March 1, 2011

TSTF-11-02
PROJ0753

Attn: Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: Correction to TSTF-510, Revision 2, "Revision to Steam Generator Program Inspection Frequencies and Tube Sample Selection"

Dear Sir or Madam:

Revision 2 of TSTF-510, "Revision to Steam Generator Program Inspection Frequencies and Tube Sample Selection," was submitted to the NRC on October 11, 2010.

We have been informed that Page 1 of the justification was inadvertently omitted from the submitted Traveler. Enclosed is a complete copy of TSTF-510, Revision 2.

Should you have any questions, please do not hesitate to contact us.

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Enclosure

cc: Robert Elliott, Technical Specifications Branch, NRC
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Technical Specification Task Force
Improved Standard Technical Specifications Change Traveler

Revision to Steam Generator Program Inspection Frequencies and Tube Sample Selection

NUREGs Affected: ☑ 1430 ☑ 1431 ☑ 1432 ☐ 1433 ☐ 1434

Classification 1) Technical Change

Recommended for CLIIP?: Yes

Correction or Improvement: Improvement

NRC Fee Status: Exempt

Benefit: Allows Less Stringent Testing

See attached.

Revision History

OG Revision 0 Revision Status: Closed

Revision Proposed by: NEI SGTF

Revision Description:
Original Issue

Owners Group Review Information

Date Originated by OG: 27-Feb-09

Owners Group Comments
(No Comments)

Owners Group Resolution: Approved Date: 13-Mar-08

TSTF Review Information

TSTF Received Date: 15-Mar-08 Date Distributed for Review 15-Mar-08

OG Review Completed: ☑ BWOG ☑ WOG ☑ CEOG ☑ BWROG

TSTF Comments:
(No Comments)

TSTF Resolution: Approved Date: 26-Mar-09

NRC Review Information

NRC Received Date: 26-Mar-09

NRC Comments:
Fee exemption letter dated 7/20/09.

The NRC provided an RAI by e-mail on 2/4/2010.

Final Resolution: Superceded by Revision

TSTF Revision 1 Revision Status: Closed

TSTF Revision 1 Revision Status: Closed

Revision Proposed by: NRC

Revision Description:
TSTF-510 is revised to reflect the responses to an RAI provided by the NRC on February 4, 2010.

1. Pages 5 and Section 2 of the justification are revised to clarify that the 20% minimum SG tube sample size appears in the EPRI guideline documents, not the Technical Specifications.

2. Page 16 of the justification is revised to eliminate the discussion of changes made to SG tubes under 10 CFR 50.59.

3. TS 5.5.9.c and the Steam Generator Tube Integrity Specification are revised to state "alternate tube plugging [or repair] criteria" instead of "alternate tube repair criteria."

4. The Revision 0 proposed change to replace "flaw" and "indication" with "degradation" is removed in Revision 1.

5. TS 5.5.9.d.2 is revised to clarify that the inspection frequency is a minimum requirement.

6. TS 5.5.9.d.2 for Alloy 600 mill annealed tubing is revised to make clear that the inspection interval is 60 EFPM.

7. TS 5.5.9.d.2 for all material types is revised to clarify the treatment of new degradation types at unexamined locations.

8. TS 5.5.9.d.2 for Alloy 600 mill annealed tubing is revised to reorder the discussion to improve clarity.

A new change is added to TS 5.5.9.d.3 to clarify which SGs are to be tested when a crack indication is found.

A new change is made to consistently refer to "inspection periods" instead of sometimes using the term "inspection intervals."

Owners Group Review Information

Date Originated by OG: 30-Apr-10

Owners Group Comments
(No Comments)

Owners Group Resolution: Approved Date: 14-May-10

TSTF Review Information

TSTF Received Date: 29-Apr-10 Date Distributed for Review 15-Jun-10

OG Review Completed: ☑ BWOG ☑ WOG ☑ CEOG ☑ BWROG

TSTF Comments:

(No Comments)

TSTF Resolution: Approved Date: 29-Jun-10

NRC Review Information

NRC Received Date: 29-Jun-10

TSTF Revision 1 Revision Status: Closed

NRC Comments:

At a public meeting between the NRC and the Nuclear Energy Institute (NEI) Steam Generator Task Force (SGTF) held on August 12, 2010, the NRC disagreed with the change in Revision 1 to replace the term "interval" with "period." The NRC believes the terms "interval" and "period" to mean the "interval between steam generator inspections" and "the overall inspection period", respectively.

Final Resolution: NRC Requests Changes: TSTF Will Revise Final Resolution Date: 12-Aug-10

TSTF Revision 2 Revision Status: Active

Revision Proposed by: NRC

Revision Description:
At a public meeting between the NRC and the Nuclear Energy Institute (NEI) Steam Generator Task Force (SGTF) held on August 12, 2010, the NRC provided the following comments on TSTF-510, Rev. 1.

In Revision 2, the TSTF-510 justification, Technical Specifications, and Bases are revised to use the terms "interval" and "period" to mean the "interval between steam generator inspections" and "the overall inspection period" respectively. A description of the terms is added to the justification. The only change to the TS is in paragrph d of the Steam Generator Program, in which the term "periods" is replaced with "intervals."

Owners Group Review Information

Date Originated by OG: 31-Aug-10

Owners Group Comments
(No Comments)

Owners Group Resolution: Approved Date: 22-Sep-10

TSTF Review Information

TSTF Received Date: 22-Sep-10 Date Distributed for Review 22-Sep-10

OG Review Completed: ☑ BWOG ☑ WOG ☑ CEOG ☑ BWROG

TSTF Comments:

(No Comments)

TSTF Resolution: Approved Date: 11-Oct-10

NRC Review Information

NRC Received Date: 11-Oct-10

Affected Technical Specifications

5.5.9 Steam Generator (SG) Program

5.6.7	Steam Generator Tube Inspection Report	
LCO 3.4.17	SG Tube Integrity	NUREG(s)- 1430 Only
LCO 3.4.17 Bases	SG Tube Integrity	NUREG(s)- 1430 Only
Action 3.4.17.A	SG Tube Integrity	NUREG(s)- 1430 Only
Action 3.4.17.A Bases	SG Tube Integrity	NUREG(s)- 1430 Only
SR 3.4.17.1 Bases	SG Tube Integrity	NUREG(s)- 1430 Only
SR 3.4.17.2	SG Tube Integrity	NUREG(s)- 1430 Only
SR 3.4.17.2 Bases	SG Tube Integrity	NUREG(s)- 1430 Only
LCO 3.4.20	SG Tube Integrity	NUREG(s)- 1431 Only
LCO 3.4.20 Bases	SG Tube Integrity	NUREG(s)- 1431 Only
Action 3.4.20.A	SG Tube Integrity	NUREG(s)- 1431 Only
Action 3.4.20.A Bases	SG Tube Integrity	NUREG(s)- 1431 Only
SR 3.4.20.1 Bases	SG Tube Integrity	NUREG(s)- 1431 Only
SR 3.4.20.2	SG Tube Integrity	NUREG(s)- 1431 Only
SR 3.4.20.2 Bases	SG Tube Integrity	NUREG(s)- 1431 Only
LCO 3.4.18	SG Tube Integrity	NUREG(s)- 1432 Only
LCO 3.4.18 Bases	SG Tube Integrity	NUREG(s)- 1432 Only
Action 3.4.18.A	SG Tube Integrity	NUREG(s)- 1432 Only
Action 3.4.18.A Bases	SG Tube Integrity	NUREG(s)- 1432 Only
SR 3.4.18.1 Bases	SG Tube Integrity	NUREG(s)- 1432 Only
SR 3.4.18.2	SG Tube Integrity	NUREG(s)- 1432 Only
SR 3.4.18.2 Bases	SG Tube Integrity	NUREG(s)- 1432 Only

1.0 DESCRIPTION

The proposed change revises the Improved Standard Technical Specification (ISTS), NUREGs 1430, 1431, and 1432, Specification 5.5.9, "Steam Generator (SG) Program," 5.6.7, "Steam Generator Tube Inspection Report," and the Steam Generator Tube Integrity specification, (LCO 3.4.17, LCO 3.4.20, and LCO 3.4.18 in ISTS NUREG-1430, -1431, and -1432, respectively) The proposed changes are necessary to address implementation issues associated with the inspection periods, and address other administrative changes and clarifications.

2.0 PROPOSED CHANGE

The proposed change will revise Technical Specification 5.5.9, "Steam Generator (SG) Program."

An editorial correction is made to the introductory paragraph. The last sentence is revised from "In addition, the Steam Generator Program shall include the following provisions" to "In addition, the Steam Generator Program shall include the following." The subsequent paragraphs start with "Provisions for …" and stating "provisions" in the introductory paragraph is duplicative.

An editorial correction is made to Paragraph 5.5.9.b.1. The closing parenthesis is misplaced. It currently states "All in-service steam generator tubes shall retain structural integrity over the full range of normal operating conditions (including startup, operation in the power range, hot standby, and cool down, and all anticipated transients included in the design specification) and design basis accidents." This inappropriately includes anticipated transients in the description of normal operating conditions. The sentence is revised to, "All in-service steam generator tubes shall retain structural integrity over the full range of normal operating conditions (including startup, operation in the power range, hot standby, and cool down), all anticipated transients included in the design specification, and design basis accidents."

An editorial correction is made to add a missing closing bracket to the end of Paragraph 5.5.9.b.2.

Clarifications are made to Paragraph 5.5.9.c. The title is revised from "Provisions for SG tube repair criteria" to "Provisions for SG tube plugging [or repair] criteria" to be consistent with the treatment of SG tube repair throughout Specification 5.5.9. All references in Paragraph 5.5.9.c to "SG tube repair criteria" are changed to "SG tube plugging [or repair] criteria. To be consistent with this change, references to the "tube repair criteria" are revised to "tube plugging [or repair] criteria in the Steam Generator (SG) Tube Integrity Specification (LCO 3.4.17 in NUREG-1430, LCO 3.4.20 in NUREG-1431, and LCO 3.4.18 in NUREG-1432) and the associated Bases.

Clarifications are made to Paragraph 5.5.9.d. Reference to "tube repair criteria" is revised to "tube plugging [or repair] criteria" to be consistent with the treatment of SG tube repair throughout Specification 5.5.9. The term "assessment of degradation" is replaced with "degradation assessment" to be consistent with the terminology used in the industry program documents.

Paragraph 5.5.9.d.1 is revised from "Inspect 100% of the tubes in each SG during the first refueling outage following SG replacement" to "Inspect 100% of the tubes in each SG during the first refueling outage following SG installation." This wording change will allow the Steam Generator Program to apply to both existing plants and new plants.

The proposed change revises TS 5.5.9.d.2 within the Steam Generator (SG) Program to modify the frequency of verification of SG tube integrity and SG tube sample selection to reduce implementation issues experienced with the current specification. The revised specification is consistent with the existing specification in that it continues to be based on SG tube material type, age, condition and cycle length, and continues to address the time dependence of degradation and prevent front end or back end loading of inspections. In addition, the maximum interval allowed between inspections is the same as in the current Technical Specification.

Paragraph 5.5.9.d.3 refers to "next inspection for each SG … shall not exceed 24 effective full power months or one refueling outage (whichever is less)." An editorial change is made to the parenthetical statement in order to clarify the intent. It is revised to "(whichever results in more frequent inspections)". Paragraph 5.5.9.d.3 is also revised to clarify the SG inspection requirements when crack indications are found.

Specification 5.6.7, "Steam Generator Tube Inspection Report," is revised to change the reporting requirements. Paragraph f is revised to require reporting the effective plugging percentage. Optional paragraph h, which required reporting the effective plugging percentage, is deleted. The word "active" was removed from 5.6.7.b and e to be consistent with Specification 5.5.9.

Technical Specification 5.5.9 and the Bases of the Steam Generator Tube Integrity Specification use the terms "interval" and "period" when referring to the steam generator inspections. For consistency, the term "period" is used when referring to the overall inspection period and the term "interval" is used when referring to the time between steam generator inspections.

3.0 BACKGROUND

The SG tubes in pressurized water reactors have a number of important safety functions. Steam generator tubes are an integral part of the reactor coolant pressure boundary (RCPB) and, as such, are relied on to maintain the primary system's pressure and inventory. As part of the RCPB, the SG tubes are unique in that they act as a heat transfer surface between the primary and secondary systems to remove heat from the primary system. In addition, the SG tubes isolate the radioactive fission products in the primary coolant from the secondary system.

