SOUTHERN CALIFORNIA
EDISON®
An EDISON INTERNATIONAL® Company

Brian Katz
Vice President

June 28, 2007

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

Subject: **San Onofre Nuclear Generating Station, Units 2 and 3**
Docket Nos. 50-361 and 50-362
Response to Request for Additional Information and Submittal of Supplement 1 to Proposed Technical Specification Change Number NPF-10/15-572 License Amendment Request, "Proposed Technical Specification Change, Steam Generator Tube Surveillance Program, Tube Repair"

References:

1. Letter from A. E. Scherer (SCE) to Document Control Desk dated October 26, 2004, Subject: Docket Nos. 50-361 and 50-362, NRC Generic Letter 2004-01 Requirements for Steam Generator Tube Inspections, San Onofre Nuclear Generating Station, Units 2 and 3

2. Letter from A. E. Scherer (SCE) to Document Control Desk dated November 23, 2005, Subject: Docket Nos. 50-361 and 50-362, NRC Generic Letter 2004-01 Requirements for Steam Generator Tube Inspections, Additional Information, San Onofre Nuclear Generating Station, Units 2 and 3

3. Letter from N. Kalyanam (NRC) to Mr. Richard M. Rosenblum (SCE) dated January 18, 2006, Subject: San Onofre Nuclear Generating Station (SONGS), Unit 2 – Request for Additional Information Concerning Response to Generic Letter 2004-01, "Requirements for Steam Generator Tube Inspections" (TAC NO. MC4849)

P.O. Box 128
San Clemente, CA 92674-0128
949-368-9275
Fax 949-368-9881

A001

NRR

4. Letter from Brian Katz (SCE) to NRC (Document Control Desk) Dated July 14, 2006, Subject: San Onofre Nuclear Generating Station, Units 2 and 3, Docket Nos. 50-361 and 50-362, Response to Request For Additional Information and Submittal of Proposed Technical Specification Change Number (PCN) 572, Steam Generator Tube Surveillance Program, Tube Repair

5. Letter from D. Terao (NRC) to Richard M. Rosenblum (SCE) Dated December 7, 2006, Subject: San Onofre Nuclear Generating Station, Unit 2 – Evaluation of the Response to Generic Letter 2004-01, "Requirements for Steam Generator Tube Inspections" (TAC NO. MC4849)

6. Letter from N. Kalyanam (NRC) to Mr. Richard M. Rosenblum (SCE) dated May 17, 2007, Subject: San Onofre Nuclear Generating Station, Units 2 and 3 – Request for Additional Information on the Proposed Amendment on Steam Generator Tube Surveillance Program, Tube Repair (TAC Nos. MD2584 and MD2585)

Dear Sir or Madam:

This letter provides information that was requested by the NRC staff in Reference 6. Revisions to San Onofre Units 2 and 3 Proposed Change Number (PCN) 572 are also included since the TS has been amended since PCN 572 submission.

By Reference 1, Southern California Edison (SCE) submitted a required response to the Nuclear Regulatory Commission (NRC) Generic Letter GL-2004-01. A response to a Request for Additional Information (RAI) received in October 2004 was provided in Reference 2. NRC staff requested additional information in Reference 3. This information and a resulting proposed Technical Specification (TS) change was provided in Reference 4. Subsequently, NRC staff concluded in Reference 5 that SCE's overall response to GL-2004-01 was acceptable since SCE is in the process of modifying its TSs (Reference 4) consistent with the NRC staff's position outlined in GL 2004-01.

Enclosure 3, (Supplement 1 to PCN-572) is SCE's response to Request Number 2 of Reference 6. Enclosure 4 is the Westinghouse response to Requests Number 1 and 3 through 20.

Also, this Supplement 1 submittal provides the revised pages to implement PCN-572 upon NRC approval.

The No Significant Hazards Consideration and Environmental Evaluation provided with PCN-572 both remain bounding.

Should you have any questions, or require additional information, please contact Ms. L. T. Conklin at (949) 368-9443.

Sincerely,

Brian Katz

Enclosures:

1. Notarized affidavit, Unit 2
2. Notarized affidavit, Unit 3
3. Supplement 1 to the Proposed License Amendment Request, Proposed Change Number 572, with attachments A – D (revised Technical Specification change pages)
4. Westinghouse Response to NRC Request for Additional Information Regarding SONGS 2 and 3 Steam Generator Tube Surveillance Technical Specification Amendment

cc: B. S. Mallett, Regional Administrator, NRC Region IV
N. Kalyanam, NRC Project Manager, San Onofre Units 2 and 3
C. C. Osterholtz, NRC Senior Resident Inspector, San Onofre Units 2 and 3
S. Y. Hsu, California Department of Health Services, Radiologic Health Branch

Enclosure 1

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Application of SOUTHERN CALIFORNIA	)	
EDISON COMPANY, ET AL. for a Class 103	)	Docket No. 50-361
License to Acquire, Possess, and Use	)	Supplement 1 to
a Utilization Facility as Part of	)	Amendment Application
Unit No. 2 of the San Onofre Nuclear	)	No. 245
Generating Station	)	

SOUTHERN CALIFORNIA EDISON COMPANY, ET AL. pursuant to 10 CFR 50.90, hereby submit Supplement 1 to Amendment Application No. 245. This amendment application consists of Supplement 1 to Proposed Change No. 572 which is a request to revise Facility Operating License NPF-10 to update the Technical Specification steam generator program.

State of California
County of San Diego

Brian Katz

Brian Katz, Vice President

Subscribed and sworn to ~~(or affirmed)~~ before me on this 28th day of

June, 2007,

by Brian Katz

personally known to me ~~or proved to me on the basis of satisfactory evidence~~ to be the person who appeared before me.

Dawn A. Farrell

Notary Public

DAWN A. FARRELL
Commission # 1623105
Notary Public - California
San Diego County
My Comm. Expires Nov 20, 2009

Enclosure 2

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Application of SOUTHERN CALIFORNIA EDISON COMPANY, ET AL. for a Class 103 License to Acquire, Possess, and Use a Utilization Facility as Part of Unit No. 3 of the San Onofre Nuclear Generating Station	))))))	Docket No. 50-362 Supplement 1 to Amendment Application No. 230

SOUTHERN CALIFORNIA EDISON COMPANY, ET AL. pursuant to 10 CFR 50.90, hereby submit Supplement 1 to Amendment Application No. 230. This amendment application consists of Supplement 1 to Proposed Change No. 572 which is a request to revise Facility Operating License NPF-15 to update the Technical Specification steam generator program.

