

8.0 REVISED SECTION 4.18 TO ANO-1 TECHNICAL SPECIFICATIONS

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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

4.18.1 Baseline Inspection

The first steam generator tubing inspection performed according to Specifications 4.18.2 and 4.18.3.a shall be considered as constituting the baseline condition for subsequent inspections.

4.18.2 Examination Methods

- a. 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 except for a sleeved tube at the lower sleeve end.
- b. For examination of the sleeved steam generator tubing at the lower sleeve end, the indications will be compared to those obtained during the baseline sleeved tube inspection. Significant deviations between these indications will be considered sufficient evidence to warrant designation as a degraded tube. Direct quantification of the 40 percent through-wall plugging limit is available with eddy-current testing.

4.18.3 Selection and Testing

The steam generator sample size is specified in Table 4.18.1. The steam generator tube minimum sample size, inspection result classification, and the corresponding action required shall be as specified in Table 4.18.2. The inservice inspection of steam generator tubes shall be performed at the frequencies specified in Specification 4.18.4 and the inspected tubes shall be verified acceptable per the acceptance criteria of Specification 4.18.5. The tubes selected for each inservice inspection shall include at least 3% of the total number of tubes in both steam generator; the tubes selected for these inspections shall be selected on a random basis except:

a. The first sample inspection during each inservice inspection (subsequent to the baseline inspection) of each steam generator shall include:

1. All nonplugged tubes that previously had detectable wall penetrations (>20%), except tubes in which the wall penetration has been spanned by a sleeve, and
2. At least 50% of the tubes inspected shall be in those areas where experience has indicated potential problems, except where specific groups are inspected per Specification: 4.18.3.a.3.

A tube inspection (pursuant to Specification 4.18.5.a.9) 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.

3. Tubes in the following groups may be excluded from the first random sample if all tubes in a group in both steam generators are inspected. The inspection may be concentrated on those portions of the tubes where imperfections were previously found. No credit will be taken for these tubes in meeting minimum sample size requirements. Where only a portion of the tube is inspected, the remainder of the tube will be subjected to the random inspection.

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

(2) Group A-2: Unplugged tubes with sleeves installed.

(3) Group A-3: Tubes in the wedge-shaped group on either side of the lane region (Group A-1) as defined by Figure 4.18.1.

b. The second and third sample inspections during each inservice inspection as required by Table 4.18.2 may be less than a full tube inspection by concentrating the inspection on those areas of the tube sheet array and on those portions of the tubes where tubes with imperfections were previously found.

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

<u>Category</u>	<u>Inspection Results</u>
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.

- NOTES:
- (1) In all inspections, previously degraded tubes whose degradations have not been spanned by a sleeve must exhibit significant (>10%) further wall penetrations to be included in the above percentage calculations.
 - (2) Where special inspections are performed pursuant to 4.18.3.a.3, 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.

4.18.4 Inspection Intervals

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

- a. The baseline inspection shall be performed during the first refueling shutdown. Subsequent inservice inspections shall be performed at intervals of not less than 10 nor more than 24 calendar months after the previous inspection. If the results of two consecutive inspections for a given group* of tubes 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 for that group 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 4.18.2 at 40-month intervals for a given group* of tubes fall in Category C-3, subsequent inservice inspections shall be performed at intervals of not less than 10 nor more than 20 calendar months after the previous inspection. The increase in inspection frequency shall apply until a subsequent inspection meets the conditions specified in 4.18.4.a and the interval can be extended to 40 months.
- c. Additional unscheduled inservice inspections shall be performed on each steam generator in accordance with the first sample inspection specified in Table 4.18.2 during the shutdown subsequent to any of the following conditions:
 1. Primary-to-secondary leakage in excess of the limits of Specification 3.10 (inservice inspection not required if leaks originate from tube-to-tubesheet welds),
 2. A seismic occurrence greater than the Operating Basis Earthquake,

*A group of tubes means: (a) All tubes inspected pursuant to 4.18.3.a.3, or
(b) All tubes in a steam generator less those inspected pursuant to 4.18.3.a.3.

