# TECHNICAL SPECIFICATION

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# 3.1.6 Leakage

#### **Specification**

- 3.1.6.1 If the total reactor coolant leakage rate exceeds 10 gpm, the reactor shall be shutdown within 24 hours of detection.
- 3.1.6.2 If unidentified reactor coolant leakage (excluding normal evaporative losses) exceeds 1 gpm or if any reactor coolant leakage is evaluated as unsafe, the reactor shall be shutdown within 24 hours of detection.
- 3.1.6.3 If any reactor coolant leakage exists through a non-isolable fault in a RCS strength boundary (such as the reactor vessel, piping, valve body, etc., except the steam generator tubes), the reactor shall be shutdown, and cooldown to the cold shutdown condition shall be initiated within 24 hours of detection.
- 3.1.6.4 If the total leakage through the tubes of any one steam generator equals or exceeds 150 gallons per day, a reactor shutdown shall be initiated within 4 hours and the reactor shall be in a cold condition within the next 36 hours.
- 3.1.6.5 If reactor shutdown is required by Specification 3.1.6.1, 3.1.6.2 or 3.1.6.3, the rate of shutdown and the conditions of shutdown shall be determined by the safety evaluation for each case and justified in writing as soon thereafter as practicable.
- 3.1.6.6 Action to evaluate the safety implication of reactor coolant leakage shall be initiated within 4 hours of detection. The nature, as well as the magnitude, of the leak shall be considered in this evaluation. The safety evaluation shall assure that the exposure of offsite personnel to radiation is within the guidelines of 10 CFR 20.
- 3.1.6.7 If reactor shutdown is required per Specification 3.1.6.1, 3.1.6.2, 3.1.6.3 or 3.1.6.4, the reactor shall not be restarted until the leak is repaired or until the problem is otherwise corrected.
- 3.1.6.8 When the reactor is critical and above 2% power, two reactor coolant leak detection systems of different operating principles shall be operable, with one of the two systems sensitive to radioactivity. The systems sensitive to radioactivity may be out-of-service for 48 hours provided two other means to detect leakage are operable.
- 3.1.6.9 Loss of reactor coolant through reactor coolant pump seals and system valves to connecting systems which vent to the gas vent header and from which coolant can be returned to the reactor coolant system shall not be considered as reactor coolant leakage and shall not be subject to the consideration of Specifications 3.1.6.1, 3.1.6.2, 3.1.6.3, 3.1.6.4, 3.1.6.5, 3.1.6.6 or 3.1.6.7 except that such losses when added to leakage shall not exceed 30 gpm.

## 3.1.6.10

a. The maximum allowable leakage for valves CF-12, CF-14, LP-47 and LP-48 shall be as follows:

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# 4.17 STEAM GENERATOR TUBING SURVEILLANCE

# Applicability

Applies to the surveillance of tubing of each steam generator.

## **Objective**

To ensure integrity of the steam generator tubing through a defined inservice surveillance program, and to minimize exposure of personnel to radiation during performance of the surveillance program.

#### Specification

#### 4.17.1 Examination Methods

Inservice inspection of steam generator tubing shall include non-destructive examination by eddy-current testing or other equivalent techniques. The inspection equipment shall provide a sensitivity that will detect defects with a penetration of 20 percent or more of the minimum allowable as-manufactured tube wall thickness.

## 4.17.2 Acceptance Criteria

The steam generator shall be considered operable after completion of the specified actions. All tubes examined exceeding the repair limit shall be repaired by sleeving or rerolling or removed from service (e.g., plugged, stabilized).

#### 4.17.3 Selection and Testing

The steam generator tube minimum sample size, inspection result classification, and the corresponding action required shall be as specified in Table 4.17.1. The inservice inspection of steam generator tubes shall be performed at the frequencies specified in Specification 4.17.4 and the inspected tubes shall be verified acceptable per Specification 4.17.5. The tubes selected for each inservice inspection shall include at least 3% of the total number of tubes in both steam generators, with one or both steam generators being inspected. The tubes selected for these inspections shall be selected on a random basis except:

- a. The first sample inspection during each inservice inspection of each steam generator shall include:
  - 1. All tubes that previously had detectable wall penetrations (>20%) and have not been plugged or sleeve repaired in the affected area.
  - 2. At least 50% of the tubes inspected shall be in those areas where experience has indicated potential problems.
  - 3. A tube adjacent to any selected tube which does not permit passage of the eddy current probe for tube inspection.