State of California
County of San Diego

Brian Katz
Brian Katz, Vice President

Subscribed and sworn to ~~(or affirmed)~~ before me on this 28th day of

June, 2007,

by Brian Katz

personally known to me ~~or proved to me on the basis of satisfactory evidence~~ to be the person who appeared before me.

Dawn A. Farrell
Notary Public

DAWN A. FARRELL
Commission # 1623108
Notary Public - California
San Diego County
My Comm. Expires Nov 20, 2009

ENCLOSURE 3

Supplement 1 to the Proposed License Amendment Request

Proposed Change Number 572 with attachments A – D
(revised Technical Specification change pages)

LICENSEE'S EVALUATION

DESCRIPTION FOR PROPOSED TECHNICAL SPECIFICATION CHANGE
NPF-10/15-572 SUPPLEMENT 1,
STEAM GENERATOR TUBE SURVEILLANCE PROGRAM, TUBE REPAIR
San Onofre Nuclear Generating Station Units 2 and 3

PCN-572 SUPPLEMENT 1 PROPOSED TECHNICAL SPECIFICATION CHANGE REVISIONS (changes indicated by highlight and strikeout on approved Technical Specification pages)

Unit 2: see Attachment A
Unit 3: see Attachment B

PCN-572 SUPPLEMENT 1 PROPOSED TECHNICAL SPECIFICATIONS PAGES (New Pages)

Unit 2: see Attachment C
Unit 3: see Attachment D

1.0 INTRODUCTION

This supplement to PCN-572 provides revised proposed Technical Specification change pages that provide consistency with the approved Technical Specifications that incorporated:

- Technical Specification Task Force (TSTF)-449 Unit 2 and 3 amendments 204 and 196, respectively, that were issued by the NRC on September 19, 2006.
- Modified definitions of steam generator tube "Repair Limit" and "Tube Inspection" for Units 2 and 3, amendments 206 and 198 respectively, that were issued by the NRC on November 9, 2006.

2.0 PROPOSED CHANGE

A letter was issued by the NRC on September 19, 2006 issuing San Onofre Unit 2 and 3 Amendments 204 and 196, respectively, approving SCE Technical Specification proposed change (PCN)-564 which incorporates TSTF-449, "Steam Generator Tube Integrity." Another letter was issued by the NRC on November 9, 2006 issuing San Onofre Unit 2 and 3 Amendments 206 and 198, respectively, approving SCE Technical Specification PCN-565 which modified the definitions of steam generator tube "Repair Limit" and "Tube Inspection". Since Amendments 204, 196, 206 and 198 introduced significant revisions to Technical Specification 5.5.2.11, "Steam Generator (SG) Program," it is now necessary to revise the PCN-572 proposed Technical Specification changed pages accordingly. This Supplement 1 submittal provides the revised pages to implement PCN-572

Amendments onto the currently approved San Onofre Units 2 and 3 Technical Specification pages upon NRC approval.

3.0 REGULATORY SAFETY ANALYSIS

The No Significant Hazards Consideration and Environmental Evaluation provided with PCN-572 both remain bounding.

Attachment A

PCN-572 SUPPLEMENT 1

PROPOSED TECHNICAL SPECIFICATION CHANGE REVISIONS
(changes indicated by highlight and strikeout on approved Technical Specification pages)

SONGS Unit 2

5.5 Procedures, Programs, and Manuals (continued)

5.5.2.11 Steam Generator (SG) Program (continued)

c) For tubes that have been repaired in the hot leg tubesheet region: Below the bottom of the lower sleeve-to-tube joint or greater than 10.6 inches below the bottom of the hot leg expansion transition or greater than 10.6 inches below the top of the hot leg tubesheet, whichever of these three is lowest.

d) For tubes that have been repaired in the cold leg tubesheet region: Below the bottom of the lower sleeve-to-tube joint or greater than 11.0 inches below the bottom of the cold leg expansion transition or greater than 11.0 inches below the top of the cold leg tubesheet, whichever of these three is lowest.

d. Provisions for SG tube inspections. Periodic SG tube inspections shall be performed. The number and portions of the tubes inspected and methods of inspection shall be performed with the objective of detecting flaws of any type (e.g., volumetric flaws, axial and circumferential cracks) that may be present along the length of the tube, from the tube-to-tubesheet weld at the tube inlet to the tube-to-tubesheet weld at the tube outlet, and that may satisfy the applicable tube repair criteria. The tube-to-tubesheet weld is not part of the tube. In tubes repaired by sleeving, the portion of the original tube wall between the sleeve's joints is not an area requiring re-inspection.

---NOTE---

The requirement for methods of inspection with the objective of detecting flaws of any type (e.g., volumetric flaws, axial and circumferential cracks) that may be present along the length of the tube does not apply to the portion of the original tube wall adjacent to the nickel band portion (the lower half) of the lower joint for the repair process that is discussed in Technical Specification (TS) 5.5.2.11.f.1. However, the method of inspection in this area should be a rotating plus point (or equivalent) coil. The SG tube repair criterion of TS 5.5.2.11.c.3.b is applicable to flaws in this area.

In addition to meeting the requirements of d.1, d.2, d.3, and d.4 below, the inspection scope, inspection methods, and inspection intervals shall be such as to ensure that SG tube integrity is maintained until the next SG inspection. An assessment of degradation shall be performed to determine the

5.5 Procedures, Programs, and Manuals (continued)

5.5.2.11 Steam Generator (SG) Program (continued)

type and location of flaws to which the tubes may be susceptible and, based on this assessment, to determine which inspection methods need to be employed and at what locations.

1. Inspect 100% of the tubes in each SG during the first refueling outage following SG replacement.

2. Inspect 100% of the tubes at sequential periods of 60 effective full power months. The first sequential period shall be considered to begin after the first inservice inspection of the SGs. No SG shall operate for more than 24 effective full power months or one refueling outage (whichever is less) without being inspected.

3. If crack indications are found in any SG tube, then the next inspection for each SG for the degradation mechanism that caused the crack indication shall not exceed 24 effective full power months or one refueling outage (whichever is less). If definitive information, such as from examination of a pulled tube, diagnostic non-destructive testing, or engineering evaluation indicates that a crack-like indication is not associated with a crack(s), then the indication need not be treated as a crack.

