Verification Monitoring Plan,(required if technologies or operational measures were used for compliance).

Facilities using compliance alternative 1 were not required to submit a CDS and those using compliance alternative 4 were only required to submit the Technology Installation and Operation Plan (TIOP) and Verification Monitoring Plan. All facilities that used compliance alternatives 2, 3, and 5 were required to prepare and submit components 1, 2, 3, and 7, but depending on the compliance alternative(s) selected, the facility would submit a 4) Design and Construction Technology Plan and Technology Installation and Operation Plan (TIOP), Restoration Plan, and/or information to support a site-specific BTA determination. Also facilities could choose to base the CDS on one or any combination of components 5–7.

The first CDS document required for submittal is the PIC. SCE submitted their PIC for SONGS to the San Diego Regional Water Quality Control Board (SDRWQCB) and other agencies for review in October 2005, and a revised edition in November 2006 (See discussion below). The Rule at 125.95(b) (1) required that the PIC include:

1. *A description of the proposed and/or implemented technologies, operational measures, and/or restoration measures to be evaluated in the Study.*

2. *A list and description of any historical studies characterizing impingement mortality and entrainment (IM&E) and/or the physical and biological conditions in the vicinity of the cooling water intake structures (CWIS) and their relevance to this proposed Study. If you propose to use existing data, you must demonstrate the extent to which the data are representative of current conditions and that the data were collected using appropriate quality assurance/quality control procedures.*

3. *A summary of any past or ongoing consultations with appropriate Federal, State, and Tribal fish and wildlife agencies that are relevant to this Study and a copy of written comments received as a result of each consultation.*

4. *A sampling plan for any new studies you plan to conduct in order to ensure that you have sufficient data to develop a scientifically valid estimate of IM&E at your site. The sampling plan must document all methods and quality assurance/quality control procedures for sampling and data analysis. The sampling and data analysis methods you propose must be appropriate for a quantitative survey and include consideration of the methods used in other studies performed in the source waterbody. The sampling plan must include a description of the study area (including the area of influence of the CWIS(s)), and provide a taxonomic identification of the sampled or evaluated biological assemblages (including all life stages of fish and shellfish).*

An important feature of the Rule was use of the calculation baseline. The calculation baseline was defined as follows:

> *Calculation baseline means an estimate of impingement mortality and entrainment that would occur at your site assuming that: the cooling water system has been designed as a once-through system; the opening of the cooling water intake structure is located at, and the face of the standard 3/8-inch mesh traveling screen is oriented parallel to, the shoreline near the surface of the source waterbody; and the baseline practices, procedures, and structural configuration are those that your facility would maintain in the absence of any structural or operational controls, including flow or velocity reductions, implemented in whole or in part for the purposes of reducing impingement mortality and entrainment. You may also choose to use the current level of impingement mortality and entrainment as the calculation baseline. The calculation baseline may be estimated using: historical impingement mortality and entrainment data from your facility or another facility with comparable design, operational, and environmental conditions; current biological data collected in the waterbody in the vicinity of your cooling water intake structure; or current impingement mortality and entrainment data collected at your facility. You may request that the calculation baseline be modified to be based on a location of the opening of the cooling water intake structure at a depth other than at or near the surface if you can demonstrate to the Director that the other depth would correspond to a higher baseline level of impingement mortality and/or entrainment.*

The calculation baseline is especially significant in the case of SONGS, because the facility significantly deviates from the baseline conditions. Therefore, the baseline had to be calculated

in order for SONGS to claim credit for any deviations from the baseline that offered reductions in fish or shellfish losses.

1.3 SONGS 316(b) NPDES Permit Requirements

As a result of EPA's issuance of the Rule, the SDRWQCB included Special Provisions 1(a)(ii) of Order Nos. R9-2005-05 and R9-2005-006 respectively into the SONGS Unit 2 (Permit Number CA0108073) and Unit 3 (Permit Number CA0108181) NPDES Permits. These provisions required SCE to comply with the Rule by submitting CDS Documents by January 7, 2008 for SONGS Units 2 and 3 including:

- An Impingement Mortality and Entrainment Characterization Study,
- A description of the SONGS cooling water intake structures, and
- Confirmation of technologies, operational measures, and/or restoration measures selected and installed, or planned for installation to meet applicable requirements of 40 CFR §125.94.

The PIC was submitted to SDRWQCB in October 2005 with a transmittal letter. SCE also requested comments from the California Coastal Commission, the California Department of Fish and Game, the National Marine Fisheries Service, and the U.S. Fish and Wildlife Service. Verbal authorization was given by the SDRWQCB, and SONGS began the IM&E sampling in March 2006. The SDRWQCB issued comments on the PIC in a letter dated May 23, 2006. As a result, SCE met with the SDRWQCB on September 26, 2006 and agreed to modify the PIC studies in response to the comments, and in November 2006 revised the original PIC. The PIC modifications were summarized in a letter to the SDRWQCB dated December 22, 2006.

1.4 Second Circuit Court Decision

Shortly after the final Rule was issued, a number of States and Stakeholders (including environmental organizations and industry) filed lawsuits on various aspects of the new regulations. The Second Circuit Court issued its §316(b) Phase II Rule decision (Decision) on January 27, 2007. The Decision remanded significant portions of the Phase II Rule (Rule) to EPA. The Court determined that use of neither restoration measures nor the cost-benefit test could be used as compliance options. Two Rule provisions, the cost-cost test and the Technology Installation and Operation Plan (TIOP) were remanded to EPA for failure to provide adequate opportunity for public review and comment. The Court also remanded to EPA the determination of BTA, and specifically raised several issues that EPA will have to address in the promulgation of a revised Phase II Rule. These issues include:

- Closed-cycle Cooling as BTA – The Court said that EPA, in determining that closed-cycle cooling was not BTA for existing Phase II facilities, may have based that decision, at least in part, on the cost of the technology relative to the benefits. The Court pointed out that any consideration of the environmental benefits is not allowed and remanded this determination to EPA for clarification. The Court stated that EPA could consider factors

such as the industry's ability to bear the cost, impacts to energy production and supply, and adverse impacts associated with retrofits as a basis to determine that closed-cycle cooling was not BTA.

- Use of "Best Performing" Technology – The Court upheld EPA's use of performance standard ranges. However, the Court determined that facilities must be required to use the "best performing" technology in the performance standard range rather than the most cost-effective technology.
- Consideration of Cost – The Court ruled that EPA could consider the cost of technologies to a limited extent in the BTA determination. The first cost consideration is whether or not facilities can reasonably bear the cost of the technology. The second is the limited use of cost-effectiveness. On this point the Court ruled that if there was an overlap in the expected environmental performance range of two best performing technologies, the facility could select the most cost-effective option rather than the one that had the potential for higher performance.

1.5 EPA Withdrawal of the §316(b) Phase II Rule

In response to the Decision, EPA issued a memorandum to EPA's Regional Offices dated March 20, 2007 announcing withdrawal of the §316(b) Phase II Rule. This was followed by a notice in the Federal Register on July 9, 2007. Specifically, the memorandum and Federal Register Notice stated the withdrawal of the Rule was a result of the Decision's impact on the overall compliance approach. With so many of the Rule's provisions affected by the Decision, the overall approach was no longer suitable for compliance. The memorandum and Federal Register notice further directed EPA Regional Offices and delegated States to implement §316(b) in NPDES permits on a "Best Professional Judgment" (BPJ) basis until the Decision issues are resolved. EPA is now proceeding to revise the Rule and a proposed Phase II Rule is expected to be issued by the end of 2008. This could result in a revised final Phase II Rule as early as 2009.

In response to the March 2007 EPA memorandum, SCE submitted a letter to SDRWQCB (letter dated March 23, 2007) requesting that the SONGS Units 2 and 3 requirements to comply with the Rule be withdrawn from the permit. SDRWQCB issued a letter dated May 31, 2007 stating it considered the Phase II Rule requirements in the permit to be suspended until such time that either EPA or the SWRCB provided further direction for compliance with §316(b). However, SCE continued with the CDS process for two reasons: the first was that information developed in the CDS would be helpful to inform state and federal agencies, and the second was it would facilitate BPJ discussions.