Steam generator tube integrity is necessary in order to satisfy the tubing's safety functions. Maintaining tube integrity ensures that the tubes are capable of performing their intended safety functions consistent with the plant licensing basis, including applicable regulatory requirements.

Concerns relating to the integrity of the tubing stem from the fact that the SG tubing is subject to a variety of degradation mechanisms. Steam generator tubes have experienced tube degradation related to corrosion phenomena, such as wastage, pitting, intergranular attack, and stress corrosion cracking, along with other mechanically induced phenomena such as wear. These degradation mechanisms can impair tube integrity if they are not managed effectively. When the degradation of the tube wall reaches a prescribed criterion for action, the tube is considered defective and corrective action is taken. Note that not all plants have approved repair techniques. Therefore, references to "repair" are bracketed in the proposed TS changes. Plants without approved repair techniques should remove the bracketed references to repair and make editorial changes to the text as needed for proper English usage.

The industry, through the Electric Power Research Institute (EPRI) Steam Generator Management Program (SGMP), has previously developed a generic approach to improving SG performance referred to as "Steam Generator Degradation Specific Management" (SGDSM). Under this approach, different methods of inspection and different repair criteria may be developed for different types of degradation. A degradation specific approach to managing SG tube integrity has several important benefits. These include:

- increased scope and improved methods for SG inspection,
- industry incentive to continue to improve inspection methods, and
- development of plugging and repair criteria based on appropriate NDE parameters.

As a result, the assurance of SG tube integrity is improved.

Over the course of this effort, the SGMP has developed a series of EPRI guidelines that define the elements of a successful SG Program. These guidelines include:

- "Steam Generator Examination Guideline" (Ref. 1),
- "Steam Generator Integrity Assessment Guideline" (Ref. 2),
- "Steam Generator In-situ Pressure Test Guideline" (Ref. 3),
- "PWR Primary-to-Secondary Leak Guideline" (Ref. 4),
- "Primary Water Chemistry Guideline" (Ref. 5), and
- "Secondary Water Chemistry Guideline" (Ref. 6).

These EPRI Guidelines, along with NEI 97-06 (Ref. 7), tie the entire Steam Generator Program together, while defining a comprehensive, performance based approach to managing SG performance.

In parallel with the industry efforts, the NRC pursued resolution of SG performance issues. In December of 1998, the NRC Staff acknowledged that the Steam Generator Program described by NEI 97-06 (Ref. 7) and its referenced EPRI Guidelines provides an acceptable starting point to use in the resolution of differences between it and the staff's proposed Generic Letter and draft Regulatory Guide (DG-1074). Since then the industry and the NRC have participated in a series of meetings to resolve the differences and develop the regulatory framework necessary to implement a comprehensive Steam Generator Program.

As a result of these interactions, the regulatory framework was recently revised via Reference 8 to accommodate degradation specific management and to address the issues of regulatory stability, resource expenditure, use of state-of-the-art inservice inspection techniques, repair criteria, and enforceability. The NRC Staff has stated that an integrated approach for addressing SG tube integrity is essential and that materials, systems, and radiological issues that pertain to tube integrity need to be considered in the development of the new regulatory framework. The NRC Staff approved Reference 8 and it was posted for adoption by licensees in the NRC Federal Register Notice of Availability published on May 6, 2005 (70 FR 24126). All US PWR licensees have now adopted this approach.

4.0 TECHNICAL ANALYSIS

The proposed changes do not affect the design of the SGs, their method of operation, the operational leakage limit, the accident analyses or primary coolant chemistry controls. The primary coolant activity limit and its assumptions are not affected by the proposed changes to the standard technical specifications. The proposed changes are an improvement to the existing SG inspection requirements and continue to provide assurance that the plant licensing basis will be maintained between SG inspections.

The proposed changes contain a number of editorial corrections, changes, and clarifications intended to improve internal consistency, consistency with the implementing industry documents, and usability without changing the intent of the requirements.

The proposed changes to TS 5.5.9.d.2 are more effective in managing the frequency of verification of tube integrity and sample selection than those required by current technical specifications. As a result, the proposed changes will not reduce the assurance of the function and integrity of SG tubes.

The table below and associated sections describe in detail the proposed changes and provide the technical justification .

Condition or Requirement	**Current Licensing Basis**	**Location - Proposed Change**	**Sec.**
Frequency of verification of SG tube integrity	SG Tube Integrity SR 3.4.17.1 (NUREG-1430), SR 3.4.20.1 (NUREG-1431), and SR 3.4.18.1 (NUREG-1432) The Frequency is in accordance with TS 5.5.9, Steam Generator Program. Frequency is dependent on tubing material and the previous inspection results and the anticipated defect growth rate. The Steam Generator Program establishes maximum inspection periods.	The SG Tube Integrity Surveillance Requirements are unchanged. Steam Generator Program TS 5.5.9.d.2 for Alloy 600TT and Alloy 690TT tubing, (1) Inspection period midpoint requirement is deleted, (2) the 2nd and subsequent inspection periods lengths are lengthened marginally and (3) for all tube material types, a provision is added to allow extending each inspection period by up to three effective full power months. For all tubing types, a provision is added to clarify prorating of new sample plans. Frequency remains dependent on tubing material and the previous inspection results and the anticipated defect growth rate. The maximum inspection periods are unchanged. A conforming change is made to the parenthetical expression "(whichever is less)" in TS 5.5.9.d.3 for consistency with changes proposed for TS 5.5.9.d.2.	1
Tube sample selection	Implementing procedures required by the Steam Generator Program - Dependent on a preoutage evaluation of actual degradation locations and mechanisms, and operating experience – minimum 20% of all tubes as required by Reference 1.	Implementing procedures required by the Steam Generator Program - Dependent on a pre-outage evaluation of actual degradation locations and mechanisms, and operating experience – minimum 20% of all tubes as required by Reference 1. Adds provisions to increase minimum sample size based on the number of inspections scheduled in each inspection period for 600TT and 690TT tubing types.	2

Condition or Requirement	Current Licensing Basis	Location - Proposed Change	Sec.
Steam Generator Tube Inspection Report	TS 5.6.7 - 180 days after the initial entry into MODE 4 after performing a SG inspection	The term "active" is removed from 5.6.7.b and 5.6.7.e as this term is not defined in the specifications. TS 5.6.7.h is combined with TS 5.6.7.f and, therefore, 5.6.7.h is deleted. TS 5.6.7.i is changed to TS 5.6.7.h as a conforming change.	3

Section 1: Frequency of Verification of SG Tube Integrity

Minor wording changes are made to the surveillance Frequency in Technical Specification 5.5.9.d.2 as detailed in the discussion below. The maximum surveillance interval between inspections in the existing Steam Generator Tube Integrity specification, which is specified in the Steam Generator Program, is unchanged. The interval between inspections is dependent on tubing material and whether any degradation is found. The interval between inspections is limited by existing and potential degradation mechanisms and their anticipated growth rate.

The current Technical Specification 5.5.9.d.2 establishes sequential periods for inspection of steam generator tubes. The length of each inspection period is based on tubing material type and the age of the steam generators. Materials that are more susceptible to corrosion degradation have shorter inspection periods in which to complete all inspections. The inspection period length for Alloy 600 mill annealed tubing (600MA) is fixed at 60 effective full power months (EFPM) because this material is more susceptible to degradation than other materials. The inspection period length for Alloy 600 thermally treated tubing (600TT) and Alloy 690 thermally treated tubing (690TT) tubing are longer early in the life of the steam generators and shorten as the steam generators age and become more susceptible to degradation. These fundamental aspects of the current specification are retained.

Within each inspection period for 600TT tubing and 690TT tubing, the current specification establishes inspection requirements for the midpoint and end point of each period such that 50% of the tubes are inspected by the refueling outage nearest the midpoint, and the remaining 50% is inspected by the refueling outage nearest the end point.

After all US PWR licensees amended their Technical Specifications to incorporate the current specifications, plants with 600TT and 690TT tubing have or will experience implementation issues associated with the current TS 5.5.9.d.2. Generally, these issues interfere with a plant's ability to operate for the maximum inspection inverval allowed by the specification even when no degradation is present. Sampling requirements for the midpoint and end point of each inspection period, and requirements for addition of new sample plans after the start of a inspection period are not well defined (this issue also applies to plants with 600MA tubing) and frequently require a plant to adjust the size of the inspection sample to meet these requirements.

The current TS 5.5.9.d.2 for plants with 600MA tubing states:

> "Inspect 100% of the tubes at sequential periods of 60 effective full power months. The first sequential period shall be considered to begin after the first inservice inspection of the SGs. No SG shall operate for more than 24 effective full power months or one refueling outage (whichever is less) without being inspected."

The current TS 5.5.9.d.2 for plants with 600TT tubing states:

> "Inspect 100% of the tubes at sequential periods of 120, 90, and, thereafter, 60 effective full power months. The first sequential period shall be considered to begin after the first inservice inspection of the SGs. In addition, inspect 50% of the tubes by the refueling outage nearest the midpoint of the period and the remaining 50% by the refueling outage nearest the end of the period. No SG shall operate for more than 48 effective full power months or two refueling outages (whichever is less) without being inspected."

The current TS 5.5.9.d.2 for plants with 690TT tubing states:

> "Inspect 100% of the tubes at sequential periods of 144, 108, 72, and, thereafter, 60 effective full power months. The first sequential period shall be considered to begin after the first inservice inspection of the SGs. In addition, inspect 50% of the tubes by the refueling outage nearest the midpoint of the period and the remaining 50% by the refueling outage nearest the end of the period. No SG shall operate for more than 72 effective full power months or three refueling outages (whichever is less) without being inspected."

Specifically, the implementation issues with the current TS 5.5.9.d.2 are:

- As originally envisioned by the Industry, the current wording would provide flexibility in completion of inspection requirements by the midpoint and end point of the period such that it would permit using a refueling outage that occurs after the midpoint or end point provided it was closer than the prior refueling outage. NRC Staff, however, determined in Reference 9 that the specification requires completion of all inspections within the inspection period and does not permit completion of inspections at a refueling outage after the end point. This determination resulted in a significant loss of flexibility in scheduling inspections to meet the end point requirement.

- As plants with 600TT and 690TT tubing age, they progress from longer to shorter inspection periods. In addition, each period has inspection requirements associated with the midpoint and end point. It has been recognized that the shorter inspection periods in combination with the midpoint and end point requirements prevent 600TT and 690TT plants from operating for the maximum interval between inspections permitted by the specification, even if no degradation has been detected. The limitation is most severe for 690TT plants with 24 month fuel cycles during the 60-month inspection periods. For example: A 690TT plant with no degradation would be allowed to operate for 72 effective full power months or three refueling outages (whichever is less) between inspections during the longer inspection periods, but can operate only one cycle between inspections during the 60EFPM inspection period because there are only 30 EFPM before the midpoint or end point is reached.

- Sampling requirements for the midpoint and end point of each inspection period are not well defined and frequently require a plant to adjust the size of the inspection sample to meet these requirements. For example, a plant may have two inspections scheduled in the first half of the inspection period and only one inspection scheduled in the second half of the inspection period. The plant can select a sample size of 25% for each inspection in the first half to meet the midpoint requirement, but must increase the sample size to 50% in the second half to meet the end point requirement when it would be preferable to maintain a set sample size of 33.3% at each inspection throughout the inspection period. The current specification, however, requires the sample size for the only inspection scheduled in the later half of the inspection period to be adjusted to at least 50%.

- The current specification does not clarify sampling requirements when a new sampling plan is added to the inspection scope after the start of an inspection period (this issue also applies to plants with 600MA tubing). For example: if a licensee adds a new sample plan during their last inspection in a given inspection period, and the licensee has already completed two prior inspections during the inspection period, it is unclear if the licensee must sample 100% of the tubing to meet the end point requirement or if the sample can be prorated in some manner. The NRC Staff has determined in Reference 9 that prorating of new sample plans would be acceptable. Thus, it is appropriate to include such provisions in the Steam Generator Program.

To address these implementation issues, the following changes to TS 5.5.9.d.2 are proposed:

1. For 600MA tubing, a provision is added to clarify prorating for inspection of new degradation types or locations. The inspection period length, inspection requirements and maximum inspection interval between inspections are unchanged. A provision is added to allow extending each inspection period by up to three EFPM to resolve the inflexible nature of a fixed end point in the current specification, and a provision is added to clarify prorating for inspection of new degradation types or locations. These provisions are discussed in detail

below. The maximum intervals between inspections for 600MA tubing are unchanged.