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- b. Tubes in the following Group(s) may be excluded from the first sample if all tubes in a Group in both OTSG are inspected. No credit will be taken for these tubes in meeting minimum sample size requirements.
  - (1)Group A-1: Tubes within one, two, or three rows of the open inspection lane.
- All tubes which have been repaired using the reroll process will have the new roll area c. inspected during the inservice inspection.
- d. The tubes selected as the second and third samples (if required by Table 4.17-1) during each inservice inspection may be subjected to less than a full tube inspection provided:
  - 1. The tubes selected for these samples include the tubes from those areas of the tubesheet array where tubes with imperfections were previously found.
  - 2. The inspections include those portions of the tubes where imperfections were previously found.

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 ins of the inspected tubes are defectiv	pected are degraded tub e.	es and none
C-2		One or more tubes, but no more th are defective, or between 5% and degraded tubes.	an 1% of the total tubes 10% of the total tubes in	inspected aspected are
C-3		More than 10% of the total tubes i than 1% of the inspected tubes are	nspected are degraded to defective.	ubes or more
NOTES:	(1)	In all inspections, previously degra (>10%) further wall penetrations t percentage calculations.	aded tubes must exhibit o be included in the abo	significant ve
	(2)	Where special inspections are perf defective or degraded tubes found included in determining the Inspec special inspection but need not be Inspection Results Category for the tion, unless the mechanism of degr	ormed pursuant to 4.17. as a result of the inspect tion Results Category for included in determining e general steam generator radation is random in na	3.b, tion shall be or that the or inspec- ture.
	(3)	Where special inspections are performed pursuant to 4.17.3.c, defective or degraded tubes found as a result of the inspection need not be included in determining the Inspection Results Category for the general steam generator inspection.		
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## 4.17.4 Inspection Intervals

The above required inservice inspections of steam generator tubes shall be performed at the following frequencies.

- a. Inservice inspections shall be performed at intervals of not less than 12 nor more than 24 calendar months after the previous inspection. If the results of two consecutive inspections following service under all volatile treatment (AVT) conditions fall 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 40 months.
- b. If the results of the inservice inspection of a steam generator performed in accordance with Table 4.17-1 at 40 month intervals fall in Category C-3, subsequent inservice inspections shall be performed at intervals of not less than 10 months nor more than one fuel cycle after the previous inspection. The increase in inspection frequency shall apply until a subsequent inspection meets the conditions specified in 4.17.4.a and the interval can be extended to a maximum of 40 months.
- c. Additional, unscheduled inservice inspections shall be performed on each steam generator in accordance with the first sample inspection specified in Table 4.17-1 during the shutdown subsequent to any of the following conditions:
  - 1. A seismic occurrence greater than the Operating Basis Earthquake,
  - 2. A loss-of-coolant accident requiring actuation of the engineered safeguards, or
  - 3. A main steam line or feedwater line break.
- d. After primary to secondary leakage in excess of the limits of Specification 3.1.6, an inspection of the affected steam generator will be performed in accordance with the following criteria:
  - 1. If the leaking tube is in a Group as defined in Section 4.17.3.b, all of the tubes in this Group in this steam generator will be inspected. If the results of this inspection fall into the C-3 category, additional inspections will be performed in the same Group in the other steam generator.
  - 2. If the leaking tube has been repaired by the reroll process and is leaking in the new roll area, all of the tubes in the steam generator that have been repaired by the reroll process will have the new roll area inspected. If the results of this inspection fall into the C-3 category, additional inspections will be performed in the new roll area in the other steam generator.
  - 3. If the leaking tube is not in a Group as defined in 4.17.4.d.1, then an inspection will be performed on the affected steam generator in accordance with Table 4.17-1 with an initial inspection sample size of 6% of the tubes in the affected steam generator.

# 4.17.5 Definitions

As used in this specification:

- a. <u>Imperfection</u> 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 or sleeve wall thickness, if detectable, may be considered as imperfections.
- b. <u>Degradation</u> means a service-induced cracking, wastage, wear or general corrosion occurring on either the inside or outside of a tube or a sleeve.
- c. <u>Degraded Tube</u> means a tube or a sleeve containing imperfections  $\geq 20\%$  of the nominal wall thickness caused by degradation.
- d. <u>% Degradation</u> means the percentage of the tube or sleeve wall thickness affected or removed by degradation.
- e. <u>Defect</u> means an imperfection of such severity that it exceeds the repair limit. A tube or sleeve containing a defect is defective.
- f. <u>Repair Limit</u> means the imperfection depth beyond which the tube shall be either removed from service by plugging or repaired by sleeving or rerolling because it may become unserviceable prior to the next inspection; it is equal to 40% of the nominal tube or sleeve wall thickness.

The Babcock and Wilcox process (or method) equivalent to the method described in report, BAW-1823P, Revision 1 will be used for sleeving repairs.