3. A loss-of-coolant accident requiring actuation of the engineered safeguards, or
4. A main steam line or feedwater line break.

4.18.5 Acceptance Criteria

a. As used in this specification:

1. Tubing or Tube means that portion of the tube or sleeve which forms the primary system to secondary system pressure boundary.
2. Imperfection means an exception to the dimensions, finish or contour of a tube from that required by fabrication drawings or specifications. Eddy current testing indications below 20% of the nominal tube wall thickness, if detectable, may be considered as imperfections.
3. Degradation means service-induced cracking, wastage, wear or general corrosion occurring on either the inside or outside of a tube.
4. Degraded Tube means a tube containing imperfections $\geq 20\%$ of the nominal wall thickness caused by degradation, except where all degradation has been spanned by the installation of a sleeve.
5. % Degradation means the percentage of the tube wall thickness affected or removed by degradation.
6. Defect means an imperfection of such severity that it exceeds the plugging limit except where the imperfection has been spanned by the installation of a sleeve. A tube containing a defect in its pressure boundary is defective.
7. Plugging Limit means the imperfection depth at or beyond which the tube shall be restored to serviceability by the installation of a sleeve or removed from service because it may become unserviceable prior to the next inspection; it is equal to 40% of the nominal tube wall thickness.
8. 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 an Operating Basis Earthquake, a loss-of-coolant accident, or a steam line or feedwater line break as specified in Specification 4.18.4.c.
9. Tube Inspection means an inspection of the steam generator tube from the point of entry completely to the point of exit.

- b. The steam generator shall be determined operable after completing the corresponding actions (plug or sleeve all tubes exceeding the plugging limit and all tubes containing through-wall cracks) required by Table 4.18.2

4.18.6 Reports

Following each inservice inspection of steam generator tubes, the complete results of the inspection shall be reported to the NRC. This report, to be submitted within 45 days of inspection completion, shall include:

- a. Number and extent of tubes inspected;
- b. Location and percent of wall-thickness penetration for each indication of an imperfection; and
- c. Identification of tubes plugged and tubes sleeved.

Bases

The surveillance requirements for inspection of the steam generator tubes ensure that the structural integrity of this portion of the RCS will be maintained. The program for inservice inspection of steam generator tubes is based on a modification of Regulatory Guide 1.83, Revision 1. Inservice inspection of steam generator tubing is essential in order to maintain surveillance of the conditions of the tubes in the event that there is evidence of mechanical damage or progressive degradation due to design, manufacturing errors, or inservice conditions that lead to corrosion. Inservice inspection of steam generator tubing also provides a means of characterizing the nature and cause of any tube degradation so that corrective measures can be taken.

TABLE 4.18-1

MINIMUM NUMBER OF STEAM GENERATORS TO BE
INSPECTED DURING INSERVICE INSPECTION

Preservice Inspection	No
No. of Steam Generators per Unit	Two
First Inservice Inspection	Two
Second & Subsequent Inservice Inspection	One ¹

Table Notation:

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

TABLE 4.18-2

STEAM GENERATOR TUBE INSPECTION^{2,3}

1ST SAMPLE INSPECTION			2ND SAMPLE INSPECTION		3RD SAMPLE INSPECTION	
Sample Size	Result	Action Required	Result	Action Required	Result	Action Required
A minimum of S Tubes per S.G. ¹	C-1	None	N/A	N/A	N/A	N/A
	C-2	Plug or sleeve defective tubes and inspect additional 2S tubes in this S.G.	C-1	None	N/A	N/A
			C-2	Plug or sleeve defective tubes and inspect additional 4S tubes in this SG	C-1	None
			C-3	Perform action for C-3 result of first sample	C-2	Plug or sleeve defective tubes
					C-3	Perform action for C-3 result of first sample
	C-3	Inspect all tubes in this S. G. plug or sleeve defective tubes and inspect 2S tubes in other S.G.	N/A		N/A	N/A
			Other S.G. is C-1	None	N/A	N/A
			Other S.G. is C-2	Perform action for C-2 results of second sample	N/A	N/A
			Other S.G. is C-3	Inspect all tubes in each S.G. and plug or sleeve defective tubes. Request NRC approval of remedial action	N/A	N/A

