June 17, 2002

Mr. Harold B. Ray
Executive Vice President
Southern California Edison Company
San Onofre Nuclear Generating Station
P.O. Box 128
San Clemente, CA 92674-0128

SUBJECT: SAN ONOFRE NUCLEAR GENERATING STATION, UNITS 2 AND 3 - ISSUANCE OF AMENDMENTS ON STEAM GENERATOR TUBE INSPECTIONS (TAC NOS. MB5145 and MB5146)

Dear Mr. Ray:

The Commission has issued the enclosed Amendment No. 189 to Facility Operating License No. NPF-10 and Amendment No. 180 to Facility Operating License No. NPF-15 for San Onofre Nuclear Generating Station (SONGS), Units 2 and 3, respectively. The amendments are in response to your application dated May 22, 2002, as supplemented by letters dated on June 10, and 14, 2002. Pursuant to 10 CFR 50.91(a)(6), Southern California Edison (SCE) requested that this request be processed as an exigent Technical Specification (TS) amendment. By letters dated June 10, and 14, 2002, SCE requested that this exigent TS change apply only for Cycle 12 operation for SONGS, Unit 2 and for Cycle 11 operation for SONGS, Unit 3, respectively.

The amendments revises TS 5.5.2.11.f.1.h, "Steam Generator (SG) Tube Surveillance Program," to more clearly delineate the scope of the SG tube inspection required in the tubesheet region. The licensee's basis for the proposed change is WCAP-15894-P, Revision 0, "NDE Inspection Strategy for the Tubesheet Region In SONGS Units 2 and 3." As a result of our review of this topical report, while we concluded there was sufficient information to approve this request for Cycle 12 operation for SONGS, Unit 2 and for Cycle 11 operation for SONGS, Unit 3, additional information is needed to support a permanent TS change. Enclosed is a list of the more significant issues that will need to be resolved.

A copy of the related Safety Evaluation is also enclosed. The Notice of Issuance will be included in the Commission's next biweekly *Federal Register* notice.

Sincerely,

/RA/
Alan B. Wang, Project Manager, Section 2
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. 50-361 and 50-362
Enclosures:
1. Amendment No. 189 to NPF-10
2. Amendment No. 180 to NPF-15
3. Safety Evaluation
4. Comments on WCAP-15894-P

cc w/encls: See next page

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SOUTHERN CALIFORNIA EDISON COMPANY

SAN DIEGO GAS AND ELECTRIC COMPANY

THE CITY OF RIVERSIDE, CALIFORNIA

THE CITY OF ANAHEIM, CALIFORNIA

SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 2

DOCKET NO. 50-361

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 189
License No. NPF-10

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Southern California Edison Company, et al. (SCE or the licensee), dated May 22, 2002, as supplemented by letters dated June 10, and June 14, 2002, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 2.C(2) of Facility Operating License No. NPF-10 is hereby amended to read as follows:

   (2) Technical Specifications

   The Technical Specifications contained in Appendix A and the Environmental Protection Plan contained in Appendix B, as revised through Amendment No. 180 , are hereby incorporated in the license. Southern California Edison Company shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

3. This license amendment is effective as of the date of its issuance and shall be implemented within 30 days of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

Stephen Dembek, Chief, Section 2
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Attachment: Changes to the Technical Specifications

Date of Issuance: June 17, 2002

ATTACHMENT TO LICENSE AMENDMENT NO. 189

FACILITY OPERATING LICENSE NO. NPF-10

DOCKET NO. 50-361

Replace the following page of the Appendix A Technical Specifications with the attached page. The revised page is identified by amendment number and contain marginal lines indicating the areas of change.

REMOVE	INSERT
5.0-18	5.0-18

SOUTHERN CALIFORNIA EDISON COMPANY

SAN DIEGO GAS AND ELECTRIC COMPANY

THE CITY OF RIVERSIDE, CALIFORNIA

THE CITY OF ANAHEIM, CALIFORNIA

SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 3

DOCKET NO. 50-362

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 180
License No. NPF-15

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Southern California Edison Company, et al. (SCE or the licensee) dated May 22, 2002, as supplemented by letters dated June 10, and June 14, 2002, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 2.C(2) of Facility Operating License No. NPF-15 is hereby amended to read as follows:

   (2) Technical Specifications

   The Technical Specifications contained in Appendix A and the Environmental Protection Plan contained in Appendix B, as revised through Amendment No. 180, are hereby incorporated in the license. Southern California Edison Company shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

3. This license amendment is effective as of the date of its issuance and shall be implemented within 30 days of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

Stephen Dembek, Chief, Section 2
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Attachment: Changes to the Technical Specifications

Date of Issuance: June 17, 2002

ATTACHMENT TO LICENSE AMENDMENT NO. 180

FACILITY OPERATING LICENSE NO. NPF-15

DOCKET NO. 50-362

Replace the following page of the Appendix A Technical Specifications with the attached page. The revised page is identified by amendment number and contain marginal lines indicating the areas of change.