1.6 California SWRCB §316(b) Policy Development

After holding public stakeholder meetings for input, the California State Water Resources Control Board (SWRCB) issued a proposed Statewide §316(b) Policy in June 2006 (Draft Policy). The Draft Policy proposed requirements for 316(b) for California's Phase II facilities that were substantially more stringent than the Federal Rule. There were a number of significant deviations that included:

- Requiring facilities to meet the Rule's maximum performance standards for reduction of impingement mortality and entrainment rather than the performance standard range provided for in the Rule
- Consideration of zooplankton as an entrainable life stage
- Only allowing the use of restoration measures for achieving the maximum 90% entrainment reduction after reducing entrainment by a minimum of 60% from the calculated baseline by any combination of operational or structural controls
- Not allowing facilities to use restoration measures for compliance with the impingement reduction performance standard
- Using actual average flow and including reference stations as part of the calculation baseline
- Not allowing facilities to use the Rule's Compliance Alternative 5 by demonstrating that the cost of meeting the performance standard would be significantly greater than the benefit or costs considered by EPA
- Requiring that facilities use the "habitat production foregone" method to determine appropriate restoration for compliance
- Requiring facilities to conduct studies to evaluate cumulative impacts
- Requiring detailed monitoring studies including:
  - Quantification of all species and life stages
  - Quantification of impacts to zooplankton in addition to fish and shellfish
  - Requiring use of specific performance assessment models based on life history and population impacts on fish (Fecundity Hindcasting, Adult Equivalent Loss and Empirical Transport Method)

The SWRCB has not yet finalized the California Policy. However, it is SCE's understanding that SWRCB is working on a revised State §316(b) Policy and that such a Policy may be forthcoming in 2008.

1.7 Supreme Court Review of Second Circuit Decision

The Utility Water Act Group, Entergy Corporation and Public Service Gas and Electric Company filed a timely petition for Certiorari with the Supreme Court. At this point it is not yet know if the Court will hear this case. The Court has extended the deadline for filing responses to the three petitions to February 1, 2008.

1.8 Comprehensive Demonstration Study Organization

As a result of the §316(b) federal and state regulatory developments the nature of SCE's CDS approach for SONGS has shifted from that proposed in the PIC. The CDS is designed to

facilitate BPJ discussions and assist in informing state and federal agencies. Section 2 provides a description of SONGS and the current compliance approach is discussed in Section 3. Section 4 provides a summary of the results of the Impingement Mortality and Entrainment Characterization Study. Section 5 provides a summary of compliance for impingement, while Section 6 provides a summary of compliance for entrainment. Section 7 provides an overall summary of compliance for the CDS and important considerations for the final SONGS BPJ determination.

2 FACILITY DESCRIPTION

SONGS is located on the coast of the Pacific Ocean in north San Diego County, approximately 2.5 miles southeast of San Clemente, California. The facility consists of two nuclear-fueled generating units (Unit 2 & Unit 3) each rated at 1,087 MW. SONGS is considered a baseloaded facility and has a capacity utilization of 85% and 84%, for Units 2 and 3 respectively, during the period 2001 through 2006. Each unit utilizes once-through cooling technology and withdraws approximately 1,200 million gallons a day (mgd). SONGS is located on the Pacific Ocean, withdraws more than 50 mgd, and has a capacity factor in excess of 15%, it is therefore subject to both the impingement mortality and entrainment reduction performance standards.

The design of the Cooling Water Intake Structures (CWIS) deviates significantly from the Rule's calculation baseline. Modifications to the intake that provide reductions in fish losses include the use of an offshore, submerged intake with a velocity cap in combination with a fish collection and return system (FRS). Units 2 and 3 each have submerged intakes located 3,183 ft offshore with the cooling water intake located at a depth of −32 ft MLLW. A schematic of this layout is shown in Figure 1. Condenser cooling water for each unit flows through a 49-foot diameter velocity cap at 1.8 feet per second (fps) into an 18-foot internal diameter, submerged pipe to the CWIS located onshore within the facility. Inside the CWIS onshore the cooling water passes through a series of vanes and angled louvers located in front of the traveling screens. The louvers and vanes are designed to guide fish to a quiet water area at the end of the intake where the FRS is located. There is a fish lift located in front of the traveling screens. The lift consists of a large tray that rests on the bottom of the intake and can be raised via a belt to collect fish in the water column in front of the screen. The tray is then tilted to transfer fish and shellfish collected to the fish return system which transfers them offshore in the Pacific Ocean. The louvers also function as bar racks designed to prevent large debris from entering the CWIS. The FRS is operated daily and returns fish to the ocean through a common conduit for both units.

In addition to the louvers, a "fish chase" procedure has been implemented that uses elevated temperatures to further guide fish into the FRS collection area prior to heat treatments. Heat treatments are conducted at approximately six-week intervals to control biofouling in the intake tunnels. This is done by manipulating gates to allow the discharge tunnel to act as the intake tunnel and the intake tunnel as the discharge. By maintaining water heated to 105°F through the intake tunnel for up to one hour, biofouling organisms are killed. SONGS is unique in using the FRS to remove fish from the intake screen wells and return them back to the ocean.

The cooling water for each of the two units, after passing through the bar racks, passes through six traveling screens. It is then is pumped through each Unit's four 202,750 gpm circulating water pumps into to the condensers. The through-screen water velocity of the traveling screens is 3.0 fps.

SONGS has installed a diffuser at the end of each the discharge tunnels to rapidly diffuse the thermal discharge plume and comply with thermal water quality standards. These diffusers extend to approximately 8,350 feet offshore for Unit 2 and 6,020 feet offshore for Unit 3. The fish return system discharges into a common pipe that extends approximately 1,312 feet offshore.

Further details on SONGS design and operations are provided in the Impingement Mortality and Entrainment Characterization Study (Attachment 2), the 122.21(r)(2)(3)&(5) Information (Attachment 1) and the Comprehensive Cost Evaluation Study (Attachment 4).

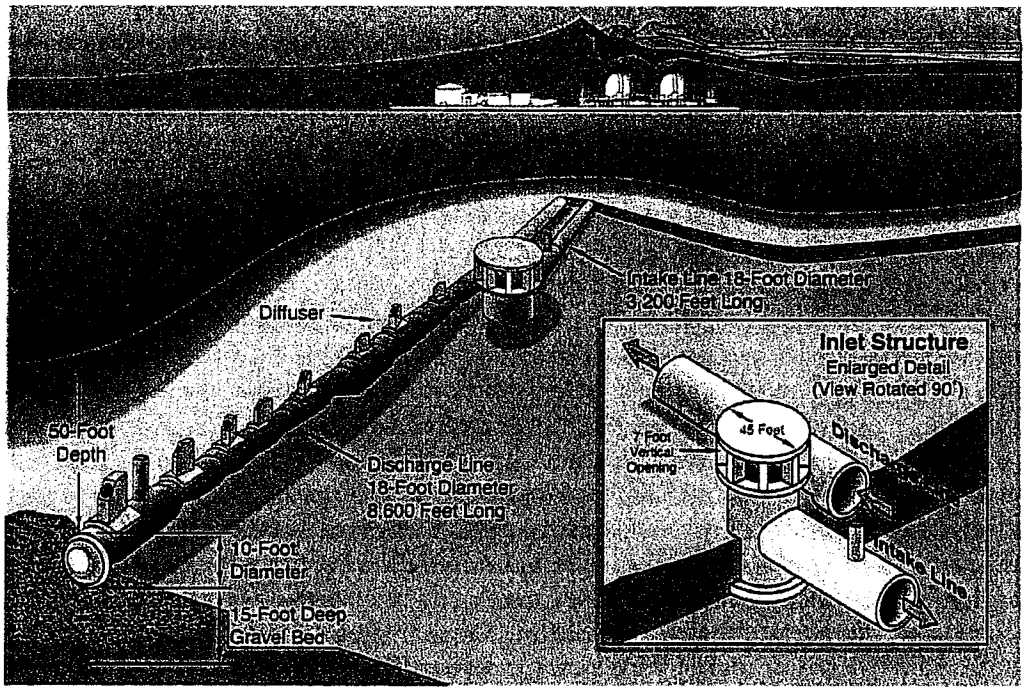

Figure 1. Schematic of SONGS cooling water intake and discharge.