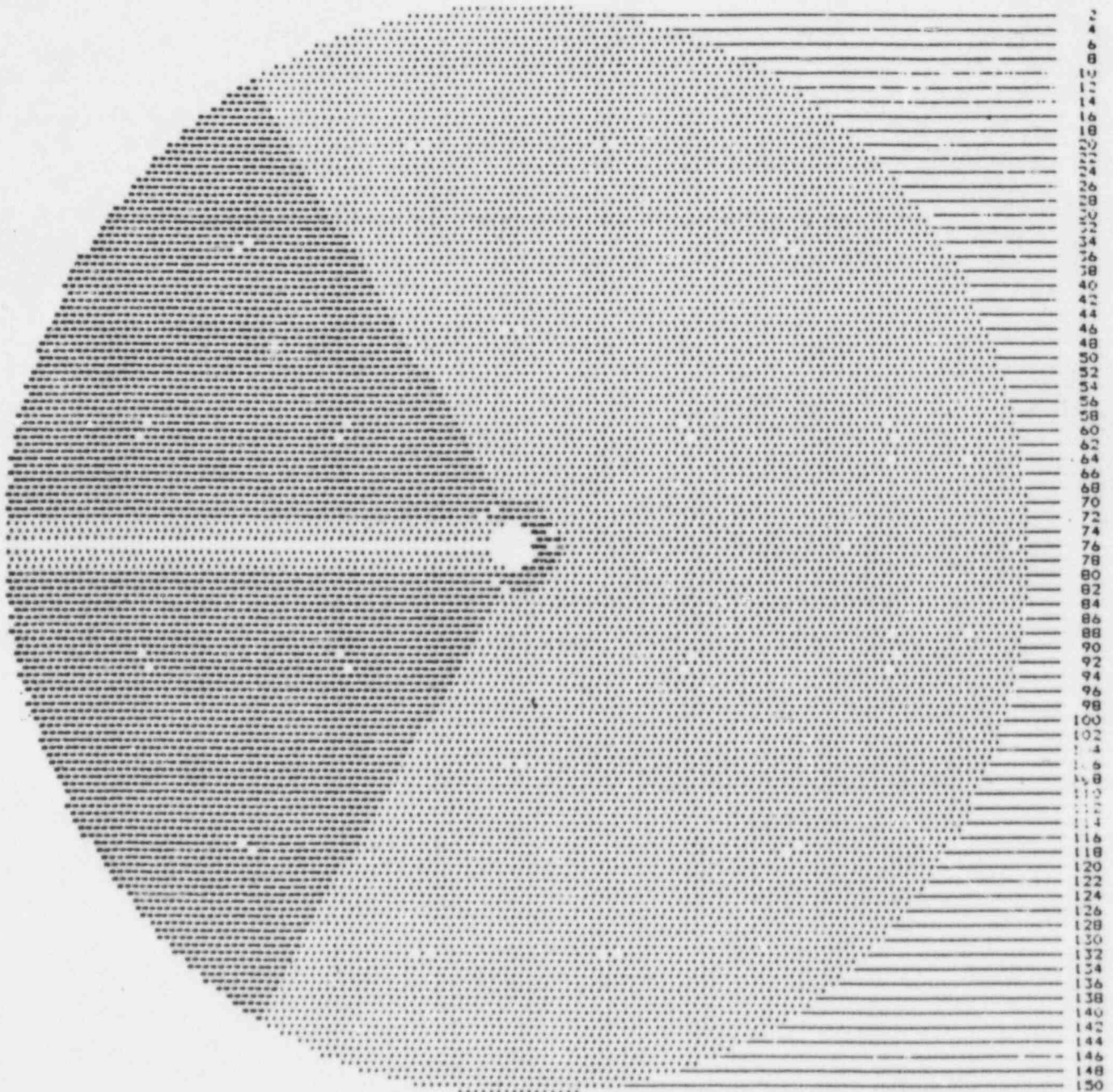
NOTES: ¹ $S=3\frac{N}{n}\%$ Where N is the number of steam generators in the unit, and n is the number of steam generators inspected during an inspection.