REMOVE	INSERT
5.0-18	5.0-18

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 189 TO FACILITY OPERATING LICENSE NO. NPF-10

AND AMENDMENT NO. 180 TO FACILITY OPERATING LICENSE NO. NPF-15

SOUTHERN CALIFORNIA EDISON COMPANY

SAN DIEGO GAS AND ELECTRIC COMPANY

THE CITY OF RIVERSIDE, CALIFORNIA

THE CITY OF ANAHEIM, CALIFORNIA

SAN ONOFRE NUCLEAR GENERATING STATION, UNITS 2 and 3

DOCKET NOS. 50-361 and 50-362

1.0 INTRODUCTION

By letter dated May 22, 2002, as supplemented by letters dated June 10, and June 14, 2002, Southern California Edison (SCE) submitted an exigent technical specification (TS) amendment request for San Onofre Nuclear Generating Station (SONGS), Units 2 and 3. The requested changes would revise the TSs to incorporate a modified definition of a steam generator tube inspection. By letters dated June 10, and June 14, 2002, SCE requested that these amendments be limited to Cycle 12 operation for SONGS, Unit 2 and to Cycle 11 operation for SONGS, Unit 3. The supplemental letters dated June 10, and June 14, 2002, provided additional information that clarified the application, did not expand the scope of the application as originally noticed, and did not change the NRC staff's original proposed no significant hazards consideration determination as published in the *Federal Register* on May 31, 2002 (67 FR 38150).

Currently, the applicable tube inspection criteria in the TSs is an inspection of the steam generator tube from the point of entry (hot leg side) completely around the U-bend to the top support of the cold leg. The new definition would define a tube inspection to be from 5.0-inches below the secondary face (i.e., top) of the hot-leg tubesheet completely around the U-bend to the top support of the cold-leg. Essentially, the new definition would not require inspection of approximately an 18 inch portion of the tube near the bottom of the hot-leg tubesheet region.

2.0 BACKGROUND

SONGS, Units 2 and 3 are 2-loop Combustion Engineering (CE) plants with CE designed steam generators. Each steam generator contains about 9400 tubes. The steam generator tubes are high temperature mill annealed Alloy 600 with an outside diameter of 0.750-inches

and a wall thickness of 0.048-inches. Each tube was secured in the tubesheet by an explosive-expansion process referred to as the CE explosive-expansion (explansion) process. The tubesheet is approximately 23-inches thick and the tube is expanded for essentially the full thickness of the tubesheet. The explansion process forms an interference fit between the tube and tubesheet. This interference fit forms an interface which provides the structural and part of the leaktight boundary between the primary and secondary systems at each end of a steam generator tube. The transition from the expanded portion of the tube to the unexpanded portion of the tube is referred to as the expansion transition or explanded joint and is located at the top of the tubesheet.

The steam generator has a stay cylinder which is a cylindrical supporting member within the steam generator primary bowl. The stay cylinder serves to reduce tubesheet flexure or "bow" from the influence of primary coolant pressure.

Each steam generator contains horizontal supports (eggcrates), diagonal supports (batwings) and vertical supports (vertical straps) to support the tubing. All tube support material is carbon steel. The eggcrate elements are 1-inch and 2-inches in height and 0.090-inch thick. The first 7 eggcrates are full supports (i.e., they provide support to all of the tubes) whereas the next 3 eggcrates (eggcrates 8, 9 and 10) are partial supports which do not extend across the entire tube bundle. A scalloped bar forms the non-peripheral edge of partial eggcrate supports. All tubes are supported by 2 batwings. All tubes in rows greater than or equal to row 19 are supported by a combination of vertical straps.

Historically, circumferential flaws have primarily occurred at the expansion transition zone. As a result, the use of techniques qualified for detecting circumferential flaws to inspect other regions of the tube within the tubesheet were not necessary (since there was no operating experience or expectation that they would occur in this region). The presence of circumferential flaws in the expanded region of the tube represents a new degradation mechanism.

