SOUTHERN CALIFORNIA
EDISON
An EDISON INTERNATIONAL Company

A. Edward Scherer
Manager of
Nuclear Regulatory Affairs

March 10, 2006

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Subject: **Docket Nos. 50-361, 50-362**
Response to Requests for Additional Information on,
PCN-555 – "Alternative Source Term"
San Onofre Nuclear Generating Station, Units 2 and 3

References: 1) Letter from D. E. Nunn (SCE) to Document Control Desk (NRC) dated December 27, 2004, Subject: "San Onofre Nuclear Generating Station, Units 2 and 3, Docket Nos. 50-361 and 50-362, Proposed Change Number (PCN) 555, Alternative Source Term"

2) Letter from A. E. Scherer (SCE) to Document Control Desk (NRC) dated October 27, 2005, Subject: "San Onofre Nuclear Generating Station, Units 2 and 3, Docket Nos. 50-361 and 50-362, Replacement Pages for Proposed Change Number (PCN) 555 Alternative Source Term"

Dear Sir or Madam:

Enclosed is Southern California Edison's (SCE) response to two Requests for Additional Information (RAIs) regarding SCE's submittal dated December 27, 2004 (Reference 1). Reference 1 is a License Amendment Request (LAR), designated by SCE as PCN-555, that requests adoption of an Alternative Source Term.

Enclosure 1 of this letter provides a response to an RAI received on August 18, 2005. Enclosure 2 of this letter provides a response to an RAI received on October 7, 2005.

Enclosure 3 of this letter provides an updated version of PCN-555 to correct two areas in the original submittal. The first concerns the post-accident mixing rate between the sprayed and unsprayed regions in containment. The second was the subject of SCE's letter dated October 27, 2005 (Reference 2), which provided replacement pages to

A001
w/CD Rom

P.O. Box 128
San Clemente, CA 92672
949-368-7501
Fax 949-368-7575

reflect corrected meteorological data and make editorial changes. Enclosure 3 of this letter provides a complete replacement of PCN-555 with redline-strikeout markings to show all changes from the original submittal (i.e., both those changes provided by Reference 2 and the current changes).

As a result of the corrections, the accident analysis dose consequences are slightly increased. SCE has, however, determined that the conclusions of the original No Significant Hazards Consideration in PCN-555 are unchanged.

If you have any questions or require additional information, please contact Jack Rainsberry at (949) 368-7420.

Sincerely,

Enclosures:

cc: B. S. Mallett, Regional Administrator, NRC Region IV
C. C. Osterholtz, NRC Senior Resident Inspector, San Onofre Units 2 and 3
N. Kalyanam, NRC Project Manager, San Onofre Units 2 and 3

Enclosure 1

Response to Request for

Additional Information

dated August 18, 2005

RAI 1:
In order to minimize conversion of iodine in the cesium iodide (CsI) dissolved in sump water from the ionic to the elemental form, the pH of the sump water has to be maintained basic during the 30-day period after a loss-of-coolant accident (LOCA) (see NUREG\CR-5950). Describe the procedures for maintaining a basic pH in the sump water. The description should include the following:

(a) Values of pH during the 30-day period after a LOCA.

(b) Amounts of strong acids (hydrochloric and nitric) generated in the containment.

(c) Concentration of boric acid in the containment sump.

(d) Methods used for calculating the amount of trisodium phosphate dodecahydrate needed for maintaining the sump pH at 7 or higher values. (If the calculations were performed by hand, provide details of the calculations. If they were done by a computer, identify the name of the code, and provide input and output data of the program.)

RESPONSE:

Containment pH control at SONGS is a passive design using baskets filled with Trisodium Phosphate (TSP) Dodecahydrate. A Chemistry procedure implements Technical Specification Surveillance Requirement (SR) 3.5.5.1 to verify that the TSP baskets contain an adequate quantity of TSP, and SR 3.5.5.2 to verify that a sample from the TSP baskets provides adequate pH adjustment of RWST water.

As discussed in Section 4.5.1.3.4 of the application, the Combustion Engineering Owners Group (CEOG) evaluated the effect of non-traditional acid formers on the post-accident containment sump pH for CEOG plants, including SONGS. The evaluation is documented in WCAP-15737-P Revision 0, a copy of which is provided as Attachment A of this Enclosure. WCAP-15737-P predicted that the containment sump pH will be no lower than 6.9 at the end of 30 days. The evaluation concluded that this pH will continue to ensure that radioiodines remain in the sump solution and are not re-evolved to the containment atmosphere. The answers to the four specific questions regarding the evaluation are documented in the report.