4. All sleeves shall be inspected with eddy current prior to initial operation. This includes pressure retaining portions of the parent tube in contact with the sleeve, the sleeve-to-tube weld and the pressure retaining portion of the sleeve.

e. Provisions for monitoring operational primary to secondary LEAKAGE.

f. Provisions for SG tube repair methods. Steam generator tube repair methods shall provide the means to re-establish the RCS pressure boundary integrity of SG tubes without removing the tube from service. For the purposes of these Specifications, tube plugging is not a repair. All acceptable tube repair methods are listed below.

1. TIG welded sleeving with heat treatment, as described in ABB/CE Topical Report, CEN-630-P, Rev. 2, is currently approved by the NRC.

Tube repair can be performed on certain tubes that have been previously plugged as a corrective or preventive measure. A tube inspection of the entire length of the tube shall be performed on a previously plugged tube prior to returning the tube to service.

Attachment B

PCN-572 SUPPLEMENT 1

PROPOSED TECHNICAL SPECIFICATION CHANGE REVISIONS
(changes indicated by highlight and strikeout on approved Technical Specification pages)

SONGS Unit 3

5.5.2.11 Steam Generator (SG) Program (continued)

c) For tubes that have been repaired in the hot leg tubesheet region: Below the bottom of the lower sleeve-to-tube joint or greater than 10.6 inches below the bottom of the hot leg expansion transition or greater than 10.6 inches below the top of the hot leg tubesheet, whichever of these three is lowest.

d) For tubes that have been repaired in the cold leg tubesheet region: Below the bottom of the lower sleeve-to-tube joint or greater than 11.0 inches below the bottom of the cold leg expansion transition or greater than 11.0 inches below the top of the cold leg tubesheet, whichever of these three is lowest.

d. Provisions for SG tube inspections. Periodic SG tube inspections shall be performed. The number and portions of the tubes inspected and methods of inspection shall be performed with the objective of detecting flaws of any type (e.g., volumetric flaws, axial and circumferential cracks) that may be present along the length of the tube, from the tube-to-tubesheet weld at the tube inlet to the tube-to-tubesheet weld at the tube outlet, and that may satisfy the applicable tube repair criteria. The tube-to-tubesheet weld is not part of the tube. In tubes repaired by sleeving, the portion of the original tube wall between the sleeve's joints is not an area requiring re-inspection.

--------------------------NOTE------------------------------

The requirement for methods of inspection with the objective of detecting flaws of any type (e.g., volumetric flaws, axial and circumferential cracks) that may be present along the length of the tube does not apply to the portion of the original tube wall adjacent to the nickel band portion (the lower half) of the lower joint for the repair process that is discussed in Technical Specification (TS) 5.5.2.11.f.1. However, the method of inspection in this area should be a rotating plus point (or equivalent) coil. The SG tube repair criterion of TS 5.5.2.11.c.3.b is applicable to flaws in this area.

In addition to meeting the requirements of d.1, d.2, d.3, and d.4 below, the inspection scope, inspection methods, and inspection intervals shall be such as to ensure that SG tube integrity is maintained until the next SG inspection. An assessment of degradation shall be performed to determine the

5.5 Procedures, Programs, and Manuals (continued)

5.5.2.11 Steam Generator (SG) Program (continued)

type and location of flaws to which the tubes may be susceptible and, based on this assessment, to determine which inspection methods need to be employed and at what locations.

1. Inspect 100% of the tubes in each SG during the first refueling outage following SG replacement.

2. Inspect 100% of the tubes at sequential periods of 60 effective full power months. The first sequential period shall be considered to begin after the first inservice inspection of the SGs. No SG shall operate for more than 24 effective full power months or one refueling outage (whichever is less) without being inspected.

3. If crack indications are found in any SG tube, then the next inspection for each SG for the degradation mechanism that caused the crack indication shall not exceed 24 effective full power months or one refueling outage (whichever is less). If definitive information, such as from examination of a pulled tube, diagnostic non-destructive testing, or engineering evaluation indicates that a crack-like indication is not associated with a crack(s), then the indication need not be treated as a crack.

4. All sleeves shall be inspected with eddy current prior to initial operation. This includes pressure retaining portions of the parent tube in contact with the sleeve, the sleeve-to-tube weld and the pressure retaining portion of the sleeve.

e. Provisions for monitoring operational primary to secondary LEAKAGE.

f. Provisions for SG tube repair methods. Steam generator tube repair methods shall provide the means to re-establish the RCS pressure boundary integrity of SG tubes without removing the tube from service. For the purposes of these Specifications, tube plugging is not a repair. All acceptable tube repair methods are listed below.

1. TIG welded sleeving with heat treatment, as described in ABB/CE Topical Report, CEN-630-P, Rev. 2, is currently approved by the NRC.

   Tube repair can be performed on certain tubes that have been previously plugged as a corrective or preventive measure. A tube inspection of the entire length of the tube shall be performed on a previously plugged tube prior to returning the tube to service.

Attachment C

PCN-572 SUPPLEMENT 1 PROPOSED TECHNICAL SPECIFICATIONS PAGES
(New Pages)

SONGS Unit 2

5.5 Procedures, Programs, and Manuals (continued)

5.5.2.11 Steam Generator (SG) Program (continued)

c) For tubes that have been repaired in the hot leg tubesheet region: Below the bottom of the lower sleeve-to-tube joint or greater than 10.6 inches below the bottom of the hot leg expansion transition or greater than 10.6 inches below the top of the hot leg tubesheet, whichever of these three is lowest.

d) For tubes that have been repaired in the cold leg tubesheet region: Below the bottom of the lower sleeve-to-tube joint or greater than 11.0 inches below the bottom of the cold leg expansion transition or greater than 11.0 inches below the top of the cold leg tubesheet, whichever of these three is lowest.

d. Provisions for SG tube inspections. Periodic SG tube inspections shall be performed. The number and portions of the tubes inspected and methods of inspection shall be performed with the objective of detecting flaws of any type (e.g., volumetric flaws, axial and circumferential cracks) that may be present along the length of the tube, from the tube-to-tubesheet weld at the tube inlet to the tube-to-tubesheet weld at the tube outlet, and that may satisfy the applicable tube repair criteria. The tube-to-tubesheet weld is not part of the tube. In tubes repaired by sleeving, the portion of the original tube wall between the sleeve's joints is not an area requiring re-inspection.