3 §316(b) COMPLIANCE APPROACH FOR SONGS

As discussed in the introduction, EPA has suspended the Rule in its entirety. The result is that, from a federal perspective, the requirements to meet specific numeric performance standards, to submit a CDS, to submit the 122.21(r)(2)(3) and (5) information, and associated schedules are no longer applicable. As a result of EPA's action and the other §316(b) regulatory developments discussed in the introduction, SCE has modified its §316(b) approach for SONGS in a manner that meets the requirements of Special Provision 1(a)(ii) of the NPDES permit, is consistent with the overall Decision, and provides information to the SDRWQCB relative to BPJ compliance. The effect of the modification is that some of the CDS documents are submitted as originally proposed in the PIC, while others have been modified to be consistent with the Court Decision and/or BPJ. The approach used in this CDS and changes to the approach in the PIC are discussed in the section below.

3.1 Formation of Technical Oversight Team

SCE established a technical oversight work group to provide technical review and comment on the impingement and entrainment study and approach for estimating the calculation baseline. The Team consisted of the following organizations and individuals:

Southern California Edison

Robert Heckler – *Manager, Environmental Compliance*

Mary Jane Johnson – *Manager, Site Support Services*

David Kay – *Manager Corporate Environment, Health, and Safety*

Patrick Tennant - *Biologist*

State Water Quality Control Board – San Diego Region

John Odermat – *Senior Engineering Geologist*

Charles Cheng – *Engineering Geologist*

California Department of Fish and Game

William Paznokas – *Staff Environmental Scientist, Marine Region*

National Marine Fisheries Service

Bryant Chesney – *Southern California Habitat Coordinator*

California State Parks

Dave Pryor – *Resource Ecologist*

MBC Applied Environmental Sciences (IM&E Study Consultant)

Shane Beck – *Vice President*

EPRI (CDS – Consultant)

Dave Bailey – *Senior Project Manager*

Tenera Environmental (IM&E Study Consultant)

John Steinbeck – *Vice President*

ACT Environmental (SCE Marine Biology/316(b) Support)

Kevin Herbinson – *Senior Marine Biologist*

Subject Matter Experts

Andy Jahn, PhD – *Environmental and Statistical Consultant*

Peter Raimondi, PhD – *Associate Professor, University of California, Santa Cruz, Department of Ecology and Evolutionary Biology*

Dr. Raimondi is also a member of the California Coastal Commission's Scientific Advisory Panel for SONGS, and reviewed the draft Impingement Mortality and Entrainment Study.

3.2 Source Waterbody Information

The Source Waterbody Information CDS document is only required for facilities located on freshwater rivers or reservoirs. Since SONGS withdraws its condenser cooling water from the ocean, this CDS document is not required.

3.3 Impingement Mortality and Entrainment Characterization Study

This document was prepared in a manner consistent with the studies described in the revised PIC and the associated letter to SDRWQCB dated December 22, 2006. Section 4 provides a summary of the impingement and entrainment study results, and the complete Impingement Mortality and Entrainment Characterization Study Report is provided as Attachment 2. The approach used in the study and CDS is consistent with the requirements of §125.95(b)(3) of the Rule.

3.4 Use of Compliance Alternative 2 to Meet the Impingement Mortality Reduction Performance Standard

Compliance with impingement mortality reduction performance standard will be based on the approach discussed in the revised PIC. SCE has installed a combination of impingement mortality reduction technologies and operational measures at SONGS that meet the Rule's performance standard. The Rule at §125.94(a)(2) allows facilities to take credit for existing design and construction technologies to meet the performance standards. The specific fish protection technologies and operational measures installed at SONGS include a velocity cap and FRS installed on each of the two units. They are discussed in Section 5 of this document and the calculation baseline section of the Impingement Mortality and Entrainment Characterization Study (Attachment 2, Chapter 6). Use of existing technologies and operational measures for compliance (other than use of Compliance Alternatives 1 and 4 technologies) requires submittal

of a Design and Construction Technology Plan, Technology Installation and Operation Plan (TIOP) and Verification Monitoring Plan. These CDS documents are also summarized in Section 5 and provided as Attachment 3.

3.5 Use of Site-specific Standards to Meet the Entrainment Performance Standard

Section 6 provides the SONGS compliance analysis for the entrainment performance standard based on use of Compliance Alternative 5 (Site-specific Performance Standards) using the cost-cost test. SCE had originally intended to submit a Restoration Plan for entrainment compliance based on SCE's agreement with the California Coastal Commission. The agreement includes restoration of 150 acres of coastal wetland as part of the overall San Dieguito River Valley Regional Open Space Park project for an estimated cost of $86 million. An April 1977 amendment to the Coastal Development Permit authorized a credit of 35 acres of wetlands if SCE provided continuous tidal flow maintenance in the San Dieguito Lagoon. The construction of this coastal wetland project was initiated in August 2006 and completion is expected in December 2009. Consistent with requirements for the use of restoration measures, the agreement includes funding of monitoring to ensure that the project goals are attained. Other restoration/mitigation programs included partial funding of a white sea bass fish hatchery. The agreement was specifically designed to offset losses of mid-water fish species based on an IM&E analysis conducted in the 1980s. As a result of the Second Circuit Decision, SCE is not proposing to use restoration measures for CDS compliance or submit a Restoration Plan for SONGS. However, a restoration plan has been submitted and approved by the California Coastal Commission and funding for construction of the wetlands to offset entrainment losses will continue.

SCE is submitting the CDS Documents required at §125.95(a)(6) of the Rule for compliance based on site-specific determination of BTA. Specifically, SCE is using the cost-cost test compliance option as authorized at Section §125.94(a)(5)(i) of the Rule. The specific CDS documents required for this approach include a Comprehensive Cost Evaluation Study, Site-specific Technology Plan, and a Verification Monitoring Plan. These CDS documents are provided as Attachment 4 and are summarized in Section 6.

3.6 BPJ Compliance Considerations

Because EPA has withdrawn the Rule and directed EPA Regions and States to implement §316(b) in individual NPDES permits on a BPJ basis, SCE provides a discussion of key factors for consideration by the SDRWQCB in developing its final BPJ determination for SONGS. These factors include a summary of the previous BPJ determination based on the MRC studies and recommendations, the information provided in the CDS, and EPA and SWRCB rulemaking efforts currently in progress. A discussion of these considerations is provided in Section 7.

4 IMPINGEMENT MORTALITY AND ENTRAINMENT CHARACTERIZATION STUDY

4.1 Summary of Regulatory Requirements and Studies

§125.95(b)(3) of the Rule requires submittal of an Impingement Mortality and Entrainment Characterization Study for the purpose of providing information to support the development of the calculation baseline and for characterizing current levels of impingement mortality and entrainment. The following components are required in support of the overall CDS:

1. Taxonomic identifications of all life stages of fish, shellfish, and protected species in the vicinity of the CWIS that are susceptible to impingement and entrainment;
2. Characterization of all life stages of fish, shellfish, and protected species identified in Item 1. The characterization must include a description of the abundance and temporal and spatial characteristics of species in the vicinity of the CWIS based on sufficient data to characterize annual, seasonal, and diel variations in impingement mortality and entrainment (e.g., related to climate and weather differences, spawning, feeding and water column migration); and
3. Documentation of the current impingement mortality and entrainment of all life stages of fish, shellfish, and any protected species in Item 1 and an estimate of impingement mortality and entrainment to be used as the calculation baseline. The documentation may include historical data if the data are representative of the current facility operation and current biological conditions at the site. Samples must be collected during periods of representative operational flows for the cooling water intake structure and the flows associated with the samples must be documented.

While SCE conducted extensive impingement and entrainment sampling at SONGS beginning in 1979 under the direction of the Marine Review Committee (MRC), SCE initiated new studies in 2006–2007 to ensure that the data were representative of current biological conditions. The most recent studies were conducted as required by NPDES permits (CA0108073 and CA0108181) that were based on the Federal Phase II Rule.

The studies included both in-plant and offshore field surveys. The initial sampling plan was submitted in the SONGS PIC in October 2005, and was modified as described in an amendment to the PIC submitted in November 2006. Impingement and FRS sampling were conducted from March 2006 through May 2007, and entrainment and source water sampling were conducted from March 2006 through April 2007. As discussed in the introduction, SCE formed a technical review committee consisting of fishery biologists and Federal and State Agencies to review

study results, and additional experts to review the draft Impingement Mortality and Entrainment Characterization Study.

