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PG&E Letter DCL-01-110

U.S. Nuclear Regulatory Commission
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Docket No. 50-275, OL-DPR-80
Docket No. 50-323, OL-DPR-82
Diablo Canyon Units 1 and 2
Supplement 3 to License Amendment Request 00-06,
"Alternate Repair Criteria for Axial PWSCC at Dented Intersections in Steam Generator Tubing"

Dear Commissioners and Staff:

In PG&E letter DCL-00-094, "License Amendment Request 00-06, 'Alternate Repair Criteria for Axial PWSCC at Dented Intersections in Steam Generator Tubing,'" dated June 19, 2000, PG&E submitted a request to amend Facility Operating License Nos. DPR-80 and DPR-82. License Amendment Request (LAR) 00-06 proposed Technical Specification (TS) changes to incorporate an alternate repair criteria (ARC) for axial primary water stress corrosion cracking (PWSCC) at dented tube support plate intersections. Based on subsequent discussions with the NRC, Supplement 1 to LAR 00-06 was submitted in PG&E letter DCL-00-119, "Supplement to License Amendment Request 00-06, 'Alternate Repair Criteria for Axial PWSCC at Dented Intersections in Steam Generator Tubing,'" dated September 12, 2000, and Supplement 2 to LAR 00-06 was submitted in PG&E letter DCL-01-016, "Supplement 2 to License Amendment Request 00-06, 'Alternate Repair Criteria for Axial PWSCC at Dented Intersections in Steam Generator Tubing,'" dated February 20, 2001.

Based on a meeting with the NRC on June 28, 2001, PG&E is submitting Supplement 3 to LAR 00-06. This supplement supersedes the changes proposed in PG&E letter DCL-00-094 and supplemented in letters DCL-00-119 and DCL-01-016.

Supplement 3 includes revised mixed mode (axial PWSCC and circumferential) indication evaluation methodology and supports a permanent PWSCC ARC. Supplement 3 also changes the TS to include a minimum dent sample size and revised reporting requirements. These changes do not affect the conclusion of the safety evaluation or the no significant hazards consideration determination made in LAR 00-06 as supplemented by letters DCL-00-119 and DCL-01-016. The technical

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basis for the PWSCC ARC is contained in WCAP-15573, Revision 1, "Depth-Based SG Tube Repair Criteria for Axial PWSCC at Dented TSP Intersections – Alternate Burst Pressure Calculation," which will be submitted separately. Enclosure 1 provides the basis for a permanent license amendment including the supporting technical analyses and the no significant hazards evaluation. Enclosures 2 and 3 provide markups of the existing TS pages and the proposed TS pages, respectively.

PG&E desires to implement this ARC during the Diablo Canyon Power Plant Unit 1 eleventh refueling outage currently scheduled to begin on April 28, 2002. Therefore, PG&E requests that the license amendment be issued by April 1, 2002 and be effective immediately, to be implemented within 30 days of issuance of an amendment.

Sincerely,

Gregory M. Rueger
Senior Vice President – Generation and Chief Nuclear Officer

cc: Edgar Bailey, DHS
Ellis W. Merschoff
David L. Proulx
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Diablo Distribution

Enclosures
KJS

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

Gregory M. Rueger, of lawful age, first being duly sworn upon oath says that he is Senior Vice President - Generation and Chief Nuclear Officer, Pacific Gas and Electric Company; that he has executed Supplement 3 to LAR 00-06 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.

Gregory M. Rueger
Senior Vice President - Generation and Chief Nuclear Officer

Subscribed and sworn to before me this 13th day of November, 2001.

Notary Public
County of San Francisco
State of California

AMY EMIKO DONG
Commission # 1206749
Notary Public - California
San Francisco County
My Comm. Expires Jan 2, 2003

ADDITION OF TECHNICAL SPECIFICATION SURVEILLANCE REQUIREMENTS TO ESTABLISH ALTERNATE REPAIR CRITERIA FOR AXIAL PWSCC AT DENTED TUBE SUPPORT PLATE INTERSECTIONS

A. DESCRIPTION OF AMENDMENT REQUEST

This license amendment request (LAR) adds new surveillance and reporting requirements to the technical specifications (TS) associated with steam generator (SG) tube inspection and repair. The new requirements establish alternate repair criteria (ARC) for axial primary water stress corrosion cracking (PWSCC) at dented tube support plate (TSP) intersections.