Also for 600MA tubing, minor wording changes are made for greater clarity as follows:

- The phrase "After the first refueling outage following SG installation " is added to the beginning of the specification to clarify the timing of the applicability.

- The phrase "every 24 effective full power months" is changed to "at least every 24 effective full power months" for greater clarity.

- The parenthetical expression "(whichever is less)" is changed to "(whichever results in more frequent inspections)" since effective full power months reflect an operating time, whereas one refueling outage reflects an event.

- The phrase "one refueling outage" is changed to "at least every refueling outage" for greater clarity.

2. For 600TT and 690TT tubing, the inspection period midpoint requirement is deleted. The length of the second and subsequent inspection periods is increased marginally for consistency with typical fuel cycle lengths and, thus, better accommodates scheduling of inspections. A provision is added to allow extending each inspection period by up to three EFPM to resolve the inflexible nature of a fixed end point in the current specification, and a provision is added to clarify prorating for inspection of new degradation types or locations. The maximum intervals between inspections for 600TT and 690TT tubing are unchanged.

   Also, minor wording changes are made for greater clarity as follows:

   - For 600TT and 690TT tubing the phrase "After the first refueling outage following SG installation" is added to the beginning of the specification to clarify the timing of the applicability.

   - For 600TT tubing, the phrase "every 48 effective full power months" is changed to "at least every 48 effective full power months" for greater clarity.

   - For 690TT tubing, the phrase "every 72 effective full power months" is changed to "at least every 72 effective full power months" for greater clarity.

   - For 600TT and 690TT tubing the parenthetical expression "(whichever is less)" is changed to "(whichever results in more frequent inspections)" since effective full power months reflect an operating time, whereas one refueling outage reflects an event. A conforming change is also made to TS 5.5.9.d.3 to modify the parenthetical expression "(whichever is less)" is changed to "(whichever results in more frequent inspections)".

- For 600TT tubing the phrase "or two refueling outages" is changed to "or at least every other refueling outage" for greater clarity.

- For 690TT tubing the phrase "or three refueling outages" is changed to "or at least every third refueling outage" for greater clarity.

A provision is added to TS 5.5.9.d.2 [600MA, 600TT and 690TT] to clarify prorating of inspections for new degradation types or locations for each of the tube material types. It requires that the fraction of locations to be inspected for new potential degradation types or locations at the end of the inspection period shall be no less than the ratio of the number of times the SG is scheduled to be inspected in the inspection period after the determination that a new form of degradation could potentially be occurring at this location divided by the total number of times the SG is scheduled to be inspected in the inspection period. This is expressed in the following equation:

$$I_f \geq I_s / I_t$$

Where:

I_f = the prorated <u>fraction</u> of tubes/locations scheduled to be inspected by the end of the inspection period.

I_s = the number of SG inspection outages scheduled to be performed in the inspection period <u>subsequent</u> to the determination that a new degradation type may occur or that new locations may be susceptible to degradation.

I_t = the <u>total</u> number of SG inspection outages scheduled to be performed in the inspection period.

For example, a licensee has completed one of three inspections (I_t) in a given inspection period. The licensee's degradation assessment indicates that tubes/new locations may be susceptible to degradation at the next scheduled inspection and, therefore, is adding tubes/new locations to the two remaining inspections (I_s) in that inspection period. Therefore, at the end of the inspection period (i.e., when the two remaining inspections in that inspection period are completed), the licensee must ensure that the fraction of tubes/locations inspected is equal to at least 2/3 of the total number of tubes/new locations susceptible. Thus, in each of the two inspections subsequent to the determination that a new degradation type may occur or that new locations may be susceptible to degradation, the licensee would inspect at least 1/3 of the tubes/new locations.

Specification 5.5.9.d.2 [600TT and 690TT] is revised to lengthen some inspection periods in order to better align the inspections with fuel cycle length. For 600TT tube material, the inspection periods are changed from 120 EFPM, 90 EFPM, and 60 EFPM to 120 EFPM, 96 EFPM, and 72 EFPM. For 690TT tube material, the inspection periods are changed from 144 EFPM, 108 EFPM, 72 EFPM, and 60 EFPM to 144 EFPM, 120 EFPM, 96 EFPM, and 72 EFPM. The maximum interval between inspections (48 EFPM for 600TT and 72 EFPM for 690TT) is unchanged, so the proposed increase in the total length of each inspection period does not increase the maximum time of the surveillance frequency. The interval between inspections must be supported by an assessment that concludes tube integrity will be maintained for the period of planned operations. Industry guidance requires this assessment to consider operating experience of other units and the potential need for more frequent inspections. This guidance also requires timely reporting of significant operating experience, including potentially new degradation mechanisms, to EPRI issue groups for consideration of generic action among members. Thus, incorporation of relevant operating experience is considered as an industry approach and is less subject to isolation of individual experiences. The assessment must be reviewed at each refueling outage regardless of whether a SG inspection is planned. If this assessment concludes that tube integrity cannot be ensured for the maximum interval between inspections, more frequent inspections are required. In addition, if crack-like indications are found in any SG, the interval to the next inspection is limited by TS 5.5.9.d.3 to 24 effective full power months or one refueling outage (whichever results in more frequent inspections). The specification would allow a plant with cracking to return to a longer inspection frequency if cracking was not detected in a subsequent inspection provided it is supported with adequate justification in the degradation and operational assessments. The potential that the total number of SG inspections completed during a given inspection period may be less is offset by the addition of provisions to increase the minimum sample size at each inspection to ensure that 100% of tubes are inspected. This justification also supports the provision to allow a 3 effective full power month extension of the inspection period to include a SG inspection outage in an inspection period. Thus, the proposed increase in the total length of each inspection period for 600TT and 690TT tubing does not reduce or adversely impact the integrity of SG tubing.

Taken in total, the proposed changes provide an acceptable margin of safety compared to the current requirements because the maximum allowable interval between inspections is the same as the current technical specifications. The minimum sample size at each inspection is also the same as that required by the SG Program (20 percent of the tubes in each SG). A provision is added to clarify prorating of new sample plans. A provision is added to allow extending each inspection period by up to three effective full power months to resolve the inflexible nature of a fixed end point in the current specification. A requirement is added to increase the minimum sample size based on the number of inspections performed in each inspection period. For example; if only one inspection is performed during a given inspection period, the minimum sample size would be 100% of the tubes in each steam generator, thus providing added assurance that any degradation within the SGs will be detected and accounted for in establishing the inspection period.

The proposed maximum inspection periods are based on the historical performance of advanced SG tubing materials. Reference 10 shows that the performance of Alloy 600TT and 690TT is significantly better than the performance of 600MA tubing. There have been relatively few instances of crack-like indications reported in 600TT tubes in U.S. SGs. To date, there are no known instances of cracking in 690TT tubes, sleeves, or plugs in either the U.S. or international SGs.

TS 5.5.9.d.2 for the 600TT and 690TT includes a Reviewer's Note that states that licensees may elect to retain historical and existing inspection period lengths in order to not revise those inspection periods. For example, a 600TT plant at the end of the second SG inspection period may elect to retain the 90 effective full power month length of the second inspection period instead of the revised 96 effective full power month length so that the second period may be completed under the current inspection plan.

The proposed TS 5.5.9.d.2 for 600MA tubing is:

> "After the first refueling outage following SG installation, inspect each steam generator at least every 24 effective full power months or at least every refueling outage (whichever results in more frequent inspections). In addition, inspect 100% of the tubes at sequential periods of 60 effective full power months beginning after the first refueling outage inspection following SG installation. Each 60 effective full power month inspection period may be extended up to 3 effective full power months to include a SG inspection outage in an inspection period and the subsequent inspection period begins at the conclusion of the included SG inspection outage. If a degradation assessment indicates the potential for a type of degradation to occur at a location not previously inspected with a technique capable of detecting this type of degradation at this location and that may satisfy the applicable tube repair criteria, the minimum number of locations inspected with such a capable inspection technique during the remainder of the inspection period may be prorated. The fraction of locations to be inspected for this potential type of degradation at this location at the end of the inspection period shall be no less than the ratio of the number of times the SG is scheduled to be inspected in the inspection period after the determination that a new form of degradation could potentially be occurring at this location divided by the total number of times the SG is scheduled to be inspected in the inspection period."

The proposed TS 5.5.9.d.2 for 600TT tubing is:

> "After the first refueling outage following SG installation, inspect each SG at least every 48 effective full power months or at least every other refueling outage (whichever results in more frequent inspections). In addition, the minimum number of tubes inspected at each scheduled inspection shall be the number of tubes in all SGs divided by the number of SG inspection outages scheduled in each inspection period as defined in a, b, and c below. If a degradation assessment indicates the potential for a type of

degradation to occur at a location not previously inspected with a technique capable of detecting this type of degradation at this location and that may satisfy the applicable tube repair criteria, the minimum number of locations inspected with such a capable inspection technique during the remainder of the inspection period may be prorated. The fraction of locations to be inspected for this potential type of degradation at this location at the end of the inspection period shall be no less than the ratio of the number of times the SG is scheduled to be inspected in the inspection period after the determination that a new form of degradation could potentially be occurring at this location divided by the total number of times the SG is scheduled to be inspected in the inspection period. Each inspection period defined below may be extended up to 3 effective full power months to include a SG inspection outage in an inspection period and the subsequent inspection period begins at the conclusion of the included SG inspection outage.

-------------------------------- Reviewer's Note -----------------------------------
A licensee may elect to retain historical and existing inspection period lengths in order to not revise those inspection periods.
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a) After the first refueling outage following SG installation, inspect 100% of the tubes during the next 120 effective full power months. This constitutes the first inspection period;

b) During the next 96 effective full power months, inspect 100% of the tubes. This constitutes the second inspection period; and

c) During the remaining life of the SGs, inspect 100% of the tubes every 72 effective full power months. This constitutes the third and subsequent inspection periods."

The proposed TS 5.5.9.d.2 for 690TT tubing is:

"After the first refueling outage following SG installation, inspect each SG at least every 72 effective full power months or at least every third refueling outage (whichever results in more frequent inspections). In addition, the minimum number of tubes inspected at each scheduled inspection shall be the number of tubes in all SGs divided by the number of SG inspection outages scheduled in each inspection period as defined in a, b, c and d below. If a degradation assessment indicates the potential for a type of degradation to occur at a location not previously inspected with a technique capable of detecting this type of degradation at this location and that may satisfy the applicable tube repair criteria, the minimum number of locations inspected with such a capable inspection technique during the remainder of the inspection period may be prorated. The fraction of locations to be inspected for this potential type of degradation at this location at the end of the inspection period shall be no less than the ratio of the number of times the SG is scheduled to be inspected in the inspection period after the determination that a new form of degradation could potentially be occurring at this location divided by the total number of times the SG is scheduled to be inspected in the inspection period. Each inspection period defined below may be extended up to 3 effective full power months to include a SG inspection outage in an inspection period and the subsequent inspection period begins at the conclusion of the included SG inspection outage.

-------------------------------- Reviewer's Note ----------------------------------
A licensee may elect to retain historical and existing inspection period lengths in order to not revise those inspection periods.
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a) After the first refueling outage following SG installation, inspect 100% of the tubes during the next 144 effective full power months. This constitutes the first inspection period;

b) During the next 120 effective full power months, inspect 100% of the tubes. This constitutes the second inspection period;

c) During the next 96 effective full power months, inspect 100% of the tubes. This constitutes the third inspection period; and

d) During the remaining life of the SGs, inspect 100% of the tubes every 72 effective full power months. This constitutes the fourth and subsequent inspection periods."

The current TS 5.5.9.d.3 states:

"If crack indications are found in any SG tube, then the next inspection for each SG for the degradation mechanism that caused the crack indication shall not exceed 24 effective full power months or one refueling outage (whichever is less). If definitive information, such as from examination of a pulled tube, diagnostic non-destructive testing, or engineering evaluation indicates that a crack-like indication is not associated with a crack(s), then the indication need not be treated as a crack."

For conformance with TS 5.5.9.d.2, the proposed TS 5.5.9.d.3 states:

"If crack indications are found in any SG tube, then the next inspection for each affected and potentially affected SG for the degradation mechanism that caused the crack indication shall not exceed 24 effective full power months or one refueling outage (whichever results in more frequent inspections). If definitive information, such as from examination of a pulled tube, diagnostic non-destructive testing, or engineering evaluation indicates that a crack-like indication is not associated with a crack(s), then the indication need not be treated as a crack."