4.2 Summary of Entrainment and Source Water Sampling Results

Bi-weekly entrainment sampling was conducted in the onshore intake bays in 2006 and 2007. The dominant species collected were:

- northern anchovy (*Engraulis mordax*; 39% of the total larvae collected);
- unidentified anchovies (Engraulidae; 20%);
- queenfish (*Seriphus politus*; 6%);
- clinid kelpfishes (*Gibbonsia* spp.; 6%);
- combtooth blennies (*Hypsoblennius* spp.; 5%);
- gobies (Gobiidae; 5%); and
- white croaker (*Genyonemus lineatus*; 4%).

These seven taxa comprised over 84% of the larvae collected. The dominant species of fish eggs in the samples could not be identified to family due to current limitations in taxonomic knowledge of fish eggs in southern California. Total annual entrainment based on in-plant collections was estimated to be 1.1–1.4 billion larvae per unit, and 13–14 billion fish eggs per unit. The highest densities of eggs and larvae occurred in spring, and were relatively low throughout the remainder of the year. An exception was sea bass (*Paralabrax* spp.) when larvae peaked in summer (July and August 2006). Larvae were generally entrained in higher numbers at night but fish eggs exhibited no clear diel pattern of entrainment.

Thirteen offshore surveys were conducted during 2006–2007 concurrently with the in-plant entrainment sampling. Results of offshore sampling determined that there were greater concentrations of larvae offshore than at the in-plant entrainment stations, particularly for anchovies. During paired in-plant and offshore surveys, concentrations of fish larvae were higher in-plant during 5 of 13 surveys, while fish egg concentrations were higher in-plant during 11 of 13 surveys. Cropping by fouling organisms between offshore and in-plant sampling locations did not appear to be a major factor in the differences between the two sites. The highest concentrations of larvae occurred in April and June 2006 resulting in 34% of the annual entrainment occurring in April and 46% in June. Thus entrainment during these two months accounted for 80% of the estimated annual entrainment. During these two months the fish densities collected offshore were approximately three times higher than in-plant estimates for larvae, but only about 40% higher than the in-plant estimates for fish eggs.

Vertical distributions of eggs and larvae offshore followed previously recorded patterns for SONGS. Larvae were most abundant just above the bottom and in the surface waters. The lowest larval densities were found in the mid-water column. Fish egg concentrations at the surface were four times higher than in the mid-water column and were thirteen times higher than at the bottom of the water column. Crab megalopae (a larval stage) were most abundant at the bottom of the water column. It was also determined that fish egg and fish larvae densities were 10.1 and 3.6 times higher in the nearshore surface waters than in the water column near the intakes. However,

the reverse was true for target invertebrate larvae (i.e., 50% higher near the intakes than in nearshore surface waters). Midwater offshore larval fish concentrations in the study were similar to those recorded during the MRC studies in 1978–1986. However, in-plant larval fish concentrations in this study were much lower than those found in the MRC study.

High year-to-year variability in densities of fish eggs and larvae has been documented by the California Cooperative Oceanic Fisheries Investigations (CalCOFI) in southern California. It is therefore not known if the differences between concentrations measured in 2006-2007 and studies conducted 20–30 years ago represent a true long-term decline in larval densities. However, conclusions from other studies suggest that the productivity of southern California waters declined with the onset of an ocean temperature regime shift of 1977.

4.3 Summary of Impingement Mortality Studies

An estimated 1,353,000 fish weighing 28,742 lbs were estimated to be impinged during the one-year study. This estimate is based on the cooling water flow for each unit during that period. The dominant species collected during the study were:

- queenfish 52.7% by number and 26.6% by weight;
- northern anchovy 29.3% by number and 2.6% by weight;
- Pacific sardine (*Sardinops sagax*) 7.9% by number and 9.8% by weight;
- deepbody anchovy (*Anchoa compressa*) 1.7% by number and 1.5% by weight;
- white seaperch (*Phanerodon furcatus)* 1.4% by number and 0.5% by weight;
- topsmelt (*Atherinops affinis)* 0.8% by number and 2.4% by weight;
- white croaker (*Genyonemus lineatus)* 0.7% by number and 0.5% by weight; and
- yellowfin croaker (*Umbrina roncador)* 0.7% by number and 25.2% by weight.

Together these eight species made up 95.2% by number and almost 70% by weight of the total annual impingement. SONGS impingement consists of two components. One component is the impingement resulting from daily operation of the cooling water intake structure. During normal operations fish and shellfish impinged on the screens are removed as screens are rotated to prevent the screen blockage from impeding cooling water flow to the condensers. This is accomplished by rotating the screens once per shift. The second component of impingement is the loss of fish and shellfish living in the intake bays that suffer mortality during periodic heat treatments to control biofouling in the intake tunnels. Each of these components and the methods used to reduce impingement mortality at the traveling screens is discussed separately.

4.3.1 Impingement During Normal Cooling Water Intake Operations

As discussed in Section 2, SONGS is equipped with a fish lift to collect and transfer fish and shellfish in front of the traveling screens to the FRS for transport back to the Pacific Ocean. The fish lift is operated at least once each 12-hr shift to remove fish from the area in front of the

screens prior to screen operation. Normal screen rotation operations accounted for 97% of the fish impingement by number and 63% of the biomass. An estimated 118,000 shellfish weighing 2,886 lbs were also impinged. The dominant impinged shellfishes were rock crabs (*Cancer* spp.), swimming crab (*Portunus xantusii*), and blackspotted bay shrimp (*Crangon nigromaculata*). Normal screen rotation operations accounted for 71% of invertebrate impingement and 89% of the impingement biomass. Fish impingement peaked in summer and winter. Northern anchovy was the most frequently impinged fish in June 2006, while impingement of queenfish and bay anchovies (*Anchoa* spp.) peaked in November and December 2006. Invertebrate impingement showed a strong seasonal peak with highest numbers impinged in winter (November 2006 through January 2007). Impingement was generally higher during nighttime than during daytime.

4.3.2 Impingement Resulting from Heat Treatments

There are six generating facilities (including SONGS) in California with offshore intakes and velocity caps similar to SONGS. Each uses heat treatments conducted approximately every six weeks to control biofouling. Studies at the other five facilities indicate that impingeable-sized fish losses during heat treatments exceed impingement losses during normal operations on an annual basis (e.g., Huntington Beach Generating Station heat treatment losses accounted for approximately 75% of annual losses). SONGS is unique among these facilities in its use of a FRS and associated operational procedures to minimize fish mortality during heat treatments.

The SONGS FRS is designed to reduce fish mortality by guiding fish to a removal area where they are subsequently lifted and transported back to the source water body. Quantification of the FRS impingement mortality reduction was a component of the present study. The most abundant fishes collected in the FRS samples in 2006–2007 included northern anchovy, queenfish, Pacific sardine, and salema (*Xenistius californiensis*). Annual return estimates for fishes were 72% based on abundance and 89% based on biomass. For invertebrates, return estimates were much lower: 4% based on abundance and 40% based on biomass. Fish return was highest from June through August 2006, corresponding primarily to high return of northern anchovy, queenfish, and Pacific sardine. Bay anchovies occurred primarily in winter (November and December 2006). Invertebrate return was highest in spring and early summer, though return of spiny lobster occurred year-round, with peaks in July 2006 and February–March 2007. Consistent with normal operations, fish return was generally higher at nighttime than daytime for fishes, while there was no consistent diel pattern with respect to invertebrates. Fish return was higher than documented in previous studies, although species-specific return rates of common fishes were similar to those measured previously. Almost all of the fish taxa returned in highest abundance had slightly higher return efficiencies based on biomass, indicating that larger individuals were returned with greater efficiency than smaller individuals. This was particularly evident with queenfish, Pacific sardine, white seaperch, and white croaker.

Overall, the abundance of fish impinged both in terms of numbers and biomass was below the long-term annual averages since monitoring began in 1982. However, annual impingement estimates from 2005 were the highest on record, and resulted from the impingement of relatively high numbers of Pacific sardine and northern anchovy in normal traveling screen operation impingement sampling. Over the years there has been high year-to-year variability in fish

impingement at SONGS, with peaks every four or five years. Analysis of the previously collected data indicates the impingement totals at SONGS are driven by the impingement of three species, including northern anchovy, Pacific sardine, and queenfish. When compared with commercial and recreational fishery losses, SONGS impingement totals are relatively low (1.0% or less for most species).