The proposed TS changes are permanent and applicable to Diablo Canyon Power Plant (DCPP) Units 1 and 2, as follows:

1. Add TS 5.5.9.b.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.

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."

2. Add TS 5.5.9.d.1.f.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."

3. Add TS 5.6.10.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 (reduced by leakage from all other alternate repair criteria) exceeds the leakage limit determined from the licensing basis steam line break dose calculation."

4. Add TS 5.6.10.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.

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."

The proposed TS changes are noted on the marked-up TS pages provided in Enclosure 2. The proposed TS are provided in Enclosure 3. The marked-up and proposed TS pages include changes to pages 5.0-13 and 5.0-30. Changes to pages 5.0-13 and 5.0-30 have also been proposed as part of LAR 01-03 submitted in letter DCL-01-095, "License Amendment Request 01-03, Extension of Steam Generator Tube W* Alternate Repair Criteria for Indications in the Westinghouse Explosive Tube Expansion (WEXTEX) Region," dated September 13, 2001.

B. BACKGROUND

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 of SG tube integrity are in DCPP TS, Section XI of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (ASME Code), and Regulatory Guide (RG) 1.83. These include requirements for periodic inservice inspection of the tubing, flaw acceptance criteria (i.e., repair limits), 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 repair limits are specified in the DCPP TS. The current DCPP TS require that flawed tubes be repaired if the depths of the flaws are greater than or equal to 40 percent throughwall, unless the degradation is subject to voltage-based repair criteria or W* repair criteria. The TS 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 steam generator tubing. Leakage integrity refers to limiting primary to secondary leakage to within acceptable limits.

The traditional strategy for achieving the objectives of the GDC related to SG tube integrity has been to establish a minimum wall thickness requirement in accordance with the structural criteria of RG 1.121. Development of minimum wall thickness requirements to satisfy RG 1.121 was governed by analyses for uniform thinning of the tube wall in the axial and circumferential directions. The assumption of uniform thinning results in development of a repair limit that is conservative for flaw types occurring in the field. The resultant 40 percent depth-based repair limit incorporated into the DCPP TS is conservative for highly localized flaws such as axial PWSCC that occurs at dented TSPs.

Examination of crack morphology for PWSCC at dented intersections has been found to show one or two microcracks well aligned with only a few uncorroded ligaments and little or no other inside diameter axial cracking at the intersection. This relatively simple morphology is conducive to obtaining good accuracy in nondestructive examination (NDE) sizing of these indications.

PG&E currently performs NDE measurements of axial PWSCC at dented TSPs in accordance with validated Plus Point rotating coil sizing techniques. If the measured maximum depth of the indication is less than 40 percent, the tube is left in service. If the measured maximum depth of the indication is greater than or equal to 40 percent, the tube is repaired.

Under the proposed ARC in this LAR, if the measured maximum depth of the indication is greater than or equal to 40 percent within the confines of the TSP, the tube may be allowed to remain in service using the methodology of WCAP-15573, Revision 1.

C. JUSTIFICATION

The proposed TS changes are necessary to avoid the need for repairing SG tubes

that contain axial PWSCC indications that are greater than or equal to 40 percent deep within dented TSP intersections, but still have adequate structural and leakage integrity for additional service. The proposed change would preserve and restore reactor coolant flow margins through the SGs that are assumed in the loss-of-coolant accident (LOCA) analysis, and reduce the probability of unnecessary SG replacement. In addition, the proposed change would reduce the radiation exposure incurred by personnel involved in tube repair operations, and reduce the man hours and potential impact to critical path time during refueling outages.

The NRC previously issued a PWSCC ARC license amendment to Tennessee Valley Authority (TVA) for Sequoyah Nuclear Plant (SQN) Units 1 and 2 by letter dated March 8, 2000.

D. SAFETY EVALUATION

The purpose of SG tube repair limits is to provide reasonable assurance that tubes accepted for continued service without repair will exhibit adequate structural and leakage integrity with appropriate allowance for error or variability and for defect growth prior to the next inservice inspection.