Specification 5.5.9.d.3 is revised to clarify the term "each SG". The existing wording can be misinterpreted. The intention is that those SGs that are affected and those SGs that are potentially affected must be inspected for the degradation mechanism that caused the crack indication. However, some licensees have questioned whether the current reference to "each SG" requires only the SGs that are affected to be inspected for the degradation mechanism. Paragraph d.3 is altered as shown to eliminate this ambiguity. The Bases of the Steam Generator Tube Integrity Surveillance (Surveillance 3.4.17.1 in NUREG-1430, Surveillance 3.4.20.1 in NUREG-1431, and Surveillance 3.4.18.1 in NUREG-1432) are revised to reflect this clarification.

TS 5.5.9.d.2 [600TT and 690TT] changed the parenthetical expression "(whichever is less)" to "(whichever results in more frequent inspections)" since effective full power months reflect an operating time, whereas one refueling outage reflects an event. A conforming change is also made to TS 5.5.9.d.3 to modify the parenthetical expression "(whichever is less)" is changed to "(whichever results in more frequent inspections)".

Section 2: SG Tube Sample Selection

The current technical specifications refer to the Steam Generator Program degradation assessment guidance for sampling requirements. The minimum sample size is 20% of all tubes as a minimum, as required by Reference 1. The proposed change adds a new requirement to increase the minimum number of tubes inspected at each SG inspection based on the number of tubes in all SGs divided by the number of SG outage inspections scheduled during each inspection period.

The Steam Generator Program requires the preparation of a degradation assessment. The degradation assessment is the key document used for planning a SG inspection, where inspection plans and related actions are determined, documented, and communicated. The degradation assessment addresses the various reactor coolant pressure boundary components within the SG (e.g., plugs, sleeves, tubes, and components that support the pressure boundary.) In a degradation assessment, tube sample selection is performance based and is dependent upon actual SG conditions and plant operational experience and of the industry in general. Existing and potential degradation mechanisms and their locations are evaluated to determine which tubes will be inspected. Tube sample selection is adjusted to minimize the potential for tube integrity to degrade during an operating cycle beyond the limits defined by the performance criteria. NEI 97-06 (Ref. 7) and the EPRI Steam Generator Integrity Assessment Guidelines (Ref. 2) provide guidance on degradation assessment.

The sample selection considerations required by the SG Program (Ref. 1) and the requirements as proposed by this change are consistent. However, added assurance that degradation will be detected is provided by a new requirement to increase the minimum number of tubes inspected at each SG inspection based on the number of tubes in all SGs divided by the number of SG outage inspections scheduled during each inspection period. For example; if only one inspection is scheduled during a given inspection period, the minimum sample size would be 100% of the tubes in each steam generator. Therefore the sample selection method proposed by this change is more conservative than the current technical specification requirements.

Section 3: Steam Generator Tube Inspection Report

Specification 5.6.7, "Steam Generator Tube Inspection Report," is revised to change the reporting requirements. Paragraph f is revised to require reporting the effective plugging percentage. Optional paragraph h, which required reporting the effective plugging percentage, is deleted. Vendors of tube repair methods provide the equivalent RCS flow reduction to licensees for effective plugging percentage. A licensee may state that the plugging percentage and the effective plugging percentage are the same. In addition, the word "active" was removed from paragraphs 5.6.7.b and e. This term is not defined in the specifications.

Conclusion

The proposed changes will provide an acceptable level of assurance of SG tube integrity compared to the current technical specifications. The proposed requirements resolve implementation issues associated with the current specifications. These changes are consistent with the guidance in NEI 97-06, "Steam Generator Program Guidelines," (Ref. 7).

Adopting the proposed changes will provide reasonable assurance that SG tubing will remain capable of fulfilling its specified safety function of maintaining RCPB integrity.

5.0 REGULATORY ANALYSIS

5.1 No Significant Hazards Consideration

The proposed change revises the Improved Standard Technical Specification (ISTS) Specification 5.5.9, "Steam Generator (SG) Program," 5.6.7, "Steam Generator Tube Inspection Report," and the Steam Generator Tube Integrity Technical Specification (LCO 3.4.17, LCO 3.4.20, and LCO 3.4.18 in ISTS NUREG-1430, -1431, and -1432, respectively) to address inspection periods and other administrative changes and clarifications. The TSTF has evaluated whether or not a significant hazards consideration is involved with the proposed generic change by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," as discussed below:

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

Response: No

The proposed change revises the Steam Generator (SG) Program to modify the frequency of verification of SG tube integrity and SG tube sample selection. A steam generator tube rupture (SGTR) event is one of the design basis accidents that are analyzed as part of a plant’s licensing basis. The proposed SG tube inspection frequency and sample selection criteria will continue to ensure that the SG tubes are inspected such that the probability of a SGTR is not increased. The consequences of a SGTR are bounded by the conservative assumptions in the design basis accident analysis. The proposed change will not cause the consequences of a SGTR to exceed those assumptions. The proposed change to reporting requirements and clarifications of the existing requirements have no affect on the probability or consequences of SGTR.

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

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

Response: No

The proposed changes to the Steam Generator Program will not introduce any adverse changes to the plant design basis or postulated accidents resulting from potential tube degradation. The proposed change does not affect the design of the SGs or their method of operation. In addition, the proposed change does not impact any other plant system or component.

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

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

Response: No

The SG tubes in pressurized water reactors are an integral part of the reactor coolant pressure boundary and, as such, are relied upon to maintain the primary system's pressure and inventory. As part of the reactor coolant pressure boundary, the SG tubes are unique in that they are also relied upon as a heat transfer surface between the primary and secondary systems such that residual heat can be removed from the primary system. In addition, the SG tubes also isolate the radioactive fission products in the primary coolant from the secondary system. In summary, the safety function of a SG is maintained by ensuring the integrity of its tubes.

Steam generator tube integrity is a function of the design, environment, and the physical condition of the tube. The proposed change does not affect tube design or operating environment. The proposed change will continue to require monitoring of the physical condition of the SG tubes such that there will not be a reduction in the margin of safety compared to the current requirements.

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

5.2 Applicable Regulatory Requirements/Criteria

The regulatory requirements applicable to SG tube integrity are the following:

10 CFR 50.55a, Codes and Standards - Section (b), ASME Code - c) *Reactor coolant pressure boundary*. (1) Components which are part of the reactor coolant pressure boundary must meet the requirements for Class 1 components in Section III of the ASME Boiler and Pressure Vessel Code, except as provided in paragraphs (c)(2), (c)(3), and (c)(4) of this section.

The proposed change and the Steam Generator Program requirements which underlie it are in full compliance with the ASME Code. The proposed technical specifications are more effective at ensuring tube integrity and, therefore, compliance with the ASME Code, than the current technical specifications as described in Section 4.0 (Technical Analysis).

10 CFR 50.65 Maintenance Rule – Each holder of a license to operate a nuclear power plant under 50.21(b) or 50.22 shall monitor the performance or condition of structures, systems, or components, against licensee-established goals, in a manner sufficient to provide reasonable assurance that such structures, systems, and components, as defined in paragraph (b), are capable of fulfilling their intended functions. Such goals shall be established commensurate with safety and, where practical, take into account industry-wide operating experience. When the performance or condition of a structure, system, or component does not meet established goals, appropriate corrective action shall be taken. For a nuclear power plant for which the licensee has submitted the certifications specified in 50.82(a)(1), this section only shall apply to the extent that the licensee shall monitor the performance or condition of all structures, systems, or components associated with the storage, control, and maintenance of spent fuel in a safe condition, in a manner sufficient to provide reasonable assurance that such structures, systems, and components are capable of fulfilling their intended functions.

Under the Maintenance Rule, licensees classify SGs as risk significant components because they are relied on to remain functional during and after design basis events. The performance criteria included in the proposed technical specifications are used to demonstrate that the condition of the SG "is being effectively controlled through the performance of appropriate preventive maintenance" (Maintenance Rule §(a)(2)). If the performance criteria are not met, a root cause determination of appropriate depth is done and the results evaluated to determine if goals should be established per §(a)(1) of the Maintenance Rule.

NEI 97-06, Steam Generator Program Guidelines, and its referenced EPRI guidelines define a SG program that provides the appropriate preventive maintenance that meets the intent of the Maintenance Rule. NUMARC 93-01, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," (Ref. 11) offers guidance for implementing the Maintenance Rule should a licensee elect to incorporate additional monitoring goals beyond the scope of those documented in NEI 97-06.

10 CFR 50, Appendix A, GDC 14 – *Reactor Coolant Pressure Boundary.* The reactor coolant pressure boundary shall be designed, fabricated, erected, and tested so as to have an extremely low probability of abnormal leakage, or rapidly propagating failure, and of gross rupture.

There are no changes to the SG design that impact this general design criteria. The evaluation performed in Section 4.0 concludes that the proposed change will continue to comply with this regulatory requirement.

10 CFR 50, Appendix A, GDC 30 -*Quality of reactor coolant pressure boundary*. Components which are part of the reactor coolant pressure boundary shall be designed, fabricated, erected, and tested to the highest quality standards practical. Means shall be provided for detecting and, to the extent practical, identifying the location of the source of reactor coolant leakage.

There are no changes to the SG design that impact this general design criteria. The evaluation performed in Section 4.0 concludes that the proposed change will continue to comply with this regulatory requirement.

10 CFR 50, Appendix A, GDC 32 – Inspection of reactor coolant pressure boundary. Components which are part of the reactor coolant pressure boundary shall be designed to (1) periodic inspection and testing of important areas and features to assess their structural and leaktight integrity, and (2) an appropriate material surveillance program for the reactor pressure vessel.

There are no changes to the SG design that impact this general design criteria. The evaluation performed in Section 4.0 concludes that the proposed change will continue to comply with this regulatory requirement.

General Design Criteria (GDC) 14, 30, and 32 of 10 CFR Part 50, Appendix A, define requirements for the reactor coolant pressure boundary with respect to structural and leakage integrity. Steam generator tubing and tube repairs constitute a major fraction of the reactor coolant pressure boundary surface area. Steam generator tubing and associated repair techniques and components, such as plugs and sleeves, must be capable of maintaining reactor coolant inventory and pressure. The Steam Generator Program required by the proposed technical specification establishes performance criteria, repair criteria, repair methods, inspection periods and the methods necessary to meet them. These requirements provide reasonable assurance that tube integrity will be met in the interval between SG inspections.

The proposed change provides requirements that are at least as effective in detecting SG degradation and prescribing corrective actions. The proposed change results in added assurance of the function and integrity of SG tubes. Therefore, based on the considerations discussed above:

1) There is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner;

2) Such activities will be conducted in compliance with the Commission's regulations; and

3) Issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

6.0 ENVIRONMENTAL CONSIDERATION

A review has determined that the proposed change would change a requirement with respect to installation or use of a facility component located within the restricted areas, as defined in 10 CFR 20, or would change an inspection or surveillance requirement. However, the proposed change does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed change meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed change.

7.0 REFERENCES

1. EPRI, "PWR Steam Generator Examination Guidelines"
2. EPRI, "Steam Generator Integrity Assessment Guidelines"
3. EPRI, "Steam Generator In Situ Pressure Test Guidelines"
4. EPRI, "PWR Primary-to-Secondary Leak Guidelines"
5. EPRI, "PWR Primary Water Chemistry Guidelines"
6. EPRI, "PWR Secondary Water Chemistry Guidelines"
7. NEI 97-06, "Steam Generator Program Guidelines."
8. Technical Specification Task Force (TSTF) Standard Technical Specification Change Traveler, TSTF-449 Rev. 4 "Steam Generator Tube Integrity."
9. NRC memo from Catherine Haney to Jim Riley of NEI dated November 9, 2007, "Steam Generator Inspection Requirements."
10. EPRI Report R-5515-00-2, "Experience of US and Foreign PWR Steam Generators with Alloy 600TT and Alloy 690TT Tubes and Sleeves," June 5, 2002.
11. NUMARC 93-01, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," Revision 3.

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.17 Steam Generator (SG) Tube Integrity

LCO 3.4.17 SG tube integrity shall be maintained.

AND

All SG tubes satisfying the tube plugging [or repair] criteria shall be plugged [or repaired] in accordance with the Steam Generator Program.

APPLICABILITY: MODES 1, 2, 3, and 4.