The rerolling repair process will only be used to repair tubes with defects in the upper tubesheet area. The rerolling repair process will be performed only once per steam generator tube using a 1 inch reroll length. The new roll area must be free of degradation in order for the repair to be considered acceptable. The rerolling process used by Oconee is described in the topical report, BAW-2303P, Revision 3.

- g. <u>Unserviceable</u> describes the condition of a tube if it leaks or contains a defect large enough to affect its structural integrity in the event of an Operating Basis Earthquake, a loss-of-coolant accident, or a steam line or feedwater line break as specified in Specification 4.17.4.
- h. <u>Tube Inspection</u> means an inspection of the steam generator tube from the point of entry completely to the point of exit. The degraded tube above the new roll area can be excluded from future periodic inspection requirements because it is no longer part of the pressure boundary once the repair roll is installed.
- 4.17.6 Reports
- a. The number of tubes plugged or repaired in each steam generator shall be reported to the NRC within 30 days following the completion of the plugging or repair procedure.

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The results of the steam generator tube inservice inspection shall be reported to the NRC within 3 months following completion of the inspection. This report shall include:

- 1. Number and extent of tubes inspected.
- 2. Location and percent of wall-thickness penetration for each indication of a degraded tube.
- 3. Identification of tubes plugged or repaired.

c. Results of steam generator tube inspections which fall into Category C-3 and require prompt notification of the NRC shall be reported pursuant to Specification 6.6.2.1.a prior to resumption of plant operation. The written followup of this report shall provide a description of investigations conducted to determine cause of the tube degradation and corrective measures taken to prevent recurrence.

#### <u>Bases</u>

The program of periodic inservice inspection of steam generators provides the means to monitor the integrity of the tubing and to maintain surveillance in the event there is evidence of mechanical damage or progressive deterioration due to design, manufacturing errors, or operating conditions. Inservice inspection of the steam generator tubing also provides a means of characterizing the nature and cause of any tube degradation so that corrective measures may be taken.

Repair or removal from service will be required for any tube with service-induced metal loss in excess of 40% of the tube or sleeve nominal wall thickness or with a through wall crack. Additional corrective actions may be required to stabilize a circumferentially cracked tube.

The initial sample of tubes inspected in a steam generator includes tubes from three groups. First, lane tubes are inspected to assure their integrity. Second, all other inservice tubes with degradation, inspected in previous inspections, are inspected to assure tube integrity and determine degradation growth, if any. Third, a random sample of 3% of the total number of tubes in both steam generators is inspected. The results of the latter inspection dictate the extent of further examinations.

An objective of this Specification is to provide an inspection plan which will insure, with a high degree of confidence, that no more than 30 defective tubes will remain in a steam generator after an initial C-3 category inspection.

Following an 18% random inspection (C-3 category inspection) an unaffected area is identified. The unaffected area will be logically and consistently defined based on generator design, defect location and characteristics. The criteria for accepting an area as unaffected depend on the number of defects found in the sample inspected in that area and are established such that there is a 0.05 or smaller probability of accepting the area as unaffected if it contains 30 or more defective tubes.

Experience with Babcock and Wilcox steam generators has indicated that tubes near the open inspection lane are susceptible to forms of degradation unique to that area. Therefore, tubes within one, two, or three rows of the inspection lane have been defined as a special group. If all of these tubes are inspected in both steam generators, no credit will be taken for them in meeting minimum sample size requirements and the results of their inspection will not be used in classifying the results of the general inspection into

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C-1, C-2 or C-3 categories, unless the mechanism of tube degradation is random in nature. Random degradation mechanisms are those which based on location, steam generator design and operation, and operating experience cannot logically and consistently be shown as limited to a local area.

The affected area will be 100% inspected to assure all defective tubes therein are identified and either removed from service or repaired by sleeving. NRC concurrence in this determination is required prior to completion of the inspection.

Degraded steam generator tubes can be repaired by the installation of sleeves which span the area of degradation and serve as a replacement pressure boundary for the degraded portion of the tube, thus permitting the tube to remain in service. An additional repair method for degraded steam generator tubes consists of rerolling the tubes to create a new roll area and pressure boundary for the tube. The rerolling method will ensure that the area of degradation will not serve as a pressure boundary, thus permitting the tube to remain in service. The degraded tube above the new roll area can be excluded from future periodic inspection requirements because it is no longer part of the pressure boundary once the repair roll is installed.

All tubes which have been repaired using the reroll process will have the new roll area inspected during the inservice inspection. Defective or degraded tubes found as a result of the inspection of the new roll area need not be included in determining the Inspection Results Category for the general steam generator inspection.