The SG tube repair limits for axial PWSCC in this proposed TS amendment represents a SG tube ARC for greater than or equal to 40 percent deep axial PWSCC indications which are located within the thickness of the dented tube support plates. These repair bases are not applicable to other types of localized tube wall degradation located at tube-to-tube support plate intersections.

The ARC is based on the use of crack depth profiles (crack length, average depth, maximum depth) obtained from Plus Point analyses. Based on the analysis of crack profiles and the accuracy that can be demonstrated for sizing PWSCC indications in the TSP region, the proposed change will preserve structural and leakage integrity of SG tubes.

PG&E has removed five intersections containing axial PWSCC indications, and all are representative of the types of indications to which the ARC will be applied. Four intersections are included in the data set used in the Plus Point qualification. Therefore, further tube removals are not required at DCPP Units 1 and 2 to support PWSCC ARC application.

Indications with measured maximum depths of less than 40 percent through-wall are left in service in accordance with the limits of the existing TS. For each indication greater than or equal to 40 percent through-wall, this ARC requires Monte Carlo analysis techniques to perform condition monitoring (to determine the as-found condition) and operational assessment (to determine the need for tube repair). The results of the condition monitoring and operational

assessments will be reported to the NRC within 120 days following completion of the inspection.

In the analysis of a SG tube rupture event, a bounding primary-to-secondary leakage rate equal to the operational leakage limits in the TS, plus the leak rate associated with the double-ended rupture of a single tube, is assumed. For other design basis accidents such as a main steam line break (MSLB), main feed line break (MFLB), control rod ejection, and locked reactor coolant pump motor, the tubes are assumed to retain their structural integrity and exhibit primary-to-secondary leakage within the limits assumed in the current licensing basis accident analyses. MSLB accident leakage rates from the proposed PWSCC ARC are combined with postaccident leakage rates from other approved ARC (i.e., voltage-based ARC and W* ARC). The combined postulated accident leakage rates due to ARC will not exceed the limits assumed in the limiting licensing basis accident analyses, currently 12.8 gpm (at room temperature) for a faulted SG.

The 40 percent maximum depth repair limit for free span indications provides a very low likelihood of free span leakage under design basis or severe accident conditions. Leakage from indications inside the TSP is limited by the constraint of the TSP even under severe accident conditions, and leakage behavior in a severe accident would be similar to that found acceptable by the NRC under approved ARC for axial ODSCC at TSP intersections.

The following summarizes the ARC repair limits and bases, exclusions to application of the ARC, and inspection requirements.

Freespan Indication Repair Limit

The tube will be repaired if the crack depth outside the dented TSP is greater than or equal to 40 percent maximum depth, the current TS repair limit. This LAR proposes no change to this limit for free span indications.

Crack Length Limit for Greater Than or Equal to 40 percent Maximum Depth Indications

The crack length limit for greater than or equal to 40 percent maximum depth indications is defined as 0.375 inch from the centerline of the TSP. This limit defines the edges of the TSP thickness of 0.75 inch for Model 51 SGs. It is acceptable for the crack to extend to both edges of the TSP as long as the maximum depth of the crack outside the TSP is less than 40 percent maximum depth and the requirements for end of cycle (EOC) conditions are acceptable.

Operational Assessment (OA) Repair Bases

If the indication satisfies the above maximum depth and length requirements, the repair basis is then obtained by projecting the crack profile to the end of the next operating cycle and determining the burst pressure and leakage for the projected profile using Monte Carlo analysis techniques described in WCAP-15573, Revision 1. The burst pressure and leakage are compared to the requirements in WCAP-15573, Revision 1. Separate analyses are required for the total crack length and the length outside the TSP due to differences in requirements. If the projected EOC requirements are satisfied, the tube will be left in service. If projected EOC requirements are not satisfied, the tube will be repaired.