²For tubes inspected pursuant to 4.18.3.a.3: No action is required for C-1 results. For C-2 results in one or both steam generators plug or sleeve defective tubes. For C-3 results in one or both steam generators, plug or sleeve defective tubes and request NRC approval of remedial action.

³No more than ten thousand (10,000) sleeves may be installed in both ANO-1 steam generators combined.

FIGURE 4.18.1

Upper Tube Sheet View of Wedge Shaped Group (Group A-3) per
Specification 4.18.3.a.3



Description	Tube Count
Group A-1: Lane region tubes as defined in 4.18.3.a.3.(1)	382
Group A-3: Wedge shaped group depicted by darkened region of figure	4880

9.0 DETAILED DISCUSSION OF CHANGES TO SECTION 4.18:

This change request includes the following changes to the ANO-1 Technical Specifications 4.18 pertaining to Steam Generator Tubing Surveillance.

- a. Technical Specification 4.18.2: This section is divided into Parts (a) and (b) to account for the inability to directly quantify a 20% through-wall penetration in a sleeved tube at the lower sleeve end.

The phrase "except for a sleeved tube at the lower sleeve end" is added to Part (a) to exclude the requirement of direct quantification of 20% through-wall penetration in a sleeved tube at the sleeve end.

"For examination of the sleeved steam generator tubing at the lower sleeve end, the indications will be compared to those obtained during the baseline sleeved tube inspection. Significant deviations between these indications will be considered sufficient evidence to warrant designation as a degraded tube. Direct quantification of the 40% through-wall plugging limit is available with eddy-current testing." is added as Part (b) to describe the examination method for a sleeved tube at the lower sleeve end.

- b. Technical Specification 4.18.3.a.1: The phrase "except tubes in which the wall penetration has been spanned by a sleeve" is added to exclude tubes which have been repaired via the installation of sleeves from the mandatory examination required of the tubes with previously detected wall penetration of >20%.

This exception applies to tubes in which sleeves have been installed to span detectable degradations. The portion of the tube which is spanned by the sleeve (from the bottom of the uppermost rolled joint to the top of the lowermost rolled joint) is no longer considered a part of the primary to secondary system pressure boundary. Any degradation in the parent tube in the area spanned by the sleeve poses no threat to the integrity of the pressure boundary and, therefore, does not require the same degree of scrutiny as a wall penetration >20% in a portion of the tube that does constitute the pressure boundary. The mandatory inspection requirement still applies to a sleeved tube which has been subjected to a random full-length examination and has been found to have a wall penetration >20% in either the portion of the tube which is not spanned by the sleeve or in the sleeve itself.

Examination of the sleeved tubes is addressed in Technical Specification 4.18.3.a.3 where sleeved tubes are defined as a special group and the inspection frequency is determined accordingly.

- c. Technical Specification 4.18.3.a.2: Parenthetical reference to Specification 4.18.5.a.8 is changed to 4.18.5.a.9 to reflect numbering change due to addition of the definition of tubing or tube.

- d. Technical Specification 4.18.3.a.3(2): Group A-2 is defined as "unplugged tubes with sleeves installed".

Specification 4.18.3.a.3 designated special groups of tubes (i.e., areas of the tube bundle) where experience has indicated potential problems may exist. These "potential problem" areas were originally identified in Technical Specification Amendment 41. They represent areas where AP&L has acquired enough data from inspections to designate them "critical areas unique to the ANO-1 steam generators." Amendment 41 permitted the option of inspecting 100% of the tubes in the "critical area" in lieu of including these areas in the first random inspection.

The use of sleeves to repair defective steam generator tubes is a relatively new technology. Until a sufficient data base on their installed performance can be collected, AP&L intends to inspect 100% of the sleeves at each refueling outage. The designation of these sleeved tubes as a special group accommodates this inspection.

