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PG&E Letter DCL-03-132

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555-0001

Docket No. 50-275, OL-DPR-80
Docket No. 50-323, OL-DPR-82
Diablo Canyon Units 1 and 2
License Amendment Request 03-15
Steam Generator Tube Repair Using Leak Limiting Alloy 800 Sleeves and Revision to Technical Specification Table 5.5.9-2, "Steam Generator (SG) Tube Inspection"

Dear Commissioners and Staff:

In accordance with 10 CFR 50.90, enclosed is an application for amendment to Facility Operating License Nos. DPR-80 and DPR-82 for Units 1 and 2 of the Diablo Canyon Power Plant (DCPP) respectively. The enclosed license amendment request (LAR) proposes to change Technical Specifications (TS) Section 5.5.9, "Steam Generator (SG) Tube Surveillance Program," and TS Section 5.6.10, "Steam Generator (SG) Tube Inspection Report," to allow use of leak limiting Alloy 800 sleeves to repair degraded SG tubes as an alternative to plugging the SG tubes. The LAR also proposes to remove an unnecessary reporting requirement contained in TS Table 5.5.9-2, "Steam Generator (SG) Tube Inspection."

The proposed change will revise TSs 5.5.9.b.2.d, 5.5.9.b.2.e, 5.5.9.d.1.a, 5.5.9.d.1.f, 5.5.9.d.1.f.1, 5.5.9.d.1.f.2, 5.5.9.d.1.f.4, 5.5.9.d.1.j, 5.5.9.d.1.k, 5.5.9.d.2, Table 5.5.9-2, 5.6.10.a, 5.6.10.b.1, 5.6.10.b.3, 5.6.10.d.1, 5.6.10.f, 5.6.10.g.2 and will add new TS 5.5.9.b.2.f, 5.5.9.d.1.f.5, and 5.5.9.d.1.l to allow DCPP use of leak limiting Alloy 800 sleeves to repair degraded SG tubes. The technique to use leak limiting Alloy 800 sleeves to repair degraded SG tubes is contained in Westinghouse Electric LLC WCAP-15919-NP, Revision 00, "Steam Generator Tube Repair for Westinghouse Designed Plants with 7/8 Inch Inconel 600 Tubes Using Leak Limiting Alloy 800 Sleeves," dated August 2003 (nonproprietary) and WCAP-15919-P, Revision 00, "Steam Generator Tube Repair for Westinghouse Designed Plants with 7/8 Inch Inconel 600 Tubes Using Leak Limiting Alloy 800 Sleeves," dated August 2003 (proprietary). These reports detail the analyses and testing performed to verify the adequacy of leak limiting Alloy 800 sleeves for installation in a SG tube, and demonstrate sleeving to be an acceptable repair technique.

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The proposed change to TS 5.5.9 Table 5.5.9-2 deletes the requirement to notify the NRC pursuant to 10 CFR 50.72(b)(2) if the first sample inspection or the second sample inspection results in a C-3 classification. The requirement to report a C-3 classification is already adequately governed by 10 CFR 50.72(b)(3)(ii).

Eddy current examination is used to measure the extent of SG tube degradation. Currently, when the reduction in tube wall thickness reaches 40 percent of nominal SG tube wall thickness or when alternate repair criteria are exceeded, the SG tube is considered defective and is removed from service by installing plugs in the SG tube at the inlet and outlet of the SG tube. However, the installation of plugs in a SG tube eliminates the heat transfer surface associated with the tube. In addition, plug installation leads to the reduction in the primary coolant flow available for core cooling. The use of leak limiting Alloy 800 sleeves can allow the SG tube to remain in service, with minimal effect on heat transfer surface area and coolant flow.

The NRC has previously approved the use of leak limiting Alloy 800 sleeves for the Watts Bar Nuclear Plant Unit 1 in License Amendment No. 44 to Facility Operating License No. NPF-90, "Watts Bar Nuclear Plant, Unit 1 - Issuance of Amendment for Steam Generator Tube Repair (TAC No. MB6976)," dated August 15, 2003, and for the Calvert Cliffs plant in License Amendment No. 231 to Facility Operating License No. DPR-53 and Amendment No. 207 to Facility Operating License No. DPR-69, "Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 - Issuance of Amendment RE: Steam Generator Tube Repair Using Leak Limiting Alloy 800 Sleeves (TAC Nos. MA4278 and MA4279)," dated September 1, 1999. In addition, a similar request for NRC approval to use leak limiting Alloy 800 sleeves has been made by TXU Generation Company LP (TXU Energy) for Comanche Peak Steam Electric Station in Letter CPSES-200301190, "Comanche Peak Steam Electric Station (CPSES), Docket Nos. 50-445 and 50-446, License Amendment Request (LAR) 03-03, Revision to Technical Specification (TS) 5.5.9, Steam Generator Repair Using Leak Limiting Alloy 800 Sleeves," dated July 21, 2003. DCPP is the first application of leak limiting Alloy 800 sleeves for 7/8 inch tubing.

Enclosure 1 contains a description of the proposed change, the supporting technical analyses, and the no significant hazards consideration determination. Enclosures 2 and 3 contain marked-up and retyped (clean) TS pages, respectively. Enclosure 4 contains Westinghouse Electric LLC (Westinghouse) WCAP-15919-NP, Revision 00, "Steam Generator Tube Repair for Westinghouse Designed Plants with 7/8 Inch Inconel 600 Tubes Using Leak Limiting Alloy 800 Sleeves," dated August 2003 (nonproprietary). Enclosure 5 contains an affidavit, proprietary information notice, and copyright notice for Westinghouse proprietary WCAP-15919-P, Revision 00. Enclosure 6 contains Westinghouse proprietary report WCAP-15919-P, Revision 00.

WCAP-15919-P, Revision 00, contains information proprietary to Westinghouse. Accordingly, Enclosure 5 includes a Westinghouse authorization letter, CAW-03-1680, an accompanying affidavit, a Proprietary Information Notice, and a Copyright Notice. The affidavit is signed by Westinghouse, the owner of the information. The affidavit sets forth the basis on which the Westinghouse proprietary information contained in WCAP-15919-P, Revision 00, may be withheld from public disclosure by the Commission, and it addresses with specificity the considerations listed in paragraph (b)(4) of 10 CFR 2.790 of the Commission's regulations. PG&E requests that the Westinghouse proprietary information be withheld from public disclosure in accordance with 10 CFR 2.790.

Correspondence with respect to the copyright or proprietary aspects of the application for withholding related to the Westinghouse proprietary information or the Westinghouse affidavit provided in Enclosure 5 should reference Westinghouse Letter CAW-03-1680 and be addressed to H. A. Sepp, Manager of Regulatory Compliance and Plant Licensing, Westinghouse Electric Company, P.O. Box 355, Pittsburgh, Pennsylvania 15230-0355.

PG&E has determined that this LAR does not involve a significant hazards consideration as determined per 10 CFR 50.92. Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment needs to be prepared in connection with the issuance of this amendment.

The change in this LAR is not required to address an immediate safety concern. PG&E requests approval of this LAR by October 1, 2004, to enable repair of SG tubes using Alloy 800 sleeves as a contingency in the event the SG tube plugging limits cannot be met during the upcoming twelfth DCPP Unit 2 refueling outage (2R12) currently scheduled for October, 2004. Approval of this change will reduce the number of SG tubes which need to be removed from service by plugging during 2R12 and will also allow certain SG tubes which are currently plugged to be returned to service by removing the plugs and inserting an Alloy 800 sleeve. PG&E requests the LAR be made effective upon NRC issuance, to be implemented within 60 days from the date of issuance.

If you have any questions or require additional information, please contact Stan Ketelsen at 805-545-4720.

Sincerely,

David H. Oatley
Vice President and General Manager - Diablo Canyon

kjse/4328
Enclosures
cc: Edgar Bailey, DHS
Bruce S. Mallett
David L. Proulx
Diablo Distribution
cc/enc: Girija S. Shukla

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of PACIFIC GAS AND ELECTRIC COMPANY	)	Docket No. 50-275 Facility Operating License No. DPR-80
Diablo Canyon Power Plant Units 1 and 2	)	Docket No. 50-323 Facility Operating License No. DPR-82

AFFIDAVIT

David H. Oatley, of lawful age, first being duly sworn upon oath says that he is Vice President and General Manager - Diablo Canyon of Pacific Gas and Electric Company; that he has executed license amendment request LAR 03-15 on behalf of said company with full power and authority to do so; that he is familiar with the content thereof; and that the facts stated therein are true and correct to the best of his knowledge, information, and belief.

David H. Oatley
Vice President and General Manager - Diablo Canyon

Subscribed and sworn to before me this 22nd day of October 2003.

Notary Public
County of San Luis Obispo
State of California

KAREN T. MASON
Commission # 1428454
Notary Public - California
San Luis Obispo County
My Comm. Expires Jul 31, 2007

EVALUATION

1.0 DESCRIPTION

This letter is a request to amend Operating Licenses DPR-80 and DPR-82 for Units 1 and 2 of the Diablo Canyon Power Plant (DCPP), respectively.

The proposed change would revise Technical Specifications Section 5.5.9, "Steam Generator (SG) Tube Surveillance Program," and Technical Specifications Section 5.6.10, "Steam Generator (SG) Tube Inspection Report," to allow use of the leak limiting Alloy 800 sleeves to repair degraded SG tubes as an alternative to plugging the SG tube. The leak limiting Alloy 800 sleeves were developed by Westinghouse Electric LLC. The technique to use leak limiting Alloy 800 sleeves to repair degraded SG tubes is described in Westinghouse Electric LLC WCAP-15919-NP, Revision 00, "Steam Generator Tube Repair for Westinghouse Designed Plants with 7/8 Inch Inconel 600 Tubes Using Leak Limiting Alloy 800 Sleeves," dated August 2003 (nonproprietary), contained in Enclosure 4 of this letter and WCAP-15919-P, Revision 00, "Steam Generator Tube Repair for Westinghouse Designed Plants with 7/8 Inch Inconel 600 Tubes Using Leak Limiting Alloy 800 Sleeves," dated August 2003 (proprietary), contained in Enclosure 6 of this letter. These reports detail the analyses and testing performed to verify the adequacy of Alloy 800 sleeves for installation in a SG tube and demonstrate sleeving to be an acceptable repair technique.

The proposed change also eliminates an unnecessary reporting requirement contained in Technical Specification Table 5.5.9-2, "Steam Generator (SG) Tube Inspection." This change removes the reporting requirement for a category C-3 SG inspection result from Technical Specification Table 5.5.9-2 that is already adequately governed by Title 10 of the Code of Federal Regulations, Part 50 (10 CFR 50), Section 72(b)(3)(ii).

2.0 PROPOSED CHANGE

2.1 Alloy 800 SG Tube Sleeves

The following changes are made to Technical Specifications Section 5.5.9, "Steam Generator (SG) Tube Surveillance Program" to allow Alloy 800 SG tube sleeves as a repair criteria:

Section 5.5.9.b.2.d - an editorial change is made to replace the period at the end of the sentence with a comma,

Section 5.5.9.b.2.e - an editorial change is made to replace the period at the end of the sentence with a comma,

New Section 5.5.9.b.2.f - leak limiting sleeve inspection requirements are included in the new sentences "Tubes repaired by leak limiting sleeve(s). Each leak limiting sleeve shall be inspected over the full length using a Plus Point coil or equivalent qualified technique during all future refueling outages." added to new Technical Specification Section 5.5.9.b.2.f,

Section 5.5.9.d.1.a "Imperfection" - the second sentence is changed from "Eddy-current testing indications below 20% of the nominal tube wall thickness, if detectable, may be considered as imperfections" to "Eddy-current testing indications below 20% of the nominal tube wall thickness, if detectable, are to be considered as imperfections,"

Section 5.5.9.d.1.f "Plugging Limit" - the term "Plugging Limit" is changed to "Plugging or Repair Limit." The definition is changed from "the imperfection depth at or beyond which the tube shall be removed from service and is equal to 40% of the nominal tube wall thickness" to "the imperfection depth at or beyond which the tube shall be removed from service by plugging or repaired by sleeving in the affected area and is equal to 40% of the nominal tube wall thickness,"

Section 5.5.9.d.1.f.1 - the sentence "Refer to 5.5.9.d.1.j for the repair limit applicable to these intersections" is changed to "Refer to 5.5.9.d.1.j for the plugging or repair limit applicable to these intersections,"

Section 5.5.9.d.1.f.2 - the sentence "This definition does not apply to the portion of the tube within the tubesheet below the W* length" is changed to "This definition does not apply to the portion of the tube within the tubesheet below the W* length provided the tube does not have a sleeve installed in the tubesheet region of the tube,"

Section 5.5.9.d.1.f.4 - the sentence "A tube which contains a tube support plate intersection with both an axial ODSCC indication and an axial PWSCC indication will be removed from service" is changed to "A tube which contains a tube support plate intersection with both an axial ODSCC indication and an axial PWSCC indication will be removed from service by plugging or repaired by sleeving,"

New Section 5.5.9.d.1.f.5 - new SG tube plugging limits are added for the sleeve/tube assembly in the new section "This definition does not apply to the leak limiting sleeve/tube assembly, for which the plugging limits are defined as follows: A sleeved tube shall be plugged if an imperfection is detected in any portion of the sleeve. A sleeved tube shall be plugged if an imperfection is detected in the pressure boundary portion of the original tube wall in the leak limiting sleeve/tube assembly (i.e., at the sleeve-tube joint(s)). Imperfections detected in the non-pressure boundary portion of the original tube wall associated with a sleeve may remain in service,"

Section 5.5.9.d.1.j "Tube Support Plate Plugging Limit" - the term "Tube Support Plate Plugging Limit" is changed to "Tube Support Plate Plugging or Repair Limit,"

Section 5.5.9.d.1.j "Tube Support Plate Plugging Limit" - the sentence "At tube support plate intersections, the plugging limit is based on maintaining steam generator tube serviceability as described below" is changed to "At tube support plate intersections, the plugging or repair limit is based on maintaining steam generator tube serviceability as described below,"

Section 5.5.9.d.1.k "W* Plugging Limit" - a new sentence is added for tubes with a sleeve installed in the tubesheet region of the tube which states "The W* Plugging limit does not apply to a tube with a sleeve installed in the tubesheet region of the tube,"

A new section 5.5.9.d.1.l is added to define tube repair which states "Tube Repair refers to a process that establishes tube serviceability. Tube repair of defective tubes will be performed by installation of the leak limiting sleeve as described in Westinghouse Report WCAP-15919-P, Revision 00.,"