The rerolling repair process will only be used to repair tubes with defects in the upper tubesheet area. The rerolling repair process will be performed only once per steam generator tube using a 1 inch reroll length. Thus, multiple applications of the rerolling process to any individual tube is not acceptable. The new roll area must be free of degradation in order for the repair to be considered acceptable. After the new roll area is initially deemed acceptable, future degradation in the new roll area will be analyzed to determine if the tube is defective and needs to be removed from service. The rerolling process used by Oconee is described in the topical report, BAW-2303P, Revision 3.

This inspection plan enables exposures to be maintained as low as reasonably achievable to the personnel involved in the inspection and assured that generator areas with significant numbers of degraded tubes are adequately inspected.

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# TECHNICAL SPECIFICATION MARKUP

#### 3.1.6 Leakage

#### Specification

- 3.1.6.1 If the total reactor coolant leakage rate exceeds 10 gpm, the reactor shall be shutdown within 24 hours of detection.
- 3.1.6.2 If unidentified reactor coolant leakage (excluding normal evaporative losses) exceeds 1 gpm or if any reactor coolant leakage is evaluated as unsafe, the reactor shall be shutdown within 24 hours of detection.
- 3.1.6.3 If any reactor coolant leakage exists through a non-isolable fault in a RCS strength boundary (such as the reactor vessel, piping, valve body, etc., except the steam generator tubes), the reactor shall be shutdown, and cooldown to the cold shutdown condition shall be initiated within 24 hours of detection:
- 3.1.6.4 If the total leakage through the tubes of any one steam generator equals or exceeds <del>0.35 gpm</del>, a reactor shutdown shall be initiated within 4 hours and the reactor shall be in a cold condition within the next 36 hours.
- 3.1.6.5 If reactor shutdown is required by Specification 3.1.6.1, 3.1.6.2 or 3.1.6.3, the rate of shutdown and the conditions of shutdown shall be determined by the safety evaluation for each case and justified in writing as soon thereafter as practicable.
- 3.1.6.6 Action to evaluate the safety implication of reactor coolant leakage shall be initiated within 4 hours of detection. The nature, as well as the magnitude, of the leak shall be considered in this evaluation. The safety evaluation shall assure that the exposure of offsite personnel to radiation is within the guidelines of 10 CFR 20.
- 3.1.6.7 If reactor shutdown is required per Specification 3.1.6.1, 3.1.6.2, 3.1.6.3 or 3.1.6.4, the reactor shall not be restarted until the leak is repaired or until the problem is otherwise corrected.
- 3.1.6.8 When the reactor is critical and above 2% power, two reactor coolant leak detection systems of different operating principles shall be operable, with one of the two systems sensitive to radioactivity. The systems sensitive to radioactivity may be out-of-service for 48 hours provided two other means to detect leakage are operable.
- 3.1.6.9 Loss of reactor coolant through reactor coolant pump seals and system values to connecting systems which vent to the gas vent header and from which coolant can be returned to the reactor coolant system shall not be considered as reactor coolant leakage and shall not be subject to the consideration of Specifications 3.1.6.1, 3.1.6.2, 3.1.6.3, 3.1.6.4, 3.1.6.5, 3.1.6.6 or 3.1.6.7 except that such losses when added to leakage shall not exceed 30 gpm.

#### 3.1.6.10

a. The maximum allowable leakage for values CF-12, CF-14, LP-47 and LP-48 shall be as follows:

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#### 4.17 STEAM GENERATOR TUBING SURVEILLANCE

# Applicability

Applies to the surveillance of tubing of each steam generator.

#### Objective

To ensure integrity of the steam generator tubing through a defined inservice surveillance program, and to minimize exposure of personnel to radiation during performance of the surveillance program.

#### Specification

#### 4.17.1 Examination methods

Inservice inspection of steam generator tubing shall include non-destructive examination by eddy-current testing or other equivalent techniques. The inspection equipment shall provide a sensitivity that will detect defects with a penetration of 20 percent or more of the minimum allowable as-manufactured tube wall thickness.

#### 4.17.2 Acceptance Criteria

The steam generator shall be considered operable after completion of the specified actions. All tubes examined exceeding the repair limit shall be repaired by sleeving or removed from service (e.g., plugged, stabilized).

The steam generator tube minimum sample size, inspection result classification, and the corresponding action required shall be as specified in Table 4.17.1. The inservice inspection of steam generator tubes shall be performed at the frequencies specified in Specification 4.17.4 and the inspected tubes shall be verified acceptable per Specification 4.17.5. The tubes selected for each inservice inspection shall include at least 3% of the total number of tubes in both steam generators, with one or both steam generators being inspected. The tubes selected for these inspections shall be selected on a random basis except:

- The first sample inspection during each inservice inspection of each а. steam generator shall include:
  - All tubes that previously had detectable wall penetrations (>20%) 1. and have not been plugged or sleeve repaired in the affected area.
  - 2. At least 50% of the tubes inspected shall be in those areas where experience has indicated potential problems.
  - A tube adjacent to any selected tube which does not permit passage 3. of the eddy current probe for tube inspection.
- Tubes in the following Group(s) may be excluded from the first sample if Ь. all tubes in a Group in both OTSG are inspected. No credit will be taken for these tubes in meeting minimum sample size requirements.