Appendix B to 10 CFR Part 50 (Criterion IX) requires the use of qualified procedures during the performance of non-destructive testing. During the SONGS, Unit 2 outage beginning May 20, 2002, circumferential flaws were identified (i.e., circumferential flaws were found in the expanded portion of the tube at a significant distance away from the expansion transition). However, techniques qualified for detecting circumferential flaws were not used to inspect other portions of the tubesheet region of the tube bundle. Therefore, the NRC staff determined that the licensee could either inspect the tubesheet region with a qualified probe (to comply with Appendix B) or request a TS change. SCE decided to request a TS change. Since the TSs require an inspection (a non-destructive test) of the tube for the entire length of the tube within the tubesheet and the licensee sought to inspect only the upper 5 inches with appropriately qualfied methods, the licensee proposed a TS amendment to more clearly delineate the scope of the inspection. Since similar inspections were performed in the past at SONGS, Unit 3 and circumferential flaws were detected in the expanded portion of the tubes in the tubesheet, the licensee requested a similar amendment for SONGS, Unit 3.

The NRC staff believes circumferential flaws in the tubesheet region can pose a safety concern, depending on their location with respect to the top of the tubesheet. If significant circumferential flaws are located near the top of the tubesheet, the tube could pull out of the tubesheet or the tube may leak during normal operating or postulated accident conditions. As discussed more fully below, if circumferential flaws are located a significant distance below the top of the tubesheet, the safety significance is reduced since the likelihood of tube pullout from the tubesheet and primary-to-secondary leakage is reduced or eliminated. As part of this

request, the licensee intended to provide the basis for the minimum inspection distance to demonstrate the necessary distance to preclude tube pullout or leakage in the tubesheet region.

3.0 PROPOSED TECHNICAL SPECIFICATION AMENDMENT

SCE proposes a one-cycle change to the TSs for SONGS, Units 2&3 inspection as follows:

> Change Technical Specification surveillance requirement (SR) (5.5.2.11.f.1.h) to define a tube inspection as an inspection of the steam generator tube from the point of entry (hot leg side) completely around the U-bend to the top support of the cold leg excluding the portion of the tube within the tubesheet below 5-inches from the secondary face of the tubesheet.

4.0 EVALUATION

4.1 Introduction

Because of the importance of steam generator tube integrity to maintaining the reactor coolant pressure boundary integrity, the NRC requires the performance of periodic inservice inspections of steam generator tubes. These inspections are performed to detect steam generator tube degradation prior to leakage or failure. Upon the detection of degraded tubes, the NRC requires the degraded tubes to be plugged or repaired prior to restoring the steam generators to service. The minimum requirements are outlined in the plant's TSs.

The requirements for the inspection of steam generator tubes are intended to ensure that this portion of the reactor coolant system maintains its structural and leakage integrity. Structural integrity refers to maintaining adequate margins against gross failure, rupture, and collapse of the steam generator tubes. Leakage integrity refers to limiting primary-to-secondary leakage during normal operation and postulated accidents to within acceptable limits.

Acceptable criteria for tube structural integrity are specified in Regulatory Guide (RG) 1.121, "Bases for Plugging Degraded PWR Steam Generator Tubes." Adequate leakage integrity during transients and postulated accidents is demonstrated by showing that the resulting leakage from the tubes will not exceed a rate that would violate offsite or control room dose criteria. These criteria are specified, in part, in 10 CFR Part 100 and in General Design Criteria 19 of Appendix A to 10 CFR Part 50.

To provide assurance of adequate structural and leakage integrity, licensees perform inservice inspections of the steam generator tubes. These inspections are intended to detect mechanical or corrosive damage to the tubes, which may result from manufacturing or inservice conditions. In addition, the inservice inspections of the steam generator tubes may provide a means of characterizing the nature and cause of any tube degradation so that corrective measures can be taken. Tubes with degradation that exceeds the tube repair limits specified in a plant's TSs are removed from service by plugging or are repaired by sleeving.

The existing TSs do not take into account the reinforcing effect of the tubesheet on the external surface of the expanded tube. The presence of the tubesheet will constrain the tube and

complement tube integrity in that region by essentially precluding tube deformation beyond the expanded outside diameter of the tube. The tube's resistance to both rupture and collapse is significantly enhanced by the tubesheet. In addition, the proximity of the tubesheet to the tube in the expanded region significantly reduces the leakage resulting from through-wall flaws in a tube.

Based on these considerations, utilities have proposed, and the NRC has approved, alternate repair criteria for defects located in the portion of the steam generator tube contained in the tubesheet when these defects are a specific distance below the expansion transition or the top of the tubesheet, whichever is lower. Although none of these alternate repair criteria approvals have been for CE plants with tubes that have been expanded by the CE explansion process, the NRC has approved alternate repair criteria and changes to the tube inspection definition for licensees that have expanded their steam generator tubes into the tubesheet using the Westinghouse Explosive Tube Expansion (WEXTEX) process. The WEXTEX process is similar, but not identical to the CE explansion process (i.e., both use explosive techniques to expand the tube into the tubesheet); however, as discussed below, insights from evaluating the WEXTEX expansions provide useful information regarding the integrity of explosive tube-to-tubesheet joints, in general.