Section 5.5.9.d.2 - the sentence "The SG tube integrity shall be determined after completing the corresponding actions (plug all tubes exceeding the plugging limit) required by Table 5.5.9-2" is changed to "The SG tube integrity shall be determined after completing the corresponding actions (plug or repair all tubes exceeding the plugging or repair limit) required by Table 5.5.9-2.,"

Section 5.5.9.d - an editorial change is made to move the note "* Applicable for Units 1 and 2, Cycles 10, 11, 12, and 13 only.," which applies to Section 5.5.9.d.1.k, from the top of Technical Specification page 5.0-17 to the bottom of Technical Specification page 5.0-16 and the words "THIS PAGE NOT USED" is added to Technical Specification page 5.0-17.,

Table 5.5.9-2, "Steam Generator (SG) Tube Inspection" - in five places in the "Action Required" column, the word "plug" is replaced with "plug or repair,"

The following changes are made to Technical Specifications Section 5.6.10, "Steam Generator (SG) Tube Inspection Report" to allow Alloy 800 SG tube sleeves as a repair criteria:

Section a - The sentence "Within 15 days following the completion of each inservice inspection of SG tubes, the number of tubes plugged in each SG shall be reported to the Commission" is changed to "Within 15 days following the completion of each inservice inspection of SG tubes, the number of tubes plugged or repaired in each SG shall be reported to the Commission,"

Section b.1 - The Special Report content requirement "Number and extent of tubes inspected" is changed to "Number and extent of tubes and sleeves inspected,"

Section b.3 - The Special Report content requirement "Identification of tubes plugged" is changed to "Identification of tubes plugged or repaired,"

Section d.1 - The NRC notification requirement for voltage-based repair criteria for estimated leakage is revised from "If estimated leakage based on the projected end-of-cycle (or if not practical, using the actual measured end-of-cycle) voltage distribution (reduced by estimated leakage by all other alternate repair criteria - *) exceeds the leak limit determined form the licensing basis dose calculation for the postulated main steamline break for the next operating cycle" to "If estimated leakage based on the projected end-of-cycle (or if not practical, using the actual measured end-of-cycle) voltage distribution, increased by estimated leakage by all other sources (alternate repair criteria and non-alternate repair criteria indications and sleeves), exceeds the leak limit determined from the licensing basis dose calculation for the postulated main steamline break for the next operating cycle". The word "form" is changed to the word "from,"

Section f - The asterisk which applies to the W* plugging limit is deleted. The definition of the aggregate steam line break leakage to be reported pursuant to 10 CFR 50.4 is changed from "The aggregate calculated steam line break leakage from application of all alternate repair criteria shall be reported to the Commission pursuant to 10 CFR 50.4 within 90 days following return to service of the steam generators" to "The aggregate calculated steam line break leakage from application of all alternate repair criteria and sleeves shall be reported to the Commission pursuant to 10 CFR 50.4 within 90 days following return to service of the steam generators,"

Section g.2 - The NRC notification requirement for the calculated SG leakage for the repair criteria for axial primary water stress corrosion cracking (PWSCC) at dented tube support plates (TSP) is changed from "The calculated SG leakage for condition monitoring from all sources (all alternate repair criteria and non-alternate repair criteria indications) exceeds the leakage limit determined from the licensing basis steam line

break dose calculation" to "The calculated SG leakage for condition monitoring from all sources (all alternate repair criteria and non-alternate repair criteria indications and sleeves) exceeds the leakage limit determined from the licensing basis steam line break dose calculation."

2.2 NRC Reporting Requirements

The proposed change to Technical Specification 5.5.9 Table 5.5.9-2, "Steam Generator (SG) Tube Inspection," deletes the requirement to notify the NRC pursuant to 10 CFR 50.72(b)(2) if the first sample inspection or the second sample inspection results in a C-3 classification.

In summary, the proposed changes to Technical Specification Sections 5.5.9 and 5.6.10 provide an alternative to plugging degraded SG tubes. By repairing the degraded tubes with leak limiting Alloy 800 sleeves, the tube is allowed to remain in service. The proposed changes to Technical Specification 5.5.9 Table 5.5.9-2, "Steam Generator (SG) Tube Inspection," delete the requirement to notify the NRC pursuant to 10 CFR 50.72(b)(2) if the first sample inspection or the second sample inspection results in a C-3 classification. The asterisk which applies to the W* plugging limit is deleted from Technical Specifications 5.6.10.d.1 and 5.6.10.f. In addition, several editorial changes are made to Technical Specification Sections 5.5.9 and 5.6.10.

The DCPP Technical Specification Section 5.0, "Administrative Controls," does not have a bases section and therefore no changes to the Technical Specification Bases are required.

The proposed Technical Specification changes are noted on the markup Technical Specification pages provided in Enclosure 2. The proposed retyped Technical Specification pages are provided in Enclosure 3.

3.0 BACKGROUND

3.1 SG System Description

The SGs are vertical shell and U-tube evaporators with integral moisture separating equipment. The reactor coolant flows through inverted U-tubes, entering and leaving through the nozzles located in the hemispherical bottom head of the SG. Steam is generated on the shell side and flows upward through the moisture separators to the outlet nozzle at the top of the vessel. The U-tubes are 7/8 inch outer diameter (OD) and are manufactured from Inconel 600 material.

3.2 SG Tube Surveillance Program

The SG tubes constitute more than half of the reactor coolant pressure boundary (RCPB). Design of the RCPB for structural and leakage integrity is a requirement under 10 CFR 50 Appendix A. Specific requirements governing the maintenance and inspection of SG tube integrity are in the DCPP Technical Specifications, Section XI of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, and Regulatory Guide (RG) 1.83. These include requirements for periodic inservice inspection of the tubing, flaw acceptance criteria (i.e., repair limits for plugging), and primary-to-secondary leakage limits. These requirements, coupled with the broad scope of plant operational and maintenance programs, have formed the basis for assuring adequate SG tube integrity.

SG tube plugging limits are specified in the DCPP Technical Specifications. The current DCPP Technical Specifications require that a tube with an imperfection be removed from service by plugging if the imperfection depth in the tube is greater than or equal to 40 percent through-wall, unless the degradation is subject to voltage-based OD stress corrosion cracking (ODSCC) repair criteria, W* repair criteria, or primary water stress corrosion cracking within dented TSP repair criteria. The current DCPP Technical Specifications do not allow a SG tube with an imperfection to be repaired with a sleeve. Repairing a SG tube imperfection with a sleeve would allow the repaired tube to remain in service.

Technical Specification 5.5.9 repair limits ensure that tubes accepted for continued service will retain adequate structural and leakage integrity during normal operating, transient, and postulated accident conditions, consistent with General Design Criteria (GDC) 14, 15, 30, 31, and 32 of 10 CFR 50, Appendix A. Structural integrity refers to maintaining adequate margins against gross failure, rupture, and collapse of the SG tubing. Leakage integrity refers to limiting primary-to-secondary leakage to within acceptable limits.

Technical Specification Table 5.5.9-2, "Steam Generator Tube Inspection," requires notification to the NRC pursuant to 10 CFR 50.72(b)(2) if the results of the SG tube inspection identify more than 10 percent of the total tubes inspected are degraded tubes or more than 1 percent of the inspected tubes are defective (Category C-3).

The SGs are discussed in detail in Chapter 5.5.2 of the DCPP Final Safety Analysis Report Update (FSARU). Section 5.5.2.5 of the DCPP FSARU discusses the SG tube surveillance program including the inservice

inspection requirements, primary-to-secondary leakage requirements, and SG alternate repair criteria (ARC). Sections 15.3.1 and 15.4.1 of the DCPP FSARU discuss the small break loss-of-coolant accident (LOCA) and large break LOCA accident respectively. The small and large break LOCA analyses assume a maximum of 15 percent SG tube plugging in any SG as indicated in DCPP FSARU Section 15.3.1.3.1 and FSARU Table 15.4-7A. The consequences associated with a SG tube rupture (SGTR) event are discussed in DCPP FSARU Section 15.4.3. The limit for accident induced leakage through SG tubes is based on the FSARU Section 15.5.18.1 main steam line break (MSLB) radiological consequences analysis. The current limit on postaccident induced leakage is 10.5 gallons per minute.

3.3 SG Tube Repair By Sleeving

The proposed changes revise the Technical Specifications to permit the installation of leak limiting Alloy 800 sleeves developed by Westinghouse to repair SG tubes at DCPP. Westinghouse provides two types of leak limiting Alloy 800 sleeves. The first type of sleeve spans the transition zone (TZ) of the parent SG tube at the top of the tubesheet and is called a TZ sleeve. The TZ sleeve is hydraulically expanded into the SG tube at the upper end and is hard rolled into the SG tube within the SG tubesheet. The length of the TZ sleeves permits the sleeve to span the degraded SG tube section at the top of the tubesheet. The second type of sleeve spans degraded areas of the SG tube at a TSP elevation or in a free span section and is called a tube support (TS) sleeve. The TS sleeve is hydraulically expanded into the SG tube near each end of the sleeve.

There are two distinct advantages associated with the leak limiting Alloy 800 sleeves compared to other sleeve designs. First, no welding, brazing, or heat treatment is required during sleeve installation. Secondly, the strain within the tube is low, thereby reducing the likelihood of future degradation due to stress-influenced mechanisms. Although the Alloy 800 sleeves may allow slight leakage past the sleeve (assuming the parent SG tube is leaking), the sleeve is designed to maintain normal operation and postulated post-accident leakage to be extremely small compared to the Technical Specification primary-to-secondary leakage limits.

The SG tube with the installed sleeve meets the structural requirements of SG tubes that are not degraded. Even in the event of the severance of the SG tube, the sleeve will provide the required structural support and acceptable primary-to-secondary leakage for normal operating and accident conditions. Extensive analyses and testing have been performed on the sleeve and repair joints to demonstrate that the design and licensing criteria are met.

Analysis was performed by Westinghouse for SG tube repair in Westinghouse designed plants with 7/8 inch OD Inconel 600 tubes of varying wall thickness and addresses a combination of one TZ sleeve and/or up to two TS sleeves that could be installed in a single SG tube. Acceptable sleeve locations covered by the analysis are in the SG tube straight legs from the top of the tubesheet up to the u-bend region. WCAP-15919-P, Revision 00, provides a detailed description of the design, installation, and testing associated with the leak limiting Alloy 800 sleeves.

In addition to the analysis and test programs discussed in WCAP-15919-P, Revision 00, a significant number of sleeves have been in operation for a number of years with no service induced degradation or significant leakage. No degradation of the installed sleeves or SG tube in the area of the expansions has been identified.

3.4 Purpose for Proposed Amendments

Pressurized water reactor SGs have experienced tube degradation related to service-induced cracking, wastage, wear, or general corrosion occurring on either inside or outside the SG tube along with other phenomena such as denting and vibration wear. SG tubes that experience excessive degradation reduce the integrity of the primary-to-secondary pressure boundary. Eddy current examination is used to measure the extent of SG tube degradation. Currently, when the reduction in tube wall thickness reaches 40 percent of nominal SG tube wall thickness or when other ARC are exceeded, the SG tube is considered defective and is removed from service by installing plugs in the SG tube at the inlet and outlet of the SG tube. However, the installation of plugs in a SG tube eliminates the heat transfer surface associated with the tube. In addition, plug installation leads to the reduction in the primary coolant flow available for core cooling. Therefore, the installation of plugs into SG tubes is currently limited to a maximum of 15 percent of the tubes in any SG. The use of Alloy 800 sleeves can allow the SG tube to remain in service, with minimal effect on heat transfer surface area and coolant flow. The Alloy 800 sleeves are installed at the local area of tube wall degradation and impose only a minor restriction to primary coolant flow. In addition, the currently plugged SG tubes can be returned to service by removing the installed plugs and inserting an Alloy 800 sleeve in the degraded section of the SG tube.

PG&E requests approval of this LAR by October 1, 2004, to enable repair of SG tubes using Alloy 800 sleeves as a contingency in the event the SG tube plugging limits cannot be met during the upcoming twelfth DCPP Unit 2 refueling outage (2R12) currently scheduled for October, 2004. Approval of this change will reduce the number of SG tubes which need to

be removed from service by plugging during 2R12 and will also allow certain SG tubes which are currently plugged to be returned to service by removing the plugs and inserting an Alloy 800 sleeve.

4.0 TECHNICAL ANALYSIS

4.1 Alloy 800 SG Tube Sleeves

Introduction

The principal accident associated with the proposed changes is the SGTR event. The consequences associated with a SGTR event are discussed in DCPP FSARU 15.4.3, "Steam Generator Tube Rupture." The SGTR event is a breach of the barrier between the reactor coolant system and the main steam system. The integrity of this barrier is significant from the standpoint of radiological safety in that a leaking SG tube allows the transfer of reactor coolant into the main steam system. In the event of a SGTR, radioactivity contained in the reactor coolant mixes with water in the shell side of the affected SG. This radioactivity is transported by steam to the turbine and then to the condenser, or directly to the condenser via the turbine bypass valves, or directly to the atmosphere via the atmospheric dump/relief valves, main steam safety valves, or the auxiliary feedwater pump turbine exhaust. Noncondensible radioactive gases in the condenser are removed by the condenser air removal system and discharged to the plant vent. The use of leak limiting Alloy 800 sleeves allows the repair of degraded SG tubes such that the function and integrity of the SG tube is maintained. Therefore the SGTR accident is not affected by the use of leak limiting Alloy 800 sleeves.

The consequences of a hypothetical failure of a leak limiting Alloy 800 sleeve and/or the associated SG tube would be bounded by the current SGTR analysis. Due to the slight reduction in the inside diameter of the SG tube caused by the sleeve wall thickness, primary coolant release rates through a ruptured parent tube would be slightly less than assumed for the SGTR analysis and, therefore, would result in lower total primary fluid mass release to the secondary system. A MSLB or feedwater line break (FLB) will not cause a SGTR since the sleeves are analyzed for a design basis accident differential pressure greater than that predicted in the DCPP safety analysis. The impact of sleeving on SG performance, heat transfer, and flow restriction is minimal and/or insignificant compared to plugging. The proposed DCPP Technical Specification changes to allow the use of leak limiting Alloy 800 sleeves do not adversely impact any other previously evaluated design basis accident.