(a) Values of pH during the 30-day period after a LOCA.

WCAP-15737-P Table 3 presents containment sump pH as a function of time.

(b) Amounts of strong acids (hydrochloric and nitric) generated in the containment.

WCAP-15737-P Section 7.0 addresses the amounts of acids generated in the containment.

(c) Concentration of boric acid in the containment sump.

WCAP-15737-P Table 1 addresses the boric acid in the containment sump.

(d) Methods used for calculating the amount of trisodium phosphate dodecahydrate needed for maintaining the sump pH at 7 or higher values. (If the calculations were performed by hand, provide details of the calculations. If they were done by a computer, identify the name of the code, and provide input and output data of the program.)

WCAP-15737-P Section 5.0 presents the methodology used in the evaluation. The methodology is implemented by the STARpH code. The input data is summarized in the WCAP-15737-P Table 1. The output data is summarized in WCAP-15737-P Section 6.0

RAI 2:
Discuss and explain how the elemental iodine decontamination factors listed in Table 4.5-5 of Enclosure 2 to the application were calculated.

RESPONSE:

Provided as Attachment B of this Enclosure is a copy of Calculation N-6030-001 which calculates the elemental iodine decontamination factors used in the dose calculation.

The method and theory of the determination of the elemental iodine decontamination factor (DF) are discussed in Standard Review Plan (SRP) 6.5.2 Section III.4.d. The SONGS AST dose analyses follow the elemental iodine DF guidance in SRP 6.5.2 Section III.4.d.

The SRP 6.5.2 Section III.4.d equation for calculating the iodine DF was used in the AST analysis that evaluates containment spray system performance. Per the equation, the iodine DF is a function of the effective iodine partition coefficient (PC), the containment sump liquid volume, and the containment building volume. Section 4.5.1.3.4 of the SONGS AST application provides detailed information on the modeling of these parameters. Per the application, the AST analysis calculates an elemental iodine PC for each of the time periods shown in Table 4.5-5, based on the time period's minimum containment sump water temperature. The elemental iodine DF for that time period is then calculated using the SRP 6.5.2 equation. Table 4.5-5 of the AST application presents the elemental iodine spray removal rate and DF for various time periods up to the 720 hour (30 day) LOCA event duration. The actual calculation of the iodine DF is performed in Section 8.3.2 of Calculation N-6030-001.

Per the AST application, the containment spray is assumed to operate for four hours after the onset of the loss of coolant accident (LOCA). After four hours, natural deposition is credited as an elemental iodine removal mechanism. Per the AST application, the Table 4.5-5 elemental iodine DF entries for time periods after 4 hours are modeled in the AST LOCA dose analysis as a limit for the removal of elemental iodine due to natural deposition.

Table 4.5-5 of the AST application shows that the elemental iodine DF modeled in the AST LOCA dose analysis does not exceed the maximum allowable elemental iodine DF of 200 specified in SRP 6.5.2, Section III.4.d.

RAI 3:
During the recirculation phase, some of the containment sump water containing dissolved iodine will leak into the refueling water storage tank (RWST) and mix with the remaining borated water there. Since the RWST water contains relatively high concentrations of boric acid, the resulting pH of the mixture in the RWST will have lower pH than the water in the sump, which will cause increased conversion of iodine from the ionic to the elemental form. Since solubility of elemental iodine is significantly lower than ionic iodine, some of it will be released to the air space from which it may leak to the outside atmosphere. Provide values of the pH in the RWST water during the recirculation phase.

RESPONSE:

The RWST water pH as a function of time has not been calculated. Per Regulatory Guide 1.183 Appendix A Section 5.6, for the analysis of the RWST releases, an iodine composition of 97% elemental iodine and 3% organic iodine was assumed. As discussed in Section 4.5.3.2.1 of the application, per guidance from Regulatory Guide 1.183 Appendix A Section 5.5, 10% of the leakage from the containment sump to the RWST was assumed to flash into the RWST air space with a partition coefficient of 1. The remaining 90% was assumed to mix instantaneously with the RWST water volume. A partition coefficient of 200 for all iodine species was assumed between the RWST water volume and the RWST air space. Per NUREG/CR-0009 (page 61), for plain borated acid solution without other chemical additives, use of a partition coefficient of 200 is appropriate. As discussed in NUREG/CR-0009 (page 61) added impurities in the boric acid solution tend to increase the effectiveness of the iodine removal mechanism. The sump liquid leakage post LOCA into the RWST will add additional chemicals and impurities, which will tend to increase the RWST PF.