The NRC has approved alternate repair criteria referred to as the W-star (W*) criteria for defects located in the portion of the tube below a WEXTEX expansion transition. These criteria have been approved for Diablo Canyon Units 1 and 2, which have WEXTEX tube expansions (refer to NUDOCS Accession Number 9903030010 and ADAMS Accession Number ML021200166). In addition, the NRC staff has approved a redefinition of a tube inspection which relies on the W* methodology for one cycle at Sequoyah Unit 2, which also has WEXTEX tube expansions (ADAMS Accession Number ML021340595).

The W* repair criteria define distances referred to as W* distances below which any type or combination of tube degradation is considered acceptable (i.e., even if inspections below this region would identify flaws, the regulatory requirements pertaining to tube structural integrity would still be met provided there are no flaws within the W* distance). The W* distances are measured from the bottom of the WEXTEX transition. The key consideration in determining a W* distances are the amount of undegraded tubing necessary to prevent axial pullout of the tube from the tubesheet. Tube pullout could result from the internal pressure in the tube.

In determining the alternate repair criteria for Diablo Canyon Units 1 and 2, a specific methodology was used. This methodology determined the required W* distance for two regions of the tube bundle: Zone A and Zone B. The analysis considered the forces acting to pull the tube out of the tubesheet (i.e., from the internal pressure on the tube) and the forces acting to keep the tube in place. These latter forces are a result of friction and the forces arising from (1) the residual preload from the WEXTEX expansion process, (2) the differential thermal expansion between the tube and the tubesheet, (3) internal pressure in the tube within the tubesheet, and (4) dilation of the tubesheet holes from bowing of the tubesheet due to pressure and thermal differentials across the tubesheet. This generic analysis, using bounding or non-plant specific values for secondary system pressure and primary temperature, resulted in W* distances of 5.2 inches for Zone A and 7.0 inches for Zone B. Zone A includes tubes within the periphery of the tube bundle and Zone B includes tubes in the interior of the tube bundle. The steam generator is divided into zones because the effects of bowing of the tubesheet are a function of the radial position of the tube in the tube bundle.

In applying the W* distances, uncertainties in the non-destructive examination (NDE) parameters must be accounted for. These uncertainties include the uncertainty in determining the inspection distance relative to the location of the bottom of the WEXTEX expansion transition. These uncertainties are also addressed in the W* methodology as discussed in the NRC staff's safety evaluation approving the W* repair criteria for Diablo Canyon.

The tube expansion process used in CE steam generators, such as at SONGS, is similar to that used in Westinghouse plants; however, the contact pressure from the explansion process is expected to exceed the contact pressure of the WEXTEX joint (which would result in less engagement length needed for explanded tubes than for WEXTEX tubes, all others factors being equal). As a result, it is reasonable to expect that similar alternate repair criteria (or definitions of tube inspection) would be applicable to CE plants. In addition, the effects of tubesheet bow would be expected to be less in CE plants because of the presence of a stay cylinder central to the tubesheet which stiffens it and allows the use of a thinner tubesheet. Westinghouse-designed steam generators do not use stay cylinders to add out-of-plane stiffness to the tubesheet. This design difference results in a different response of the tubesheet to loads such as would be experienced during a steam line break such that the maximum flexure occurs at different radial positions (i.e., zones).

4.2 San Onofre Proposal

During the 2002 steam generator tube inspections at SONGS Unit 2, SCE used the bobbin coil and rotating probes to inspect portions of the tube within the hot-leg tubesheet. Specifically, the bobbin coil was used to inspect the entire portion of the tube in the tubesheet and the rotating probe was used to inspect the portion of the tube from the top of the tubesheet to at least 5 inches below the secondary face (i.e., top) of the tubesheet. The bobbin coil is sensitive to axial flaws and is relatively insensitive to circumferentially oriented flaws (i.e., the bobbin coil is not qualified to detect circumferentially oriented tube degradation). The rotating probe is sensitive to both axially and circumferentially oriented flaws. During these inspections, circumferential flaws were identified with the rotating probe that were near the inspection boundary (i.e., 5 inches below the top of the tubesheet). These tubes were taken out of service by plugging or sleeving. Given these results, it is likely that similar circumferential indications could be located below 5 inches from the top of the tubesheet, indicating the need to expand the inspection scope. SONGS, Unit 3 performed similar inspections and had similar results in past outages. To clearly delineate the scope of the steam generator tube inspections required in the tubesheet region, SCE submitted this amendment.