Evaluation of the proposed leak limiting Alloy 800 sleeves indicates no detrimental effects on the sleeve or sleeved tube assembly from reactor

system flow, primary coolant chemistry, secondary coolant chemistry, thermal conditions or transients, or other pressure conditions that may be experienced at DCPP. Any leakage, which is assumed but not expected, experienced during normal operation and post-accident conditions is extremely small relative to the primary-to-secondary operational leakage limits in the Technical Specifications and the DCPP accident induced MSLB leak limits. Data and calculation methodology concerning the reduction in primary coolant flow rate and sleeve-to-plug equivalency ratios is contained in Section 10 of WCAP-15919-P, Revision 00. Table 1 of this enclosure provides a comparison of loading conditions assumed in WCAP-15919-P, Revision 00, with respect to corresponding DCPP operating and accident values. The values assumed in WCAP-15919-P, Revision 00, are either equivalent or more conservative than DCPP plant specific values.

Table 1

LOADING CONDITIONS COMPARISON

		DCPP Units 1 and 2	WCAP-15919-P
T-Hot (Primary) Inlet	Actual Design	~606 °F 650 °F	594 °F 650 °F
T-Steam (Secondary)	Actual Design	>512 °F 600 °F	467.5 °F 550 °F
Primary-to-secondary ΔT	Actual	<94 °F	126.5 °F
Primary Pressure	Actual Design	2250 psia 2500 psia	2250 psia 2500 psia
Secondary Pressure	Actual Design	>760 psia 1100 psia	700 psia 1130 psia
Normal Operating Primary-to-secondary ΔP	Actual	<1490 psi	1550 psi
MSLB FLB Primary-to-secondary ΔP		<2405 psi <2650 psi	2650 psi
LOCA Secondary-to-Primary ΔP		< 1100 psi	1130 psi

WCAP-15919-P, Revision 00, describes the specific qualifications of leak limiting Alloy 800 sleeves. The summary of the results from WCAP-15919-P, Revision 00, is discussed below.

Technical Specification Changes for Leak Limiting Alloy 800 Sleeves

To support SG tube repair using leak limiting Alloy 800 sleeves, a new Technical Specification 5.5.9.d.1.l is added to define that tube repair refers to a process that establishes tube serviceability and that acceptable tube repair of defective tubes will be performed by installation of the leak limiting sleeve as described in Westinghouse Report WCAP-15919-P, Revision 00. In Technical Specification 5.5.9, in places that refer to plug or plugging, the word "repair" or words "repaired by sleeving" are added to support repair of a SG tube using leak limiting Alloy 800 sleeves. The definition for the plugging limit in Technical Specification Section 5.5.9.d.1.f is changed to "the imperfection depth at or beyond which the tube shall be removed from service by plugging or repaired by sleeving in the affected area and is equal to 40% of the nominal tube wall thickness." This allows an imperfection with depth greater than 40 percent of the nominal tube wall thickness to be repaired with a leak limiting Alloy 800 sleeve. In addition, the sentence in Technical Specification Section 5.5.9.d.1.f.1 is changed to add plugging as a limit which is contained in Technical Specification 5.5.9.d.1.j. This provides consistent use of the term "plugging or repair limit" in Section 5.5.9.d.

Several editorial corrections are made to support the changes supporting leak limiting sleeves. An editorial correction is made to Technical Specification Section 5.5.9.b.2.d to replace the period at the end of the sentence with a comma. An editorial correction is made to Technical Specification Section 5.5.9.b.2.e to replace the period at the end of the sentence with a comma to support new Section 5.5.9.b.2.f. Also, an editorial change is made to Technical Specification Section 5.5.9.d to move the note "* Applicable for Units 1 and 2, Cycles 10, 11, 12, and 13 only.," which applies to Section 5.5.9.d.1.k, from the top of Technical Specification page 5.0-17 to the bottom of Technical Specification page 5.0-16. The words "This page is not used" is added to Technical Specification page 5.0-17 since this page is no longer used.

The other Technical Specification changes associated with leak limiting Alloy 800 sleeves are discussed below in the applicable technical sections.

Sleeve Installation Requirements

A plant specific document that specifies the allowable location of tube eddy current testing indications in order to perform a successful sleeve installation will be established upon NRC approval of the Technical Specification changes supporting tube repair by leak limiting sleeves. This document will be utilized to determine that a tube is an acceptable

sleeving candidate. Tubes with indications outside of the acceptable locations would not be sleeved.

To prepare for sleeve installation, the current installation process requires the inside surface of the parent SG tube to be cleaned with a high speed buffing tool. Based on current testing and evaluation, this process step may be eliminated in the future when a sufficient confidence level is developed.

After the parent SG tube is cleaned, the sleeve is inserted in the parent tube and positioned at the desired location. Sleeve expansion equipment is used to provide the required structural fit-up of the sleeve by making the required number of hydraulic expansion joints with the parent tube. The expansion equipment is controlled and monitored to ensure proper diametrical expansion. For the TZ sleeve, a hard roll is performed with sleeve rolling equipment in the lower part of the sleeve to expand the sleeve into contact with the SG tube within the SG tubesheet. The torque of the rolling equipment is monitored and controlled to ensure a leak tight joint.

After installation, all sleeve-tube joints undergo initial eddy current test acceptance and baseline inspection of 100 percent of the installed sleeves.

General Structural Assessment

The Alloy 800 tubing, from which the sleeves are fabricated, is procured to the requirements of the ASME Boiler and Pressure Vessel Code, Section II, Part B, SB-163, NiFeCr Alloy, Unified Numbering System N08800, and Section III, Subsection NB-2000. Alloy 800 is incorporated in ASME Code Case N-21 and is considered acceptable for use by Regulatory Guide 1.85, "Materials Code Case Acceptability ASME Section III, Division 1," Revision 24, dated July 1986. Additionally, supplemental requirements more tightly controlling parameters within the limits allowed by the ASME specification are imposed.

Fatigue and stress analysis of the sleeved tube assemblies have been completed in accordance with the requirements of Section III of the ASME Boiler and Pressure Vessel Code and NRC RG 1.121, "Bases for Plugging Degraded PWR Steam Generator Tubes," August, 1976. SG tubes with installed Alloy 800 sleeves meet the structural integrity requirements of tubes that are not degraded. Even in the event of the severance of the SG tube in the region behind the sleeve, the sleeve will provide the required structural support and acceptable leakage between the primary and secondary systems for normal operating and accident conditions. The selected design criteria for the sleeves ensure that all design and

licensing requirements are considered. Extensive testing and analysis have been performed on the sleeve and sleeve-to-tube joints to demonstrate that these design criteria are met.

Mechanical testing has been performed to support the analyses prepared using ASME Code stress allowable values. Corrosion testing of sleeve-tube assemblies has been performed in Belgium (Laborelec Labatories) and the U.S. (Westinghouse) with satisfactory results. These results, when analyzed in conjunction with corrosion test results from the tungsten inert gas-welded sleeve program, confirm the adequacy of the sleeve joint design. The Alloy 800 sleeve material showed no signs of degradation under high temperature and pressure conditions in a caustic environment, while the sleeve-tube specimens maintained primary side pressure and exhibited no leakage throughout the duration of the test program. Earlier design variations of this sleeve-tube assembly (larger diametrical hydraulic expansion or varying number of expansions/configurations) were used at KORI 1 (South Korea) and Tihange 3 (Belgium) SGs. The current design configuration is in service at Angra 1 (Brazil), KRSKO (Slovenia), Ringhals 4 (Sweden), Tihange 2 (Belgium), Ulchin 1 & 2 (South Korea), and Calvert Cliffs 1 and 2 (United States) SGs.

RG 1.121, along with EPRI Technical Report 10001191, "Steam Generator Degradation Specific Management Flaw Handbook," dated 2001, which adds margin to account for the configuration of a long axial crack, are used to develop the structural limit of the sleeve should sleeve wall degradation occur as described in Section 8.2 of WCAP-15919-P. Leak limiting Alloy 800 sleeves are shown (by test and analysis) to retain burst strength in excess of three times the normal operating pressure differential at end of operating cycle conditions. No credit for the presence of the parent SG tube behind the sleeve was assumed for the minimum wall burst evaluation for the Alloy 800 sleeve. Bounding normal operating, design seismic, and transient loading conditions on the SG tube sleeves were used for the structural analysis of the sleeves and are summarized in Section 8.5 of WCAP-15919-P. The loading conditions assumed in Section 8.5 of WCAP-15919-P are the same as the reactor coolant system design transients described in DCPP FSARU Table 5.2-4, except for the inadvertent spray transient. The WCAP-15919-P structural analyses assumed 10 inadvertent spray cycles while the DCPP FSARU Table specifies 12 inadvertent spray cycles. However this difference of 2 cycles is a small fraction of the 780 total reactor trip and upset transients, which are assumed in the structural analysis for the sleeves as indicated in Table 8-4 of WCAP-15919-P. Therefore this difference of 2 cycles is considered to have a negligible impact on the structural analysis for the sleeves.

The RG 1.121 DCPP specific structural limit for leak limiting Alloy 800 sleeves based on DCPP plant specific conditions is 47.1 percent. This is greater than the bounding 45 percent structural limit contained in Section 8.2.1 of WCAP-15919-P, Revision 00, which is based on normal operating conditions for the worst case envelopment of SG conditions for Westinghouse Model 44, 44F, and 51 SGs. The 47.1 percent limit provides a 2.1 percent operational margin for theoretical defect growth compared to the detection threshold of 45 percent for the leak limiting Alloy 800 sleeves as documented in Section 5.1 of WCAP-15919-P, Revision 00.

The eddy current inspection method used has a documented qualification, per Appendix H of EPRI Technical Report TR-107569-V1R5, "PWR Steam Generator Examination Guidelines: Revision 5, Volume 1: Requirements," dated September 1997, of the Alloy 800 sleeve for 3/4 (0.750) inch tubing. An equivalency assessment was performed to establish that the essential variables developed for the eddy current examination of the Alloy 800 sleeve for a 3/4 (0.750) inch tube can be applied to a 7/8 (0.875) inch tube.

Corrosion Assessment

Historically, Alloy 800 has been used successfully for SG tubes, tube plugs, and sleeves primarily in Western Europe. Over 200,000 Alloy 800 tubes have been used for up to 19 years with only minimal tube failures (thinning/wastage, wear). No evidence of primary or secondary side stress corrosion cracking has been identified in any Alloy 800 tube. Over 5,300 Alloy 800 sleeves of the leak limiting type design have been used in 10 nuclear plants worldwide of which none have identified any service induced stress corrosion cracking in the sleeved tube assembly to-date. Accelerated corrosion testing of Alloy 800 sleeve-tube assemblies has been performed in simulated primary and secondary side SG environments and the Alloy 800 sleeves showed no signs of cracking in both the primary and secondary side tests. The specific details of Alloy 800 sleeve corrosion performance are contained in Section 6 of WCAP-15919-P, Revision 00.

Mechanical Integrity Assessment

Mechanical testing of Alloy 800 sleeve-tube assemblies was performed using mock-up SG tubes. The tests determined axial load, collapse pressure, burst pressure, leak rates, wear, and thermal cycling capability. The demonstrated load capacity of the assemblies provides an adequate safety factor for normal operating and postulated accident conditions. The load capacity of the upper and lower sleeve joints is sufficient to withstand

thermally induced stresses and displacements resulting from the temperature differential between the sleeve and the SG tube and pressure induced stresses resulting from normal operating and postaccident conditions. The burst and collapse pressures of the sleeve provide margin over the limiting pressure differential. The mechanical testing demonstrated that the installed sleeve will withstand the cyclic loading resulting from power changes in the plant and other transients. The loading conditions developed in Section 8 of WCAP-15919-P were used to develop the conditions for the mechanical tests described in Section 7 of WCAP-15919-P. The temperature and pressure differentials described in Section 8 of WCAP-15919-P are conservative with respect to DCPP operating and accident conditions.

Leakage Rate Assessment

Although the Alloy 800 sleeve to SG tube joint is not required to be leak tight, conservative leak rate tests have been performed to provide the basis for leak rate calculations considering normal operating and accident conditions. The Alloy 800 TZ and TS sleeve leakage characteristics were evaluated at shutdown, normal operating, and accident temperatures so that all possible plant conditions would be enveloped by the test results. Based on a conservative sleeve leak rate determined from the sleeve leak rate tests and excluding calculated leakage from alternate plugging criteria in effect, over 11,000 TZ sleeves or 4000 TS sleeves could be installed and still meet the DCPP Technical Specification 3.4.13, "RCS Operational Leakage," leakage limits of 150 gallons per day primary to secondary leakage for a single SG. Under MSLB and FLB accident conditions, over 100,000 TS or TZ sleeves could be installed without exceeding the 10.5 gallons per minute postaccident leakage assumed in the affected SG in the limiting FSARU Section 15.5.18.1 MSLB radiological consequences analysis. Details of the leakage assessment are contained in Section 7 of WCAP-15919-P.

PG&E will conservatively assume all installed sleeves will leak for postaccident leakage calculations. The leak rate for each sleeve will be based on the upper 95 percent confidence limit on the mean value of leakage for appropriate temperature and pressure conditions. The total sleeve leak rate will be combined with the total amount of leakage from all other sources (i.e. all ARC and nonalternate repair criteria indications) for comparison against the limit on accident induced leakage as specified in the FSARU for the MSLB radiological consequences analysis. This total calculated accident induced leakage will be reported in the 90-day report per Technical Specification 5.6.10.f. The current limit on postaccident induced leakage, as specified in FSARU Section 15.5.18.1 for the MSLB accident, is 10.5 gallons per minute.

Sleeve Inspections

Post-installation

As required by EPRI Technical Report 1003138, post-installation (pre-service) examination will be performed on the full length of 100 percent of leak limiting Alloy 800 sleeve/tube assemblies using Plus Point rotating coil or an equivalent EPRI Technical Report 1003138 Appendix H technique if one becomes available. This examination will establish inservice inspection baseline data and initial installation acceptance data on the primary pressure boundary of the sleeve/SG tube assembly repair.

First In-service Inspection

As required by EPRI Technical Report 1003138, during the first in-service inspection, examinations will be performed on the full length of 100 percent of leak limiting Alloy 800 sleeve/tube assemblies using Plus Point rotating coil or an equivalent EPRI Technical Report 1003138 Appendix H technique if one becomes available.

The first in-service inspection establishes an operational baseline to determine if degradation has initiated. The first in-service inspection is performed in the first outage after a sleeve is installed for which the cycle duration is not less than 6 effective full power months and not more than 24 effective full power months.