-------------------------NOTE-----------------------------
The requirement for methods of inspection with the objective of detecting flaws of any type (e.g., volumetric flaws, axial and circumferential cracks) that may be present along the length of the tube does not apply to the portion of the original tube wall adjacent to the nickel band portion (the lower half) of the lower joint for the repair process that is discussed in Technical Specification (TS) 5.5.2.11.f.1. However, the method of inspection in this area should be a rotating plus point (or equivalent) coil. The SG tube repair criterion of TS 5.5.2.11.c.3.b is applicable to flaws in this area.

In addition to meeting the requirements of d.1, d.2, d.3, and d.4 below, the inspection scope, inspection methods, and inspection intervals shall be such as to ensure that SG tube integrity is maintained until the next SG inspection. An assessment of degradation shall be performed to determine the

5.5 Procedures, Programs, and Manuals (continued)

5.5.2.11 Steam Generator (SG) Program (continued)

type and location of flaws to which the tubes may be susceptible and, based on this assessment, to determine which inspection methods need to be employed and at what locations.

1. Inspect 100% of the tubes in each SG during the first refueling outage following SG replacement.

2. Inspect 100% of the tubes at sequential periods of 60 effective full power months. The first sequential period shall be considered to begin after the first inservice inspection of the SGs. No SG shall operate for more than 24 effective full power months or one refueling outage (whichever is less) without being inspected.

3. If crack indications are found in any SG tube, then the next inspection for each SG for the degradation mechanism that caused the crack indication shall not exceed 24 effective full power months or one refueling outage (whichever is less). If definitive information, such as from examination of a pulled tube, diagnostic non-destructive testing, or engineering evaluation indicates that a crack-like indication is not associated with a crack(s), then the indication need not be treated as a crack.

4. All sleeves shall be inspected with eddy current prior to initial operation. This includes pressure retaining portions of the parent tube in contact with the sleeve, the sleeve-to-tube weld and the pressure retaining portion of the sleeve.

e. Provisions for monitoring operational primary to secondary LEAKAGE.

f. Provisions for SG tube repair methods. Steam generator tube repair methods shall provide the means to re-establish the RCS pressure boundary integrity of SG tubes without removing the tube from service. For the purposes of these Specifications, tube plugging is not a repair. All acceptable tube repair methods are listed below.

1. TIG welded sleeving with heat treatment, as described in ABB/CE Topical Report, CEN-630-P, Rev. 2, is currently approved by the NRC.

   Tube repair can be performed on certain tubes that have been previously plugged as a corrective or preventive measure. A tube inspection of the entire length of the tube shall be performed on a previously plugged tube prior to returning the tube to service.

Attachment D

PCN-572 SUPPLEMENT 1 PROPOSED TECHNICAL SPECIFICATIONS PAGES
(New Pages)

SONGS Unit 3

5.5 Procedures, Programs, and Manuals (continued)

5.5.2.11 Steam Generator (SG) Program (continued)

c) For tubes that have been repaired in the hot leg tubesheet region: Below the bottom of the lower sleeve-to-tube joint or greater than 10.6 inches below the bottom of the hot leg expansion transition or greater than 10.6 inches below the top of the hot leg tubesheet, whichever of these three is lowest.

d) For tubes that have been repaired in the cold leg tubesheet region: Below the bottom of the lower sleeve-to-tube joint or greater than 11.0 inches below the bottom of the cold leg expansion transition or greater than 11.0 inches below the top of the cold leg tubesheet, whichever of these three is lowest.

d. Provisions for SG tube inspections. Periodic SG tube inspections shall be performed. The number and portions of the tubes inspected and methods of inspection shall be performed with the objective of detecting flaws of any type (e.g., volumetric flaws, axial and circumferential cracks) that may be present along the length of the tube, from the tube-to-tubesheet weld at the tube inlet to the tube-to-tubesheet weld at the tube outlet, and that may satisfy the applicable tube repair criteria. The tube-to-tubesheet weld is not part of the tube. In tubes repaired by sleeving, the portion of the original tube wall between the sleeve's joints is not an area requiring re-inspection.

--------------------------NOTE------------------------------

The requirement for methods of inspection with the objective of detecting flaws of any type (e.g., volumetric flaws, axial and circumferential cracks) that may be present along the length of the tube does not apply to the portion of the original tube wall adjacent to the nickel band portion (the lower half) of the lower joint for the repair process that is discussed in Technical Specification (TS) 5.5.2.11.f.1. However, the method of inspection in this area should be a rotating plus point (or equivalent) coil. The SG tube repair criterion of TS 5.5.2.11.c.3.b is applicable to flaws in this area.

In addition to meeting the requirements of d.1, d.2, d.3, and d.4 below, the inspection scope, inspection methods, and inspection intervals shall be such as to ensure that SG tube integrity is maintained until the next SG inspection. An assessment of degradation shall be performed to determine the

5.5.2.11 Steam Generator (SG) Program (continued)

type and location of flaws to which the tubes may be susceptible and, based on this assessment, to determine which inspection methods need to be employed and at what locations.

1. Inspect 100% of the tubes in each SG during the first refueling outage following SG replacement.

2. Inspect 100% of the tubes at sequential periods of 60 effective full power months. The first sequential period shall be considered to begin after the first inservice inspection of the SGs. No SG shall operate for more than 24 effective full power months or one refueling outage (whichever is less) without being inspected.

3. If crack indications are found in any SG tube, then the next inspection for each SG for the degradation mechanism that caused the crack indication shall not exceed 24 effective full power months or one refueling outage (whichever is less). If definitive information, such as from examination of a pulled tube, diagnostic non-destructive testing, or engineering evaluation indicates that a crack-like indication is not associated with a crack(s), then the indication need not be treated as a crack.

4. All sleeves shall be inspected with eddy current prior to initial operation. This includes pressure retaining portions of the parent tube in contact with the sleeve, the sleeve-to-tube weld and the pressure retaining portion of the sleeve.

e. Provisions for monitoring operational primary to secondary LEAKAGE.

f. Provisions for SG tube repair methods. Steam generator tube repair methods shall provide the means to re-establish the RCS pressure boundary integrity of SG tubes without removing the tube from service. For the purposes of these Specifications, tube plugging is not a repair. All acceptable tube repair methods are listed below.

1. TIG welded sleeving with heat treatment, as described in ABB/CE Topical Report, CEN-630-P, Rev. 2, is currently approved by the NRC.

   Tube repair can be performed on certain tubes that have been previously plugged as a corrective or preventive measure. A tube inspection of the entire length of the tube shall be performed on a previously plugged tube prior to returning the tube to service.