ACTIONS

---NOTE---
Separate Condition entry is allowed for each SG tube.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more SG tubes satisfying the tube plugging [or repair] criteria and not plugged [or repaired] in accordance with the Steam Generator Program.	A.1 Verify tube integrity of the affected tube(s) is maintained until the next refueling outage or SG tube inspection.	7 days
	AND	
	A.2 Plug [or repair] the affected tube(s) in accordance with the Steam Generator Program.	Prior to entering MODE 4 following the next refueling outage or SG tube inspection
B. Required Action and associated Completion Time of Condition A not met. OR SG tube integrity not maintained.	B.1 Be in MODE 3.	6 hours
	AND	
	B.2 Be in MODE 5.	36 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.4.17.1	Verify SG tube integrity in accordance with the Steam Generator Program.	In accordance with the Steam Generator Program
SR 3.4.17.2	Verify that each inspected SG tube that satisfies the tube plugging [or repair] criteria is plugged [or repaired] in accordance with the Steam Generator Program.	Prior to entering MODE 4 following a SG tube inspection

5.5 Programs and Manuals

5.5.8 Inservice Testing Program (continued)

ASME OM Code and applicable Addenda terminology for inservice testing activities	Required Frequencies for performing inservice testing activities
Weekly	At least once per 7 days
Monthly	At least once per 31 days
Quarterly or every 3 months	At least once per 92 days
Semiannually or every 6 months	At least once per 184 days
Every 9 months	At least once per 276 days
Yearly or annually	At least once per 366 days
Biennially or every 2 years	At least once per 731 days

b. The provisions of SR 3.0.2 are applicable to the above required Frequencies and other normal and accelerated Frequencies specified in the Inservice Testing Program for performing inservice testing activities,

c. The provisions of SR 3.0.3 are applicable to inservice testing activities, and

d. Nothing in the ASME OM Code shall be construed to supersede the requirements of any TS.

5.5.9 Steam Generator (SG) Program

A Steam Generator Program shall be established and implemented to ensure that SG tube integrity is maintained. In addition, the Steam Generator Program shall include the following ~~provisions~~:

a. Provisions for condition monitoring assessments. Condition monitoring assessment means an evaluation of the "as found" condition of the tubing with respect to the performance criteria for structural integrity and accident induced leakage. The "as found" condition refers to the condition of the tubing during an SG inspection outage, as determined from the inservice inspection results or by other means, prior to the plugging [or repair] of tubes. Condition monitoring assessments shall be conducted during each outage during which the SG tubes are inspected, plugged, [or repaired] to confirm that the performance criteria are being met.

5.5 Programs and Manuals

5.5.9 Steam Generator (SG) Program (continued)

b. Performance criteria for SG tube integrity. SG tube integrity shall be maintained by meeting the performance criteria for tube structural integrity, accident induced leakage, and operational LEAKAGE.

1. Structural integrity performance criterion: All in-service steam generator tubes shall retain structural integrity over the full range of normal operating conditions (including startup, operation in the power range, hot standby, and cool down), ~~and~~ all anticipated transients included in the design specification,~~)~~ and design basis accidents. This includes retaining a safety factor of 3.0 against burst under normal steady state full power operation primary-to-secondary pressure differential and a safety factor of 1.4 against burst applied to the design basis accident primary-to-secondary pressure differentials. Apart from the above requirements, additional loading conditions associated with the design basis accidents, or combination of accidents in accordance with the design and licensing basis, shall also be evaluated to determine if the associated loads contribute significantly to burst or collapse. In the assessment of tube integrity, those loads that do significantly affect burst or collapse shall be determined and assessed in combination with the loads due to pressure with a safety factor of 1.2 on the combined primary loads and 1.0 on axial secondary loads.

2. Accident induced leakage performance criterion: The primary to secondary accident induced leakage rate for any design basis accident, other than a SG tube rupture, shall not exceed the leakage rate assumed in the accident analysis in terms of total leakage rate for all SGs and leakage rate for an individual SG. Leakage is not to exceed [1 gpm] per SG [, except for specific types of degradation at specific locations as described in paragraph c of the Steam Generator Program].

3. The operational LEAKAGE performance criterion is specified in LCO 3.4.13, "RCS Operational LEAKAGE."

c. Provisions for SG tube plugging [or repair] criteria. Tubes found by inservice inspection to contain flaws with a depth equal to or exceeding [40%] of the nominal tube wall thickness shall be plugged [or repaired].

5.5 Programs and Manuals

5.5.9 Steam Generator (SG) Program (continued)

--------------------------------------REVIEWER'S NOTE--------------------------------------
Alternate tube plugging [or repair] criteria currently permitted by plant technical specifications are listed here. The description of these alternate tube plugging [or repair] criteria should be equivalent to the descriptions in current technical specifications and should also include any allowed accident induced leakage rates for specific types of degradation at specific locations associated with tube plugging [or repair] criteria.

[The following alternate tube plugging [or repair] criteria may be applied as an alternative to the 40% depth based criteria:

1. . . .]

d. Provisions for SG tube inspections. Periodic SG tube inspections shall be performed. The number and portions of the tubes inspected and methods of inspection shall be performed with the objective of detecting flaws of any type (e.g., volumetric flaws, axial and circumferential cracks) that may be present along the length of the tube, from the tube-to-tubesheet weld at the tube inlet to the tube-to-tubesheet weld at the tube outlet, and that may satisfy the applicable tube plugging [or repair] criteria. The tube-to-tubesheet weld is not part of the tube. In addition to meeting the requirements of d.1, d.2, and d.3 below, the inspection scope, inspection methods, and inspection intervals shall be such as to ensure that SG tube integrity is maintained until the next SG inspection. An ~~assessment of~~ degradation assessment shall be performed to determine the type and location of flaws to which the tubes may be susceptible and, based on this assessment, to determine which inspection methods need to be employed and at what locations.

---------------------------------REVIEWER'S NOTE---------------------------------
Plants are to include the appropriate Frequency (e.g., select the appropriate Item 2.) for their SG design. The first Item 2 is applicable to SGs with Alloy 600 mill annealed tubing. The second Item 2 is applicable to SGs with Alloy 600 thermally treated tubing. The third Item 2 is applicable to SGs with Alloy 690 thermally treated tubing.
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1. Inspect 100% of the tubes in each SG during the first refueling outage following SG installation~~replacement~~.

[2. After the first refueling outage following SG installation, inspect each steam generator at least every 24 effective full power months or at least every refueling outage (whichever results in more frequent inspections). In addition, inspect 100% of the tubes at sequential periods of 60 effective full power months beginning after the first refueling outage inspection following SG installation. Each 60 effective full power month inspection period may be extended up to 3 effective full power months to include a SG inspection outage in an inspection period and the subsequent inspection period begins at the conclusion of the included SG inspection outage. If a degradation assessment indicates the potential for a type of degradation to occur at a location not previously inspected with a technique capable of detecting this type of degradation at this location and that may satisfy the applicable tube repair criteria, the minimum number of locations inspected with such a capable inspection technique during the remainder of the inspection period may be prorated. The fraction of locations to be inspected for this potential type of degradation at this location at the end of the inspection period shall be no less than the ratio of the number of times the SG is scheduled to be inspected in the inspection period after the determination that a new form of degradation could potentially be occurring at this location divided by the total number of times the SG is scheduled to be inspected in the inspection period. Inspect 100% of the tubes at sequential periods of 60 effective full power months. The first sequential period shall be considered to begin after the first inservice inspection of the SGs. No SG shall operate for more than 24 effective full power months or one refueling outage (whichever is less) without being inspected.]

5.5 Programs and Manuals

5.5.9 Steam Generator (SG) Program (continued)

[2. After the first refueling outage following SG installation, inspect each SG at least every 48 effective full power months or at least every other refueling outage (whichever results in more frequent inspections). In addition, the minimum number of tubes inspected at each scheduled inspection shall be the number of tubes in all SGs divided by the number of SG inspection outages scheduled in each inspection period as defined in a, b, and c below. If a degradation assessment indicates the potential for a type of degradation to occur at a location not previously inspected with a technique capable of detecting this type of degradation at this location and that may satisfy the applicable tube repair criteria, the minimum number of locations inspected with such a capable inspection technique during the remainder of the inspection period may be prorated. The fraction of locations to be inspected for this potential type of degradation at this location at the end of the inspection period shall be no less than the ratio of the number of times the SG is scheduled to be inspected in the inspection period after the determination that a new form of degradation could potentially be occurring at this location divided by the total number of times the SG is scheduled to be inspected in the inspection period. Each inspection period defined below may be extended up to 3 effective full power months to include a SG inspection outage in an inspection period and the subsequent inspection period begins at the conclusion of the included SG inspection outage.

------------------------------ Reviewer's Note ------------------------------------
A licensee may elect to retain historical and existing inspection period lengths in order to not revise those inspection periods.
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a) After the first refueling outage following SG installation, inspect 100% of the tubes during the next 120 effective full power months. This constitutes the first inspection period;

b) During the next 96 effective full power months, inspect 100% of the tubes. This constitutes the second inspection period; and

c) During the remaining life of the SGs, inspect 100% of the tubes every 72 effective full power months. This constitutes the third and subsequent inspection periods.

~~Inspect 100% of the tubes at sequential periods of 120, 90, and, thereafter, 60 effective full power months. The first sequential period shall be considered to begin after the first inservice inspection of the SGs. In addition, inspect 50% of the tubes by the refueling outage nearest the midpoint of the period and the remaining 50% by the refueling outage nearest the end of the period. No SG shall operate~~

~~for more than 48 effective full power months or two refueling outages (whichever is less) without being inspected.]~~

[2. After the first refueling outage following SG installation, inspect each SG at least every 72 effective full power months or at least every third refueling outage (whichever results in more frequent inspections). In addition, the minimum number of tubes inspected at each scheduled inspection shall be the number of tubes in all SGs divided by the number of SG inspection outages scheduled in each inspection period as defined in a, b, c and d below. If a degradation assessment indicates the potential for a type of degradation to occur at a location not previously inspected with a technique capable of detecting this type of degradation at this location and that may satisfy the applicable tube repair criteria, the minimum number of locations inspected with such a capable inspection technique during the remainder of the inspection period may be prorated. The fraction of locations to be inspected for this potential type of degradation at this location at the end of the inspection period shall be no less than the ratio of the number of times the SG is scheduled to be inspected in the inspection period after the determination that a new form of degradation could potentially be occurring at this location divided by the total number of times the SG is scheduled to be inspected in the inspection period. Each inspection period defined below may be extended up to 3 effective full power months to include a SG inspection outage in an inspection period and the subsequent inspection period begins at the conclusion of the included SG inspection outage.

----------------------------- Reviewer's Note ----------------------------------
A licensee may elect to retain historical and existing inspection period lengths in order to not revise those inspection periods.
----

a) After the first refueling outage following SG installation, inspect 100% of the tubes during the next 144 effective full power months. This constitutes the first inspection period;

b) During the next 120 effective full power months, inspect 100% of the tubes. This constitutes the second inspection period;

c) During the next 96 effective full power months, inspect 100% of the tubes. This constitutes the third inspection period; and

d) During the remaining life of the SGs, inspect 100% of the tubes every 72 effective full power months. This constitutes the fourth and subsequent inspection periods.

~~Inspect 100% of the tubes at sequential periods of 144, 108, 72, and, thereafter, 60 effective full power months. The first sequential period shall be considered to begin after the first inservice inspection of the SGs. In addition, inspect 50% of the tubes by the refueling outage~~

~~nearest the midpoint of the period and the remaining 50% by the refueling outage nearest the end of the period. No SG shall operate for more than 72 effective full power months or three refueling outages (whichever is less) without being inspected.]~~

3. If crack indications are found in any SG tube, then the next inspection for each affected and potentially affected SG for the degradation mechanism that caused the crack indication shall not exceed 24 effective full power months or one refueling outage (whichever results in more frequent inspections~~is less~~). If definitive information, such as from examination of a pulled tube, diagnostic non-destructive testing, or engineering evaluation indicates that a crack-like indication is not associated with a crack(s), then the indication need not be treated as a crack.

e. Provisions for monitoring operational primary to secondary LEAKAGE.

[f. Provisions for SG tube repair methods. Steam generator tube repair methods shall provide the means to reestablish the RCS pressure boundary integrity of SG tubes without removing the tube from service. For the purposes of these Specifications, tube plugging is not a repair. All acceptable tube repair methods are listed below.

---------------------------------------REVIEWER'S NOTE---------------------------------------
Tube repair methods currently permitted by plant technical specifications are to be listed here. The description of these tube repair methods should be equivalent to the descriptions in current technical specifications. If there are no approved tube repair methods, this section should not be used.
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1. . . .]