As described in WCAP-15573, Revision 1, for OA identifying the need for tube repair, burst pressures are calculated as the larger of the Argonne National Laboratories (ANL) model ligament tearing pressure or the Electric Power Research Institute (EPRI) throughwall burst pressure arbitrarily assuming the crack length is throughwall. This burst methodology is used pending resolution of a generic issue related to pressurization rate on burst pressure measurements. If the industry resolves the generic issue to the satisfaction of the NRC, PG&E requests that the OA burst pressures be calculated using the Westinghouse burst pressure model instead of the combined ANL/EPRI model.

Exclusions to ARC: Wedge Region and Seventh TSP Bending Region

Certain wedge region intersections and seventh tube support plate intersections will be excluded from application of depth-based repair criteria at dented TSPs. The excluded intersections are the same as those excluded from voltage-based repair criteria at TSPs.

As discussed in WCAP-15573, Revision 1, in addressing the combined loading effects of a LOCA and safe shutdown earthquake (SSE) on the SGs, the potential exists for yielding of the TSP in the vicinity of the wedge groups, accompanied by deformation of tubes and a subsequent postulated in-leakage. Tube deformation could lead to opening of preexisting tight through wall cracks, resulting in secondary to primary in-leakage following the event. Secondary to primary in-leakage is a potential concern because, although not quantified, in-leakage could have an adverse affect on Final Safety Analysis Report (FSAR) results. Thus, any tubes that are defined to be potentially susceptible to significant deformation under LOCA plus SSE loads are excluded from application of ARC at the wedge location. The tubes susceptible to deformation are identified in PG&E letter DCL-97-034 dated February 26, 1997, and have been previously approved by the NRC in Amendments 124 and 122 of DCPP Units 1 and 2 respectively in a letter to PG&E dated March 12, 1998.

WCAP-15573, Revision 1, also discusses the affects of MFLB/MSLB plus SSE loading. A total of 914 tubes per SG are excluded from application of ARC at the seventh TSP due to high bending stresses at the seventh TSP, because MFLB/MSLB plus SSE loading cause the stresses in certain tubes to exceed the maximum imposed bending stress for existing test data (equal to approximately the lower tolerance limit yield stress). The tube locations are defined as follows: seventh TSP intersections in rows 11 through 15 and rows 36 through 46.

Tubes in the wedge region and seventh TSP exclusion zones are inspected by bobbin coil every outage. If crack-like degradation is identified, then the tube intersection is inspected by Plus Point. If Plus Point confirms a crack-like indication at the intersection, then the tube will be excluded from ARC and repaired.

Exclusions to ARC: Missing TSP Ligaments

The PWSCC ARC will not apply to intersections that contain a cracked or missing TSP ligament, as detected by bobbin and confirmed by Plus Point or pancake coil. A complete discussion of PG&E's program for detection of cracked or missing ligaments is described in PG&E letter DCL-98-046 dated March 27, 1998, in response to NRC Generic Letter (GL) 97-06. In letter DCL-98-046, PG&E committed to exclude voltage-based repair criteria to intersections that contain a missing TSP ligament as measured by eddy current techniques, because only a missing ligament (not a cracked ligament) could permit a burst under normal operating conditions. For consistency of application, voltage-based ARC and PWSCC ARC will not be applied at intersections containing either a cracked or missing ligament.

Inspection Requirements

To support ARC for axial PWSCC at dented TSP intersections, the following six inspection requirements are identified in WCAP-15573, Revision 1. NRC approval of inspection requirements 4, 5, and 6 were provided in the letter to PG&E "Diablo Canyon Nuclear Power Plant, Unit Nos. 1 and 2 - Supplement 2 to License Amendment Request 00-06, 'Alternate Repair Criteria for Axial Primary Water Stress-Corrosion Cracking (PWSCC) at Dented Intersections in Steam Generator Tubing,' (TAC Nos. MB1494 and MB1495)," dated May 1, 2001. The NRC letter also defines a Plus Point inspection methodology for greater than or equal to 5 volt dents in support of GL 95-05 voltage-based repair criteria.

1. Bobbin coil inspection of all TSP intersections.

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

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

4. 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 percent 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 percent of dents greater than "x - 0.3" volts up to the affected TSP elevation in the affected SG, plus 20 percent 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.

5. If bobbin coil is not relied upon for detection of axial PWSCC in less than 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 percent of all dents at the next higher TSP.

6. 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.