4.4 Calculation Baseline Estimate

The calculation baseline was a component of the Phase II Rule intended to provide a credit toward compliance for those facilities such as SONGS that have already installed design construction technologies and/or operational measures to protect fish and shellfish from impingement and/or entrainment. The calculation baseline was defined in the Phase II Rule as the level of impingement mortality and entrainment that would occur assuming a shoreline intake, 3/8-inch traveling screens oriented parallel to shore near the water surface, and the baseline practices and procedures of the facility (see introduction for full definition). The cooling water intake systems at SONGS deviate from the Rule's definition for the following reasons:

- the intakes are submerged;
- the intakes are located more than 3,000 ft offshore;
- the traveling screens are not oriented parallel to the shoreline;
- both intake designs include a velocity cap; and
- both cooling water intakes are designed with fish return systems.

At SONGS, calculation baseline estimates were made for both impingement mortality and entrainment assuming (1) there were no velocity caps on the intakes, and (2) all juvenile/adult fishes and invertebrates entrained at SONGS were subsequently impinged (i.e., no FRS, fish guidance systems, or fish chases). Since a site-specific analysis of velocity cap effectiveness is not possible at SONGS due to the configuration of the diffuser-port discharge structure, determination of the level of fish protection provided by the velocity caps at SONGS was made through analysis of previous laboratory and field studies in southern California at facilities with similar structures. This is entirely consistent with the Rule's definition of the calculation baseline that states: "*The calculation baseline may be estimated using historical impingement mortality and entrainment data from your facility or another facility with comparable design, operational, and environmental conditions*".

A statistical analysis of velocity cap efficacy data from El Segundo, Huntington Beach, Ormond Beach and Scattergood Generating Stations was performed. The analysis projected that impingement mortality at SONGS is reduced by an estimated 88.2% as a result of the velocity cap design presently in place.

The determination of fish and invertebrate return rates through the FRS was made by direct measurement throughout the study. Previous estimates of survival upon return were used to estimate the number and weight of fishes that would survive return through the FRS. The

combined reduction in impingement mortality afforded by the velocity caps and FRS (taking into account return survival) at SONGS was 94.2% based on abundance and 97.7% based on biomass. These estimates were slightly lower than those calculated assuming all returned fish survived transit through the FRS (96.6% based on abundance and 98.7% based on biomass). No adjustments to annual entrainment estimates were made for purposes of the calculation baseline, although there was evidence during offshore sampling in 2007 that the offshore location of the intake and the depth of withdrawal could decrease entrainment relative to a shoreline, near-surface intake.

The complete SONGS Impingement Mortality and Entrainment Characterization Study is provided as Attachment 2.

5 USE OF COMPLIANCE ALTERNATIVE 2 TO MEET THE IMPINGEMENT MORTALITY REDUCTION PERFORMANCE STANDARD

The Rule at §125.94(2) allows facilities to demonstrate that they have currently installed and properly operate and maintain design technologies and operational measures that meet the performance standards. The combination of the installed offshore velocity cap and FRS result in an estimated 94.2% reduction in impingement mortality by number and a 97.7% reduction by weight. This level of reduction meets the upper end of the 80% to 95% reduction required by the Federal Phase II Rule and the impingement reduction standard proposed in the Draft California §316(b) Policy. Because SCE has installed, operates and maintains such technologies and operational measures at SONGS, SCE is using the Rule's Compliance Alternative 2 for impingement mortality reduction compliance. Use of Compliance Alternative 2 requires submittal of the technology and compliance assessment information as specified at §125.94(b)(4) and a Verification Monitoring Plan as specified at §125.94(b)(7) of the Phase II Rule.

The technology information required consists of two components that include a Design and Construction Technology Plan (DCTP) and a Technology Installation and Operation Plan (TIOP). For SONGS, these CDS components are based on the currently installed design and operational measures that have already been summarized in this document. These CDS documents are provided as Attachment 3. SCE is proposing two years of biological verification monitoring for SONGS as required by the Rule. This monitoring will continue to include monitoring during each heat treatment, as well as monthly impingement monitoring during normal operations. The details of the proposed impingement verification monitoring are also provided in Attachment 3

6 USE OF SITE-SPECIFIC STANDARDS TO MEET THE ENTRAINMENT REDUCTION PERFORMANCE STANDARD

The Rule at §125.94(a)(5)(i) allows facilities to comply by demonstrating that they have or will install technologies and operational measures based on a comparison of site-specific cost estimates to those considered by EPA in the Rule (i.e. cost-cost test). The CDS requirements for this compliance alternative are provided at §125.95(b)(6) of the Rule. EPA included SONGS as one of the facilities listed in Appendix B of the Rule and a cost estimate was provided in Attachment A of the Rule for comparison with SONGS detailed site-specific estimates. This Section provides a description of the screening process used to identify potential entrainment reduction alternatives (6.1), a discussion of alternatives evaluated as not feasible (6.2), a discussion of potentially feasible alternatives (6.3), a discussion of the costs for these alternatives (6.4), the cost-cost test analysis (6.5), and an entrainment compliance summary (6.6).

The determination of "feasibility" is only based on an engineering and cost analysis of the technology. The actual feasibility of the technology would need to incorporate not only the engineering and costs analyses, but also an environmental impact analysis. This analysis would take into concern environmental, social, potential impacts to the California power system, potential permitting issues, and nuclear safety analysis.

6.1 Entrainment Reduction Technology Screening Process

Alden conducted an analysis of alternative entrainment fish protection technologies and operational measures to reduce entrainment at SONGS. The details of the process used to identify the alternatives are provided in the Comprehensive Cost Evaluation Study (Attachment 4, Appendix A). Additionally, Dr. John Maulbetsch conducted an evaluation of closed-cycle cooling for SONGS (Attachment 4, Appendix C). The following eight alternatives were evaluated:

1. Reduced circulating pump flow using variable frequency drives;
2. Aquatic filter barrier;
3. Relocation of the intake further offshore to a point below the thermocline;
4. Fine-mesh modified traveling screens;
5. Offshore narrow-slot cylindrical wedgewire screens; and
6. Aquatic filter barrier
7. Offshore narrow-slot cylindrical wedgewire screens

8. Reduced circulating pump flow using variable frequency drives
9. Relocation of the intake further offshore to a point below the thermocline
10. Closed-cycle cooling.

6.2 Entrainment Reduction Options Evaluated as Not Feasible

6.2.1 Reduced Use of Cooling Water Pumps

The Rule assumed a proportional relationship between flow and entrainment. SONGS is a baseloaded nuclear facility and routinely requires use of all circulating water pumps for Units 2 and 3 to meet energy demands. A reduction in flow is expected to result in a reduction in generation capacity due to decreased plant efficiency and could ultimately increase the temperature of the discharge. Flow is only reduced during scheduled outages. Because flow reduction opportunities for SONGS are very limited and unpredictable this option is not considered feasible for use at SONGS.

6.2.2 Aquatic Filter Barrier (AFB)

The aquatic filter barrier (AFB) is a relatively new fish protection technology and has only been deployed on a full-scale basis at the Lovett Generating Station in New York on the Hudson River. The technology consists of two layers of fabric with 0.5 mm perforations and an integral air burst backwash system. The AFB would be installed around the cooling water intake structure. The surface area for passage of cooling water flow is such that the through-net fabric velocities are in the range of 0.02 feet per second (fps). At these low velocities, ambient water current can carry entrainable organisms away from the net. After several years of development, structural issues with the fabric and clogging were resolved and the most recent AFB entrainment reduction performance results indicate that the technology is capable of meeting the performance standards.

For impingeable-sized organisms this option would eliminate the benefit of the velocity cap and the FRS. Since this option has a maximum through-filter velocity that does not exceed 0.5 fps, it would automatically comply with the impingement mortality reduction standard in the Phase II Rule and no CDS would be required for impingement. An AFB deployed at SONGS would be expected to achieve a relatively high level of entrainment reduction if it could be designed to withstand the hydraulic forces and debris loading conditions that exist at SONGS. In order to ensure egg and larval fish protection, the AFB is designed to have a flow rate of 10 gpm/ft^2 providing a through-fabric velocity of approximately 0.02 fps. The offshore SONGS intakes are at a depth of approximately 30 ft MLLW, and 2,820 ft length of AFB material (i.e., over a half mile) would be required to maintain the design flow rate. The AFB could be deployed in the shape of a square with 725 ft on each side and would surround both intakes. Substantial intermediate support structures would be required to hold the AFB fabric in place. The installation would also require a storm-proof shelter to house the air burst system required to dislodge debris from the fabric. An AFB installation of this size would encompass 12 acres of ocean bottom habitat.