5.6 Reporting Requirements

5.6.5 Post Accident Monitoring Report

When a report is required by Condition B or F of LCO 3.3.[17], "Post Accident Monitoring (PAM) Instrumentation," a report shall be submitted within the following 14 days. The report shall outline the preplanned alternate method of monitoring, the cause of the inoperability, and the plans and schedule for restoring the instrumentation channels of the Function to OPERABLE status.

5.6.6 [Tendon Surveillance Report

Any abnormal degradation of the containment structure detected during the tests required by the Pre-stressed Concrete Containment Tendon Surveillance Program shall be reported to the NRC within 30 days. The report shall include a description of the tendon condition, the condition of the concrete (especially at tendon anchorages), the inspection procedures, the tolerances on cracking, and the corrective action taken.]

5.6.7 Steam Generator Tube Inspection Report

A report shall be submitted within 180 days after the initial entry into MODE 4 following completion of an inspection performed in accordance with the Specification 5.5.9, "Steam Generator (SG) Program." The report shall include:

a. The scope of inspections performed on each SG,

b. ~~Active ~~D~~d~~egradation mechanisms found,

c. Nondestructive examination techniques utilized for each degradation mechanism,

d. Location, orientation (if linear), and measured sizes (if available) of service induced indications,

e. Number of tubes plugged [or repaired] during the inspection outage for each ~~active ~~degradation mechanism,

f. The number and percentage of tubes plugged [or repaired] to date, and the effective plugging percentage in each steam generator~~Total number and percentage of tubes plugged [or repaired] to date~~,

g. The results of condition monitoring, including the results of tube pulls and in-situ testing,

~~[h. The effective plugging percentage for all plugging [and tube repairs] in each SG, and]~~

[h~~i~~. Repair method utilized and the number of tubes repaired by each repair method.]

BASES

APPLICABLE SAFETY ANALYSES

The steam generator tube rupture (SGTR) accident is the limiting design basis event for SG tubes and avoiding an SGTR is the basis for this Specification. The analysis of a SGTR event assumes a bounding primary to secondary LEAKAGE rate equal to the operational LEAKAGE rate limits in LCO 3.4.13, "RCS Operational LEAKAGE," plus the leakage rate associated with a double-ended rupture of a single tube. The accident analysis for a SGTR assumes the contaminated secondary fluid is only briefly released to the atmosphere via safety valves and the majority is discharged to the main condenser.

The analysis for design basis accidents and transients other than a SGTR assume the SG tubes retain their structural integrity (i.e., they are assumed not to rupture.) In these analyses, the steam discharge to the atmosphere is based on the total primary to secondary LEAKAGE from all SGs of [1 gallon per minute] or is assumed to increase to [1 gallon per minute] as a result of accident induced conditions. For accidents that do not involve fuel damage, the primary coolant activity level of DOSE EQUIVALENT I-131 is assumed to be equal to the LCO 3.4.16, "RCS Specific Activity," limits. For accidents that assume fuel damage, the primary coolant activity is a function of the amount of activity released from the damaged fuel. The dose consequences of these events are within the limits of GDC 19 (Ref. 2), 10 CFR 100 (Ref. 3) or the NRC approved licensing basis (e.g., a small fraction of these limits).

Steam generator tube integrity satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).

LCO

The LCO requires that SG tube integrity be maintained. The LCO also requires that all SG tubes that satisfy the plugging [or repair] criteria be plugged [or repaired] in accordance with the Steam Generator Program.

During an SG inspection, any inspected tube that satisfies the Steam Generator Program plugging [or repair] criteria is [repaired or] removed from service by plugging. If a tube was determined to satisfy the plugging [or repair] criteria but was not plugged [or repaired], the tube may still have tube integrity.

In the context of this Specification, a SG tube is defined as the entire length of the tube, including the tube wall [and any repairs made to it], between the tube-to-tubesheet weld at the tube inlet and the tube-to-tubesheet weld at the tube outlet. The tube-to-tubesheet weld is not considered part of the tube.

A SG tube has tube integrity when it satisfies the SG performance criteria. The SG performance criteria are defined in Specification 5.5.9, "Steam Generator Program," and describe acceptable SG tube performance. The Steam Generator Program also provides the evaluation process for determining conformance with the SG performance criteria.

BASES

LCO (continued)

The operational LEAKAGE performance criterion provides an observable indication of SG tube conditions during plant operation. The limit on operational LEAKAGE is contained in LCO 3.4.13, "RCS Operational LEAKAGE," and limits primary to secondary LEAKAGE through any one SG to 150 gallons per day. This limit is based on the assumption that a single crack leaking this amount would not propagate to a SGTR under the stress conditions of a LOCA or a main steam line break. If this amount of LEAKAGE is due to more than one crack, the cracks are very small, and the above assumption is conservative.

APPLICABILITY

Steam generator tube integrity is challenged when the pressure differential across the tubes is large. Large differential pressures across SG tubes can only be experienced in MODE 1, 2, 3, or 4.

RCS conditions are far less challenging in MODES 5 and 6 than during MODES 1, 2, 3, and 4. In MODES 5 and 6, primary to secondary differential pressure is low, resulting in lower stresses and reduced potential for LEAKAGE.

ACTIONS

The ACTIONS are modified by a Note clarifying that the Conditions may be entered independently for each SG tube. This is acceptable because the Required Actions provide appropriate compensatory actions for each affected SG tube. Complying with the Required Actions may allow for continued operation, and subsequent affected SG tubes are governed by subsequent Condition entry and application of associated Required Actions.

A.1 and A.2

Condition A applies if it is discovered that one or more SG tubes examined in an inservice inspection satisfy the tube plugging [or repair] criteria but were not plugged [or repaired] in accordance with the Steam Generator Program as required by SR 3.4.17.2. An evaluation of SG tube integrity of the affected tube(s) must be made. Steam generator tube integrity is based on meeting the SG performance criteria described in the Steam Generator Program. The SG plugging [or repair] criteria define limits on SG tube degradation that allow for flaw growth between inspections while still providing assurance that the SG performance criteria will continue to be met. In order to determine if a SG tube that should have been plugged [or repaired] has tube integrity, an evaluation must be completed that demonstrates that the SG performance criteria will continue to be met until the next refueling outage or SG tube inspection. The tube integrity

BASES

SURVEILLANCE REQUIREMENTS (continued)

The Steam Generator Program determines the scope of the inspection and the methods used to determine whether the tubes contain flaws satisfying the tube plugging [or repair] criteria. Inspection scope (i.e., which tubes or areas of tubing within the SG are to be inspected) is a function of existing and potential degradation locations. The Steam Generator Program also specifies the inspection methods to be used to find potential degradation. Inspection methods are a function of degradation morphology, non-destructive examination (NDE) technique capabilities, and inspection locations.

The Steam Generator Program defines the Frequency of SR 3.4.17.1. The Frequency is determined by the operational assessment and other limits in the SG examination guidelines (Ref. 6). The Steam Generator Program uses information on existing degradations and growth rates to determine an inspection Frequency that provides reasonable assurance that the tubing will meet the SG performance criteria at the next scheduled inspection. In addition, Specification 5.5.9 contains prescriptive requirements concerning inspection intervals to provide added assurance that the SG performance criteria will be met between scheduled inspections. If crack indications are found in any SG tube, the maximum inspection interval for all affected and potentially affected SGs is restricted by Specification 5.5.9 until subsequent inspections support extending the inspection interval.

SR 3.4.17.2

During an SG inspection, any inspected tube that satisfies the Steam Generator Program plugging [or repair] criteria is [repaired or] removed from service by plugging. The tube plugging [or repair] criteria delineated in Specification 5.5.9 are intended to ensure that tubes accepted for continued service satisfy the SG performance criteria with allowance for error in the flaw size measurement and for future flaw growth. In addition, the tube plugging [or repair] criteria, in conjunction with other elements of the Steam Generator Program, ensure that the SG performance criteria will continue to be met until the next inspection of the subject tube(s). Reference 1 provides guidance for performing operational assessments to verify that the tubes remaining in service will continue to meet the SG performance criteria.

[Steam generator tube repairs are only performed using approved repair methods as described in the Steam Generator Program.]

The Frequency of prior to entering MODE 4 following a SG inspection ensures that the Surveillance has been completed and all tubes meeting

the plugging [or repair] criteria are plugged [or repaired] prior to subjecting the SG tubes to significant primary to secondary pressure differential.

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.20 Steam Generator (SG) Tube Integrity

LCO 3.4.20 SG tube integrity shall be maintained.

AND

All SG tubes satisfying the tube plugging [or repair] criteria shall be plugged [or repaired] in accordance with the Steam Generator Program.

APPLICABILITY: MODES 1, 2, 3, and 4.

ACTIONS

---NOTE---
Separate Condition entry is allowed for each SG tube.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more SG tubes satisfying the tube plugging [or repair] criteria and not plugged [or repaired] in accordance with the Steam Generator Program.	A.1 Verify tube integrity of the affected tube(s) is maintained until the next refueling outage or SG tube inspection.	7 days
	AND	
	A.2 Plug [or repair] the affected tube(s) in accordance with the Steam Generator Program.	Prior to entering MODE 4 following the next refueling outage or SG tube inspection
B. Required Action and associated Completion Time of Condition A not met. OR SG tube integrity not maintained.	B.1 Be in MODE 3.	6 hours
	AND	
	B.2 Be in MODE 5.	36 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.4.20.1	Verify SG tube integrity in accordance with the Steam Generator Program.	In accordance with the Steam Generator Program
SR 3.4.20.2	Verify that each inspected SG tube that satisfies the tube plugging [or repair] criteria is plugged [or repaired] in accordance with the Steam Generator Program.	Prior to entering MODE 4 following a SG tube inspection

5.5 Programs and Manuals

5.5.7 Reactor Coolant Pump Flywheel Inspection Program (continued)

--------------------------------------REVIEWER'S NOTE---------------------------------------
The inspection interval and scope for RCP flywheels stated above can be applied to plants that satisfy the requirements in WCAP-15666, "Extension of Reactor Coolant Pump Motor Flywheel Examination."

5.5.8 Inservice Testing Program

This program provides controls for inservice testing of ASME Code Class 1, 2, and 3 components. The program shall include the following:

a. Testing frequencies applicable to the ASME Code for Operations and Maintenance of Nuclear Power Plants (ASME OM Code) and applicable Addenda as follows:

ASME OM Code and applicable Addenda terminology for inservice testing activities	Required Frequencies for performing inservice testing activities
Weekly	At least once per 7 days
Monthly	At least once per 31 days
Quarterly or every 3 months	At least once per 92 days
Semiannually or every 6 months	At least once per 184 days
Every 9 months	At least once per 276 days
Yearly or annually	At least once per 366 days
Biennially or every 2 years	At least once per 731 days

b. The provisions of SR 3.0.2 are applicable to the above required Frequencies and other normal and accelerated Frequencies specified in the Inservice Testing Program for performing inservice testing activities,

c. The provisions of SR 3.0.3 are applicable to inservice testing activities, and

d. Nothing in the ASME OM Code shall be construed to supersede the requirements of any TS.

5.5 Programs and Manuals

5.5.9 Steam Generator (SG) Program

A Steam Generator Program shall be established and implemented to ensure that SG tube integrity is maintained. In addition, the Steam Generator Program shall include the following ~~provisions~~:

a. Provisions for condition monitoring assessments. Condition monitoring assessment means an evaluation of the "as found" condition of the tubing with respect to the performance criteria for structural integrity and accident induced leakage. The "as found" condition refers to the condition of the tubing during an SG inspection outage, as determined from the inservice inspection results or by other means, prior to the plugging [or repair] of tubes. Condition monitoring assessments shall be conducted during each outage during which the SG tubes are inspected, plugged, [or repaired] to confirm that the performance criteria are being met.

b. Performance criteria for SG tube integrity. SG tube integrity shall be maintained by meeting the performance criteria for tube structural integrity, accident induced leakage, and operational LEAKAGE.

   1. Structural integrity performance criterion: All in-service steam generator tubes shall retain structural integrity over the full range of normal operating conditions (including startup, operation in the power range, hot standby, and cool down), ~~and~~ all anticipated transients included in the design specification, ~~)~~ and design basis accidents. This includes retaining a safety factor of 3.0 against burst under normal steady state full power operation primary-to-secondary pressure differential and a safety factor of 1.4 against burst applied to the design basis accident primary-to-secondary pressure differentials. Apart from the above requirements, additional loading conditions associated with the design basis accidents, or combination of accidents in accordance with the design and licensing basis, shall also be evaluated to determine if the associated loads contribute significantly to burst or collapse. In the assessment of tube integrity, those loads that do significantly affect burst or collapse shall be determined and assessed in combination with the loads due to pressure with a safety factor of 1.2 on the combined primary loads and 1.0 on axial secondary loads.