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Group A-1: Tubes within one, two, or three rows of the open inspection lane.

The tubes selected as the second and third samples (if required by Table 4.17.1) during each inservice inspection may be subjected to less than a full tube inspection provided:

- The tubes selected for these samples include the tubes from those 1. areas of the tubesheet array where tubes with imperfections were previously found.
- The inspections include those portions of the tubes where 2. imperfections were previously found.

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

#### Category

# Inspection Results

- 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

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- More than 10% of the total tubes inspected are degraded tubes or more than 1% of the inspected tubes are defective.
- In all inspections, previously degraded tubes must exhibit NOTES: (1)significant (>10%) further wall penetrations to be included in the above percentage calculations.
- (2) Where special inspections are performed pursuant to 4.17.3.b, defective or degraded tubes found as a result of the inspection shall be included in determining the Inspection Results Category for that special inspection but need not be included in determining the Inspection Results Category for the general steam generator inspection, unless the mechanism of degradation is random in nature. Insert Binformation from the attached page. Inspection Intervals

4.17.4

The above required inservice inspections of steam generator tubes shall be performed at the following frequencies.

Inservice inspections shall be performed at intervals of not less than 12 а. nor more than 24 calendar months after the previous inspection. If the results of two consecutive inspections following service under all volatile treatment (AVT) conditions fall into the C-1 category or if two consecutive inspections demonstrate that previously observed degradation

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c. All tubes which have been repaired using the reroll process will have the new roll area inspected during the inservice inspection.

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(3) Where special inspections are performed pursuant to 4.17.3.c, defective or degraded tubes found as a result of the inspection need not be included in determining the Inspection Results Category for the general steam generator inspection. has not continued and no additional degradation has occurred, the inspection interval may be extended to a maximum of 40 months.

- b. If the results of the inservice inspection of a steam generator performed in accordance with Table 4.17-1 at 40 month intervals fall in Category C.3, subsequent inservice inspections shall be performed at intervals of not less than 10 months nor more than one fuel cycle after the previous inspection. The increase in inspection frequency shall apply until a subsequent inspection meets the conditions specified in 4.17.4.a and the interval can be extended to a maximum of 40 months.
- c. Additional, unscheduled inservice inspections shall be performed on each steam generator in accordance with the first sample inspection specified in Table 4.17-1 during the shutdown subsequent to any of the following conditions:
  - 1. A seismic occurrence greater than the Operating Basis Earthquake,
  - 2. A loss-of-coolant accident requiring actuation of the engineered safeguards, or
  - 3. A main steam line or feedwater line break.
- d. After primary to secondary leakage in excess of the limits of Specification 3.1.6, an inspection of the affected steam generator will be performed in accordance with the following criteria:
  - If the leaking tube is in a Group as defined in Section 4.17.3.b, all of the tubes in this Group in this steam generator will be inspected. If the results of this inspection fall into the C-3.
    <u>category</u>, additional inspections will be performed in the same Group

in the other steam generator. Insert information from the attached page. 3X. If the leaking tube is not in a Group as defined in 4.17.4.d.1, then

an inspection will be performed on the affected steam generator in accordance with Table 4.17-1 with an initial inspection sample size of 6% of the tubes in the affected steam generator.

4.17.5 Definitions

As used in this specification:

- a. <u>Imperfection</u> 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 or sleeve wall thickness, if detectable, may be considered as imperfections.
- b. <u>Degradation</u> means a service-induced cracking, wastage, wear or general corrosion occurring on either the inside or outside of a tube or a sleeve.
- c. <u>Degraded Tube</u> means a tube or a sleeve containing imperfections  $\geq 20\%$  of the nominal wall thickness caused by degradation.

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2. If the leaking tube has been repaired by the reroll process and is leaking in the new roll area, all of the tubes in the steam generator that have been repaired by the reroll process will have the new roll area inspected. If the results of this inspection fall into the C-3 category, additional inspections will be performed in the new roll area in the other steam generator.

- d. <u>% Degradation</u> means the percentage of the tube or sleeve wall thickness affected or removed by degradation.
- e. <u>Defect</u> means an imperfection of such severity that it exceeds the repair limit. A tube or sleeve containing a defect is defective.