Mixed Mode Indications

PG&E recognizes the potential for mixed mode (combined axial and circumferential) indications at dented intersections. Axial and circumferential PWSCC indications have been detected in five intersections. However, as described in WCAP-15573, Revision 1, there is an extremely low probability for occurrence of a mixed mode indication leading to a significant reduction in the axial indication burst pressure. Nonetheless, the WCAP provides an assessment methodology to evaluate potential mixed mode indications detected during an inspection.

Assessment for Permanent Amendment

The NRC issued a PWSCC ARC license amendment to TVA for SQN Units 1 and 2 by letter dated March 8, 2000. The NRC limited the PWSCC ARC for two cycles of operation at SQN Units 1 and 2. PG&E requests a permanent TS amendment. The NRC safety evaluation in the March 8, 2000 letter indicated that a request for a permanent TS change should address five additional items. PG&E's response to these items is provided below. These responses provide a basis for NRC approval of a permanent PWSCC ARC for DCPP.

1. *NRC safety evaluation: WCAP-15128, Revision 2, should be revised to incorporate the clarifications and commitments made in TVA's letter dated March 2, 2000.*

   PG&E response: WCAP-15128 Revision 3 incorporated the clarifications made in Enclosure 2 to TVA's letter dated March 2, 2000, and was transmitted to the NRC by PG&E letter DCL-01-100, "Transmittal of Revision 3 to WCAP-15128 and 15129," dated July 13, 2000. Clarifications that remain applicable to DCPP have been retained in WCAP-15573, Revision 1.

2. *NRC safety evaluation: Consider incorporating refinements into the operational assessment methodology to permit consideration of a more complete amount of the growth rate data from the most recent operating cycle.*

   PG&E response: As described in WCAP-15573 Revision 1, as a minimum, growth rates for large indications that could impact the upper tail of the growth distribution will be evaluated during the outage. If the new growth data causes the growth distribution above 90% probability to be more conservative, the new growth data will be added to the growth distribution for the operational assessment. This method ensures that the growth distribution is conservative for determining the need for tube repair. Growth rate distributions for indications found in the inspection and growth rate distributions used to establish the tube repair limits will be provided in the 120 day report.

3. *NRC safety evaluation: Assess the performance of the operational assessment methodologies for predicting end of cycle (EOC) flaw distributions as a function of flaw size. Assess differences between predicted and actual flaw size distributions in terms of their impact on predicted burst pressures for the most limiting tube and total SG accident leak rate.*

   PG&E response: The 120 day report will provide a performance evaluation of the operational assessment methodologies for predicting flaw distributions as a function of flaw size. The operational assessment methodology will be assessed for performance of both burst and leakage predictions. WCAP-15573, Revision 1, defines specific under prediction criteria and, if the criteria are not satisfied, possible corrective actions to modify the operational assessment performed at the next inspection.

4. *NRC safety evaluation: Assess the early experience with the number and size of indications previously detected and left in service versus the number*

and size of indications of PWSCC indications not previously detected and the need for accounting for the appearance of such new indications in the operational assessment burst evaluation.

PG&E response: The 120 day report will provide 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. WCAP-15573, Revision 1, defines specific acceptance criteria for new indications and corrective actions that must be taken prior to startup if new indications fail to meet these criteria.

5. *NRC safety evaluation: Consider developing refinements into the overall accident leakage model such that the leak test regression calibration of the deterministic model includes a calibration of the model to predict pop-through of crack ligaments. In addition, refinements to the breakthrough model should be incorporated to ensure that all potential pop-through ligaments are identified (within the limits of reasonable refinement of the model) and that all significant ligaments are included in the leakage assessment.*

   PG&E response: The current leak rate model is very conservative, and inclusion of the refinements as requested by the NRC would result in a less conservative leak rate model. Therefore, PG&E believes that refining the model is not necessary at this time.

