

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 flexible W* length shall be inspected using a rotating pancake coil (RPC) probe or equivalent for the full length of the W* region during all future refueling outages.

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- 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.
 - 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.
- 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, excluding the portion of the tube within the tubesheet below the Flexible W* Length or below 8 inches from the hot leg top of tubesheet, whichever is bounding;
- 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.

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

- (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.

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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 DCPD 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). 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 in 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-P, Revision 2, 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 degradation within or below the W* length that is left in service, and degraded within the limits specified in Specification 5.5.9.d.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.

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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 crack growth allowance, such that at the end of the subsequent operating cycle the entire crack remains below the BWT.
- 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 $(45 \text{ degrees} - \Delta NDE_{CA})$ within the flexible W^* length shall be plugged or repaired.
- 6) Any type or combination of tube degradation below the flexible W^* length is acceptable.

2. 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.

e. Reports

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

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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 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 inspected,
 - 2) Location and percent of wall-thickness penetration for each indication of an imperfection, and
 - 3) Identification of tubes plugged.
- 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), exceeds the leak limit determined from the licensing basis dose calculation for the postulated main steamline break for the next operating cycle.
 2. If ODS/CC indications are identified that extend beyond the confines of the tube support plate.
 3. 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.

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5.6 Reporting Requirements

5.6.10 Steam Generator (SG) Tube Inspection Report (continued)

- 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* tube indications and indications that do not meet W* requirements and were plugged or repaired, including the following information: the number of indications, the locations of the indications (relative to the BWT and TTS), the orientation (axial, circumferential, volumetric, inclined), the radial position of the tube within the tubesheet, the W* Zone of the tube, the severity of each indication (estimated depth), the side of the tube in which the indication initiated (inside or outside diameter), the W* inspection distance measured with respect to the BWT or TTS (whichever is lower), the length of axial indications, the angle of inclination of clearly skewed axial cracks (if applicable), verification that the upper crack tip of W* indications returned to service in the prior cycle remain below the BWT by at least the 95% confidence NDE uncertainty on locating the crack tip relative to the BWT, updated 95% growth rate for use in operational assessment, the cumulative number of indications detected in the tubesheet region as a function of elevation within the tubesheet, and the condition monitoring and operational assessment main steamline break leak rate for each indication and each SG in accordance with the leak rate methodology described in PG&E Letter DCL-05-018, dated March 11, 2005, as supplemented by PG&E Letter DCL-05-090, dated August 25, 2005.
 - 2) Assessment of whether the results were consistent with expectations and, if not consistent, a description of the proposed corrective action.
- f. The aggregate calculated steam line break leakage from application of all alternate repair criteria and non-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.
- 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) exceeds the leakage limit determined from the licensing basis steam line break dose calculation.

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5.6 Reporting Requirements

5.6.10 Steam Generator (SG) Tube Inspection Report (continued)

- 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.

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5.6 Reporting Requirements

5.6.10 Steam Generator (SG) Tube Inspection Report (continued)

- 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.
- i. For implementation of the probability of prior cycle detection (POPCD) method, for the voltage-based repair criteria at tube support plate intersections, if the end-of-cycle conditional main steamline break burst probability, the projected main steamline break leak rate, or the number of indications are underpredicted by the previous cycle operational assessment, the following shall be reported to the Commission pursuant to 10 CFR 50.4 within 90 days following return to service of the steam generators:
- 1) The assessment of the probable causes for the underpredictions, proposed corrective actions, and any recommended changes to probability of detection or growth methodology indicated by potential methods assessments.
 - 2) An assessment of the potential need to revise the alternate repair criteria analysis methods if: the burst probability is underpredicted by more than 0.001 (i.e., 10% of the reporting threshold) or an order of magnitude; or the leak rate is underpredicted by more than 0.5 gpm or an order of magnitude.
 - 3) An assessment of the potential need to increase the number of predicted low voltage indications at the beginning of cycle if the total number of as-found indications in any SG are underestimated by greater than 15% or by greater than 150 indications.
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