   2. Accident induced leakage performance criterion: The primary to secondary accident induced leakage rate for any design basis accident, other than a SG tube rupture, shall not exceed the leakage rate assumed in the accident analysis in terms of total leakage rate for all SGs and leakage rate for an individual SG. Leakage is not to exceed [1 gpm] per SG [, except for specific types of degradation at specific locations as described in paragraph c of the Steam Generator Program].

5.5 Programs and Manuals

5.5.9 Steam Generator (SG) Program (continued)

3. The operational LEAKAGE performance criterion is specified in LCO 3.4.13, "RCS Operational LEAKAGE."

c. Provisions for SG tube plugging [or repair] criteria. Tubes found by inservice inspection to contain flaws with a depth equal to or exceeding [40%] of the nominal tube wall thickness shall be plugged [or repaired].

---------------------------------------REVIEWER'S NOTE--
Alternate tube plugging [or repair] criteria currently permitted by plant technical specifications are listed here. The description of these alternate tube plugging [or repair] criteria should be equivalent to the descriptions in current technical specifications and should also include any allowed accident induced leakage rates for specific types of degradation at specific locations associated with tube plugging [or repair] criteria.

[The following alternate tube plugging [or repair] criteria may be applied as an alternative to the 40% depth based criteria:

1. . . .]

d. Provisions for SG tube inspections. Periodic SG tube inspections shall be performed. The number and portions of the tubes inspected and methods of inspection shall be performed with the objective of detecting flaws of any type (e.g., volumetric flaws, axial and circumferential cracks) that may be present along the length of the tube, from the tube-to-tubesheet weld at the tube inlet to the tube-to-tubesheet weld at the tube outlet, and that may satisfy the applicable tube plugging [or repair] criteria. The tube-to-tubesheet weld is not part of the tube. In addition to meeting the requirements of d.1, d.2, and d.3 below, the inspection scope, inspection methods, and inspection intervals shall be such as to ensure that SG tube integrity is maintained until the next SG inspection. An ~~n assessment of~~ degradation assessment shall be performed to determine the type and location of flaws to which the tubes may be susceptible and, based on this assessment, to determine which inspection methods need to be employed and at what locations.

5.5 Programs and Manuals

5.5.9 Steam Generator (SG) Program (continued)

--------------------------------------REVIEWER'S NOTE---------------------------------------
Plants are to include the appropriate Frequency (e.g., select the appropriate Item 2.) for their SG design. The first Item 2 is applicable to SGs with Alloy 600 mill annealed tubing. The second Item 2 is applicable to SGs with Alloy 600 thermally treated tubing. The third Item 2 is applicable to SGs with Alloy 690 thermally treated tubing.
----

1. Inspect 100% of the tubes in each SG during the first refueling outage following SG installationreplacement.

[2. After the first refueling outage following SG installation, inspect each steam generator at least every 24 effective full power months or at least every refueling outage (whichever results in more frequent inspections). In addition, inspect 100% of the tubes at sequential periods of 60 effective full power months beginning after the first refueling outage inspection following SG installation. Each 60 effective full power month inspection period may be extended up to 3 effective full power months to include a SG inspection outage in an inspection period and the subsequent inspection period begins at the conclusion of the included SG inspection outage. If a degradation assessment indicates the potential for a type of degradation to occur at a location not previously inspected with a technique capable of detecting this type of degradation at this location and that may satisfy the applicable tube repair criteria, the minimum number of locations inspected with such a capable inspection technique during the remainder of the inspection period may be prorated. The fraction of locations to be inspected for this potential type of degradation at this location at the end of the inspection period shall be no less than the ratio of the number of times the SG is scheduled to be inspected in the inspection period after the determination that a new form of degradation could potentially be occurring at this location divided by the total number of times the SG is scheduled to be inspected in the inspection period. Inspect 100% of the tubes at sequential periods of 60 effective full power months. The first sequential period shall be considered to begin after the first inservice inspection of the SGs. No SG shall operate for more than 24 effective full power months or one refueling outage (whichever is less) without being inspected.]

[2. After the first refueling outage following SG installation, inspect each SG at least every 48 effective full power months or at least every other refueling outage (whichever results in more frequent inspections). In addition, the minimum number of tubes inspected at each scheduled inspection shall be the number of tubes in all SGs divided by the number of SG inspection outages scheduled in each inspection period as defined in a, b, and c below. If a degradation assessment indicates the potential for a type of degradation to occur at a location not previously inspected with a technique capable of detecting this type of degradation at this location and that may satisfy the applicable tube repair criteria, the minimum number of locations inspected with such a capable inspection technique during the remainder of the inspection period may be prorated. The fraction of locations to be inspected for this potential type of degradation at this location at the end of the inspection period shall be no less than the ratio of the number of times the SG is scheduled to be inspected in the inspection period after the determination that a new form of degradation could potentially be occurring at this location divided by the total number of times the SG is scheduled to be inspected in the inspection period. Each inspection period defined below may be extended up to 3 effective full power months to include a SG inspection outage in an inspection period and the subsequent inspection period begins at the conclusion of the included SG inspection outage.

----------------------------- Reviewer's Note -----------------------------------
A licensee may elect to retain historical and existing inspection period lengths in order to not revise those inspection periods.
----

a) After the first refueling outage following SG installation, inspect 100% of the tubes during the next 120 effective full power months. This constitutes the first inspection period;

b) During the next 96 effective full power months, inspect 100% of the tubes. This constitutes the second inspection period; and

c) During the remaining life of the SGs, inspect 100% of the tubes every 72 effective full power months. This constitutes the third and subsequent inspection periods.

~~Inspect 100% of the tubes at sequential periods of 120, 90, and, thereafter, 60 effective full power months. The first sequential period shall be considered to begin after the first inservice inspection of the SGs. In addition, inspect 50% of the tubes by the refueling outage nearest the midpoint of the period and the remaining 50% by the refueling outage nearest the end of the period. No SG shall operate for more than 48 effective full power months or two refueling outages (whichever is less) without being inspected.]~~

[2. After the first refueling outage following SG installation, inspect each SG at least every 72 effective full power months or at least every third refueling outage (whichever results in more frequent inspections). In addition, the minimum number of tubes inspected at each scheduled inspection shall be the number of tubes in all SGs divided by the number of SG inspection outages scheduled in each inspection period as defined in a, b, c and d below. If a degradation assessment indicates the potential for a type of degradation to occur at a location not previously inspected with a technique capable of detecting this type of degradation at this location and that may satisfy the applicable tube repair criteria, the minimum number of locations inspected with such a capable inspection technique during the remainder of the inspection period may be prorated. The fraction of locations to be inspected for this potential type of degradation at this location at the end of the inspection period shall be no less than the ratio of the number of times the SG is scheduled to be inspected in the inspection period after the determination that a new form of degradation could potentially be occurring at this location divided by the total number of times the SG is scheduled to be inspected in the inspection period. Each inspection period defined below may be extended up to 3 effective full power months to include a SG inspection outage in an inspection period and the subsequent inspection period begins at the conclusion of the included SG inspection outage.

----------------------------- Reviewer's Note -----------------------------------
A licensee may elect to retain historical and existing inspection period lengths in order to not revise those inspection periods.
----

a) After the first refueling outage following SG installation, inspect 100% of the tubes during the next 144 effective full power months. This constitutes the first inspection period;

b) During the next 120 effective full power months, inspect 100% of the tubes. This constitutes the second inspection period;

c) During the next 96 effective full power months, inspect 100% of the tubes. This constitutes the third inspection period; and

d) During the remaining life of the SGs, inspect 100% of the tubes every 72 effective full power months. This constitutes the fourth and subsequent inspection periods.

Inspect 100% of the tubes at sequential periods of 144, 108, 72, and, thereafter, 60 effective full power months. The first sequential period shall be considered to begin after the first inservice inspection of the SGs. In addition, inspect 50% of the tubes by the refueling outage nearest the midpoint of the period and the remaining 50% by the refueling outage nearest the end of the period. No SG shall operate for more than 72 effective full power months or three refueling outages (whichever is less) without being inspected.]

3. If crack indications are found in any SG tube, then the next inspection for each affected and potentially affected SG for the degradation mechanism that caused the crack indication shall not exceed 24 effective full power months or one refueling outage (whichever results in more frequent inspectionsis less). If definitive information, such as from examination of a pulled tube, diagnostic non-destructive testing, or engineering evaluation indicates that a crack-like indication

is not associated with a crack(s), then the indication need not be treated as a crack.

e. Provisions for monitoring operational primary to secondary LEAKAGE.

5.5.9 Steam Generator (SG) Program (continued)

[f. Provisions for SG tube repair methods. Steam generator tube repair methods shall provide the means to reestablish the RCS pressure boundary integrity of SG tubes without removing the tube from service. For the purposes of these Specifications, tube plugging is not a repair. All acceptable tube repair methods are listed below.

--------------------------------------REVIEWER'S NOTE---------------------------------------
Tube repair methods currently permitted by plant technical specifications are to be listed here. The description of these tube repair methods should be equivalent to the descriptions in current technical specifications. If there are no approved tube repair methods, this section should not be used.
----

1. . . .]

5.5.10 Secondary Water Chemistry Program

This program provides controls for monitoring secondary water chemistry to inhibit SG tube degradation and low pressure turbine disc stress corrosion cracking. The program shall include:

a. Identification of a sampling schedule for the critical variables and control points for these variables,

b. Identification of the procedures used to measure the values of the critical variables,

c. Identification of process sampling points, which shall include monitoring the discharge of the condensate pumps for evidence of condenser in leakage,

d. Procedures for the recording and management of data,

e. Procedures defining corrective actions for all off control point chemistry conditions, and

f. A procedure identifying the authority responsible for the interpretation of the data and the sequence and timing of administrative events, which is required to initiate corrective action.

5.6 Reporting Requirements

5.6.5 Post Accident Monitoring Report

When a report is required by Condition B or F of LCO 3.3.[3], "Post Accident Monitoring (PAM) Instrumentation," a report shall be submitted within the following 14 days. The report shall outline the preplanned alternate method of monitoring, the cause of the inoperability, and the plans and schedule for restoring the instrumentation channels of the Function to OPERABLE status.

5.6.6 [Tendon Surveillance Report

Any abnormal degradation of the containment structure detected during the tests required by the Pre-stressed Concrete Containment Tendon Surveillance Program shall be reported to the NRC within 30 days. The report shall include a description of the tendon condition, the condition of the concrete (especially at tendon anchorages), the inspection procedures, the tolerances on cracking, and the corrective action taken.]

5.6.7 Steam Generator Tube Inspection Report

A report shall be submitted within 180 days after the initial entry into MODE 4 following completion of an inspection performed in accordance with the Specification 5.5.9, "Steam Generator (SG) Program." The report shall include:

a. The scope of inspections performed on each SG,

b. ~~Active D~~Ddegradation mechanisms found,

c. Nondestructive examination techniques utilized for each degradation mechanism,

d. Location, orientation (if linear), and measured sizes (if available) of service induced indications,

e. Number of tubes plugged [or repaired] during the inspection outage for each ~~active~~ degradation mechanism,

f. The number and percentage of tubes plugged [or repaired] to date, and the effective plugging percentage in each steam generator~~Total number and percentage of tubes plugged [or repaired] to date~~,

g. The results of condition monitoring, including the results of tube pulls and in-situ testing,

~~[h. The effective plugging percentage for all plugging [and tube repairs] in each SG, and]~~

[h~~i~~. Repair method utilized and the number of tubes repaired by each repair method.]

BASES

APPLICABLE SAFETY ANALYSES

The steam generator tube rupture (SGTR) accident is the limiting design basis event for SG tubes and avoiding an SGTR is the basis for this Specification. The analysis of a SGTR event assumes a bounding primary to secondary LEAKAGE rate equal to the operational LEAKAGE rate limits in LCO 3.4.13, "RCS Operational LEAKAGE," plus the leakage rate associated with a double-ended rupture of a single tube. The accident analysis for a SGTR assumes the contaminated secondary fluid is only briefly released to the atmosphere via safety valves and the majority is discharged to the main condenser.