Subsequent In-service Inspections

During each subsequent in-service inspection, examination will be performed on the full length of 100 percent of the leak limiting Alloy 800 sleeve/tube assemblies using Plus Point rotating coil or an equivalent EPRI Technical Report 1003138 Appendix H technique if one becomes available. This inspection frequency exceeds the 20 percent sampling requirement of Section 3.4.1 of EPRI Technical Report 1003138 and therefore is conservative with respect to current industry requirements.

For the post-installation inspection, first in-service inspection, and subsequent in-service inspections of leak limiting Alloy 800 sleeves, the Plus Point coil rotating probe (or equivalent) inspection will extend beyond the sleeve ends to ensure the parent tube is adequately inspected for degradation.

The first and subsequent in-service inspection requirements will be added to new Technical Specification 5.5.9.b.2.f, which will state:

f) Tubes repaired by leak limiting sleeve(s). Each leak limiting sleeve shall be inspected over the full length using a Plus Point coil or equivalent qualified technique during all future refueling outages.

Plugging Requirements for Tubes With Sleeves

To ensure that a defect in the pressure boundary of a sleeve does not adversely impact the leakage integrity of the sleeve, a sleeved tube will be plugged if an imperfection is detected in any portion of the sleeve. In addition, to ensure that a defect in the pressure boundary of a sleeve does not adversely impact the structural integrity of the sleeve, a sleeved tube will be plugged if an imperfection is detected in the pressure boundary portion of the original tube wall in the leak limiting sleeve/tube assembly (i.e., at the sleeve-tube joint(s)). Imperfections that are detected in the nonpressure boundary portion of the original parent tube wall associated with a sleeve do not impact the pressure boundary of the sleeve/tube assembly and do not impact the structural integrity of the sleeve. Therefore, imperfections that are detected in the nonpressure boundary portion of the original parent tube wall associated with a sleeve may remain in service. These requirements are incorporated in proposed new Technical Specification 5.5.9.d.1.f.5, which states:

5) This definition does not apply to the leak limiting sleeve/tube assembly, for which the plugging limits are defined as follows:

A sleeved tube shall be plugged if an imperfection is detected in any portion of the sleeve.

A sleeved tube shall be plugged if an imperfection is detected in the pressure boundary portion of the original tube wall in the leak limiting sleeve/tube assembly (i.e., at the sleeve-tube joint(s)). Imperfection detected in the non-pressure boundary portion of the original tube wall associated with a sleeve may remain in service.

An imperfection per Technical Specification 5.5.9.d.1.a, means an exception to the dimensions, finish or contour of a tube from that required by fabrication drawings or specification. The second sentence of current Technical Specification 5.5.9.d.1.a is revised to state "Eddy-current testing indications below 20% of the nominal tube wall thickness, if detectable, are to be considered as imperfections." This change ensures that a sleeve with an imperfection or a sleeved tube with an imperfection in the pressure boundary portion of the parent tube will be plugged.

Relationship between TS Sleeves and TSP ARC

For sleeves installed at TSP locations, TSP ODSCC ARC and TSP PWSCC ARC (and associated inspection requirements) will no longer apply to the sleeved TSP intersections. No Technical Specification change is necessary to clarify this relationship for sleeved tubes because the sleeve will remove the TSP ODSCC ARC and TSP PWSCC ARC indications from service.

Relationship between TZ Sleeves and W* ARC

For conservatism, for TZ sleeves installed in the tubesheet region, W* ARC (and associated inspection requirements) will no longer apply to the sleeved tube. Potential degradation detected in the parent tube pressure boundary below the sleeve hard roll will be subject to the 40 percent plugging criteria in Technical Specification 5.5.9.d.1.f.

Accordingly, current Technical Specification 5.5.9.d.1.f.2 is revised to state "This definition does not apply to the portion of the tube within the tubesheet below the W* length provided the tube does not have a sleeve installed in the tubesheet region of the tube. In addition, a new sentence is added to current Technical Specification 5.5.9.d.1.k which states "The W* Plugging limit does not apply to a tube with a sleeve installed in the tubesheet region of the tube." The inspection of the parent tube below the TZ sleeve will be performed every refueling outage using the Plus Point coil rotating probe (or equivalent).

Effects of Sleeving on Operation

The effects of sleeve installation on SG heat removal capability and reactor coolant system flow rate are discussed in Section 10 of WCAP-15919-P, which in summary states that the installation of the sleeves does not substantially affect the primary system flow rate or the heat transfer capability of the SGs. The typical hydraulic equivalency of plugs and installed sleeves, called the sleeve/plug ratio or sleeve to plug equivalency ratio, is contained in Table 10-1 of WCAP-15919-P for different configurations of TZ sleeves and TS sleeves in 7/8 inch OD SG tubes. The Table 10-1 sleeve/plug ratio values are an approximation only based on assumed operating parameters and sleeve types for SGs with 7/8 inch tubes and some variations in the sleeve/plug ratio will occur based on operating parameters and SG conditions. PG&E will use the sleeve/plug ratio values contained in Table 10-1 of WCAP-15919-P to determine the equivalent SG plugging due to installed leak limiting Alloy 800 sleeves, unless more appropriate values become available. The total SG plugging level for each SG will be determined by adding the equivalent SG plugging percentage due to installed leak limiting Alloy 800 sleeves to

the percent of SG tubes plugged. The total SG plugging level must be maintained less than the limit allowed by accident analyses of record. The maximum SG plugging level is currently 15 percent plugging in any SG as indicated in DCPP FSARU Section 15.3.1.3.1 and FSARU Table 15.4-7A.

Alloy 800 was designed for SG tubing as an alternative to Alloy 600 and is comprised of the same three major metallurgical components (nickel, iron, chrome) as Alloys 600 and 690. It has been in use in SGs for many years in European nuclear plants and has performed well in a primary chemistry environment similar to DCPP. Therefore, Alloy 800 is compatible with the primary chemistry regime used at DCPP and no changes to this regime are necessary.

SG Tube Inspection Report Changes

To support the reporting of SG tubes, which have leak limiting Alloy 800 sleeves inserted, Technical Specification 5.6.10.a is revised to require the number of tubes repaired in each SG be reported to the Commission within 15 days following the completion of each inservice inspection of SG tubes. In addition, the Technical Specification 5.6.10.b Special Report requirements are revised to require that the number and extent of sleeves inspected and the tubes repaired be included in the 12-month Special Report.

In Technical Specification 5.6.10.d.1, the word "decreased" is replaced with the word "increased." This change is made because the estimated leakage for the voltage-based repair should be increased by the leakage due to other sources to ensure that the total estimated leakage from all sources is compared to the allowable leakage limit from the MSLB dose calculation. In addition the words "alternate repair criteria" are changed to "sources (alternate repair criteria and non-alternate repair criteria indications and sleeves" so that the estimated leakage due to nonalternate repair criteria indications and sleeves is considered in the total estimated leakage. Since the nonalternate repair criteria indications and sleeves are a source of leakage, the leakage due to nonalternate repair criteria indications and sleeves needs to be included in the total estimated leakage. These changes will ensure that NRC notification will occur if the total estimated leakage due to ARC, nonalternate repair criteria, and sleeves exceeds the allowable leakage limit determined from the licensing basis MSLB dose calculation. It is noted that these changes are consistent with the leakage reporting requirements for PWSCC ARC in Technical Specification 5.6.10.g.2 that considers the leakage from all sources (ARC and non-alternate repair criteria indications) for comparison to the leakage limit determined from the licensing basis MSLB dose calculation. These changes have no adverse effect on the NRC reporting requirement for voltage-based repair criteria estimated leakage.

The asterisk is removed from the Technical Specification 5.6.10.d.1 NRC notification requirement for voltage-based repair criteria estimated leakage. The purpose for the asterisk is to state that the W* plugging limit is applicable for DCPP Units 1 and 2, Cycles 10, 11, 12, and 13 only. With the changes described above, the existence of the asterisk in Technical Specification 5.6.10.d.1 would result in the estimated leakage not being increased by the estimated leakage for all other ARC (e.g., PWSCC ARC) after Cycle 13, which would result in a nonconservative total estimated leakage. In addition, the existence of the asterisk in Technical Specification 5.6.10.d.1 is in conflict with Technical Specification 5.6.10.g.2 that considers the leakage due to all ARC for all cycles for comparison to the leakage limit determined from the licensing basis MSLB dose calculation. Therefore, the removal of the asterisk will lead to conservative NRC notification and will have no adverse affect on Technical Specification 5.6.10.d.1.

An editorial change is made to Technical Specification 5.6.10.d.1 to replace the parentheses before the word "reduced" with a comma and to add a comma before the word "exceeds." Also, an editorial correction change is made to Technical Specification 5.6.10.d.1 to change the word "form" to "from." These editorial changes have no adverse affect on Technical Specification 5.6.10.d.1.

The Technical Specification 5.6.10.f reporting requirement for calculated MSLB leakage is revised to require that the estimated leakage include the estimated leakage due to sleeves. This change ensures that the calculated MSLB leakage due to sleeves is considered for the Commission reporting requirement and has no adverse effect on the Commission reporting requirement for calculated MSLB leakage.

The asterisk is removed from the Technical Specification 5.6.10.f reporting requirement for calculated MSLB leakage. The purpose for the asterisk is to state that the W* plugging limit is applicable for DCPP Units 1 and 2, Cycles 10, 11, 12, and 13 only. The existence of the asterisk in Technical Specification 5.6.10.f could be interpreted to mean that the calculated MSLB leakage does not need to be reported after Cycle 13. The removal of the asterisk will ensure the calculated MSLB leakage from all applicable ARC and sleeves is reported every cycle that ARC are used and every cycle that sleeves are used.

The Technical Specification 5.6.10.g.2 NRC notification requirement for SG leakage for axial PWSCC at dented TSPs is revised to require that the calculated SG leakage for condition monitoring include the leakage due to sleeves. This change ensures that the calculated leakage due to sleeves is considered for the NRC notification requirement and has no adverse

effect on the NRC notification requirement for SG leakage for axial PWSCC at dented TSPs.

Severe Accident Considerations

Severe accidents can lead to high primary pressure of 2500 psi and high primary temperature between 1200°F and 1500°F. At severe accident conditions, pressure tends to loosen the tube joint and temperature tends to tighten it. As the temperature reaches 1500°F, both the sleeve and tube yield at steam line break pressures. Because the sleeve material is specified to have a low yield stress (30 ksi minimum and controlled maximum), the sleeve will yield at a lower temperature (or pressure) than the tube, thereby tending to tighten the tube joint. At 1500°F, the ultimate stress of the sleeve material is comparable to that of the SG tube and the integrity of the sleeve repair is commensurate with the integrity of the inservice SG tubes. Therefore, under severe accident conditions, sleeving is expected to have no impact on the plant risk.

Conclusion

Based on past usage, extensive testing, and analysis, the leak limiting Alloy 800 sleeves provide satisfactory repair of defective SG tubes. Design criteria were established based on the requirements of the ASME Code and RG 1.121. Qualified nondestructive examination techniques will be used to perform necessary sleeve and tube inspections for imperfection detection, and to verify proper installation of the sleeve.

4.2 NRC Reporting Requirements

Technical Specification Table 5.5.9-2, "Steam Generator Tube Inspection," requires notification to the NRC pursuant to 10 CFR 50.72(b)(2) if the results of the SG tube inspection identify more than 10 percent of the total tubes inspected are degraded tubes or more than one percent of the inspected tubes are defective (Category C-3).

On October 25, 2000, the NRC issued a revision to 10 CFR 50.72 that amended the event reporting requirements for nuclear power reactors to reduce or eliminate the unnecessary reporting burden associated with events of little or no safety significance. Prior to the final rule, 10 CFR 50.72(b)(2)(i) required a four-hour report for any event found while the reactor is shutdown, that, had it been found while the reactor was in operation, would have resulted in the nuclear power plant, including its principle safety barriers, being seriously degraded or being in an unanalyzed condition that significantly compromises plant safety. The final rule revised section (b)(2) of the regulation to only apply to initiation of a plant shutdown required by the Technical Specifications. Under the final

rule, 10 CFR 50.72(b)(3)(ii) specifies an eight-hour reporting requirement for a principle safety barrier being significantly degraded or the plant being in an unanalyzed condition. NUREG-1022, Revision 2, "Event Reporting Guidelines 10 CFR 50.72 and 50.73," section 3.2.4 identifies serious SG tube degradation as an example of a reportable event or condition under 10 CFR 50.72(b)(3)(ii).

The current reporting requirement in Technical Specification Table 5.5.9-2 is incorrect based on the issuance of the final 10 CFR 50.72 rule. Table 5.5.9-2 is revised to delete the reporting requirement. Deletion of this requirement from the Technical Specification does not change the requirement to report results that satisfy the criteria of 10 CFR 50.72(b)(3). Routine Category C-3 results do not meet the criteria of serious SG tube degradation, a principle safety barrier being significantly degraded, or the plant being in an unanalyzed condition. Therefore, upon approval of this change, C-3 conditions will not routinely be reported to the NRC under 10 CFR 50.72, thereby eliminating the unnecessary reporting burden associated with events of little or no safety significance. However, Technical Specification 5.6.10.c still requires reporting the results of SG tube inspections, which fall into Category C-3, in a Special Report within 30 days and prior to resumption of plant operation.

In conclusion, based on the considerations discussed above, (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 amendment will not be inimical to the common defense and security or to the health and safety of the public.

5.0 REGULATORY ANALYSIS

5.1 No Significant Hazards Consideration

PG&E has evaluated whether or not a significant hazards consideration is involved with the proposed amendment by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," as discussed below:

1. Does the proposed change involve a significant increase in the probability or consequences of an accident previously evaluated?

Response: No.

The leak limiting Alloy 800 sleeves are designed using the applicable American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code and, therefore, meet the design objectives of the original

steam generator (SG) tubing. The applied stresses and fatigue usage for the sleeves are bounded by the limits established in the ASME Code. Mechanical testing has shown that the structural strength of sleeves under normal, upset, emergency, and faulted conditions provides margin to the acceptance limits. These acceptance limits bound the most limiting (three times normal operating pressure differential) burst margin recommended by NRC Regulatory Guide 1.121, "Bases for Plugging Degraded PWR Steam Generator Tubes." Burst testing of sleeve-tube assemblies has confirmed the analytical results and demonstrated that no unacceptable levels of primary-to-secondary leakage are expected during any plant condition.