The licensee's basis for using the rotating probe to inspect from the top of the tubesheet to 5 inches below the top of the tubesheet relies on arguments similar to that used in determining the W* tube repair criteria discussed above. The licensee's methodology (documented in WCAP-15894-P, Revision 0, "NDE Inspection Strategy for the Tubesheet Region in SONGS Units 2 and 3,") is similar, but not identical, to the methodology approved for use at Diablo Canyon and Sequoyah. Some of the differences include:

(1) the secondary side pressure, which affects the loads the tubes are required to withstand, the contact pressure between the tube and the tubesheet, and the tubesheet hole dilation from bowing of the tubesheet,

(2) the primary temperature, which affects the contact pressure between the tube and the tubesheet due to thermal expansion, and the tubesheet hole dilation from bowing of the tubesheet,

(3) the radial contact pressure as a result of the expansion process (i.e., expansion preload),

(4) the coefficient of friction, and

(5) the methodology for accounting for tubesheet bow.

As a result of the differences between the two methodologies (i.e., the SONGS and the W* generic methodology), the inspection distances are different. The SONGS analysis indicates that 5 inches of non-degraded material (measured from the top of the tubesheet) is sufficient to prevent tube pullout and limit leakage during a steam line break. The generic W* analysis indicates that 5.2 inches of non-degraded material (measured from the bottom of the WEXTEX transition) for Zone A (peripheral zone) or 7.0 inches for Zone B is sufficient to prevent tube pullout and limit leakage during a steam line break.

To perform this review, the NRC relied on its previous evaluation of the generic methodology used in support of the Diablo Canyon W* alternate repair criteria, the similarities between the CE and Westinghouse explosive expansion methods, and the general insights provided in WCAP-15894-P, Revision 0. The W* generic methodology used bounding values for secondary side pressure. These values are conservative compared to San Onofre's expected secondary side pressure for the next operating cycle. As a result, the inspection distance for San Onofre will be less than the 7.0 inches approved for use at Diablo Canyon. In addition, the presence of the stay cylinder in the San Onofre steam generators is expected to limit the effect of tubesheet hole dilation resulting in an inspection distance less than the 7.0 inches approved for use at Diablo Canyon. These effects and others described above should result in an inspection distance more in line with the 5 inch inspection distance used at SONGS Unit 2. However, given the expedited schedule for this review, the NRC could not review the methodology provided by SCE in WCAP-15894-P, Revision 0 in sufficient detail to conclude, on a permanent basis, that inspecting 5 inches of each tube in the top of the tubesheet is sufficient to prevent tube pullout. Therefore, the licensee has proposed to limit the proposed TS change, which would justify inspecting only a limited portion of the tube within the tubesheet, to Cycle 12 operation for Unit 2 and Cycle 11 for Unit 3.

The NRC staff's analysis to justify operation during Cycle 12 for Unit 2 and Cycle 11 for Unit 3 is not only based specifically on calculations but on inspections, tube plugging, and conservatisms that exist that were not taken into account in the staff's approval of the Diablo Canyon W* repair criteria and in the licensee's evaluation.

These factors are as follows:

1. The licensee inspected the entire tube within the tubesheet region with a bobbin coil and plugged all tubes with flaws in this region. The bobbin coil is capable of detecting axially oriented flaws.

2. The licensee inspected from the top of the tubesheet to 5 inches below the top of the tubesheet with a rotating probe and plugged all tubes with flaws in this region. The rotating probe is capable of detecting both axially and circumferentially oriented flaws.

3. The generic W* distances of 7.0 inches for Zone B (interior of tube bundle) and 5.2 inches for Zone A (peripheral tubes) represent the most limiting lengths in those regions and bounds all other tubes in the zone. The generic W* distances were determined from lower bound tube pull forces for WEXTEX expansions (based on a smooth tubesheet hole) in order to maximize the W* distance and bound the variability in WEXTEX expansions. As discussed above, it is expected that the CE explanded joint would have a higher contact pressure than a Westinghouse WEXTEX joint. As a result, other factors being equal, it would be expected that the tube engagement required to prevent pullout in explanded joints would be less than that for WEXTEX joints.

4. The most limiting region of the tube bundle at San Onofre is in the interior of the tube bundle. If tubes in this region would begin to pull out of the tubesheet, they would be constrained by contact with neighboring tubes. As a result, the likelihood that a tube would pull out of the tube bundle is potentially limited. This effect was not considered in the development of the W* distance and adds conservatism to the evaluation.