ENCLOSURE 4

Westinghouse Response to NRC Request for Additional Information Regarding SONGS 2 and 3 Steam Generator Tube Surveillance Technical Specification Amendment

REQUEST FOR ADDITIONAL INFORMATION REGARDING SAN ONOFRE NUCLEAR GENERATING STATION, UNITS 2 AND 3 STEAM GENERATOR TUBE SURVEILLANCE TECHNICAL SPECIFICATION AMENDMENT (TAC Nos. MD2584 and MD2585)

Docket Nos. 50-361 and 50-362

1. Several analyses were performed as part of the original qualification program of the sleeves as documented in Topical Report (TR) CEN-630-P, Revision 2, "Repair of 3/4 Inch OD Steam Generator Tubes Using Leak Tight Sleeves," dated June 1997. However, in your letter dated July 14, 2006, you addressed only the tensile and leakage testing of the sleeve joint. Please discuss why the additional analyses/testing are not applicable to this proposal or provide the technical justification demonstrating that the lower sleeve joint (without taking credit for the nickel-band portion of the joint) still meets the original acceptance criteria.

Response: A review of the original program was performed. Based on the analytical effort which evaluated expected resistive load capability as a function of joint length performed prior to the commencement of the test program, it was judged that additional testing was not necessary to establish integrity over the limited operating period until steam generator (SG) replacement. Most of the analytical evaluation deals with fatigue usage and stress levels within the sleeve or weld, and either does not affect the roll joint, or is unaffected by the condition of the tube behind the sleeve. Note that the analytical evaluation of joint integrity as a function of length predicted resistive load capabilities far less than observed from testing. This is a function of the applied coefficient of friction for the microlok region and assumptions applied to the tube-sleeve interface in the nickel band area, which assumed no resistive load contribution from the nickel band area.

In addition, the overall sleeved tube system should be considered. The elevation of the hardroll joint is the approximate mid-point of the tubesheet, thus, the hardroll joint is located approximately 11 inches below the top of tubesheet. The sleeve length prohibits installation in peripheral tubes. If it were assumed that the tube experienced a complete circumferential separation at the top of tubesheet and it were assumed that the hardroll joint slips, any postulated hardroll joint (and tube above tubesheet) displacement would be limited by the restraint afforded by the tube support system. Vertical displacement of the horizontal run section of tube is limited by the vertical strap tube support system. Postulated displacement of the tube in the square bend region is limited by surrounding tubes. Vertical displacement of the vertical section of tubing is limited by the eggcrate structures and surrounding tubes; i.e., a tube cannot deflect out of plane without interacting with surrounding tubes.

Additionally, the tube in tubesheet expansion should be considered. The expanded tube length above the tube to sleeve hardroll connection of approximately 11 inches far exceeds the expanded tube length required to resist tube displacement of approximately 5 inches. Thus no relative motion of the tube is expected during any loading condition. For the postulated case of axial degradation of the parent tube adjacent to the sleeve nickel-band radial displacement of the tube is precluded by the tubesheet proximity. The inherent residual preload developed within the expanded sleeve applies a constant normal force to the tube/tubesheet interface. The tube portion below the sleeve is similarly restrained from relative motion by the expanded tube length below the sleeve and tube to tubesheet weld. The original estimation of joint capabilities developed in WOG-05-338 establish that conservative estimates of joint capability far exceed any postulated compressive loading developed within the sleeve due to thermal effects thus the joint will remain in an elastic state, even for the conservative assumed boundary conditions presented by WOG-05-338. Furthermore, normal tubesheet deflection and associated tube hole deformations below the tubesheet neutral axis act to constrict the tube hole. Any assumed condition of joint slippage in the negative direction would encounter a reduced tube inside diameter further reducing any potential for slippage in the negative direction.

Thus additional testing was judged unnecessary when the entire sleeved tube system is considered, not just the lower hardroll joint individually.

2. Your proposed revisions to your Technical Specifications (TSs) were based on the version of the TSs that was applicable in July 2006. However, these pages were subsequently changed for Amendments 206 and 198, issued on November 9, 2006, for San Onofre Nuclear Generating Station, Units 2 and 3 (SONGS 2 and 3). Please discuss your plans for updating your submittal.

In addition, since your proposal is an exception to the requirement that the tubes shall be inspected with the objective of detecting flaws of any type that may be present along the length of the tubes and that may satisfy the applicable tube repair criteria, you may want to consider adding a footnote to this requirement. Such a footnote should indicate that this requirement would not apply to the portion of the parent tube adjacent to the nickel-band portion (the lower half) of the lower joint for the repair process discussed in TS 5.5.2.11.f.1 that is formed by hard rolling; however, inspections with a +PointTM coil (or equivalent technique) should be performed in this area and tubes with flaws should be plugged in accordance with TS 5.5.2.11.c.3. If you elect to reference the basis for this proposed exception to the inspection requirements in your TS, please include the entire technical basis which would include any responses to the Nuclear Regulatory Commission staff's requests for additional information.

Response: The response to request number 2 will be provided by SCE.

3. The end cap load associated with three-times-the-normal operating pressure differential reported in the July 14, 2006, letter appear to be different than those in the original TR. Please discuss the reason for the differences.

Response: The July 14, 2006 three times normal operating pressure differential ($3\Delta P$) is specific to San Onofre at current plant conditions. The value of 1515 lb is developed using a $3\Delta P$ value of 4350 psi (3 x 1450 psi) with an expanded tube inside diameter of 0.666 inch. A review of CEN-630-P could not identify a specific reference to a $3\Delta P$ end cap load. Section 8 of CEN-630-P uses a primary to secondary pressure differential of 1435 psi when evaluating sleeve minimum wall thickness requirements. The primary to secondary differential pressure used in CEN-630-P was intended to bound operating plant conditions at the time of preparation of the technical report.

The use of a $3\Delta P$ end cap load in the July 14, 2006 letter is intended to show the margin available in comparison with "burst" requirements. For a sleeved tube a burst condition could be postulated in the event that the parent tube experiences a postulated circumferential separation and subsequent lower joint slippage causes the sleeve end to be displaced above the top of tubesheet. Such a condition could lead to steam generator tube rupture type release rates.

4. The axial load capabilities of the joints in the recent testing appear higher than the results in the original testing. Please discuss the reasons for this. If the reason is attributed to using "first slip" loads rather than "no slip" loads, please provide the "no slip" loads for the recent testing and discuss whether the conclusions are still valid when the "no slip" loads are used.