The leak limiting Alloy 800 sleeve depth-based structural limit is determined using NRC guidance and the pressure stress equation of ASME Code, Section III with additional margin added to account for the configuration of long axial cracks. A sleeved tube will be plugged on detection of an imperfection in the sleeve or in the pressure boundary portion of the original tube wall in the leak limiting sleeve/tube assembly.

Evaluation of the repaired SG tube testing and analysis indicates no detrimental effects on the leak limiting Alloy 800 sleeve or sleeved tube assembly from reactor system flow, primary or secondary coolant chemistries, thermal conditions or transients, or pressure conditions as may be experienced at Diablo Canyon Power Plant (DCPP) Units 1 and 2. Corrosion testing and historical performance of sleeve-tube assemblies indicates no evidence of sleeve or tube corrosion considered detrimental under anticipated service conditions.

The implementation of the proposed change has no significant effect on either the configuration of the plant or the manner in which it is operated. The consequences of a hypothetical failure of the leak liming Alloy 800 sleeve-tube assembly is bounded by the current SG tube rupture (SGTR) analysis described in the DCPP Final Safety Analysis Report Update. Due to the slight reduction in the inside diameter caused by the sleeve wall thickness, primary coolant release rates through the parent tube would be slightly less than assumed for the SGTR analysis and therefore, would result in lower total primary fluid mass release to the secondary system. A main steam line break or feedwater line break will not cause a SGTR since the sleeves are analyzed for a maximum accident differential pressure greater than that predicted in the DCPP safety analysis. The sleeve-tube assembly leakage during plant operation would be minimal and is well within the Technical Specification (TS) leakage limits.

The proposed change to TS 5.5.9 Table 5.5.9-2, "Steam Generator (SG) Tube Inspection," to delete the requirement to notify the NRC pursuant to 10 CFR 50.72(b)(2) if the first sample inspection or the second sample

inspection results in a C-3 classification, is an administrative change only and does not affect plant equipment or accident analyses.

Therefore, the proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed change create the possibility of a new or different accident from any accident previously evaluated?

Response: No.

The leak limiting Alloy 800 sleeves are designed using the applicable ASME Code as guidance, and therefore meet the objectives of the original SG tubing. As a result, the functions of the SG will not be significantly affected by the installation of the proposed sleeve. The proposed sleeves do not interact with any other plant systems. Any accident as a result of potential tube or sleeve degradation in the repaired portion of the tube is bounded by the existing SGTR accident analysis. The continued integrity of the installed sleeve-tube assembly is periodically verified by the TS requirements and a sleeved tube will be plugged on detection of an imperfection in the sleeve or in the pressure boundary portion of the original tube wall in the leak limiting sleeve/tube assembly.

Implementation of the proposed change has no significant effect on either the configuration of the plant, or the manner in which it is operated.

The proposed change to delete the requirement to notify the NRC pursuant to 10 CFR 50.72(b)(2) from TS 5.5.9 Table 5.5.9-2 is an administrative change only and does not affect plant equipment or accident analyses.

Therefore, the proposed change does not create the possibility of a new or different accident from any accident previously evaluated.

3. Does the proposed change involve a significant reduction in a margin of safety?

Response: No.

The repair of degraded SG tubes with leak limiting Alloy 800 sleeves restores the structural integrity of the degraded tube under normal operating and postulated accident conditions and thereby maintains current core cooling margin as opposed to plugging the tube and taking it out of service. The design safety factors utilized for the sleeves are consistent with the safety factors in the ASME Boiler and Pressure Vessel Code used in the original SG design. The sleeve and portions of the

installed sleeve-tube assembly that represent the reactor coolant pressure boundary will be monitored and a sleeved tube will be plugged on detection of an imperfection in the sleeve or in the pressure boundary portion of the original tube wall in the leak limiting sleeve/tube assembly. Use of the previously identified design criteria and design verification testing assures that the margin to safety is not significantly different from the original SG tubes.

The proposed change to delete the requirement to notify the NRC pursuant to 10 CFR 50.72(b)(2) from TS 5.5.9 Table 5.5.9-2 is an administrative change only, does not affect plant equipment or accident analyses, does not relax any safety system settings, and does not relax the bases for any limiting conditions for operations.

Therefore, the proposed change does not involve a significant reduction in a margin of safety.

Based on the above evaluation, PG&E concludes that the proposed change presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and accordingly, a finding of "no significant hazards consideration" is justified.

5.2 Applicable Regulatory Requirements/Criteria

Title 10 of the Code of Federal Regulations Part 50 (10 CFR 50), Appendix A, "General Design Criterion (GDC)," Criterion 14, Reactor Coolant Pressure Boundary, contains requirements applicable to SG tubes since they are part of the reactor coolant pressure boundary. GDC 14 requires that the reactor coolant pressure boundary be designed, fabricated, erected, and tested in order to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross failure. The repair of the existing reactor coolant pressure boundary is performed in accordance with Section XI of ASME Boiler and Pressure Vessel Code, which refers to Section III of the ASME Code. The original SG tubes are designed in accordance with Section III of the ASME Code. The design criteria for the leak limiting sleeves were established to meet the loading condition and stress requirements of Section III of the ASME Code, which is the same section of the ASME Code that applies to the original SG tubes.

10 CFR 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," requires a quality assurance program for the design, fabrication, construction, and operation of structures, systems, and components in nuclear power plants. The requirements of Appendix B apply to all activities affecting the safety-related functions of those structures, systems, and components.

The activities include designing, purchasing, fabricating, handling, shipping, storing, cleaning, erecting, installing, inspecting, testing, operating, maintaining, repairing, refueling, and modifying safety-related structures, systems and components. The leak limiting sleeves are considered safety-related components and therefore will be required to meet the Appendix B requirements.

RG 1.121 provides guidance for determining the minimum wall thickness at which a SG tube should be plugged. The RG 1.121 performance criteria recommend that the margin of safety against SGTR under normal operating conditions should not be less than 3 at any tube location where defects have been detected. The margin of safety against tube failures under postulated accident conditions should be consistent with the margin of safety determined by the stress limits specified in Section II of the ASME Code. The RG 1.121 requirements were used to develop the structural limit of leak limiting Alloy 800 sleeve should sleeve wall degradation occur. In addition, the fatigue and stress analysis of the sleeved tube assemblies have been completed in accordance with the requirements of RG 1.121.

Based on past usage, extensive testing and analysis, the leak limiting Alloy 800 sleeves provide satisfactory repair of degraded SG tubes. Qualified nondestructive examination techniques will be used to perform necessary sleeve and parent SG tube inspections for defect detection, and to verify proper installation of the repair sleeve.

10 CFR 50.72 provides the reporting requirements for nuclear power reactors. NUREG-1022, Revision 2, provides event reporting guidelines for 10 CFR 50.72. The removal of the incorrect reporting requirement in Technical Specification Table 5.5.9-2 is consistent with the current 10 CFR 50.72 and does not change the requirement to report results that satisfy the criteria of 10 CFR 50.72(b)(3).

In conclusion, based on the considerations discussed above, (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 amendment will not be inimical to the common defense and security or to the health and safety of the public.

6.0 ENVIRONMENTAL CONSIDERATION

PG&E has evaluated the proposed amendment and has determined that the proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any

effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

7.0 REFERENCES

7.1 References

1. Westinghouse Electric LLC WCAP-15919-P, Revision 00, "Steam Generator Tube Repair for Westinghouse Designed Plants with 7/8 Inch Inconel 600 Tubes Using Leak Limiting Alloy 800 Sleeves," dated August 2003 (proprietary).
2. Westinghouse Electric LLC WCAP-15919-NP, Revision 00, "Steam Generator Tube Repair for Westinghouse Designed Plants with 7/8 Inch Inconel 600 Tubes Using Leak Limiting Alloy 800 Sleeves," dated August 2003 (nonproprietary).
3. American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section II, Part B, SB-163, NiFeCr Alloy UNS N08800, and Section III, Subsection NB-2000.
4. Regulatory Guide 1.85, "Materials Code Case Acceptability ASME Section III, Division 1," Revision 24, dated July 1986.
5. Regulatory Guide 1.121, "Bases for Plugging Degraded PWR Steam Generator Tubes," dated August, 1976.
6. EPRI Technical Report 10001191, "Steam Generator Degradation Specific Management Flaw Handbook," dated 2001.
7. EPRI Technical Report TR-107569-V1R5, "PWR Steam Generator Examination Guidelines: Revision 5, Volume 1: Requirements," dated September, 1997.
8. EPRI Technical Report 1003138, "Pressurized Water Reactor Steam Generator Examination Guidelines: Revision 6, Requirements," dated October, 2002.
9. Title 10 to the Code of Federal Regulations, Part 50, Section 72, (10 CFR 50.72), October 25, 2000.
10. NUREG-1022, Revision 2, "Event Reporting Guidelines 10 CFR 50.72 and 50.73," dated October 2000.
11. ABB-Combustion Engineering Report CEN-633-P, Revision 3, "Steam Generator Tube Repair for Combustion Engineering Designed Plants with ¾" - .048" Wall Inconel 600 Tubes Using Leak Limiting Alloy 800 Sleeves," dated October 1998 (proprietary).

12. Westinghouse Electric LLC WCAP-15918-P, Revision 00, (CEN-633-P, Revision 05-P), "Steam Generator Tube Repair for Combustion Engineering and Westinghouse Designed Plant with ¾ Inch Inconel 600 tubes Using Leak Limiting Alloy 800 Sleeves," dated November 2002 (proprietary).

13. Westinghouse Electric LLC WCAP-14797, Revision 1, "Generic W* Tube Plugging Criteria for 51 Series Steam Generator Tubesheet Region WEXTEX Expansions," dated February 1997 (proprietary).

14. Westinghouse Electric LLC WCAP-14798, Revision 1, "Generic W* Tube Plugging Criteria for 51 Series Steam Generator Tubesheet Region WEXTEX Expansions," dated February 1997 (nonproprietary).

15. License Amendment No. 231 to Facility Operating License No. DPR-53 and Amendment No. 207 to Facility Operating License No. DPR-69, "Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 - Issuance of Amendment RE: Steam Generator Tube Repair Using Leak Limiting Alloy 800 Sleeves (TAC Nos. MA4278 and MA4279)," dated September 1, 1999.

16. Tennessee Valley Authority letter "Watts Bar Nuclear Plant (WBN) - Unit 1 - Proposed License Amendment Request Change No. WBN-S-02-16 - Steam Generator Tube Repair Sleeve," dated December 13, 2002.

17. TXU Generation Company LP (TXU Energy) letter CPSES-200301190, "Comanche Peak Steam Electric Station (CPSES), Docket Nos. 50-445 and 50-446, License Amendment Request (LAR) 03-03, Revision to Technical Specification (TS) 5.5.9, Steam Generator Repair Using Leak Limiting Alloy 800 Sleeves," dated July 21, 2003.

7.2 Precedent

The NRC has previously approved the use of leak limiting Alloy 800 sleeves for the Watts Bar Nuclear Plant Unit 1 in License Amendment No. 44 to Facility Operating License No. NPF-90, "Watts Bar Nuclear Plant, Unit 1 - Issuance of Amendment for Steam Generator Tube Repair (TAC No. MB6976)," dated August 15, 2003, and for the Calvert Cliffs plant in License Amendment No. 231 to Facility Operating License No. DPR-53 and Amendment No. 207 to Facility Operating License No. DPR-69, "Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 - Issuance of Amendment RE: Steam Generator Tube Repair Using Leak Limiting Alloy 800 Sleeves (TAC Nos. MA4278 and MA4279)," dated September 1, 1999.

Calvert Cliffs applied the technique in ABB-Combustion Engineering Report CEN-633-P, Revision 3, "Steam Generator Tube Repair for Combustion Engineering Designed Plants with 3/4 - .048" Wall Inconel

600 Tubes Using Leak Limiting Alloy 800 Sleeves," dated October 1998 (ABB-Combustion Engineering proprietary) as the basis for the acceptability of the leak limiting Alloy 800 sleeve. Watts Bar applied the technique in Westinghouse Electric LLC WCAP-15918-P, Revision 00, (CEN-633-P, Revision 05-P), "Steam Generator Tube Repair for Combustion Engineering and Westinghouse Designed Plant with 3/4 Inch Inconel 600 tubes Using Leak Limiting Alloy 800 Sleeves," dated November 2002 (proprietary) as the basis for the acceptability of the leak limiting Alloy 800 sleeve.

Revision 3 of the CEN-633-P report addressed the specific 3/4 inch O.D. 0.048 inch wall thickness SG tube size contained in the Calvert Cliffs Combustion Engineering SGs. Since 1998, the CEN-633-P, Revision 3, report was revised to include additional testing and analysis, to incorporate other industry comments, to reflect the purchase of ABB-Combustion Engineering by Westinghouse Electric LLC, and to include evaluation for SG tube repair for Westinghouse designed plants with 3/4 inch O.D. Inconel 600 tubes. Westinghouse Electric LLC WCAP-15918-P, Revision 00, (CEN-633-P, Revision 05-P), "Steam Generator Tube Repair for Combustion Engineering and Westinghouse Designed Plant with 3/4 Inch Inconel 600 tubes Using Leak Limiting Alloy 800 Sleeves," dated November 2002 (proprietary) provides the basis for SG tube repair using leak limiting Alloy 800 sleeves for Westinghouse plants with 3/4 inch Inconel 600 tubes.

The Westinghouse Electric LLC WCAP-15918-P, Revision 00, (CEN-633-P, Revision 05-P), report has been updated to address Westinghouse plants with 7/8 inch O.D. Inconel 600 tubes in Westinghouse Electric LLC WCAP-15919-P, Revision 00, "Steam Generator Tube Repair for Westinghouse Designed Plants with 7/8 Inch Inconel 600 Tubes Using Leak Limiting Alloy 800 Sleeves," dated August 2003 (proprietary). The PG&E request for approval to use leak limiting Alloy 800 sleeves is based on Westinghouse Electric LLC WCAP-15919-P, Revision 00.

A similar request for NRC approval to use leak limiting Alloy 800 sleeves has been made based on WCAP-15918-P, Revision 00, (CEN-633-P, Revision 05-P), by TXU Generation Company LP (TXU Energy) for Comanche Peak Steam Electric Station in the letter CPSES-200301190, "Comanche Peak Steam Electric Station (CPSES), Docket Nos. 50-445 and 50-446, License Amendment Request (LAR) 03-03, Revision to Technical Specification (TS) 5.5.9, Steam Generator Repair Using Leak Limiting Alloy 800 Sleeves," dated July 21, 2003.