5. The circumferential flaws identified within the tubesheet region during the 2002 inspections at SONGS 2 (WCAP-15894-P, Rev 0 would satisfy the structural performance criteria even if evaluated as freespan indications). As a result, even if similar indications existed below the portion of the tube inspected with a rotating probe and above the appropriate distance to prevent tube pullout at the beginning of cycle, the tubes would begin the cycle with margin to tube pull-out.

6. The WCAP submitted by San Onofre provides information that the tube-to-tubesheet joints will resist pullout. Although the NRC staff has raised a number of issues with respect to the results contained within this report, the report indicates that some joints will resist tube pullout with less than 5 inches of engagement. Some of the staff concerns with WCAP-15894-P, Revision 0 are attached as Enclosure 4. Conservatisms in the licensee's analysis include not taking credit for increases in the joint contact force due to differential thermal expansion and normal operating pressure.

Although the NRC staff did not conclude on a permanent basis that inspecting 5 inches of each tube in the top of the tubesheet is sufficient to prevent tube pullout, the staff did consider the W* evaluation for Westinghouse plants; the SONGS, Units 2&3 evaluation; the unaccounted for conservatisms in these analyses; and the most recent inspection results and associated corrective actions, to arrive at the conclusion that the licensee's proposal to limit the tube inspection to the uppermost 5 inches of the hot-leg tubesheet is an acceptable approach for one cycle of operation. As noted above, the topical report was not used as the sole basis for granting this amendment (nor has the staff approved the use of this topical report).

5.0 EXIGENT CIRCUMSTANCES

The Commission's regulation in 10 CFR 50.91(a)(6) provides for procedures in circumstances in which the licensee and the Commission must act quickly, and time does not permit the Commission to publish a *Federal Register* notice allowing 30 days for prior public comment on the NRC staff's proposed no significant hazards considerations (NSHC) determination. If the Commission finds that such exigent circumstances exist, and determines that the amendment involves NSHC the Commission will either: (1) Issue a *Federal Register* notice providing notice of an opportunity for hearing and allowing at least two weeks for prior public comment, or (2)

use local media to provide reasonable notice to the public in the area surrounding the facility of the requested amendment and the staff's proposed NSHC determination. In this case, the Commission used the first approach.

In addition, 10 CFR 50.91(a)(6)(vi) requires that the licensee explain the exigency and why the licensee cannot avoid it. Although the application is not organized explicitly to address this requirement, it does contain information explaining the exigency and why the licensee could not avoid it, as follows. During the refueling outage starting in May 2002, the licensee had planned to inspect the SONGS, Unit 2, steam generator tubes in the tubesheet region using the rotating plus point probe and the bobbin coil probe. The licensee planned to use the rotating plus point probe, which is qualified to detect circumferential indications, in the 5-inch tube length beginning at the top of the tubesheet. The licensee planned to use the bobbin coil probe, which is not qualified to detect circumferential indications but is qualified to detect axial indications, in the entire length of the tube in the tubesheet. Because the licensee had performed analyses that it believed demonstrated the resistance of tubes to pullout due to circumferential cracks occurring below 5 inches from the top of the tubesheet, the licensee believed it would satisfy its TS requirements.

After steam generator inspections at Sequoyah Nuclear Plant, Unit 2, in April 2002, the NRC staff learned that the Sequoyah licensee, the Tennessee Valley Authority (TVA), was relying on analyses similar to those relied upon by SCE, and performing similar steam generator tube inspections in the tubesheet. The NRC staff determined that the TVA analyses required staff review and approval. In the alternative, TVA could have expanded the scope of the rotating plus point probe inspections. In view of the circumstances at Sequoyah, SCE could not have avoided seeking an amendment to define the appropriate scope of required SG tube inspections and allow SONGS, Unit 2 to restart as scheduled, or perform additional inspections.

Upon learning of the NRC staff's determination with respect to Sequoyah, the licensee, in mid-May, informed the NRC staff that the issue raised with respect to Sequoyah might also exist at SONGS, Units 2 and 3 and applied for this amendment on May 22, 2002. Accordingly, the NRC staff concludes that the licensee has used its best efforts to make a timely application for the amendment, and did not create the exigency to take advantage of the procedure set forth in 10 CFR 50.91(c).

There were no public comments in response to the notice published in the *Federal Register*.