Response: The original rolled joint test program described by ABB-CE Report TR-ESE-887 and summarized in CEN-630-P, Revision 2 used 0.750 inch outside diameter (OD) x 0.043 wall thickness tubing with mechanical roll expansion of the tube into a simulated tubesheet collar. Rolled tube inside diameter (ID) large as 0.694 inch was used in the original test program. The maximum tubesheet hole ID for Model D SGs is 0.767 inch. At 4 to 6% wall thinning the Model D SG tube ID is approximately 0.686 inch. The Combustion Engineering expanded tube ID is approximately 0.664 inch after explosive expansion (trade name "explansion"). The 0.664 inch diameter is developed using the largest tubesheet hole of 0.758 inch diameter, with nominal tube wall thickness reduced by 1 mil for constant area expansion to contact with tubesheet. For the original testing the amount of roll torque required to achieve contact between the tube and sleeve would be greater than for a program which is based on Combustion Engineering SG tube sizes and tubesheet hole diameters. Thus a greater amount of remaining rolling energy is present to perform additional expansion work in the more recent testing.

The original joint testing work, in about half of the cases, did not complete the loading process to sleeve slippage. The original testing work used a predetermined peak test load (3800 to 4000 pound) which provided margin against the three times normal operating pressure differential. Once the peak test load was achieved the test was manually stopped. Sleeve slippage may, or may not have occurred prior to reaching the predetermined peak test load. The available, true first slip data (for those specimens that slipped) had peak applied torques of 90 inch-pound (in-lb), the minimum acceptable torque, or less than 90 in-lb for most of the specimens. Thus, a representative relationship between first slip load and applied torque is difficult to develop as first slip loads only exist for specimens with applied torque at the minimum acceptance value or less than acceptable.

The original test data included specimens expanded at torque levels below the acceptable range. Sleeve rolling torque as low as 66 in-lb were used in the original qualification testing.

The original qualification program also included some cases where the first roll pass was purposely applied at a low value (sometimes below the current acceptance range) with the second pass at a nominal value. The first roll pass performs the majority of the work. The sleeve and tube will experience cold work during the first rolling operation so the initial condition for the start of the second roll involves a system with a much stiffer starting condition. Upon completion of the less than acceptable first pass the intermediate condition joint integrity would be reduced compared to a nominal installation. The second pass would be expected to provide little additional integrity to the completed joint. In these cases the highest applied torque was used as the applied torque even though the first pass might have been incomplete.

CEN-630-P, Revision 2 used a limiting load capability of 2140 lb when evaluating safety factors. This load is taken from the specimen rolled with a maximum torque of 66 in-lb. This torque value is well below the minimum acceptable applied torque of 90 in-lb.

The original program included cyclic axial loading of 0 to - 1000 lb (compressive) at 23,000 cycles. The combination of high cycles and conservative axial loading may have acted to reduce the first slip load however this cannot be proven by the test data. The -1000 lb load is due to the unit loading/unloading from 15% to 100% power transient. Any tensile loading introduced to the sleeve due to Poisson expansion during the mechanical rolling which would effectively reduce the applied compressive load for an intact tube is not considered. SONGS Unit 2 has been a typical plant with a goal of continuous operation throughout a fuel cycle. Thus the sleeves installed at SONGS likely have far less accumulated compressive loadings to date compared to 23,000 as simulated in the original test program.

The original program also used only a 2 inch thick tubesheet simulant. It is not known whether the limited length of the tubesheet simulant in these cases acted to artificially reduce the observed first slip load by permitting rotational deflection of the tubesheet specimen due to its limited length. In the original test configuration the lower end of the sleeve was not visible, thus the confirmation of true sleeve slip could not be performed. The more recent testing included visual confirmation of first slip based on the sleeve end displacement. Further discussion is provided in the response to request number 8.

The original program also included a compressive load of 2000 lb prior to tensile loading. This load is more than double the compressive load which might be introduced in the sleeve due to primary and secondary system temperature changes.

The increased first slip load may also be related to the method of tube expansion. The original program used a roll expansion process for the tube in tubesheet simulant. This process results in a greater amount of cold work applied to the tube than for explosively expanded tubes. Thus the tube ID surface is much harder than an explosively expanded tube. A roll expanded tube also experiences wall thinning due to a combination of radial stretching of the tube and general material compression due to the large normal loading introduced by the rolling process. This presents a condition where additional deformation of the tube due to sleeve rolling is unlikely. In the explosively expanded case the sleeve can be embedded into the tube surface; a mechanical interference between the sleeve OD in the roll area and tube ID above the roll area can be created.

First slip loads were used in the recent analysis. The first slip load used in this analysis is the point when the sleeve first slips.

5. Please discuss whether the load displacement curves for all the specimens were similar to the load displacement curves provided in the July 14, 2006 letter. If not, please provide all the load displacement curves.

Response: All load displacement curves are similar in that sleeve yielding (in tension) occurred prior to sleeve to tube joint slippage.

6. It appears that many of the sleeves in the test program yielded prior to reaching first slip load. Please confirm that no yielding occurred at an axial force less than that associated with the most limiting of $3\Delta P$ or 1.4 times accident loading conditions.

Response: No yielding of the sleeves occurred prior to achieving the three times normal operating end cap load. For Westinghouse Model D SG and Combustion Engineering SG tubes the nominal tungsten inert gas (TIG) sleeve wall thickness is 0.0315 inch with a cross sectional area of 0.0587 in^2. For the specified minimum yield strength of 40 ksi the expected load to cause general yielding of the sleeve is 2348 lb. For 7/8 inch OD tubes the nominal Alloy 800 sleeve wall thickness is 0.048 inch with a nominal cross sectional area of 0.106 in^2. For the specified minimum yield strength of 30 ksi, the expected load to cause yielding of the sleeve is 3177 lb.

7. Please discuss the nature of the electric discharge machining notch in specimen "Tensile 11." Please provide the load displacement curve for this specimen.

Response: The EDM notch setup was the axially oriented type identical to the rest of the specimens which used axially oriented notches. Specimen Tensile 11 did not include the microlok or nickel bands, and is discussed in the submittal only to show the benefit of the microlok band. The load displacement curve of this specimen is not relevant because it did not include the microlok band.

8. Please discuss how it was determined that the sleeve was not slipping within the tube given the load displacement curves. Was it assumed that the sudden drop in load corresponds to the first slip?