The NRC has previously approved the proposed change to Technical Specification 5.5.9, to delete the requirement to notify the NRC pursuant to 10 CFR 50.72(b)(2) of CFR Part 50 if the first sample inspection or the second sample inspection results in a C-3 classification, for Wolf Creek Generating Station in License Amendment No. 141 to Facility Operating License No. NPF-42, "Wolf Creek Generating Station - Issuance of Amendment Regarding Deletion of License Conditions and Revision to Steam Generator Tube Inspection Table 5.5.9-2 (TAC No. MB1611)," dated September 24, 2001.

Proposed Technical Specification Changes (mark-up)

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5.0-13a	5.0-13a
5.0-15	5.0-15
5.0-16	5.0-16
5.0-17	5.0-17
5.0-19	5.0-19
5.0-29	5.0-29
5.0-30	5.0-30

5.5 Programs and Manuals (continued)

5.5.9 Steam Generator (SG) Tube Surveillance Program

SG tube integrity shall be demonstrated by performance of the following augmented inservice inspection program.

The provisions of SR 3.0.2 are applicable to the SG Tube Surveillance Program test frequencies.

a. SG Sample Selection and Inspection - SG tube integrity shall be determined during shutdown by selecting and inspecting at least the minimum number of SGs specified in Table 5.5.9-1.

b. SG Tube Sample Selection and Inspection - The SG tube minimum sample size, inspection result classification, and the corresponding action required shall be as specified in Table 5.5.9-2. The inservice inspection of SG tubes shall be performed at the frequencies specified in Specification 5.5.9.c and the inspected tubes shall be verified acceptable per the acceptance criteria of Specification 5.5.9.d. The tubes selected for each inservice inspection shall include at least 3% of the total number of tubes in all SGs; the tubes selected for these inspections shall be selected on a random basis except:

1. Where experience in similar plants with similar water chemistry indicates critical areas to be inspected, then at least 50% of the tubes inspected shall be from these critical areas;

2. The first sample of tubes selected for each inservice inspection (subsequent to the preservice inspection) of each SG shall include:

a) All nonplugged tubes that previously had detectable wall penetrations (greater than 20%),

b) Tubes in those areas where experience has indicated potential problems,

c) A tube inspection (pursuant to Specification 5.5.9.d.1.h) shall be performed on each selected tube. If any selected tube does not permit the passage of the eddy current probe for a tube inspection, this shall be recorded and an adjacent tube shall be selected and subjected to a tube inspection,

d) Indications left in service as a result of application of the tube support plate voltage-based repair criteria shall be inspected by bobbin coil probe during all future refueling outages.

e) Tubes identified as W* tubes having a previously identified indication within the W* length shall be inspected using a rotating pancake coil (RPC) probe for the full length of the W* region during all future refueling outages. * **

Insert A

(continued)

* Applicable for Units 1 and 2, Cycles 10, 11, 12, and 13 only

** In-Situ Testing will be performed in accordance with PG&E letters DCL 98-148 dated October 22, 1998, and DCL 01-052 dated May 4, 2001, for Cycles 10 and 11 and letter DCL 01-095 dated September 13, 2001, for Cycles 12 and 13.

There are no changes to this page. Page included for information only.

5.5 Programs and Manuals

5.5.9 Steam Generator (SG) Tube Surveillance Program (continued)

3. The tubes selected as the second and third samples (if required by Table 5.5.9-2) during each inservice inspection may be subjected to a partial tube inspection provided:

   a) The tubes selected for these samples include the tubes from those areas of the tube sheet array where tubes with imperfections were previously found, and

   b) The inspections include those portions of the tubes where imperfections were previously found.

4. Implementation of the steam generator tube/tube support plate repair criteria requires a 100% bobbin coil inspection for hot-leg and cold-leg support plate intersections down to the lowest cold-leg tube support plate with known outside diameter stress corrosion cracking (ODSCC) indications. The determination of the lowest cold-leg tube support plate intersection having ODSCC indications shall be based on the performance of at least a 20% random sampling of tubes inspected over their full length.

5. Inspection of dented tube support plate intersections will be performed in accordance with WCAP-15573, Revision 1, to implement axial primary water stress corrosion cracking (PWSCC) depth-based repair criteria. The extent of required inspection is:

   a) 100 percent bobbin coil inspection of all tube support plate (TSP) intersections.

   b) Plus Point coil inspection of all bobbin coil indications at dented TSP intersections.

   c) Plus Point coil inspection of all prior PWSCC indications left in service.

   d) If bobbin coil is relied upon for detection of axial PWSCC in less than or equal to 2 volt dents, then on a SG basis perform Plus Point coil inspection of all TSP intersections having greater than 2 volt dents up to the highest TSP for which PWSCC has been detected in the prior two inspections or current inspection and 20% of greater than 2 volt dents at the next higher TSP. If a circumferential indication is detected in a dent of "x" volts in the prior two inspections or current inspection, Plus Point inspections will be conducted on 100% of dents greater than "x - 0.3" volts up to the affected TSP elevation in the affected SG, plus 20% of dents greater than "x – 0.3" volts at the next higher TSP. "x" is defined as the lowest dent voltage where a circumferential crack was detected.

(continued)

There are no changes to this page. Page included for information only.

5.5 Programs and Manuals

5.5.9 Steam Generator (SG) Tube Surveillance Program (continued)

e) If bobbin coil is not relied upon for detection of axial PWSCC in less than or equal to 2 volt dents, then on a SG basis perform Plus Point coil inspection of all dented TSP intersections (no lower dent voltage threshold) up to the highest TSP for which PWSCC has been detected in the prior two inspections or current inspection and 20% of all dents at the next higher TSP.

f) For any 20% dent sample, a minimum of 50 dents at the TSP elevation shall be inspected. If the population of dents is less than 50 at the TSP elevation, then 100% of the dents at the TSP elevation shall be inspected.

The results of each sample inspection shall be classified into one of the following three categories:

Category	Inspection Results
C-1	Less than 5% of the total tubes inspected are degraded tubes and none of the inspected tubes are defective.
C-2	One or more tubes, but not more than 1% of the total tubes inspected are defective, or between 5% and 10% of the total tubes inspected are degraded tubes.
C-3	More than 10% of the total tubes inspected are degraded tubes or more than 1% of the inspected tubes are defective.

Note: In all inspections, previously degraded tubes must exhibit significant (greater than 10%) further wall penetrations to be included in the above percentage calculations.

c. Inspection Frequencies - The above required inservice inspections of SG tubes shall be performed at the following frequencies:

1. The first inservice inspection shall be performed after 6 Effective Full Power Months but within 24 calendar months of initial criticality. Subsequent inservice inspections shall be performed at intervals of not less than 12 nor more than 24 calendar months after the previous inspection. If two consecutive inspections not including the preservice inspection, result in all inspection results falling into the C-1 category or if two consecutive inspections demonstrate that previously observed degradation has not continued and no additional degradation has occurred, the inspection interval may be extended to a maximum of once per 40 months;

(continued)

5.5.9 Steam Generator (SG) Tube Surveillance Program (continued)

2. If the results of the inservice inspection of a SG conducted in accordance with Table 5.5.9-2 at 40 month intervals fall in Category C-3, the inspection frequency shall be increased to at least once per 20 months. The increase in inspection frequency shall apply until the subsequent inspections satisfy the criteria of Specification 5.5.9.c.1. The interval may then be extended to a maximum of once per 40 months; and

3. Additional, unscheduled inservice inspections shall be performed on each SG in accordance with the first sample inspection specified in Table 5.5.9-2 during the shutdown subsequent to any of the following conditions:

   a) Reactor-to-secondary tube leaks (not including leaks originating from tube-to-tube sheet welds) in excess of the limits of Specification 3.4.13; or

   b) A seismic occurrence greater than the Double Design Earthquake, or

   c) A loss-of-coolant accident requiring actuation of the Engineered Safety Features, or

   d) A main steam line or feedwater line break.

d. Acceptance Criteria

1. As used in this Specification:

   a) Imperfection means an exception to the dimensions, finish or contour of a tube from that required by fabrication drawings or specifications. Eddy-current testing indications below 20% of the nominal tube wall thickness, if detectable, ~~may~~ **are to** be considered as imperfections;

   b) Degradation means a service-induced cracking, wastage, wear or general corrosion occurring on either inside or outside of a tube;

   c) Degraded Tube means a tube containing imperfections greater than or equal to 20% of the nominal wall thickness caused by degradation;

   d) % Degradation means the percentage of the tube wall thickness affected or removed by degradation.

   e) Defect means an imperfection of such severity that it exceeds the plugging limit. A tube containing a defect is defective;

   f) Plugging **or Repair** Limit means the imperfection depth at or beyond which the tube shall be removed from service **by plugging or repaired by sleeving in the affected area** and is equal to 40% of the nominal tube wall thickness.

      1) This definition does not apply to tube support plate intersections for which the voltage-based repair criteria are being applied. Refer to 5.5.9.d.1.j for the **plugging or** repair limit applicable to these intersections.

5.5.9 Steam Generator (SG) Tube Surveillance Program (continued)

2) This definition does not apply to the portion of the tube within the tubesheet below the W* length **provided the tube does not have a sleeve installed in the tubesheet region of the tube.** ~~Acceptable tube wall degradation within the W* length shall be~~ defined as in 5.5.9.d.1.k. *

3) This definition does not apply to axial PWSCC indications, or portions thereof, which are located within the thickness of dented tube support plates which exhibit a maximum depth greater than or equal to 40 percent of the initial tube wall thickness. WCAP-15573, Revision 1, provides repair limits applicable to these intersections.

Insert B

4) A tube which contains a tube support plate intersection with both an axial ODSCC indication and an axial PWSCC indication will be removed from service **by plugging or repaired by sleeving.**

g) Unserviceable describes the condition of a tube if it leaks or contains a defect large enough to affect its structural integrity in the event of a Double Design Earthquake, a loss-of-coolant accident, or a steam line or feedwater line break as specified in 5.5.9.c.3, above;

h) Tube Inspection means an inspection of the SG tube from the tube end (hot leg side) completely around the U-bend to the top support of the cold leg;

i) Preservice Inspection means an inspection of the full length of each tube in each SG performed by eddy current techniques prior to service to establish a baseline condition of the tubing. This inspection shall be performed after the field hydrostatic test and prior to initial Power Operation using the equipment and techniques expected to be used during subsequent inservice inspections;

j) Tube Support Plate Plugging **or Repair** Limit is used for the disposition of an alloy 600 steam generator tube for continued service that is experiencing predominantly axially oriented outside diameter stress corrosion cracking confined within the thickness of the tube support plates. At tube support plate intersections, the plugging **or repair** limit is based on maintaining steam generator tube serviceability as described below:

(i) Steam generator tubes, whose degradation is attributed to outside diameter stress corrosion cracking within the bounds of the tube support plate with bobbin voltages less than or equal to the lower voltage repair limit (NOTE 1), will be allowed to remain in service.

(ii) Steam generator tubes, whose degradation is attributed to outside diameter stress corrosion cracking within the bounds of the tube support plate with a bobbin voltage greater than the lower voltage repair limit (NOTE 1), will be repaired or plugged, except as noted in 5.5.9.d.1.j (iii) below.

(continued)

* Applicable for Units 1 and 2, Cycles 10, 11, 12, and 13 only.

There are no changes to this page. Page included for information only.

5.5 Programs and Manuals

5.5.9 Steam Generator (SG) Tube Surveillance Program (continued)

(iii) Steam generator tubes, with indication of potential degradation attributed to outside diameter stress corrosion cracking within the bounds of the tube support plate with a bobbin voltage greater than the lower voltage repair limit (NOTE 1) but less than or equal to the upper voltage repair limit (NOTE 2), may remain in service if a rotating pancake coil inspection does not detect degradation. Steam generator tubes, with indications of outside diameter stress corrosion cracking degradation with a bobbin voltage greater than the upper voltage repair limit (NOTE 2) will be plugged or repaired.

(continued)

5.5 Programs and Manuals

5.5.9 Steam Generator (SG) Tube Surveillance Program (continued)

(iv) Certain intersections as identified in Westinghouse letter to PG&E dated September 3, 1992, "Deformation of Steam Generator Tubes Following a Postulated LOCA and SSE Event", will be excluded from application of the voltage-based repair criteria as it is determined that these intersections may collapse or deform following a postulated LOCA + SSE event.

(v) If an unscheduled mid-cycle inspection is performed, the following mid-cycle repair limits apply instead of the limits identified in 5.5.9.d.1.j (i), 5.5.9.d.1.j (ii), and 5.5.9.d.1.j (iii). The mid-cycle repair limits are determined from the following equations :

$$V_{MURL} = \frac{V_{SL}}{1.0 + NDE + Gr\frac{(CL - \Delta t)}{CL}}$$

$$V_{MLRL} = V_{MURL} - (V_{URL} - V_{LRL})\frac{(CL - \Delta t)}{CL}$$

where :

V_{URL} = upper voltage repair limit

V_{LRL} = lower voltage repair limit

V_{MURL} = mid-cycle upper voltage repair limit based on time into cycle

V_{MLRL} = mid-cycle lower voltage repair limit based on V_{MURL} and time into cycle

Δt = length of time since last scheduled inspection during which V_{URL} and V_{LRL} were implemented

CL = cycle length (the time between two scheduled steam generator inspections)

V_{SL} = structural limit voltage

Gr = average growth rate per cycle length

NDE = 95% cumulative probability allowance for nondestructive examination uncertainty (i.e., a value of 20% has been approved by the NRC)

Implementation of these mid-cycle repair limits should follow the same approach as in TS 5.5.9.d.1.j (i), 5.5.9.d.1.j (ii), and 5.5.9.d.1.j (iii).

(continued)

5.5.9 Steam Generator (SG) Tube Surveillance Program (continued)

NOTE 1: The lower voltage repair limit is 2.0 volts for 7/8 inch diameter tubing at DCPP Units 1 and 2.

NOTE 2: The upper voltage repair limit is calculated according to the methodology in Generic Letter 95-05 as supplemented.

k) (*) W* Plugging Limit is used for disposition of an alloy 600 steam generator tube for continued service that is experiencing predominately axially oriented inside diameter stress corrosion cracking confined within the tubesheet, below the bottom of the WEXTEX transition (BWT). **The W* Plugging limit does not apply to a tube with a sleeve installed in the tubesheet region of the tube.** As used in this specification:

(i) Bottom of WEXTEX Transition (BWT) is the highest point of contact between the tube and tubesheet at, or below the top-of-tubesheet as determined by eddy current testing.