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f. <u>Repair Limit</u> means the imperfection depth beyond which the tube shall be either removed from service by plugging or repaired by sleeving because it may become unserviceable prior to the next inspection; it is equal to 40% of the nominal tube or sleeve wall thickness.

The Babcock and Wilcox process (or method) equivalent to the method described in report, BAW-1823P, Revision 1 will be used, for sleeving repairs

<u>Unserviceable</u> describes the condition of a tube if it leaks or contains a defect large enough to affect its structural integrity in the event of an Operating Basis Earthquake, a loss-of-coolant accident, or a steam line or feedwater line break as specified in Specification 4.17.4.

h. <u>Tube Inspection</u> means an inspection of the steam generator tube from the point of entry completely to the point of exit. Insert B information

4.17.6 Reports

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- a. The number of tubes plugged or repaired in each steam generator shall be reported to the NRC within 30 days following the completion of the plugging or repair procedure.
- b. The results of the steam generator tube inservice inspection shall be reported to the NRC within 3 months following completion of the inspection. This report shall include:
  - 1. Number and extent of tubes inspected.
  - 2. Location and percent of wall-thickness penetration for each indication of a degraded tube.
  - 3. Identification of tubes plugged or repaired.
- c. Results of steam generator tube inspections which fall into Category C-3 and require prompt notification of the NRC shall be reported pursuant to Specification 6.6.2.1.a prior to resumption of plant operation. The written followup of this report shall provide a description of investigations conducted to determine cause of the tube degradation and corrective measures taken to prevent recurrence.

#### Bases

The program of periodic inservice inspection of steam generators provides the means to monitor the integrity of the tubing and to maintain surveillance in the event there is evidence of mechanical damage or progressive deterioration due to design, manufacturing errors, or operating conditions. Inservice inspection of the steam generator tubing also provides a means of characterizing the nature and cause of any tube degradation so that corrective measures may be taken.

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The rerolling repair process will only be used to repair tubes with defects in the upper tubesheet area. The rerolling repair process will be performed only once per steam generator tube using a 1 inch reroll length. The new roll area must be free of degradation in order for the repair to be considered acceptable. The rerolling process used by Oconee is described in the topical report, BAW-2303P, Revision 3.

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The degraded tube above the new roll area can be excluded from future periodic inspection requirements because it is no longer part of the pressure boundary once the repair roll is installed. Repair or removal from service will be required for any tube with serviceinduced metal loss in excess of 40% of the tube or sleeve nominal wall thickness or with a through wall crack. Additional corrective actions may be required to stabilize a circumferentially cracked tube.

The initial sample of tubes inspected in a steam generator includes tubes from three groups. First, lane tubes are inspected to assure their integrity. Second, all other inservice tubes with degradation, inspected in previous inspections, are inspected to assure tube integrity and determine degradation growth, if any. Third, a random sample of 3% of the total number of tubes in both steam generators is inspected. The results of the latter inspection dictate the extent of further examinations.

An objective of this Specification is to provide an inspection plan which will insure, with a high degree of confidence, that no more than 30 defective tubes will remain in a steam generator after an initial C-3 category inspection.

Following an 18% random inspection (C-3 category inspection) an unaffected area is identified. The unaffected area will be logically and consistently defined based on generator design, defect location and characteristics. The criteria for accepting an area as unaffected depend on the number of defects found in the sample inspected in that area and are established such that there is a 0.05 or smaller probability of accepting the area as unaffected if it contains 30 or more defective tubes.

Experience with Babcock and Wilcox steam generators has indicated that tubes near the open inspection lane are susceptible to forms of degradation unique to that area. Therefore, tubes within one, two, or three rows of the inspection lane have been defined as a special group. If all of these tubes are inspected in both steam generators, no credit will be taken for them in meeting minimum sample size requirements and the results of their inspection will not be used in classifying the results of the general inspection into C-1, C-2 or C-3 categories, unless the mechanism of tube degradation is random in nature. Random degradation mechanisms are those which based on location, steam generator design and operation, and operating experience cannot logically and consistently be shown as limited to a local area.

The affected area will be 100% inspected to assure all defective tubes therein are identified and either removed from service or repaired by sleeving. NRC concurrence in this determination is required prior to completion of the inspection.

Degraded steam generator tubes can be repaired by the installation of sleeves which span the area of degradation and serve as a replacement pressure boundary for the degraded portion of the tube, thus permitting the tube to remain in service. Insert information from the attached page.

This inspection plan enables exposures to be maintained as low as reasonably achievable to the personnel involved in the inspection and assures that generator areas with significant numbers of degraded tubes are adequately inspected.