- e. Technical Specification 4.18.3.b, Note 1: The phrase "whose degradations have not been spanned by a sleeve" is added to eliminate growth of those defects which have been spanned by a sleeve from consideration for determination of inspection result category.

For the case in which the degraded region of a tube has been spanned by a sleeve, further tube wall penetrations in the parent tube are considered inconsequential since that portion of the tube no longer constitutes the primary to secondary system pressure boundary.

- f. Technical Specification 4.18.5.a.1: A definition for tube and tubing is added which includes the use of a sleeve to form the pressure boundary in the area of the tube spanned by the sleeve.

This definition is added to clarify that steam generator tubing surveillance applies to that portion of the tube or sleeve which forms the pressure boundary.

- g. Technical Specifications 4.18.5.a.1 through 4.18.5.a.8: Item numbers are revised to reflect the insertion of an additional item as 4.18.5.a.1.

- h. Technical Specification 4.18.5.a.4: The phrase "except where all degradation has been spanned by the installation of a sleeve" is added to exclude those tubes in which all degradation has been spanned by a sleeve.

Since the sleeve forms the pressure boundary in the sleeved region, any degradation in the parent tube in the sleeve free-span region poses no threat to the integrity of the primary to secondary system pressure boundary. Consequently, this region of the tube does not deserve the degree of scrutiny accorded a degradation of the pressure boundary.

- i. Technical Specification 4.18.5.a.6: The phrases "except where the imperfection has been spanned by the installation of a sleeve" and "in its pressure boundary" are added to clarify the definition of a defective tube as one which contains a defect in its pressure boundary.

The intent of this change is to clarify that a tube must contain a defect in its pressure boundary to be defective. A defect in the region of a tube which is spanned by a sleeve is not a defect in the tube's pressure boundary, and, therefore is not defined as such.

- j. Technical Specification 4.18.5.a.7: The phrase "shall be restored to serviceability by the installation of a sleeve or" is added to allow the option of sleeving tubes which may become unserviceable prior to the next inspection.

The intent of this change is to allow sleeving of tubes with 40% through wall degradation as an option to performing mandatory tube plugging. Hence, the "Plugging Limit" is interpreted to mean the tube degradation limit at which tube plugging or tube sleeving will be performed.

- k. Technical Specification 4.18.5.b: The phrase "or sleeve" is added to the parenthetical statement to allow plugging or sleeving of all tubes exceeding the plugging limit.

The intent of this change is to allow the determination of steam generator operability after completion of plugging or sleeving tubes which exceeded the plugging limit.

- l. Technical Specification 4.18.6.c: The phrase "and tubes sleeved" is added to require reporting of both plugged and sleeved tubes.

The intent of this change is to impose the same reporting requirements for sleeved tubes as those for plugged tubes.

- m. Table 4.18.2: The table is revised in five (5) places to allow sleeving of a defective tube as an alternative to plugging the tube. Previous Footnote 3 is deleted to reflect the completion of the installation of demonstration sleeves performed at ANO-1 during the sixth refueling outage (1R6). Tubes which were sleeved as part of this demonstration program are included in special Group A-2.

New Footnote 3, "No more than ten thousand (10,000) sleeves may be installed in both ANO-1 steam generators combined." is added to limit the number of sleeves to be installed to the number for which qualification has been obtained.

- n. Figure 4.18.1: The figure is revised to include an additional 51 tubes which surround the untubed center portion of the steam generator and which are expected to be susceptible to the same form of degradation as the wedge-shaped group which surrounds the untubed lane region.

The intent of this change is to include these additional tubes as a part of group A-3. As a part of this special group, these tubes will receive increased scrutiny.

- o. Technical Specification 4.18.6 and Table 4.18.2: Prompt reporting requirements of C-3 condition deleted per 10CFR50.72 and 50.73.

APPENDIX A

CORROSION TEST OF A
MECHANICALLY SLEEVED ANO-1 OTSG TUBE