(ii) W* Length is the distance to the tubesheet below the BWT that precludes tube pull out in the event of the complete circumferential separation of the tube below the W* length. The W* length is conservatively set at: 1) an undegraded hot leg tube length of 5.2 inches for Zone A tubes and 7.0 inches for Zone B tubes, and 2) an undegraded cold leg tube length of 5.5 inches for Zone A tubes and 7.5 inches for Zone B tubes. Information provided in WCAP-14797, Revision 1, defines the boundaries of Zone A and Zone B.

(iii) Flexible W* Length is the W* length adjusted for any cracks found within the W* region. The Flexible W* Length is the total RPC-inspected length as measured downward from the BWT, and includes NDE uncertainties and crack lengths within W* as adjusted for growth.

(iv) W* Tube is a tube with equal to or greater than 40% degradation within or below the W* length that is left in service, and degraded within the limits specified in Specification 5.5.9d.1.k)(v).

(v) Within the tubesheet, the plugging (repair) limit is based on maintaining steam generator serviceability as described below:

1) For tubes to which the W* criteria are applied, the length of non-degraded tube below BWT shall be greater than or equal to the W* length plus NDE uncertainties and crack growth for the operating cycle.

(continued)

5.5.9 Steam Generator (SG) Tube Surveillance Program (continued)

2) Axial cracks in tubes returned to service using W* shall have the upper crack tip below the BWT by at least the NDE measurement uncertainty, and below the top of tube sheet (TTS) by at least the NDE measurement uncertainty and crack growth allowance, such that at the end of the subsequent operating cycle the entire crack remains below the tubesheet secondary face.

3) Resolvable, single axial indications (multiple indications must return to the null point between individual cracks) within the flexible W* length can be left in service. Alternate RPC coils or an ultrasonic test (UT) inspection can be used to demonstrate return to null point between multiple axial indications or the absence of circumferential involvement between axial indications.

4) Tubes with inclined axial indications less than 2.0 inches long (including the crack growth allowance) having inclination angles relative to the tube axis of < 45 degrees minus the NDE uncertainty, ΔNDE_{CA}, on the measurement of the crack angle can be left in service. Tubes with two or more parallel (overlapping elevation), inclined axial cracks shall be plugged or repaired. For application of the 2.0 inch limit, an inclined indication is an axial crack that is visually inclined on the RCP C-scan, such that an angular measurement is required, and the measured angle exceeds the measurement uncertainty of ΔNDE_{CA}.

5) Circumferential, volumetric, and axial indications with inclination angles greater than (45 degrees - ΔNDE_{CA}) within the flexible W* length shall be plugged or repaired.

6) Any type of combination of the tube degradation below the W* length is acceptable.

l) Tube Repair refers to a process that establishes tube serviceability. Tube repair of defective tubes will be performed by installation of the leak limiting sleeve as described in Westinghouse Report WCAP-15919-P, Revision 00.

2. The SG tube integrity shall be determined after completing the corresponding actions (plug **or repair** all tubes exceeding the plugging **or repair** limit) required by Table 5.5.9-2.

e. Reports

The contents and frequency of reports concerning the SG tube surveillance program shall be in accordance with Specification 5.6.10.

(continued)

* Applicable for Units 1 and 2, Cycles 10, 11, 12, and 13 only.

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TABLE 5.5.9-1
MINIMUM NUMBER OF STEAM GENERATORS (SGs) TO BE INSPECTED DURING INSERVICE INSPECTION

Preservice Inspection	No			Yes		
No. of Steam Generators per Unit	Two	Three	Four	Two	Three	Four
First Inservice Inspection	All			One	Two	Two
Second & Subsequent Inservice Inspections	One[1]			One[1]	One[2]	One[3]

TABLE NOTATIONS

1. The inservice inspection may be limited to one SG on a rotating schedule encompassing 3 N % of the tubes (where N is the number of SGs in the plant) if the results of the first or previous inspections indicate that all SGs are performing in a like manner. Note that under some circumstances, the operating conditions in one or more SGs may be found to be more severe than those in other SGs. Under such circumstances the sample sequence shall be modified to inspect the most severe conditions.

2. The other SG not inspected during the first inservice inspection shall be inspected. The third and subsequent inspections should follow the instructions described in 1 above.

3. Each of the other two SGs not inspected during the first inservice inspections shall be inspected during the second and third inspections. The fourth and subsequent inspections shall follow the instructions described in 1 above.

(continued)

5.5 Programs and Manuals (continued)

or repair

TABLE 5.5.9-2
STEAM GENERATOR (SG) TUBE INSPECTION

1ST SAMPLE INSPECTION			2ND SAMPLE INSPECTION		3RD SAMPLE INSPECTION	
Sample Size	Result	Action Required	Result	Action Required	Result	Action Required
A minimum of S Tubes per S.G.	C-1	None	N.A.	N.A.	N.A.	N.A.
	C-2	Plug defective tubes and inspect additional 2S tubes in this S.G.	C-1	None	N.A.	N.A.
			C-2	Plug defective tubes and inspect additional 4S tubes in this S.G.	C-1	None
					C-2	Plug defective tubes
					C-3	Perform action for C-3 result of first sample
	C-3	Inspect all tubes in this S.G., plug defective tubes and inspect 2S tubes in each other S.G.	C-3	Perform action for C-3 result of first sample	N.A.	N.A.
			All other S.G.s are C-1	None	N.A.	N.A.
			Some S.G.s C-2 but no additional S.G. are C-3	Perform action for C-2 result of second sample	N.A.	N.A.
			Additional S.G. is C-3	Inspect all tubes in each S.G. and plug defective tubes	N.A.	N.A.

~~Notification to NRC pursuant to §50.72 (b) (2) of 10 CFR Part 50~~

~~Notification to NRC pursuant to §50.72 (b) (2) of 10 CFR Part 50~~

$S = 3\frac{N}{n}\%$ Where N is the number of SGs in the unit, and n is the number of SGs inspected during an inspection

(continued)

5.6 Reporting Requirements (continued)

5.6.10 Steam Generator (SG) Tube Inspection Report

a. Within 15 days following the completion of each inservice inspection of SG tubes, the number of tubes plugged **or repaired** in each SG shall be reported to the Commission.

b. The complete results of the SG tube inservice inspection shall be submitted to the Commission in a report within 12 months following completion of the inspection. This Special Report shall include:

1) Number and extent of tubes **and sleeves** inspected,

2) Location and percent of wall-thickness penetration for each indication of an imperfection, and

3) Identification of tubes plugged **or repaired**.

c. Results of SG tube inspections, which fall into Category C-3, shall be reported in a Special Report to the Commission within 30 days and prior to resumption of plant operation. This report shall provide a description of investigations conducted to determine cause of the tube degradation and corrective measures taken to prevent recurrence.

d. For implementation of the voltage-based repair criteria to tube support plate intersections, notify the NRC prior to returning the steam generators to service should any of the following arise:

1. If estimated leakage based on the projected end-of-cycle (or if not practical, using the actual measured end-of-cycle) voltage distribution (~~reduced~~ **increased** by estimated leakage by all other **sources (**alternate repair criteria **and non-alternate repair criteria indications and sleeves - *)** exceeds the leak limit determined ~~form~~ **from** the licensing basis dose calculation for the postulated main steamline break for the next operating cycle.

2. If circumferential crack-like indications are detected at the tube support plate intersections.

3. If indications are identified that extend beyond the confines of the tube support plate.

4. If indications are identified at the tube support plate elevations that are attributable to primary water stress corrosion cracking.

5. If the calculated conditional burst probability based on the projected end-of-cycle (or if not practical, using the actual measured end-of-cycle) voltage distribution exceeds 1×10^{-2}, notify the NRC and provide an assessment of the safety significance of the occurrence.

(continued)

5.6 Reporting Requirements (continued)

5.6.10 Steam Generator (SG) Tube Inspection Report

e. (*) The results of the inspection of W* tubes shall be reported to the Commission pursuant to 10 CFR 50.4 within 90 days following return to service of the steam generators. This report shall include:

1) Identification of W* tubes.

2) W* inspection distance measured with respect to the BWT or the top of the tubesheet, whichever is lower.

3) Elevation and length of axial indications within the flexible W* distance and the angle of inclination of clearly skewed axial cracks (if applicable).

4) The total steam line break leakage for the limiting steam generator per WCAP-14797.

f. (*) The aggregate calculated steam line break leakage from application of all alternate repair criteria **and sleeves** shall be reported to the Commission pursuant to 10 CFR 50.4 within 90 days following return to service of the steam generators.

g. For implementation of the repair criteria for axial PWSCC at dented TSPs, the NRC shall be notified prior to startup, pursuant to 10CFR50.72, of the following conditions that indicate a failure of performance criteria:

1) The calculated SG probability of burst for condition monitoring exceeds 1 x 10^{-2}.

2) The calculated SG leakage for condition monitoring from all sources (all alternate repair criteria and non-alternate repair criteria indications **and sleeves**) exceeds the leakage limit determined from the licensing basis steam line break dose calculation.

h. For implementation of the repair criteria for axial PWSCC at dented TSPs, the results of the condition monitoring and operational assessments will be reported to the NRC within 120 days following completion of the inspection. The report will include:

1) Tabulations of indications found in the inspection, tubes repaired, and tubes left in service under the ARC.

2) Growth rate distributions for indications found in the inspection and growth rate distributions used to establish the tube repair limits.

3) Plus Point confirmation rates for bobbin detected indications when bobbin is relied upon for detection of axial PWSCC in less than or equal to 2 volt dents.

4) For condition monitoring, an evaluation of any indications that satisfy burst margin requirements based on the Westinghouse burst pressure model, but do not satisfy burst margin requirements based on the combined ANL ligament tearing and throughwall burst pressure model.

(continued)

* Applicable for Units 1 and 2, Cycles 10, 11, 12, and 13 only.

There are no changes to this page. Page included for information only.

5.6 Reporting Requirements (continued)

5.6.10 Steam Generator (SG) Tube Inspection Report

5) Performance evaluation of the operational assessment methodology for predicting flaw distributions as a function of flaw size.

6) Evaluation results of number and size of previously reported versus new PWSCC indications found in the inspection, and the potential need to account for new indications in the operational assessment burst evaluation.

7) Identification of mixed mode (axial PWSCC and circumferential) indications found in the inspection and an evaluation of the mixed mode indications for potential impact on the axial indication burst pressures or leakage.

8) Any corrective actions found necessary in the event that condition monitoring requirements are not met.

Technical Specification Inserts

Insert A

f) Tubes repaired by leak limiting sleeve(s). Each leak limiting sleeve shall be inspected over the full length using a Plus Point coil or equivalent qualified technique during all future refueling outages.

Insert B

5) This definition does not apply to the leak limiting sleeve/tube assembly, for which the plugging limits are defined as follows:

   A sleeved tube shall be plugged if an imperfection is detected in any portion of the sleeve.

   A sleeved tube shall be plugged if an imperfection is detected in the pressure boundary portion of the original tube wall in the leak limiting sleeve/tube assembly (i.e., at the sleeve-tube joint(s)). Imperfections detected in the non-pressure boundary portion of the original tube wall associated with a sleeve may remain in service.

Proposed Technical Specification Changes (retyped)

5.5 Programs and Manuals (continued)

5.5.9 Steam Generator (SG) Tube Surveillance Program

SG tube integrity shall be demonstrated by performance of the following augmented inservice inspection program.

The provisions of SR 3.0.2 are applicable to the SG Tube Surveillance Program test frequencies.

a. SG Sample Selection and Inspection - SG tube integrity shall be determined during shutdown by selecting and inspecting at least the minimum number of SGs specified in Table 5.5.9-1.

b. SG Tube Sample Selection and Inspection - The SG tube minimum sample size, inspection result classification, and the corresponding action required shall be as specified in Table 5.5.9-2. The inservice inspection of SG tubes shall be performed at the frequencies specified in Specification 5.5.9.c and the inspected tubes shall be verified acceptable per the acceptance criteria of Specification 5.5.9.d. The tubes selected for each inservice inspection shall include at least 3% of the total number of tubes in all SGs; the tubes selected for these inspections shall be selected on a random basis except:

1. Where experience in similar plants with similar water chemistry indicates critical areas to be inspected, then at least 50% of the tubes inspected shall be from these critical areas;

2. The first sample of tubes selected for each inservice inspection (subsequent to the preservice inspection) of each SG shall include:

   a) All nonplugged tubes that previously had detectable wall penetrations (greater than 20%),

   b) Tubes in those areas where experience has indicated potential problems,

   c) A tube inspection (pursuant to Specification 5.5.9.d.1.h) shall be performed on each selected tube. If any selected tube does not permit the passage of the eddy current probe for a tube inspection, this shall be recorded and an adjacent tube shall be selected and subjected to a tube inspection,

   d) Indications left in service as a result of application of the tube support plate voltage-based repair criteria shall be inspected by bobbin coil probe during all future refueling outages,

   e) Tubes identified as W* tubes having a previously identified indication within the W* length shall be inspected using a rotating pancake coil (RPC) probe for the full length of the W* region during all future refueling outages, * **

(continued)

* Applicable for Units 1 and 2, Cycles 10, 11, 12, and 13 only

** In-Situ Testing will be performed in accordance with PG&E letters DCL 98-148 dated October 22, 1998, and DCL 01-052 dated May 4, 2001, for Cycles 10 and 11 and letter DCL 01-095 dated September 13, 2001, for Cycles 12 and 13.