E. NO SIGNIFICANT HAZARDS EVALUATION

PG&E has evaluated the no significant hazards considerations involved with the proposed amendment, focusing on the three standards set forth in 10 CFR 50.92(c):

> *"The commission may make a final determination, pursuant to the procedures in paragraph 50.91, that a proposed amendment to an operating license for a facility licensed under paragraph 50.21(b) or paragraph 50.22 or for a testing facility involves no significant hazards considerations, if operation of the facility in accordance with the proposed amendment would not:*
>
> *(1) Involve a significant increase in the probability or consequences of an accident previously evaluated; or*
>
> *(2) Create the possibility of a new or different kind of accident from any accident previously evaluated; or*
>
> *(3) Involve a significant reduction in a margin of safety."*

The following evaluation is provided for the no significant hazards considerations.

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

   Examination of crack morphology for primary water stress corrosion cracking (PWSCC) at dented intersections has been found to show one or two microcracks well aligned with only a few uncorroded ligaments and little or no other inside diameter axial cracking at the intersection. This relatively simple morphology is conducive to obtaining good accuracy in nondestructive examination (NDE) sizing of these indications. Accordingly, alternate repair criteria (ARC) are established based on crack length and average and maximum depth within the thickness of the tube support plate (TSP).

   The application of the ARC requires a Monte Carlo condition monitoring assessment to determine the as-found condition of the tubing. The condition monitoring analysis described in WCAP-15573, Revision 1, is consistent with NRC Generic Letter 95-05 requirements.

   The application of the ARC requires a Monte Carlo operational assessment to determine the need for tube repair. The repair bases are obtained by projecting the crack profile to the end of the next operating cycle and determining the burst pressure and leakage for the projected profile using Monte Carlo analysis techniques described in WCAP-15573, Revision 1. The burst pressure and leakage are compared to the requirements in WCAP-15573, Revision 1. Separate analyses are required for the total crack length and the length outside the TSP due to differences in requirements. If the projected end of cycle (EOC) requirements are satisfied, the tube will be left in service.

   A steam generator (SG) tube rupture event is one of a number of design basis accidents that are analyzed as part of a plant's licensing basis. A single or multiple tube rupture event would not be expected in a SG in which the ARC has been applied. The ARC requires repair of any indication having a maximum crack depth greater than or equal to 40 percent outside the TSP, thus limiting the potential length of a deep crack outside the TSP at EOC conditions and providing margin against burst and leakage for free span indications.

   For other design basis accidents such as a MSLB, MFLB, control rod ejection, and locked reactor coolant pump motor, the tubes are assumed to retain their structural integrity.

   Therefore, the proposed change does not involve a significant increase in the

probability or consequences of an accident previously evaluated.

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

Implementation of the proposed SG tube ARC does not introduce any significant changes to the plant design basis. A single or multiple tube rupture event would not be expected in a SG in which the ARC has been applied. Both condition monitoring and operational assessments are completed as part of the implementation of ARC to determine that structural and leakage margin exists prior to returning SGs to service following inspections. If the condition monitoring requirements are not satisfied for burst or leakage, the causal factors for EOC indications exceeding the expected values will be evaluated. The methodology and application of this ARC will continue to ensure that tube integrity is maintained during all plant conditions consistent with the requirements of Regulatory Guide (RG) 1.121 and Revision 1 of RG 1.83.

In the analysis of a SG tube rupture event, a bounding primary-to-secondary leakage rate equal to the operational leakage limits in the Technical Specifications (TS), plus the leak rate associated with the double-ended rupture of a single tube, is assumed. For other design basis accidents, the tubes are assumed to retain their structural integrity and exhibit primary-to-secondary leakage within the limits assumed in the current licensing basis accident analyses. MSLB leakage rates from the proposed PWSCC ARC are combined with leakage rates from other approved ARC (i.e., voltage-based ARC and W* ARC). The combined leakage rates will not exceed the limits assumed in the current licensing basis accident analyses.

The 40 percent maximum depth repair limit for free span indications provides a very low likelihood of free span leakage under design basis or severe accident conditions. Leakage from indications inside the TSP is limited by the constraint of the TSP even under severe accident conditions, and leakage behavior in a severe accident would be similar to that found acceptable by the NRC under approved ARC for axial outside diameter stress corrosion cracking (ODSCC) at TSP intersections. Therefore, even under severe accident conditions, it is concluded that application of the proposed ARC for PWSCC at dented TSP locations results in a negligible difference in risk of a tube rupture or large leakage event, when compared to current 40 percent repair limits or previously approved ARC.