Response: The first few tensile specimens were configured to provide indication of sleeve motion using an extensometer. The extensometer is essentially strain gauge readout of relative displacement between two points. The extensometer was configured between the sleeve and top of tubesheet simulant. The extensometer was used for the first five specimens. At about 2300 lb the sleeve began to yield in tension. When the sleeve cross sectional area is considered this load is approximately equal to the yield strength of the sleeve material. The lower end of the sleeve extended below the tube end which extended below the tubesheet simulant collar. A mark was placed on the sleeve at the tube end. At the point when the sleeve began to yield in tension the mark at the lower end had not moved. During the loading process the operator would call out the load applied while the sleeve end was watched by a second person. The point at which the sleeve end was visually observed to move was consistent with the reporting of first slip load. The point of sleeve first slip was typically readily evident by a popping noise that accompanied the sleeve slip. The observations of the first few tests gave no indication that the extensometer was required for the remainder of the tests. All tests were witnessed by a second person who monitored the sleeve end for motion. The sleeve lower end motion was not gradual. That is, the first slip was accompanied by a sudden displacement making the observation of first slip readily apparent. This sudden motion is clearly evident on the load-displacement curves. The point of first displacement observed on the extensometer readout is consistent with the load corresponding to sleeve yield. As the extensometer has an effective range of travel of about 1/8 inch the point of first slip could not be monitored on the extensometer readout.

The load displacement curves are similar in the first part of the loading curve, which is where the first slip loads are developed. The individual loading curves follow a general pattern of eventual peak load exceeding first slip. The individual curves are each influenced by the particulars of each sample thus the shapes of the curves after first slip may vary however this portion of the curve is not used as peak load is not being considered.

9. There appears to be a discrepancy between some of the loads reported on page 4-3 and those in Table 4-3. Please clarify.

Response: Specimen Tensile 1 (Model 51 SG specimen): Text states that *tube* slippage occurred at 6125 lb while Table 4-3 indicates a first slip (sleeve) of 6234 lb. The load displacement curve was reviewed; sleeve slippage occurred at 6234 lb. However, the tube slippage at 6125 lb questions the validity of this test.

For Specimen Tensile 3, a review of the load displacement curve shows the peak load after first slip of the sleeve was 6553 lb while the first slip load was 7267 lb. This data is correct. The discussion is only provided as the peak load and first slip load are the same. The 6553 lb point occurred after the first slip. The text may be confusing; the text should have stated that the largest load observed after first slip was 6553 lb but this value is less than the sleeve first slip load.

Specimen Tensile 4 experienced *tube* slippage at 5800 lb. Please note that the report identifies that specimens Tensile 1 thru Tensile 6 for the Model 51 tests may be invalid due to the positioning of the EDM notches and subsequent sleeve positioning which may have resulted in the sleeve rolling producing a bulge outside of the tube. Specimens Tensile 7 thru Tensile 10 of the Model 51 tests were prepared once the results of Tensile 1 thru Tensile 6 were reviewed.

10. The high-temperature leak tests were performed in collars made from 1018 carbon steel material. Given the thermal expansion coefficient of this material (compared to the actual tubesheet material), it is not clear that these results are conservative. As a result, discuss the need to modify your approach for addressing leakage through the sleeve joints.

Response: Both materials (1018 hot rolled and SA-508 Class 2 forging) are found in material Group A of the ASME Code, thus both have the same thermal expansion coefficient.

There is no basis to modify the leakage allowances as the applied values bound the original leak test results. The original leakage test data shows no leakage was encountered post cyclic testing.

11. The leakage testing program described in your July 14, 2006, letter consisted of primary-to-secondary pressure differentials of 1500 pounds per square inch (psi) and 2560 psi; however, leakage testing was not performed after load cycling tests to analyze how the cyclic loading could affect the leakage. Please provide the technical justification demonstrating that leakage through the sleeve is not affected by cyclic loading. Alternatively, provide leakage test data obtained from specimens that were subjected to cyclic loading prior to testing.

Response: The original testing program described in CEN-630-P, Revision 2 included leakage testing after cyclic testing. The original data shows the leakage resistance was unaffected by cyclic loading; no specimens experienced leakage. In addition, the peak loads which could be transferred to the sleeve are far less than the end cap load associated with three times normal operating pressure differential. Thus, no slippage of the joint will be associated with this loading. As no slippage will occur, no relative motion between the tube and sleeve can occur, contact forces between the tube and sleeve will remain constant, and the interface will remain unaffected, thus leakage resistance is unaffected.

Additional support as to the relative lack of effect of cyclic loading on mechanical joints is found in CEN-617-P. The program described in this report examined structural and leakage characteristics of a double-hydraulic expansion joint repair sleeve intended to act as a repair of Westinghouse hybrid expansion joint (HEJ) sleeved tubes in which parent tube indications were reported in the upper hardroll area of the HEJ sleeve joint. Both joints were formed using hydraulic expansion only. The hydraulic expansion length was 1 inch with a short separation distance between the two hydraulically expanded 1 inch lengths forming the joint. The lower joint was formed within the HEJ sleeve and tube elevation; the upper joint was formed in the tube only above the sleeve (thus no potential to develop large radial contact loads as would be developed for a tube in tubesheet condition). Room temperature leak rate testing at 1500 pounds per square inch differential (psid) produced a maximum leak rate for the lower joint of 6×10^{-5} gallons per minute (gpm). The largest leak rate observed for the WOG program at 1500 psid and room temperature was 5.44×10^{-5} gpm. The CEN-617-P data corroborates the WOG leak rate test results. The increased joint length of the CEN-617-P testing would be expected to reduce measured leakage for equal contact pressure conditions. However the increased contact pressure of the hardroll joint applied over a shorter length produces the same effect as a longer joint with reduced contact pressure. CEN-617-P also includes leak rate test data post cyclic testing. No leakage was reported for the post cyclic test cases. Mechanical testing was also included in CEN-617-P. The minimum load required to produce ¼ inch displacement of the sleeve relative to the tube was 2000 lb while the maximum load was 4000 lb. Thus the joints described in CEN-617-P have axial resistive load capabilities of less than a sleeve hardroll expanded joint. CEN-617-P states that the mechanical test results were consistent for the no cyclic loading tests and cyclic loading tests. Thus this data shows that;

1. Mechanical joints are typically unaffected by cyclic loading provided the cyclic load does not surpass the first slip capacity
2. Leakage integrity of mechanical joints is typically unaffected by cyclic loading. In the case of the CEN-617-P data leak rate was *reduced* for the post cyclic loading case.