5.5 Programs and Manuals

5.5.9 Steam Generator (SG) Tube Surveillance Program (continued)

f) Tubes repaired by leak limiting sleeve(s). Each leak limiting sleeve shall be inspected over the full length using a Plus Point coil or equivalent qualified technique during all future refueling outages.

continued)

5.5 Programs and Manuals

5.5.9 Steam Generator (SG) Tube Surveillance Program (continued)

2. If the results of the inservice inspection of a SG conducted in accordance with Table 5.5.9-2 at 40 month intervals fall in Category C-3, the inspection frequency shall be increased to at least once per 20 months. The increase in inspection frequency shall apply until the subsequent inspections satisfy the criteria of Specification 5.5.9.c.1. The interval may then be extended to a maximum of once per 40 months; and

3. Additional, unscheduled inservice inspections shall be performed on each SG in accordance with the first sample inspection specified in Table 5.5.9-2 during the shutdown subsequent to any of the following conditions:

   a) Reactor-to-secondary tube leaks (not including leaks originating from tube-to-tube sheet welds) in excess of the limits of Specification 3.4.13; or

   b) A seismic occurrence greater than the Double Design Earthquake, or

   c) A loss-of-coolant accident requiring actuation of the Engineered Safety Features, or

   d) A main steam line or feedwater line break.

d. Acceptance Criteria

1. As used in this Specification:

   a) Imperfection means an exception to the dimensions, finish or contour of a tube from that required by fabrication drawings or specifications. Eddy-current testing indications below 20% of the nominal tube wall thickness, if detectable, are to be considered as imperfections;

   b) Degradation means a service-induced cracking, wastage, wear or general corrosion occurring on either inside or outside of a tube;

   c) Degraded Tube means a tube containing imperfections greater than or equal to 20% of the nominal wall thickness caused by degradation;

   d) % Degradation means the percentage of the tube wall thickness affected or removed by degradation.

   e) Defect means an imperfection of such severity that it exceeds the plugging limit. A tube containing a defect is defective;

   f) Plugging or Repair Limit means the imperfection depth at or beyond which the tube shall be removed from service by plugging or repaired by sleeving in the affected area and is equal to 40% of the nominal tube wall thickness.

      1) This definition does not apply to tube support plate intersections for which the voltage-based repair criteria are being applied. Refer to 5.5.9.d.1.j for the plugging or repair limit applicable to these intersections.

(continued)

5.5 Programs and Manuals

5.5.9 Steam Generator (SG) Tube Surveillance Program (continued)

2) This definition does not apply to the portion of the tube within the tubesheet below the W* length provided the tube does not have a sleeve installed in the tubesheet region of the tube. Acceptable tube wall degradation within the W* length shall be defined as in 5.5.9.d.1.k. *

3) This definition does not apply to axial PWSCC indications, or portions thereof, which are located within the thickness of dented tube support plates which exhibit a maximum depth greater than or equal to 40 percent of the initial tube wall thickness. WCAP-15573, Revision 1, provides repair limits applicable to these intersections.

4) A tube which contains a tube support plate intersection with both an axial ODSCC indication and an axial PWSCC indication will be removed from service by plugging or repaired by sleeving.

5) This definition does not apply to the leak limiting sleeve/tube assembly, for which the plugging limits are defined as follows:

A sleeved tube shall be plugged if an imperfection is detected in any portion of the sleeve.

A sleeved tube shall be plugged if an imperfection is detected in the pressure boundary portion of the original tube wall in the leak limiting sleeve/tube assembly (i.e., at the sleeve-tube joint(s)). Imperfections detected in the non-pressure boundary portion of the original tube wall associated with a sleeve may remain in service.

g) Unserviceable describes the condition of a tube if it leaks or contains a defect large enough to affect its structural integrity in the event of a Double Design Earthquake, a loss-of-coolant accident, or a steam line or feedwater line break as specified in 5.5.9.c.3, above;

h) Tube Inspection means an inspection of the SG tube from the tube end (hot leg side) completely around the U-bend to the top support of the cold leg;

i) Preservice Inspection means an inspection of the full length of each tube in each SG performed by eddy current techniques prior to service to establish a baseline condition of the tubing. This inspection shall be performed after the field hydrostatic test and prior to initial Power Operation using the equipment and techniques expected to be used during subsequent inservice inspections;

(continued)

* Applicable for Units 1 and 2, Cycles 10, 11, 12, and 13 only.

5.5 Programs and Manuals

5.5.9 Steam Generator (SG) Tube Surveillance Program (continued)

j) Tube Support Plate Plugging or Repair Limit is used for the disposition of an alloy 600 steam generator tube for continued service that is experiencing predominantly axially oriented outside diameter stress corrosion cracking confined within the thickness of the tube support plates. At tube support plate intersections, the plugging or repair limit is based on maintaining steam generator tube serviceability as described below:

(i) Steam generator tubes, whose degradation is attributed to outside diameter stress corrosion cracking within the bounds of the tube support plate with bobbin voltages less than or equal to the lower voltage repair limit (NOTE 1), will be allowed to remain in service.

(ii) Steam generator tubes, whose degradation is attributed to outside diameter stress corrosion cracking within the bounds of the tube support plate with a bobbin voltage greater than the lower voltage repair limit (NOTE 1), will be repaired or plugged, except as noted in 5.5.9.d.1.j (iii) below.

(iii) Steam generator tubes, with indication of potential degradation attributed to outside diameter stress corrosion cracking within the bounds of the tube support plate with a bobbin voltage greater than the lower voltage repair limit (NOTE 1) but less than or equal to the upper voltage repair limit (NOTE 2), may remain in service if a rotating pancake coil inspection does not detect degradation. Steam generator tubes, with indications of outside diameter stress corrosion cracking degradation with a bobbin voltage greater than the upper voltage repair limit (NOTE 2) will be plugged or repaired.

(continued)

5.5 Programs and Manuals

5.5.9 Steam Generator (SG) Tube Surveillance Program (continued)

NOTE 1: The lower voltage repair limit is 2.0 volts for 7/8 inch diameter tubing at DCPP Units 1 and 2.

NOTE 2: The upper voltage repair limit is calculated according to the methodology in Generic Letter 95-05 as supplemented.

k) (*) W* Plugging Limit is used for disposition of an alloy 600 steam generator tube for continued service that is experiencing predominately axially oriented inside diameter stress corrosion cracking confined within the tubesheet, below the bottom of the WEXTEX transition (BWT). The W* Plugging limit does not apply to a tube with a sleeve installed in the tubesheet region of the tube. As used in this specification:

(i) Bottom of WEXTEX Transition (BWT) is the highest point of contact between the tube and tubesheet at, or below the top-of-tubesheet as determined by eddy current testing.

(ii) W* Length is the distance to the tubesheet below the BWT that precludes tube pull out in the event of the complete circumferential separation of the tube below the W* length. The W* length is conservatively set at: 1) an undegraded hot leg tube length of 5.2 inches for Zone A tubes and 7.0 inches for Zone B tubes, and 2) an undegraded cold leg tube length of 5.5 inches for Zone A tubes and 7.5 inches for Zone B tubes. Information provided in WCAP-14797, Revision 1, defines the boundaries of Zone A and Zone B.

(iii) Flexible W* Length is the W* length adjusted for any cracks found within the W* region. The Flexible W* Length is the total RPC-inspected length as measured downward from the BWT, and includes NDE uncertainties and crack lengths within W* as adjusted for growth.

(iv) W* Tube is a tube with equal to or greater than 40% degradation within or below the W* length that is left in service, and degraded within the limits specified in Specification 5.5.9d.1.k)(v).

(v) Within the tubesheet, the plugging (repair) limit is based on maintaining steam generator serviceability as described below:

1) For tubes to which the W* criteria are applied, the length of non-degraded tube below BWT shall be greater than or equal to the W* length plus NDE uncertainties and crack growth for the operating cycle.

(continued)

5.5 Programs and Manuals

5.5.9 Steam Generator (SG) Tube Surveillance Program (continued)

2) Axial cracks in tubes returned to service using W* shall have the upper crack tip below the BWT by at least the NDE measurement uncertainty, and below the top of tube sheet (TTS) by at least the NDE measurement uncertainty and crack growth allowance, such that at the end of the subsequent operating cycle the entire crack remains below the tubesheet secondary face.

3) Resolvable, single axial indications (multiple indications must return to the null point between individual cracks) within the flexible W* length can be left in service. Alternate RPC coils or an ultrasonic test (UT) inspection can be used to demonstrate return to null point between multiple axial indications or the absence of circumferential involvement between axial indications.

4) Tubes with inclined axial indications less than 2.0 inches long (including the crack growth allowance) having inclination angles relative to the tube axis of < 45 degrees minus the NDE uncertainty, ΔNDE_{CA}, on the measurement of the crack angle can be left in service. Tubes with two or more parallel (overlapping elevation), inclined axial cracks shall be plugged or repaired. For application of the 2.0 inch limit, an inclined indication is an axial crack that is visually inclined on the RCP C-scan, such that an angular measurement is required, and the measured angle exceeds the measurement uncertainty of ΔNDE_{CA}.

5) Circumferential, volumetric, and axial indications with inclination angles greater than (45 degrees - ΔNDE_{CA}) within the flexible W* length shall be plugged or repaired.

6) Any type of combination of the tube degradation below the W* length is acceptable.

l) Tube Repair refers to a process that establishes tube serviceability. Tube repair of defective tubes will be performed by installation of the leak limiting sleeve as described in Westinghouse Report WCAP-15919-P, Revision 00.

2. The SG tube integrity shall be determined after completing the corresponding actions (plug or repair all tubes exceeding the plugging or repair limit) required by Table 5.5.9-2.

e. Reports

The contents and frequency of reports concerning the SG tube surveillance program shall be in accordance with Specification 5.6.10.

(continued)

* Applicable for Units 1 and 2, Cycles 10, 11, 12, and 13 only.

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5.5 Programs and Manuals (continued)

TABLE 5.5.9-2
STEAM GENERATOR (SG) TUBE INSPECTION

1ST SAMPLE INSPECTION			2ND SAMPLE INSPECTION		3RD SAMPLE INSPECTION	
Sample Size	Result	Action Required	Result	Action Required	Result	Action Required
A minimum of S Tubes per S.G.	C-1	None	N.A.	N.A.	N.A.	N.A.
	C-2	Plug or repair defective tubes and inspect additional 2S tubes in this S.G.	C-1	None	N.A.	N.A.
			C-2	Plug or repair defective tubes and inspect additional 4S tubes in this S.G.	C-1	None
					C-2	Plug or repair defective tubes
					C-3	Perform action for C-3 result of first sample
	C-3	Inspect all tubes in this S.G., plug or repair defective tubes and inspect 2S tubes in each other S.G.	C-3	Perform action for C-3 result of first sample	N.A.	N.A.
			All other S.G.s are C-1	None	N.A.	N.A.
			Some S.G.s C-2 but no additional S.G. are C-3	Perform action for C-2 result of second sample	N.A.	N.A.
			Additional S.G. is C-3	Inspect all tubes in each S.G. and plug or repair defective tubes.	N.A.	N.A.

$S = 3\frac{N}{n}\%$ Where N is the number of SGs in the unit, and n is the number of SGs inspected during an inspection

(continued)

5.6 Reporting Requirements (continued)

5.6.10 Steam Generator (SG) Tube Inspection Report

a. Within 15 days following the completion of each inservice inspection of SG tubes, the number of tubes plugged or repaired in each SG shall be reported to the Commission.

b. The complete results of the SG tube inservice inspection shall be submitted to the Commission in a report within 12 months following completion of the inspection. This Special Report shall include:

1) Number and extent of tubes and sleeves inspected,

2) Location and percent of wall-thickness penetration for each indication of an imperfection, and

3) Identification of tubes plugged or repaired.

c. Results of SG tube inspections, which fall into Category C-3, shall be reported in a Special Report to the Commission within 30 days and prior to resumption of plant operation. This report shall provide a description of investigations conducted to determine cause of the tube degradation and corrective measures taken to prevent recurrence.

d. For implementation of the voltage-based repair criteria to tube support plate intersections, notify the NRC prior to returning the steam generators to service should any of the following arise:

1. If estimated leakage based on the projected end-of-cycle (or if not practical, using the actual measured end-of-cycle) voltage distribution, increased by estimated leakage by all other sources (alternate repair criteria and non-alternate repair criteria indications and sleeves), exceeds the leak limit determined from the licensing basis dose calculation for the postulated main steamline break for the next operating cycle.

2. If circumferential crack-like indications are detected at the tube support plate intersections.

3. If indications are identified that extend beyond the confines of the tube support plate.

4. If indications are identified at the tube support plate elevations that are attributable to primary water stress corrosion cracking.

5. If the calculated conditional burst probability based on the projected end-of-cycle (or if not practical, using the actual measured end-of-cycle) voltage distribution exceeds 1×10^{-2}, notify the NRC and provide an assessment of the safety significance of the occurrence.

(continued)

5.6 Reporting Requirements (continued)

5.6.10 Steam Generator (SG) Tube Inspection Report

e. (*) The results of the inspection of W* tubes shall be reported to the Commission pursuant to 10 CFR 50.4 within 90 days following return to service of the steam generators. This report shall include:

1) Identification of W* tubes.

2) W* inspection distance measured with respect to the BWT or the top of the tubesheet, whichever is lower.

3) Elevation and length of axial indications within the flexible W* distance and the angle of inclination of clearly skewed axial cracks (if applicable).

4) The total steam line break leakage for the limiting steam generator per WCAP-14797.

f. The aggregate calculated steam line break leakage from application of all alternate repair criteria and sleeves shall be reported to the Commission pursuant to 10 CFR 50.4 within 90 days following return to service of the steam generators.

g. For implementation of the repair criteria for axial PWSCC at dented TSPs, the NRC shall be notified prior to startup, pursuant to 10CFR50.72, of the following conditions that indicate a failure of performance criteria:

1) The calculated SG probability of burst for condition monitoring exceeds 1×10^{-2}.

2) The calculated SG leakage for condition monitoring from all sources (all alternate repair criteria and non-alternate repair criteria indications and sleeves) exceeds the leakage limit determined from the licensing basis steam line break dose calculation.

h. For implementation of the repair criteria for axial PWSCC at dented TSPs, the results of the condition monitoring and operational assessments will be reported to the NRC within 120 days following completion of the inspection. The report will include:

1) Tabulations of indications found in the inspection, tubes repaired, and tubes left in service under the ARC.

2) Growth rate distributions for indications found in the inspection and growth rate distributions used to establish the tube repair limits.

3) Plus Point confirmation rates for bobbin detected indications when bobbin is relied upon for detection of axial PWSCC in less than or equal to 2 volt dents.

4) For condition monitoring, an evaluation of any indications that satisfy burst margin requirements based on the Westinghouse burst pressure model, but do not satisfy burst margin requirements based on the combined ANL ligament tearing and throughwall burst pressure model.

(continued)

* Applicable for Units 1 and 2, Cycles 10, 11, 12, and 13 only.

Westinghouse Electric LLC WCAP 15919-NP, Revision 00, "Steam Generator Tube Repair for Westinghouse Designed Plants with 7/8 Inch Inconel 600 Tubes Using Leak Limiting Alloy 800 Sleeves," dated August 2003 (nonproprietary)