If the AFB could be successfully deployed, it would also require substantial operation and maintenance efforts, including the periodic use of divers to maintain it in a clean condition. As designed, the system uses an air burst system to control debris and biofouling buildup on the filter fabric. A compressed air hose is installed at the bottom of and in between the two layers of fabric that make up the AFB. When tension builds up on the outer fabric a tension sensor cord releases a blast of compressed air that moves up through the fabric to dislodge accumulated debris that is then carried away by ocean currents. However, an AFB has never been tested in a high biofouling marine environment such as that which exists in the vicinity of SONGS. Consequently, its ultimate efficacy cannot be determined. It is therefore expected that divers would be required to periodically conduct manual cleaning of the net and conduct other repairs and maintenance, and that such manual maintenance could be required many times a year.

The most significant concern for an ocean deployment is the ability of the system to withstand the severe hydraulic forces associated with major storm events that occur each year. Such storms have destroyed concrete piers and velocity caps at power plants (e.g., Scattergood Generating Station). The major difference in the AFB deployment at Lovett Generating Station and the one proposed for SONGS is that the area around Lovett is relatively calm compared to the open Pacific Ocean conditions during major storm events at SONGS.

Another impact would be the hindrance to vessel traffic in the area. The area surrounding the SONGS intake is open to public navigation, and the area is often used by recreational and commercial fisherman. An exclusion zone would have to be designated.

A final issue is the potential for impact to migrating marine mammals and sea turtles. The significance of this potential issue is not known at this time.

In conclusion, the AFB has never been tested in the marine environment. The potential for damage to the AFB due to storms is significant and the maintenance required due to fouling would be substantial. As a result of structural and other issues the AFB was determined infeasible for use at SONGS.

6.2.3 Relocation of the Intake Further Offshore

The Marine Review Committee (MRC) previously conducted an evaluation of the benefit in moving the SONGS cooling water intake structures to a location that could reduce overall entrainment. It was estimated that relocating the intakes 3,000 ft further offshore to a 60 ft depth would impact some 192,000 ft^2 of benthic habitat. At this distance consideration would be necessary to avoid interaction with the thermal discharge which also extends to this distance offshore. It was determined that the species composition of entrained organisms would be altered by reducing entrainment of forage species at the expense of increasing entrainment of recreational and commercial species.

The MRC concluded that relocating the intakes to a different location along the coast would result in no consistent differences in species composition and total abundances and as a result there was not a clear benefit to relocating the intake. With no clear evidence that a significant entrainment reduction would be achieved this option, it was dismissed from further

consideration. Based on the current entrainment study results and the prior MRC evaluation there is no technical basis to support reconsideration of the prior MRC conclusion.

6.3 Feasible Entrainment Reduction Options

A summary and discussion of the three remaining options and the estimated fish protection benefit of each is provided below with a discussion of how the technology functions, proposed design for use at SONGS, expected performance and potential issues. More detailed discussion is provided in the Comprehensive Cost Evaluation Study (Attachment 4) and Attachment B of that document.

Again, it should be noted that the term "feasibility" is an engineering and cost analysis of the technology based on numerous assumptions. The actual feasibility of the technology would need to incorporate not only the engineering and costs analyses, but also an environmental impact analysis. This analysis would take into concern environmental, social, potential impacts to the California power system, potential permitting issues, and nuclear safety analysis.

6.3.1 Fine-mesh Traveling Screens

How It Protects Fish – This technology is designed to reduce impingement mortality and entrainment by collecting fish off fine-mesh screens and transporting them back to the ocean offshore in a manner that maximizes survival. This is achieved by use of design components that include:

- Low-pressure Screen Spraywash – A low-pressure screenwash spraywash system is installed to gently wash larvae off screens into a return trough.
- Fish Collection Buckets – Buckets are installed at the bottom of each screen panel to hold collected fish and shellfish in water for release into the return trough.
- Continuous Screen Rotation – The screens are rotated continuously to minimize the time that eggs and larvae are exposed to the system and increase survival.
- Fish Return – A return pipe or sluice is installed to transport collected fish and shellfish back to the Pacific Ocean. The SONGS has already installed the FRS so the capability to return fish is currently in place. There a currently approximately a half dozen such systems in use across the U.S. Depending on the location, species and life stages present and other factors these systems have been found to be effective in reduction entrainment.

Proposed Design for SONGS – The effectiveness of a fine-mesh screening system is measured in terms of both exclusion and survival. The exclusion component is based on whether the mesh size proposed can retain (exclude) eggs and larvae of fish and shellfish being entrained in the cooling water. Fine-mesh screens are often designed to meet a 0.5 fps approach velocity. However, expanding the intake to meet a 0.5 fps velocity is a relatively costly option and SONGS should first conduct a pilot study to determine if replacing the existing screens with

fine-mesh screens without intake expansion will provide acceptable survival. To meet a 0.5 fps screen approach velocity a new larger intake would be required to accommodate 32 screens.

Fish and debris removed from the screens would have to be transported back to the ocean. This would be accomplished by combining the new troughs into the existing return pipe for release offshore.

Replacing the existing screens with fine-mesh Ristroph screens would cost $11,089,000 and could be completed during a scheduled outage. Construction of a new expanded screenhouse for the 32 new screens is estimated to exceed $60,000,000 and would require the plant to be shut down for a minimum of 1 year to connect the new structure. Due to space limitation on site, a new intake would need to be built out into the ocean. Detailed costs for replacing the existing screens are provided in the following section.

Expected Entrainment Reduction Performance – Currently SONGS is meeting the impingement mortality reduction standard with the existing velocity cap and FRS. Adding the fine-mesh system would be expected to result in a further reduction in impingement mortality. For entrainment, the fine-mesh screen system was evaluated to determine the likely entrainment reduction that could be achieved. The determination of the collection efficiency of 0.5 mm screens was estimated based on head capsule depth of the fish larvae. The details of this estimation method are provided in Appendix B of the Comprehensive Cost Evaluation Study (Attachment 3). The retention of dominant species such as anchovy and queenfish was relatively high at 81.3% and 89.8% respectively (Table 1). However survival was relatively low resulting in an overall estimated efficiency of 9.9% and 16.7% for these two species (Table 1). Overall performance for this option would be well below the minimum 60% entrainment reduction standard in the Phase II Rule.

Potential Issues – The requirement for continuous rotation may result in biofouling problems for these screens. Therefore, the system would require a biofouling control method as part of the overall design.

Although the system is designed to minimize stress to aquatic organisms, the process of collection and transfer will impart a stress to the organism that would not be experienced if they were not impinged. This is especially true for the earliest life stages (e.g., yolk-sac larvae). Generally, as fish grow survival will increase. For those fish that do come in contact with the screen, collecting them on a fine-mesh screen and returning them to the ocean rather than allowing them to be entrained should result in some reduction in losses.

Expanding the intake is not considered feasible based on preliminary engineering. A large screen structure would need to be built on the shoreline extending out into the ocean requiring the plant to be shut down for at least 1 year. Due to the impacts to the shoreline and cost associated with replacement power, expanding the intake should only be evaluated further if the results from the pilot study indicate it is worthwhile.

A detailed discussion of this technology option is provided in the Comprehensive Cost Evaluation Study (Attachment 4).

6.3.2 Narrow-slot Wedgewire Screens

How it Protects Fish - This technology provides fish protection through a combination of exclusion from the cooling system and low through-slot water velocities. The system effectiveness improves with ambient current sweeping velocities particularly when those velocities are greater than the velocities passing through the wedgewire slots. EPRI in a jointly funded project with EPA has conducted both laboratory and field studies on the performance of these screens. While widely deployed in freshwater and estuarine systems, experience with these systems is very limited in marine environments and there are no existing installations for electric generating stations in marine waters. A nuclear safety analysis review would also need to be conducted to determine feasibility.