Diablo Canyon Power Plant (DCPP) continues to implement a maximum operating condition leak rate limit of 150 gallons per day per SG to preclude the potential for excessive leakage during all plant conditions.

The possibility of a new or different kind of accident from any previously evaluated is not created because SG tube integrity is maintained by inservice inspection, condition monitoring, operational assessment, tube repair, and primary-to-secondary leakage monitoring.

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

Tube repair limits provide reasonable assurance that tubes accepted for continued service without repair will exhibit adequate tube structural and leakage integrity during subsequent plant operation. The implementation of the proposed ARC is demonstrated to maintain SG tube integrity consistent with the criteria of draft NRC RG 1.121. The guidelines of RG 1.121 describe a method acceptable to the NRC staff for meeting General Design Criteria (GDC) 2, 4, 14, 15, 31, and 32 by ensuring the probability or the consequences of SG tube rupture remain within acceptable limits. This is accomplished by determining the limiting conditions of degradation of SG tubing, for which tubes with unacceptable cracking should be removed from service.

Upon implementation of the proposed ARC, even under the worst-case conditions, the occurrence of PWSCC at the tube support plate elevations is not expected to lead to a SG tube rupture event during normal or faulted plant conditions. The ARC involves a computational assessment to be completed for each indication left in service ensuring that performance criteria for tube integrity and leak tightness are met until the next scheduled outage.

As discussed below, certain tubes are excluded from application of ARC. Existing tube integrity requirements apply to these tubes, and the margin of safety is not reduced. In addressing the combined loading effects of a loss-of-coolant (LOCA) and safe shutdown earthquake (SSE) on the SGs (as required by GDC 2), the potential exists for yielding of the TSP in the vicinity of the wedge groups, accompanied by deformation of tubes and a subsequent postulated in-leakage. Tube deformation could lead to opening of pre-existing tight through wall cracks, resulting in secondary to primary in-leakage following the event, which could have an adverse affect on the Final Safety Analysis Report (FSAR) results. Based on a DCPP analysis of LOCA and SSE, SG tubes located in wedge region exclusion zones are susceptible to deformation, and are excluded from application of ARC.

A DCPP tube stress analysis for MFLB/MSLB plus SSE loading determined that high bending stresses occur in certain SG tubes at the seventh TSP, because the stresses exceed the maximum imposed bending stress for existing test data (equal to approximately the lower tolerance limit yield stress). These tubes are located in rows 11 to 15 and 36 to 46, and are excluded from application of ARC.

Tube intersections that contain TSP ligament cracking are also excluded from application of ARC.

Based on the above, it is concluded that the proposed license amendment request does not result in a significant reduction in margin with respect to the plant safety analyses as defined in the FSAR or TS.

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

F. NO SIGNIFICANT HAZARDS CONSIDERATION DETERMINATION

Based on the above safety evaluation, PG&E concludes that the changes proposed by this LAR satisfy the no significant hazards consideration standards of 10 CFR 50.92(c), and accordingly a no significant hazards finding is justified.

G. ENVIRONMENTAL EVALUATION

PG&E has evaluated the proposed changes and determined the changes do not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluents that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed changes meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), an environmental assessment of the proposed change is not required.

MARKED-UP TECHNICAL SPECIFICATIONS

Remove Page	Insert Page
5.0-11	5.0-11
5.0-13	5.0-13
5.0-30	5.0-30

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.

Insert A

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 Programs and Manuals

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

Insert B

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

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 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 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)

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

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.

Insert C

f. (*) 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.

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

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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.

   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.

INSERT B

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 C

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 (reduced by leakage from all other alternate repair criteria) 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.

   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.

PROPOSED TECHNICAL SPECIFICATIONS PAGES

5.5 Programs and Manuals

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

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(continued)

5.5 Programs and Manuals

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

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(continued)

5.5 Programs and Manuals

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

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(continued)

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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.

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5.6 Reporting Requirements (continued)

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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)

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5.6 Reporting Requirements (continued)

5.6.10 Steam Generator (SG) Tube Inspection Report

5) Performance evaluation of the operational assessment methodology for prediction 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.

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