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An additional repair method for degraded steam generator tubes consists of rerolling the tubes to create a new roll area and pressure boundary for the tube. The rerolling method will ensure that the area of degradation will not serve as a pressure boundary, thus permitting the tube to remain in service. The degraded tube above the new roll area can be excluded from future periodic inspection requirements because it is no longer part of the pressure boundary once the repair roll is installed.

All tubes which have been repaired using the reroll process will have the new roll area inspected during the inservice inspection. Defective or degraded tubes found as a result of the inspection of the new roll area need not be included in determining the Inspection Results Category for the general steam generator inspection.

The rerolling repair process will only be used to repair tubes with defects in the upper tubesheet area. The rerolling repair process will be performed only once per steam generator tube using a 1 inch reroll length. Thus, multiple applications of the rerolling process to any individual tube is not acceptable. The new roll area must be free of degradation in order for the repair to be considered acceptable. After the new roll area is initially deemed acceptable, future degradation in the new roll area will be analyzed to determine if the tube is defective and needs to be removed from service. The rerolling process used by Oconee is described in the topical report, BAW-2303P, Revision 3.

#### TECHNICAL JUSTIFICATION

#### Background

During the current Oconee Unit 1 refueling outage, the hot leg tubesheet rolls were inspected with a plus point and 0.115 diameter pancake eddy current probe to determine if tube degradation was present. The initial inspection scope included a 20 percent sample of the hot leg tubesheet rolls in both steam generators. The inspection scope was increased to 100 percent of the hot leg tubesheet rolls once primary water stress corrosion cracking (PWSCC) was confirmed.

The 100 percent inspection of the hot leg tubesheet rolls is complete. The inspection has discovered approximately 1900 tubes in the 1B steam generator which have indications. Oconee repaired the tubes by utilizing a process which rerolls the upper portion of the tube. The reroll process was utilized because plugging the tubes will reduce the thermal efficiency of the 1B steam generator and could approach the current tube plugging limit of 15 percent.

Since the reroll process is not contained in the Oconee Technical Specifications as an approved repair method, NRC approval of this submittal must be obtained prior to exceeding 250°F in the Reactor Coolant System on Oconee Unit 1.

## Description of Technical Specification Change

The Technical Specifications will be revised to indicate that a steam generator tube can be repaired by rerolling. The revision to the Technical Specifications to allow the use of the reroll process includes acceptance criteria, restrictions on the use of the reroll process, and periodic surveillance requirements for the new roll areas. This revision will be made to the steam generator tubing surveillance section of the Technical Specifications. An editorial change will be made to the Technical Specifications to clarify that a Babcock and Wilcox topical report applies to sleeving repairs. In addition, the steam generator tube leakage limit is reduced to 150 gallons per day.

#### TECHNICAL JUSTIFICATION

#### Technical Justification

The current Technical Specifications for steam generator tubing surveillance allow for the repair of the steam generator tubes by use of a sleeving process. This amendment request will revise the Technical Specifications to allow a rerolling repair process to be used to repair steam generator tube defects. The rerolling process will create a new roll area and pressure boundary for the steam generator tube. The rerolling method will ensure that the area of degradation will not serve as a pressure boundary, thus permitting the tube to remain in service. The rerolling process has been qualified by Framatome Technologies, Inc. (FTI).

The gualification of the mechanical joint is based on establishing a mechanical roll length which will carry all of the structural loads imposed on the tubes. A series of tests and analyses were performed to establish this length. Tests that were performed included leak, tensile, fatigue, ultimate load, and eddy current measurement uncertainty. The analyses evaluated plant operating and faulted loads in addition to tubesheet bow effects. Testing and analysis evaluated the tube springback and radial contact stresses due to temperature, pressure, and tubesheet bow. Based on the FTI qualification, as well as the history for similar industry repair rolls, there are no new safety issues associated with a reroll repair. Additional details about the rerolling process, requirements, and verification are contained in the FTI report which is provided as Attachment 3A. This report is proprietary to FTI and is clearly marked as proprietary.

The Technical Specification requirements will allow the use of the reroll process to repair tubes with indications only in the roll transition area of the upper tubesheet. The topical report qualifies the reroll process for use on the tubes in the lower tubesheet. However, Oconee does not intend to perform any reroll repairs on tubes in the lower tubesheet. In order to ensure that the reroll process is not used in the lower tubesheet, the Technical Specifications have been revised to limit the use of the reroll process to the upper tubesheet.

In addition, the Technical Specifications require that the new roll area of the tubes, which are repaired by the reroll process, be inspected during each inservice inspection. This ensures that any degradation in the new roll area will be discovered in subsequent inspections of the steam

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#### TECHNICAL JUSTIFICATION

generators. The Technical Specifications have been revised to exclude the new roll area inspection results from being used in the classification of the Inspection Results Category. This exclusion is consistent with the exclusion provided for the other special inspections in the steam generator open inspection lane.