Proposed Design for SONGS – Alden's design for this option proposes that 68 T-120 (10 ft diameter) screens with 0.5 mm slot openings would be required for the total flow for both units. One extra screen per intake was included in the design. This was done to allow for one screen to be removed for maintenance without increasing the velocity over manufacturer's design velocity (0.5 fps through-slot). To reduce the effects of bio-fouling a 70-30 copper-nickel alloy would be used. The screens would be mounted on six, 14-ft diameter intake pipes located beneath a large offshore work platform. The platform would provide:

- housing for compressors for the air backwash system,;
- a mechanical cleaning system; and
- a work deck from which to remove and maintain the screens.

Each of the intakes would include an emergency bypass to ensure an uninterrupted condenser cooling water flow in the event of extreme fouling event or other obstruction on the screen face. These gates would allow heat treatments to continue to control fouling in the intake tunnels.

Expected Entrainment Reduction Performance – The installation of wedgewire screens would eliminate the velocity cap and need for the FRS. It is important to consider performance in terms of reducing impingement mortality. The narrow-slot wedgewire screen through-slot design velocity does not exceed 0.5 fps and therefore it would qualify for use of Compliance Alternative 1. In the Phase II Rule for impingement mortality reduction no CDS would be required under this compliance alternative. Since there are no biological efficacy data with wedgewire screens for the species entrained at SONGS, head capsule depth data fish larvae was also used to estimate exclusion effectiveness for this option (see Appendix B of Attachment 4).

Performance is expected to be variable depending on species with reductions ranging from a high of almost 90% for queenfish to no protection for sea basses. However, the overall efficacy of this technology is estimated to reduce entrainment by 76.2% for all entrainable life stages combined. The estimated performance of narrow-slot wedgewire screens is shown in Table 1 below.

Potential Issues – The installation of narrow-slot wedgewire screens is feasible from an engineering stand point; however, it would require extensive civil structure, disturbance to the sea bottom in the area of the CWIS, create a public exclusion zone offshore, and down-time for

construction. In addition, there is considerably greater operation and maintenance (O&M) cost associated with them compared to the existing O&M. A major concern is ensuring that marine biofouling can be controlled. Narrow-slot wedgewire screens should be effective at excluding some life stages of ichthyoplankton at SONGS. The ultimate efficacy is dictated by species-specific life stages and abundance of those life stages in the entrained population.

As with the previously discussed technologies, there are a number of ancillary issues that would need further study prior to full-scale deployment. A key technological issue would be quantification of performance and ensuring marine biofouling can be controlled.

Other issues that could affect the overall feasibility of this technology would be the environmental impacts and permitting associated with construction and long-term operations of the maintenance deck. This would require approval from several state agencies. Further impacts to offshore kelp forests and bottom habitat may require substantial mitigation.

6.3.3 Closed-cycle Cooling

How It Protects Fish – The Rule used the assumption of proportionality between entrainment and cooling water flow. Because wet closed-cycle cooling systems can achieve a level of reduction in excess of 90% they would automatically achieve a level of entrainment reduction at the upper end of the 60–90% performance standard range. Therefore, the Rule allowed use of Compliance Alternative I for closed-cycle cooling. While the Rule did not use the assumption of proportionality for impingement, EPA indicated a "substantial" reduction in impingement would be achieved such that closed-cycle cooling qualified for use of impingement as well.

Proposed Design for SONGS – SCE participated in a study conducted by EPRI to evaluate the cost of retrofitting each of the eighteen once-through cooling power plants in California with closed-cycle cooling. This study generated an evaluation for retrofitting SONGS with wet closed-cycle cooling.

Expected Entrainment Reduction Performance – A wet closed-cycle cooling system would be expected to reduce entrainment at SONGS by 90% as a result of the reduction in cooling water flow that would be achieved.

Potential Issues – There would be significant issues associated with a wet closed-cycle cooling retrofit at SONGS. One of the major issues is existing space constraints which are discussed in the EPRI report (Appendix C of Attachment 4). The space issues are particularly problematic as SONGS is surrounded by State Parks and Federally owned land. This option would be expected to result in significant environmental and social impacts. Such impacts could include:

- human health impacts associated with increased emissions of fine particulates;
- terrestrial impacts to nearby wetlands or structural impacts to materials due to salt drift;
- potential water quality issues due to concentration of ambient source water pollutants in blowdown;

- public safety issues due to fogging and nearby roads;
- noise; and
- aesthetics.

There are likely to be permitting issues associated with these issues that could delay or prevent permitting of this option. These include issues resulting from the construction and operation of the towers. Towers will increase particulate matter and relocation of employee parking will increase traffic in the area, requiring new air quality permits. Reductions in energy generation will force fossil fueled plants to increase generation, resulting in additional greenhouse gas emission. Development on the coast will require permission from the California Coastal Commission, U. S. Fish and Wildlife, California Department of Fish and Game, and the Regional Water Quality Control Board. Blowdown material will require landfill disposal since disposal through the outtakes will not meet water quality requirements. The construction of cooling towers at SONGS would result in expanding the security measures to include these towers as they would be required for the nuclear safety of the plant. This would result in significant costs that were not included in this report.

Table 1. Estimated entrainment reductions for fine-mesh and narrow-slot wedgewire screens.

		Fine-mesh screens				Narrow-slot wedgewire	
Species	Percent of Total Entrainment	Retention (1)	Survival (2)	% Reduction in Entrainment (3)	% Reduction in Total Entrainment (4)	% Reduction in Entrainment (5)	% Reduction in Total Entrainment (4)
northern anchovy	58.6	81.3	12.2	9.9	5.8	81.3	47.6
queenfish	6.0	89.8	18.6	16.7	1.0	89.8	5.4
white croaker	3.9	60.7	18.0	10.9	0.4	60.7	2.4
Paralabrax spp.	0.4	0.0	95.5	0.0	0.0	0.0	0.0
Gibbonsia spp.	6.0	81.7	95.5	78.0	4.7	81.7	4.9
Hypsoblennius spp.	4.9	21.8	95.5	20.8	1.0	21.8	1.1
gobies	4.9	64.1	0.0	0.0	0.0	64.1	3.1
California grunion	1.6	78.4	59.0	46.3	0.7	78.4	1.3
Totals	**86.3**				**13.7**		**65.8**
Totals Relative to Total Entrainment					**15.8**		**76.2**

(1) Percent of entrained organisms expected to be collected on the traveling screens
(2) Expected survival off screens of those collected
(3) Combined percent reduction based on retention and survival
(4) Percent reduction in entrainment based on the percent of each species comprising overall entrainment
(5) Percent each species is expected to be excluded from entrainment

6.4 Technology Costs

For two of the feasible alternative fish protection technologies, Alden prepared cost estimates based on deployment designs for SONGS. Cost estimates for a closed-cycle cooling retrofit were estimated by Dr. John Maulbetsch as part of an EPRI retrofit study. Table 2 provides cost estimates for each of the three feasible alternatives. Again, it should be cautioned that these estimates rely on many of assumptions. Costs are based on the costs estimated to retrofit the plant with these technologies if all permitting were in place. They also do not include potential mitigation costs, or any ancillary modifications to the plant (e.g., replacing the condenser system to fully maximize cooling towers) needed to support the equipment.

Table 2. Estimated costs of feasible entrainment reduction technologies.

Technology	Capital Cost	Capital Cost with Replacement Power Needed During Installation	O&M Cost	Total Annualized Cost (Capital & O&M)
Fine-mesh Traveling Screens	$11,090,000 (1)	$0	$663,000	$2,242,000
Narrow-slot Wedgewire	$59,000,000	$277,436,000	$1,534,000	$41,035,000
Closed-cycle Cooling	$676,384,000	$0(2)	$46,293,000	$177,825,000

(1) Note that the capital cost for fine-mesh traveling screens assumes installation of fine-mesh screens onto the existing screens.

(2) A $0 cost is assumed for replacement power due to uncertainty regarding the time period to connect the closed-cycle cooling system to the condenser water box. However, a significant outage lasting anywhere from a month to six months, or more, may be required per unit.