6.0 FINAL NO SIGNIFICANT HAZARDS CONSIDERATION DETERMINATION

The Commission's regulations in 10 CFR 50.92 state that the Commission may make a final determination that a license amendment involves NSHC if operation of the facility in accordance with the amendment would not: (1) involve a significant increase in the probability or consequences of an accident previously evaluated; or (2) create the possibility of a new or different kind of accident from any accident previously evaluated; or (3) involve a significant reduction in a margin of safety.

Operation of the facility in accordance with the proposed amendment will not involve a significant increase in the probability or consequences of an accident previously evaluated. SCE proposes to modify the SONGS, Units 2&3 TSs to define the steam generator tube inspection scope. The SONGS, Unit 2 and 3 specific analysis takes into account the reinforcing

effect the steam generator tubesheet has on the external surface of an expanded steam generator tube.

Tube-bundle structural integrity will not be adversely affected, during Cycle 12 operation for Unit 2 and Cycle 11 operation for Unit 3, by the implementation of the tube engagement area (TEA) tube inspection scope. Steam generator tube burst or collapse cannot occur within the confines of the steam generator tubesheet; therefore, the tube burst and collapse criteria of draft RG 1.121 are inherently met. Any degradation below the TEA length is shown by analyses and test/inspection results to be acceptable, during Cycle 12 for Unit 2 and Cycle 11 for Unit 3, thereby precluding an event with consequences similar to a postulated tube rupture event. Similarly, tube leakage will not be affected by the amendment. Adequate leakage integrity during transients and postulated accidents is demonstrated by showing that the resulting leakage from the tubes will not exceed a rate that would violate offsite or control room dose criteria. These criteria are specified, in part, in 10 CFR Part 100 and in General Design Criteria 19 of Appendix A to 10 CFR Part 50.

Tube burst is precluded for cracks within the steam generator tubesheet by the constraint provided by the steam generator tubesheet. Thus, structural integrity is maintained by the steam generator tubesheet constraint. However, a 360-degree circumferential crack or many axially oriented cracks could permit severing of the tube and tube pullout from the TS under the axial forces on the tube from primary to secondary pressure differentials. Testing was performed to define the length of non-degraded tubing that is sufficient to compensate for the axial forces on the tube and thus prevent pullout. The proposed inspection scope would cover the appropriate tube length, as determined by the staff's review which relied on its previous evaluation of the generic methodology used in support of the Diablo Canyon W* alternate repair criteria, the similarities between the CE and Westinghouse explosive expansion methods, and the general insights provided in WCAP-15894-P, Revision 0.

In view of the above, incorporation of the TEA inspection scope into SONGS, Units2&3 TSs maintains existing design limits during Cycle 12 operation for Unit 2 and Cycle 11 operation for Unit 3, and does not involve a significant increase in the probability or consequences of an accident previously evaluated.

Operation of the facility in accordance with the proposed amendment will not create the possibility of a new or different kind of accident from any accident previously evaluated. Tube-bundle integrity is expected to be maintained during all plant conditions upon implementation of the proposed tube inspection scope. Use of this scope does not induce a new tube degradation mechanism that would result in an accident different in kind from those previously analyzed. Even with the limiting circumstances of a complete circumferential separation of a tube occurring below the TEA length, steam generator tube pullout is precluded and leakage is predicted to be maintained within the Final Safety Analysis Report limits during all plant conditions during Cycle 12 operation for Unit 2 and Cycle 11 operation for Unit 3. Therefore, a possibility of a new or different kind of accident from any accident previously evaluated is not created.

Operation of the facility in accordance with the amendment will not involve a significant reduction in the margin of safety. Upon implementation of the TEA inspection scope, operational conditions in the explansion (explosive expansion process) region of the steam generator tubing below the TEA length will not change, and the tubes will continue to meet the margin of safety as defined by RG 1.121 and RG 1.83 and the requirements of General Design Criteria 14, 15, 31, and 32 during Cycle 12 operation for Unit 2 and Cycle 11 operation for Unit 3. Accordingly, the proposed change does not involve a significant reduction in a margin of safety.

Based upon the above considerations, the NRC staff concludes that the amendment meets the three criteria of 10 CFR 50.92. Therefore, the staff has made a final determination that the proposed amendment does not involve a significant hazards consideration.

7.0 STATE CONSULTATION

In accordance with the Commission's regulations, the California State official was notified of the proposed issuance of the amendment. The State official had no comments.

8.0 ENVIRONMENTAL CONSIDERATION

The amendments changes an inspection requirement. The NRC staff has determined that the amendments involve no significant increase in the amounts and no significant change in the types of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has made a final finding that the amendments involve no significant hazards consideration. Accordingly, the amendments meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b) no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

9.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendments will not be inimical to the common defense and security or to the health and safety of the public.