RAI 4:
Justify the statement in the first paragraph on page 56 of Enclosure 2 to the application that "the air mixing removal of containment unsprayed region activity can be approximated by an exponential relationship."

RESPONSE:

The exponential relationship described in the SONGS AST application was established by engineering judgment to conservatively document the time required to change out the air in the containment unsprayed region, thereby providing justification for a determination that the containment sprayed and unsprayed regions are adequately mixed. The exponential equation is equivalent to an equation that would be used in evaluating the flow rate necessary for a 2-hour purge of the containment or fuel building atmosphere in the event of a fuel handling accident (as allowed by the guidance of Regulatory Guide 1.195 Appendix B Section 4.1). This relationship is of the form:

$$A_u(t) = A_u(0) \times e^{-\lambda t} = A_u(0) \times e^{-\frac{F_{mix}}{V_u}t}$$

Where F_{mix} is the mixing rate of 62,000 cfm delivered by one operating train of Emergency Cooling Units (ECUs), V_u is the containment unsprayed region volume of 377,000 ft^3, A_u is the activity level in the containment unsprayed region. Using this relationship, 99 percent of the air in the containment unsprayed region is estimated to be mixed into the sprayed region within 28 minutes:

$$A_u(t) = A_u(0) \times e^{-\lambda t} = A_u(0) \times e^{-\frac{F_{mix}}{V_u}t}$$

$$\therefore t = -\frac{V_u}{F_{mix}} \ln\left(\frac{A_u(t)}{A_u(0)}\right) = -\frac{377{,}000\, ft^3}{62{,}000\, cfm} \ln(0.01)$$

$$t = 28 \text{ min}$$

In the 1.8 hours prior to the cessation of activity releases at the conclusion of the early in-vessel phase, approximately 4 air changes within the containment unsprayed region would occur (= 1.8 hr × 60 min/hr ÷ 28 minutes per air turnover).

The conservatism in the use of the exponential relationship is validated in the following text, which provides an alternative basis for the same conclusion that the SONGS design has an adequately mixed containment.

Per UFSAR Section 6.5.2.2.1, mixing between the sprayed and unsprayed regions is provided by the containment emergency fan cooler system and dome air circulator (DAC) system. These systems consist of four fan coolers [which are referred to in the AST application as ECUs], each rated at 31,000 ft^3/min and four dome air circulators, each rated at 37,000 ft^3/min at peak containment condition. Credit is taken for two fan coolers, one dome air circulator (conservatively modeled with a flow rate of 0), and mixing induced by the condensation of steam by one spray train in the evaluation of minimum system performance. Suction for the fan coolers is at operating deck elevation 63 feet 6 inches and the exhaust is near elevation 25 feet 0 inches.

Per UFSAR Section 9.4.1.2.2, the locating of the containment emergency cooling units in different areas of the containment, with extension of necessary ductwork and large air-moving capability of the units, ensures adequate circulation inside the containment after a LOCA. The containment dome air circulating units and the containment spray system supplement the mixing capability of these units. Hence, overall air circulation inside the containment prevents any localized high-temperature air pockets, high combustible gas concentration or regions of unsprayed radioiodine.

The areas below the containment operating deck are serviced by the containment emergency cooling units. One operating train of ECUs will deliver 62,000 ft^3/min of air from areas above the operating deck to areas below the operating deck. The air turnover time within the containment unsprayed region below the operating deck would be approximately 6 minutes (= 377,000 $ft^3 \div$ 62,000 ft^3/min). In the 1.8 hours prior to the cessation of activity releases at the conclusion of the early in-vessel phase, approximately 18 air changes within the containment unsprayed region would occur (= 1.8 hr $\times$ 60 min/hr $\div$ 6 minutes per air turnover). These 18 air changes are greater than the 4 air changes calculated with the exponential relationship, thereby validating that the air mixing removal of containment unsprayed region activity can be approximated by an exponential relationship.