12. Please clarify the sentence on page 2-1 of SG-SGDA-05-48-P, Revision 1, which reads, "In the hydraulically expanded condition the tube experiences additional wall thinning prior to completion of the wall thinning operation of the sleeve."

Response: Hydraulic expansion of a SG tube does not include compressive wall thinning as does a roll expanded tube. The tube in a sense is "spongy" compared to a hardroll expanded tube. The energy input of the sleeve hardrolling process embeds the sleeve into the tube, and results in additional wall thinning of the tube due to compression in the joint area.

13. In Section 2.1, it was indicated that the torque used to roll the sleeve specimens "bounds" the torque used for actual installations. Please clarify that the torque for the test specimens was lower than the torque used for the actual field installations (i.e., it was a lower bound).

Response: Manufacturing records for the SONGS sleeve installations were reviewed. The following table presents a summary of the minimum and mean sleeve torque values for the four sleeve installation campaigns at SONGS Unit 2. The applied torque values from the recent testing program range from 99 in-lb to 142 in-lb with an overall average of 110 in-lb. Thus a limited number of specimens include applied torque at the lower range of applied torques for SONGS. Eight of the twenty-three test specimens had an applied torque greater than the SONGS minimum for all four campaigns of 120 in-lb. Considering the observed minor variance in performance over the range of applied torque values for the test specimens the fact that not all specimens are bounded by the field installations has little significance.

SONGS UNIT 2 WELDED SLEEVE LOWER ROLLED JOINT DATA

Date	Steam Generator	Sleeve Quantity (1)	Rolling Torque (in-lb)	
			Minimum	Mean
January 1999	88	86	129	139
	89	52	124	132
November 2000	88	98	127	136
	89	59	120	150
June 2002	88	78	130	140
	89	46	134	140
March 2004	88	114	133	153
	89	58	130	148

(1): Sleeve quantity reflects all sleeves for which lower joints were made. Some may have been subsequently plugged due to NDE or other reasons resulting in a lower reported installed total.

14. Please discuss how it was verified that the microlok-to-nickel band interface was adjacent to the tube separation.

Response: The position of the sleeve was mechanically controlled during expansion based on the location of the tube separation.

15. Several of the test specimens had internal pressurization. Please discuss whether this internal pressurization contributed to the actual load on the sleeve. If so, please discuss whether this was accounted for in the load displacement curves.

Response: The main intent of the internal pressurization was to determine if the internal pressurization contributed significantly to the axial load bearing capability. The internal pressurization only slightly improved the axial load bearing capability (by increasing contact pressure between the sleeve and tube) thus the remainder of the tests did not include internal pressurization. At the internal pressure used, the pressure developed end cap load is about 600 lbf.

As the resistive load capability of the sleeve to tube joint was measured within the crosshead of the tensile machine, any end cap load produced by the internal pressurization would not be able to be measured by the crosshead force sensor. Thus, if the internal pressure end cap load is additive to the force developed by the tensile machine, the published first slip loads are artificially low.

16. Hydraulic expansion was used to simulate a tube explosively expanded into the tubesheet region. The hydraulic expansion pressure used was intended to simulate the radial contact pressure associated with an explosively expanded tube within a tubesheet. Please discuss whether the radial contact pressure simulated corresponded to the mean or lower bound of the test data for explosively expanded tubes.

Response: Pull out testing of ¾ inch OD hydraulically expanded tubes with a 4 inch joint length was used to define the hydraulic expansion pressure. Samples expanded at both 35 and 38 ksi and 38 and 40 ksi were used for the qualification tensile and leak specimens. Tube-tubesheet first slip load for 38 ksi peak pressure is approximately 2600 lb; first slip load for 40 ksi peak pressure is approximately 3500 lb. For the 38 ksi peak pressure specimens first slip and peak loads are approximately equal. For 40 ksi peak pressure, one specimen exhibited first slip and peak loads that were essentially equal; the other had a peak load of 6500 lb.

The SONGS applicable rough bore peak load data of WCAP-15720 Revision 0, "NDE Inspection Strategy for Tubesheet Regions in C-E Designed Units," for a 4 inch expansion length shows average peak load of 6364 lb with little variance in peak load. For 3 and 3.5 inch joint lengths the average peak load is 5347 lb however the range of peak loads is from 2198 to 6381 lb. For 2 and 2.5 inch joint lengths the average peak load is 5274 lb however the range of peak loads is from 2761 to 6741 lb. During development of the C* program the relationship between peak load and first slip load was evaluated. It was determined that for peak loads of about 6000 lb, estimated first slip is about 5500 lb and for peak loads of about 5250 lb first slip is about 4750 lb. Thus, the first slip characteristics of the hydraulically expanded specimens are well below the expected first slip load of true explansions.

17. For the sleeves installed at SONGS 2 and 3, please confirm that the torque used in installing the sleeves was greater than the torque used in fabricating the test specimens.

Response: See response to request number 13.

18. In preparing the circumferentially separated specimens for the Combustion Engineering simulation testing, please confirm that not only the tube collar was saw cut, but also that the tube was cut.

Response: The tube was also cut.

19. In sections 4.2 and 4.3 of Westinghouse TR SG-SGDA-05-48-NP, Revision 1, the end-cap loading associated with three-times-the- normal operating pressure was provided. Please discuss whether the end-cap loading for these different cases was determined in the same manner. In addition, please provide the differential pressures assumed in section 4.3 along with the assumed tube-wall thickness.

Response: End cap loads were determined in the same manner. An applied three times normal operating pressure differential was applied to the cross sectional area defined by the expanded tube ID.

The applied tube wall thickness and three times normal operating pressure differentials in Section 4.3 are 0.049 inch, 4470 psi and 4375 psi.

20. In section 6, it does not appear that the text in the 3rd paragraph is consistent with the data presented in Table 6-1. For example, the specimens that did not leak do not appear to be correctly referenced. In addition, the bounding leak rate appears to be misquoted. Please clarify.

The text may be confusing in that it states certain samples were *essentially* leak tight at room temperature conditions. Leak rates in the 10^{-6} gpm range were considered essentially leak tight. The text states that the bounding leak rate for the tube to tubesheet joint is 2.7×10^{-6} gpm at elevated temperature conditions while the leak rate applied for tubes with observed indications in the nickel band region is 2×10^{-5} gpm at elevated temperature conditions. Thus the text is identifying two leakage sources; from the tube to tubesheet joint and from the tube to sleeve joint.