Retrofitting SONGS with closed-cycle cooling had the highest estimated cost. SCE participated in a study conducted by EPRI to estimate retrofit costs for all once-through cooling facilities in California. That final report titled "Issues Analysis Associated with Retrofitting Once Through Cooling Plants with Closed-Cycle Cooling" included a site-specific cost estimate for SONGS as Attachment B-15. That attachment is provided as Appendix C of the Comprehensive Cost Evaluation Study (Attachment 4). Peer reviewers for this report included the California Energy Commission and Tetra Tech which is performing a similar project for the Ocean Protection Council. The report pointed out that major system components of SONGS could not operate with dry cooling and therefore dry cooling was not feasible for SONGS.

The details of the technology designs used and their associated costs and assumptions are provided in Comprehensive Cost Evaluation Study (Attachment 4) of the CDS.

6.5 Analysis

The Rule at §125.94(a)(5)(i) allows facilities to demonstrate that if the costs considered by EPA in the Phase II Rule for that facility are significantly greater than the facility site-specific costs (based on reliable, scientifically sound cost estimates) then that technology would fail the test. SCE believes the peer reviewed closed-cycle cooling estimate generated in the EPRI study and the fine-mesh and narrow-slot wedgewire screen estimates prepared by Alden meet the Phase II Rule as reliable and scientifically sound, although the estimates are likely to underestimate the total costs due to the exclusion of the issues mentioned above.

EPA provided a cost estimate for SONGS in the Phase II Rule. SONGS is identified in Appendix B as facility number AUT0573. The costs for specific facilities are listed in Appendix A, and in that Appendix SONGS is assigned an n/a cost. EPA in the preamble of the Phase II Rule clarifies facilities assigned an "n/a" cost estimate were projected to already meet the applicable performance standards. EPA stated that "These facilities should use $0 as their value for the costs considered by EPA for a like facility in establishing the applicable performance standard." This point was discussed with EPA after the final Rule was issued and EPA said that as long as the EPA Phase II Questionnaire on which the determination was based was properly filled out, a $0 cost should be used in the cost-cost test. SCE has reviewed its questionnaire responses and determined they were properly filled out.

While EPA did not define or issue guidance on what costs would be considered "significantly greater", the estimated annualized costs for fine-mesh screen, narrow-slot wedgewire screens and closed-cycle cooling at $2.2 million, $41 million and $143 million, respectively, would all reasonably be considered significantly greater than $0.

6.6 Entrainment Compliance Summary

Based on the results of the cost-cost test analysis, each of the three potentially feasible entrainment reduction technologies was determined to have a cost significantly greater than the cost considered by EPA for SONGS in the Phase II Rule. Therefore, the existing cooling water intake structures are considered BTA for entrainment. CDS documents required for use of site-specific standards based on the cost-cost test are a Comprehensive Cost Evaluation Study, Site-specific Technology Plan and Verification Monitoring Plan which are provided in Attachment 4.

7 BEST PROFESSIONAL JUDGMENT COMPLIANCE CONSIDERATIONS

SCE has prepared this CDS in conformance with the NPDES permit and the Rule. SCE has provided documentation for the impingement mortality reduction achieved by the velocity cap and FRS which is estimated to reduce impingement mortality at the upper end of the performance standard range. SCE has used a site-specific standard cost-cost test analysis to demonstrate that the costs of achieving a 60% to 90% reduction to meet the entrainment reduction performance standard are significantly greater than EPA's estimated cost for SONGS. These were based on a technically sound site-specific evaluation of entrainment reduction structural and operational controls.

SCE is fully aware that the Second Circuit Court of Appeals remanded use of the cost-cost test to EPA for failure to allow adequate opportunity for public review and comment. SCE further recognizes that additional fish protection technologies and operational measures may be required to reduce entrainment, but point out a number of important considerations for the Board in making the final BPJ compliance determination for SONGS.

1. SONGS is an important source of reliable baseload generation in California. Since SONGS is a nuclear-fueled facility, the 2,174 MW of electricity generated does not directly result in air emissions and does not contribute to global warming as does fossil fuel power generation.

   SONGS also contributes to the local economy and the quality of life in Southern California by providing employment for more than 2,000 people and a source of $200 million in direct economic benefits to local communities, with an additional $20 million in property tax revenue.

2. Precedence has been set in past determinations that SONGS has been in compliance under BPJ guidelines. Prior to the issuance of the Rule, SONGS was determined to be in compliance with Section §316(b) based on an independent review of 316(b) demonstrations (from Units 2 and 3 in 1987, and an earlier demonstration in 1983 from the now-decommissioned Unit 1) by Science Applications International Corporation. This report was submitted to the EPA in 1993.

3. Impacts associated with entrainment at SONGS are currently being mitigated. SCE is spending an estimated $86 million for the construction, maintenance and monitoring for restoration of coastal wetlands specifically designed to offset Units 2&3 entrainment losses. These wetlands will continue to provide benefits to entrainable life stages long after the facility is decommissioned.

4. SONGS is in compliance with 316(b) reduction requirements for impingement. The level of impingement mortality reduction achieved is estimated to be 94.22% in terms of finfish numbers and 98.7% by finfish weight which is at the high end of the range specified in the Rule performance standard.

5. The decision remanding the Rule is still being litigated. An appeal to the Supreme Court has been filed regarding the Second Circuit Court Decision (Decision) that could alter the Decision. In addition, the Decision does not over rule and is inconsistent with the prior §316(b) Decision by the First Circuit Court in Seacoast Antipollution League vs. Costle. In that Decision the First Circuit Court ruled that cost and benefits could be considered using the wholly disproportionate standard. It is therefore up to the Board to determine whether or not this interpretation is appropriate unless and until authoritative action is taken by EPA or the SWRCB.

6. No rules or policies have been developed in place of the remanded rule, and are not expected until at least mid-2008. EPA has initiated work to revise the Rule in a manner that addresses issues raised by the Second Circuit Court. EPA's schedule calls for issuing a proposed Rule by the end of 2008. At this point it is anticipated that the Rule will be limited to use of technologies and operational measures, and if performance standard ranges are used, the use of the best-performing technology in the performance standard range will be required.

   Although much attention has been placed on closed-cycle cooling, it is not clear whether or not this technology will be identified as Best Technology Available. The Second Circuit Court determined that EPA could consider three factors as a basis for not identifying closed-cycle cooling as BTA. These three factors included:

   - the Industry cannot reasonably bear the cost of retrofits;
   - impacts to energy production and supply; and
   - adverse impacts associated with retrofits.

   The feasibility and the impacts of closed-cycle cooling are being thoroughly studied. SCE is one of 25 companies currently funding a $2.5 million dollar EPRI research project to provide technical information relative to closed-cycle cooling retrofits. The scope of the EPRI project will provide quantitative estimates of:

   - the national cost of retrofits;
   - the reduction in generation as a result of generation unit retirements and energy penalties associated with retrofits;
   - environmental and social impacts resulting from retrofits; and
   - impacts to electric system reliability.

   Additionally, SCE will be funding a complete analysis of the environmental impacts of closed-cycle cooling at SONGS. Thus, the subject is still being investigated, and critical

data are still being developed. Therefore, deferring decisions to a later date will allow for a better informed decision.

7. The EPRI research project is national in scope and will provide information for California's facilities including SONGS. EPRI has met with EPA Staff working on the Rule to discuss the schedule, scope and approach for the research program, and EPA has expressed a strong interest in making use of this information in developing the proposed Rule.

8. The California State Water Resources Control Board continues to consider development of a State §316(b) Policy that is expected to be issued in 2008.

9. Due to points 2, 3, 4, 5, 6, and 7, it is important that the final determination of BTA for SONGS be consistent with both the revised Rule and the final State §316(b) Policy.

For these reasons SCE believes that a final BTA determination that requires additional technologies should be deferred until after the revised Rule or final State §316(b) Policy are issued. This CDS, MRC reports, and prior 316(b) demonstrations suggest that SONGS is in compliance with the intent of the §316(b) rule. Since EPA and SWRCB rule/policy making efforts are underway, additional analyses and implementation of technologies should not be required until they are finalized, to ensure consistency. Additionally, the design of the existing CWIS coupled with ongoing restoration projects have been demonstrated to significantly reduce some impacts and mitigate for others. This suggests that there is no urgency for modifications to SONGS and the existing CWIS should be considered BTA under BPJ.

A1 ATTACHMENT

122.21(r)(2),(3), and (5) Information