Principal Contributor: K. Karwoski

Date: June 17, 2002

San Onofre Nuclear Generating Station, Units 2 and 3
Steam Generator Tube Inspection Program
WCAP-15894-P, Revision 0

The NRC staff performed an initial review of WCAP-15894-P, Revision 0, and has identified a number of issues that will need resolution in order to approve a permanent technical specification change. These issues are summarized below.

Figure 4.5 and Tables 4-1 and 4-2 of WCAP-15894-P, Revision 0 provide the data supporting the required engagement length to resist tube pullout from the tubesheet. The data are from two sources (Boston Edison steam generator and rough collar specimens) and were tested with two different types of load cells (a constant load cell located in Chattanooga, Tennessee and a fixed displacement load cell located in Windsor, Connecticut). In addition, the specimens were of two different wall thicknesses (0.042-inch and 0.048-inch).

All of the specimens tested in Chattanooga (constant load) had a 0.042-inch wall thickness. These specimens were primarily from tubes from the Boston Edison steam generator, but included 2 rough collar specimens. All of the specimens tested in Windsor (fixed displacement) had a 0.048-inch wall thickness and were rough collar specimens. The purpose of testing the 2 rough collar specimens in Chattanooga was to show that the test setups provided comparable results. The Chattanooga and Windsor tests were run at various temperatures (ambient and 585°F) and pressures (ambient and normal operating pressure). All of the specimens were fabricated and tested using qualified procedures and techniques.

Evaluating the data in Figure 4.5, it is clear that all of the specimens tested at Chattanooga (constant load) had lower pullout forces than those tested at Windsor (fixed displacement) for a given joint length. This effect could be attributable to one or more of several factors including: (1) differences arising from the different load cells, (2) differences in tube wall thickness (0.42 at Chattanooga and 0.48 at Windsor), (3) differences in the surface roughness between the Boston Edison steam generator and the rough collar specimens, and (4) differences in the yield strength of the tube and the resultant contact pressures.

The rough collar specimens and the Boston Edison specimens exhibit some scatter. This scatter can be attributed to various factors including: (1) test repeatability, (2) differences in testing parameters (temperature and pressure), (3) differences in tube material properties, and (4) differences in tubesheet hole surface roughness.

The licensee has argued that the lower pullout forces for the Boston Edison steam generator are primarily a tube wall thickness effect and that the one rough collar specimen tested at Chattanooga with a low pullout force is an outlier. In addition, they have argued that the tubesheet hole surface roughness between the specimens is comparable.

There are many factors that can affect tube pullout. In addition, it is expected that there would be variability in the results because of variability in fabrication parameters. These variabilities should be accounted for in the determination of the inspection distance since the resistance to tube pullout for each and every tube is not known. The analysis provided in WCAP-15894-P did not appear to account for the variability in the results. In addition, data confirming the magnitude of various effects was not provided. For example, the licensee indicated that the difference between the tube pullout forces from the Windsor and the Chattanooga tests were a result of the tube wall thickness; however, no data was provided to support the observation that the effect would be of the magnitude seen. That is, although tube wall thickness may have

some effect, the WCAP did not appear to address whether the entire effect being observed was a result of tube wall thickness, variabilities in surface roughness, or the type of load cell.

In addition, several unexpected trends were observed in the results. Namely, as the temperature and pressure are increased in a tube, it is normally expected that a larger force would be required to pull a tube out of the steam generator tubesheet. The results did not indicate this trend except for the one specimen considered as an outlier. The reasons for the atypical results were not specified nor was a reason provided for why some specimens exhibited atypical results while others didn't.

In addition to determining the resistance of a tube to pullout, another important factor in determining the inspection distance is determining the amount of leakage that could come from these joints during normal operation or steam line break. As discussed in the WCAP, room temperature leak rate measurements were made both from the Boston Edison steam generator specimens and the rough collar specimens. Similar to the pullout tests, there was an "outlier" rough collar specimen that leaked at a greater rate than any of the other specimens.

In addition to the room temperature tests, several elevated temperature tests were performed. Also similar to the pullout tests, there was one case (in the two tested) where the effects of temperature were not as great as expected. This observation was attributed to the specimen leaking near the minimum detectable level of leakage. In the other case, the expected effect with temperature was observed, although this comparison involved the specimen which gave the "outlier" results in the room temperature tests. Given these results and the results from the pullout tests, it is not clear whether the temperature effect is as great as originally anticipated. In addition, it was not clear whether the leak rate tests addressed the effects of tubesheet bowing.