Another change to the Technical Specifications defines the steam generator inspection scope following a primary to secondary leakage in excess of the limits of Technical Specification 3.1.6. This revision indicates that the inspection scope will be limited to the new roll area if the tube leakage is the result of a defect in the new roll area. This change makes the new roll area inspections consistent with the current requirements for leaking tubes in the open inspection lane.

The final part of the rerolling Technical Specification amendment indicates that the reroll process will only be performed once per steam generator tube using a 1 inch reroll length. In order for the reroll repair to be acceptable, the Technical Specifications indicate that the new roll area must be free of degradation. These requirements ensure that the acceptance criteria for the use of the reroll process are contained in the Technical Specifications.

The editorial change to Technical Specification 4.17.7.f will clarify that the Babcock and Wilcox topical report (BAW-1823P, Revision 1) applies to the sleeving repairs. This clarification is necessary to ensure that the Technical Specifications clearly state the purpose of the topical report. By making this change, potential confusion about the applicability of the topical report to plugging or rerolling process will be eliminated.

Based on the information provided in this attachment and the Bases of the Technical Specifications, Duke Energy Corporation concludes that the proposed amendment will not present an undue risk to public health and safety.

#### NO SIGNIFICANT HAZARDS CONSIDERATION EVALUATION

This proposed change has been evaluated against the standards in 10 CFR 50.92 and has been determined to involve no significant hazards, in that 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?

No. The implementation of the tube reroll or the reduction of the steam generator tube leakage limit does not increase the probability of occurrence of an accident or the consequences of an accident previously evaluated.

Since reroll utilizes the original tube configuration and extends the roll expanded region, all of the design and operating characteristics of the steam generator and connected systems are preserved. The reroll joint length has been analyzed and tested for design, operating, and faulted condition loadings.

At worst case, a tube leak would occur with the result being a primary to secondary system leak. Should a tube leak occur, the impact is bounded by the ruptured tube evaluation which has been analyzed previously. The potential for a tube rupture is not increased by the use of the reroll process.

Since the steam generator tube leakage limit is not an accident initiator, the probability of an accident is not increased. In addition, the reduction of the leakage limit reduces the consequences of the accidents previously evaluated.

2. Create the possibility of a new or different kind of accident from the accidents previously evaluated?

No. Operation of the steam generators with reroll repaired tubes or a reduced steam generator tube leakage limit does not create the possibility of a new or different accident from the accidents previously evaluated.

The potential failure of the tube due to the defect which required the tube to initially be repaired is covered during the qualification of the reroll process. Qualification testing indicates that normal and faulted leakage would be well below the Technical Specification

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#### NO SIGNIFICANT HAZARDS CONSIDERATION EVALUATION

limits. Since the normal and faulted leak rates are well within the Technical Specification limit, the analyzed accident scenarios are still bounding.

The new roll transition may eventually develop PWSCC and require additional repair. Since the roll transition is located within the tubesheet, it is not possible for the degradation to result in a tube rupture. Additionally, industry experience with roll transition cracking has shown that PWSCC in roll transitions is normally short axial cracks, with extremely low leak rates. Finally, since the new roll transition is completely within the tubesheet there is no possibility of the repaired tube failing and impacting adjacent tubes.

In the unlikely event the reroll repaired tube failed and severed completely at the transition of the reroll region, the tube would retain engagement in the tubesheet bore, preventing any interaction with neighboring tubes. In this case, leakage is minimized and is well within the assumed leakage of the design basis tube rupture accident. In addition, the possibility of rupturing multiple steam generator tubes is not increased.

Since the steam generator tube leakage limit is not an accident initiator, no new or different accidents will result from the reduction of the steam generator tube leakage limit.

#### 3. Involve a significant reduction in a margin of safety?

No. Based on the previous response, the protective boundaries of the steam generator are preserved.

A tube with degradation can be kept in service through the use of the reroll process. The new undegraded roll expanded interface created with the tubesheet satisfies all of the necessary structural, leakage, and heat transfer requirements. Since the joint is constrained within the tubesheet bore, there is no additional risk associated with tube rupture. Therefore, the analyzed accident scenarios remain bounding, and the use of the reroll process and reduced steam generator tube leakage limit does not reduce the margin of safety.

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NO SIGNIFICANT HAZARDS CONSIDERATION EVALUATION

Since the steam generator tube leakage limit is not an accident initiator, the reduction of the steam generator tube leakage limit does not reduce the margin of safety.

Duke has concluded based on the above information that there are no significant hazards involved in this amendment request.

# ATTACHMENT 3A

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# FRAMATOME TECHNOLOGIES, INC. QUALIFICATION REPORT

# PROPRIETARY