The analysis for design basis accidents and transients other than a SGTR assume the SG tubes retain their structural integrity (i.e., they are assumed not to rupture.) In these analyses, the steam discharge to the atmosphere is based on the total primary to secondary LEAKAGE from all SGs of [1 gallon per minute] or is assumed to increase to [1 gallon per minute] as a result of accident induced conditions. For accidents that do not involve fuel damage, the primary coolant activity level of DOSE EQUIVALENT I-131 is assumed to be equal to the LCO 3.4.16, "RCS Specific Activity," limits. For accidents that assume fuel damage, the primary coolant activity is a function of the amount of activity released from the damaged fuel. The dose consequences of these events are within the limits of GDC 19 (Ref. 2), 10 CFR 100 (Ref. 3) or the NRC approved licensing basis (e.g., a small fraction of these limits).

Steam generator tube integrity satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).

LCO

The LCO requires that SG tube integrity be maintained. The LCO also requires that all SG tubes that satisfy the plugging [or repair] criteria be plugged [or repaired] in accordance with the Steam Generator Program.

During an SG inspection, any inspected tube that satisfies the Steam Generator Program plugging [or repair] criteria is [repaired or] removed from service by plugging. If a tube was determined to satisfy the plugging [or repair] criteria but was not plugged [or repaired], the tube may still have tube integrity.

In the context of this Specification, a SG tube is defined as the entire length of the tube, including the tube wall [and any repairs made to it], between the tube-to-tubesheet weld at the tube inlet and the tube-to-tubesheet weld at the tube outlet. The tube-to-tubesheet weld is not considered part of the tube.

A SG tube has tube integrity when it satisfies the SG performance criteria. The SG performance criteria are defined in Specification 5.5.9, "Steam Generator Program," and describe acceptable SG tube performance. The Steam Generator Program also provides the evaluation process for determining conformance with the SG performance criteria.

BASES

LCO (continued)

The operational LEAKAGE performance criterion provides an observable indication of SG tube conditions during plant operation. The limit on operational LEAKAGE is contained in LCO 3.4.13, "RCS Operational LEAKAGE," and limits primary to secondary LEAKAGE through any one SG to 150 gallons per day. This limit is based on the assumption that a single crack leaking this amount would not propagate to a SGTR under the stress conditions of a LOCA or a main steam line break. If this amount of LEAKAGE is due to more than one crack, the cracks are very small, and the above assumption is conservative.

APPLICABILITY

Steam generator tube integrity is challenged when the pressure differential across the tubes is large. Large differential pressures across SG tubes can only be experienced in MODE 1, 2, 3, or 4.

RCS conditions are far less challenging in MODES 5 and 6 than during MODES 1, 2, 3, and 4. In MODES 5 and 6, primary to secondary differential pressure is low, resulting in lower stresses and reduced potential for LEAKAGE.

ACTIONS

The ACTIONS are modified by a Note clarifying that the Conditions may be entered independently for each SG tube. This is acceptable because the Required Actions provide appropriate compensatory actions for each affected SG tube. Complying with the Required Actions may allow for continued operation, and subsequent affected SG tubes are governed by subsequent Condition entry and application of associated Required Actions.

A.1 and A.2

Condition A applies if it is discovered that one or more SG tubes examined in an inservice inspection satisfy the tube plugging [or repair] criteria but were not plugged [or repaired] in accordance with the Steam Generator Program as required by SR 3.4.20.2. An evaluation of SG tube integrity of the affected tube(s) must be made. Steam generator tube integrity is based on meeting the SG performance criteria described in the Steam Generator Program. The SG plugging [or repair] criteria define limits on SG tube degradation that allow for flaw growth between inspections while still providing assurance that the SG performance criteria will continue to be met. In order to determine if a SG tube that should have been plugged [or repaired] has tube integrity, an evaluation must be completed that demonstrates that the SG performance criteria will continue to be met until the next refueling outage or SG tube inspection. The tube integrity

BASES

SURVEILLANCE REQUIREMENTS (continued)

The Steam Generator Program determines the scope of the inspection and the methods used to determine whether the tubes contain flaws satisfying the tube plugging [or repair] criteria. Inspection scope (i.e., which tubes or areas of tubing within the SG are to be inspected) is a function of existing and potential degradation locations. The Steam Generator Program also specifies the inspection methods to be used to find potential degradation. Inspection methods are a function of degradation morphology, non-destructive examination (NDE) technique capabilities, and inspection locations.

The Steam Generator Program defines the Frequency of SR 3.4.20.1. The Frequency is determined by the operational assessment and other limits in the SG examination guidelines (Ref. 6). The Steam Generator Program uses information on existing degradations and growth rates to determine an inspection Frequency that provides reasonable assurance that the tubing will meet the SG performance criteria at the next scheduled inspection. In addition, Specification 5.5.9 contains prescriptive requirements concerning inspection intervals to provide added assurance that the SG performance criteria will be met between scheduled inspections. If crack indications are found in any SG tube, the maximum inspection interval for all affected and potentially affected SGs is restricted by Specification 5.5.9 until subsequent inspections support extending the inspection interval.

SR 3.4.20.2

During an SG inspection, any inspected tube that satisfies the Steam Generator Program plugging [or repair] criteria is [repaired or] removed from service by plugging. The tube plugging [or repair] criteria delineated in Specification 5.5.9 are intended to ensure that tubes accepted for continued service satisfy the SG performance criteria with allowance for error in the flaw size measurement and for future flaw growth. In addition, the tube plugging [or repair] criteria, in conjunction with other elements of the Steam Generator Program, ensure that the SG performance criteria will continue to be met until the next inspection of the subject tube(s). Reference 1 provides guidance for performing operational assessments to verify that the tubes remaining in service will continue to meet the SG performance criteria.

[Steam generator tube repairs are only performed using approved repair methods as described in the Steam Generator Program.]

The Frequency of prior to entering MODE 4 following a SG inspection ensures that the Surveillance has been completed and all tubes meeting

the plugging [or repair] criteria are plugged [or repaired] prior to subjecting the SG tubes to significant primary to secondary pressure differential.

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.18 Steam Generator (SG) Tube Integrity

LCO 3.4.18 SG tube integrity shall be maintained.

AND

All SG tubes satisfying the tube plugging [or repair] criteria shall be plugged [or repaired] in accordance with the Steam Generator Program.

APPLICABILITY: MODES 1, 2, 3, and 4.

ACTIONS

---NOTE---
Separate Condition entry is allowed for each SG tube.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more SG tubes satisfying the tube plugging [or repair] criteria and not plugged [or repaired] in accordance with the Steam Generator Program.	A.1 Verify tube integrity of the affected tube(s) is maintained until the next refueling outage or SG tube inspection.	7 days
	AND	
	A.2 Plug [or repair] the affected tube(s) in accordance with the Steam Generator Program.	Prior to entering MODE 4 following the next refueling outage or SG tube inspection
B. Required Action and associated Completion Time of Condition A not met. OR SG tube integrity not maintained.	B.1 Be in MODE 3.	6 hours
	AND	
	B.2 Be in MODE 5.	36 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.4.18.1	Verify SG tube integrity in accordance with the Steam Generator Program.	In accordance with the Steam Generator Program
SR 3.4.18.2	Verify that each inspected SG tube that satisfies the tube plugging [or repair] criteria is plugged [or repaired] in accordance with the Steam Generator Program.	Prior to entering MODE 4 following a SG tube inspection

5.5 Programs and Manuals

5.5.8 Inservice Testing Program (continued)

ASME OM Code and applicable Addenda terminology for inservice testing activities	Required Frequencies for performing inservice testing activities
Weekly	At least once per 7 days
Monthly	At least once per 31 days
Quarterly or every 3 months	At least once per 92 days
Semiannually or every 6 months	At least once per 184 days
Every 9 months	At least once per 276 days
Yearly or annually	At least once per 366 days
Biennially or every 2 years	At least once per 731 days

b. The provisions of SR 3.0.2 are applicable to the above required Frequencies and other normal and accelerated Frequencies specified in the Inservice Testing Program for performing inservice testing activities,

c. The provisions of SR 3.0.3 are applicable to inservice testing activities, and

d. Nothing in the ASME OM Code shall be construed to supersede the requirements of any TS.

5.5.9 Steam Generator (SG) Program

A Steam Generator Program shall be established and implemented to ensure that SG tube integrity is maintained. In addition, the Steam Generator Program shall include the following ~~provisions~~:

a. Provisions for condition monitoring assessments. Condition monitoring assessment means an evaluation of the "as found" condition of the tubing with respect to the performance criteria for structural integrity and accident induced leakage. The "as found" condition refers to the condition of the tubing during an SG inspection outage, as determined from the inservice inspection results or by other means, prior to the plugging [or repair] of tubes. Condition monitoring assessments shall be conducted during each outage during which the SG tubes are inspected, plugged, [or repaired] to confirm that the performance criteria are being met.

b. Performance criteria for SG tube integrity. SG tube integrity shall be maintained by meeting the performance criteria for tube structural integrity, accident induced leakage, and operational LEAKAGE.

5.5 Programs and Manuals

5.5.9 Steam Generator (SG) Program (continued)

1. Structural integrity performance criterion: All in-service steam generator tubes shall retain structural integrity over the full range of normal operating conditions (including startup, operation in the power range, hot standby, and cool down), ~~and~~ all anticipated transients included in the design specification,~~)~~ and design basis accidents. This includes retaining a safety factor of 3.0 against burst under normal steady state full power operation primary-to-secondary pressure differential and a safety factor of 1.4 against burst applied to the design basis accident primary-to-secondary pressure differentials. Apart from the above requirements, additional loading conditions associated with the design basis accidents, or combination of accidents in accordance with the design and licensing basis, shall also be evaluated to determine if the associated loads contribute significantly to burst or collapse. In the assessment of tube integrity, those loads that do significantly affect burst or collapse shall be determined and assessed in combination with the loads due to pressure with a safety factor of 1.2 on the combined primary loads and 1.0 on axial secondary loads.

2. Accident induced leakage performance criterion: The primary to secondary accident induced leakage rate for any design basis accident, other than a SG tube rupture, shall not exceed the leakage rate assumed in the accident analysis in terms of total leakage rate for all SGs and leakage rate for an individual SG. Leakage is not to exceed [1 gpm] per SG [, except for specific types of degradation at specific locations as described in paragraph c of the Steam Generator Program.]

3. The operational LEAKAGE performance criterion is specified in LCO 3.4.13, "RCS Operational LEAKAGE."

c. Provisions for SG tube plugging [or repair] criteria. Tubes found by inservice inspection to contain flaws with a depth equal to or exceeding [40%] of the nominal tube wall thickness shall be plugged [or repaired].

---------------------------------------REVIEWER'S NOTE--
Alternate tube plugging [or repair] criteria currently permitted by plant technical specifications are listed here. The description of these alternate tube plugging [or repair] criteria should be equivalent to the descriptions in current technical specifications and should also include any allowed accident induced leakage rates for specific types of degradation at specific locations associated with tube plugging [or repair] criteria.

5.5 Programs and Manuals

5.5.9 Steam Generator (SG) Program (continued)

[The following alternate tube plugging [or repair] criteria may be applied as an alternative to the 40% depth based criteria:

1. . . .]

d. Provisions for SG tube inspections. Periodic SG tube inspections shall be performed. The number and portions of the tubes inspected and methods of inspection shall be performed with the objective of detecting flaws of any type (e.g., volumetric flaws, axial and circumferential cracks) that may be present along the length of the tube, from the tube-to-tubesheet weld at the tube inlet to the tube-to-tubesheet weld at the tube outlet, and that may satisfy the applicable tube plugging [or repair] criteria. The tube-to-tubesheet weld is not part of the tube. In addition to meeting the requirements of d.1, d.2, and d.3 below, the inspection scope, inspection methods, and inspection intervals shall be such as to ensure that SG tube integrity is maintained until the next SG inspection. An assessment of degradation assessment shall be performed to determine the type and location of flaws to which the tubes may be susceptible and, based on this assessment, to determine which inspection methods need to be employed and at what locations.

--------------------------------------REVIEWER'S NOTE--------------------------------------
Plants are to include the appropriate Frequency (e.g., select the appropriate Item 2.) for their SG design. The first Item 2 is applicable to SGs with Alloy 600 mill annealed tubing. The second Item 2 is applicable to SGs with Alloy 600 thermally treated tubing. The third Item 2 is applicable to SGs with Alloy 690 thermally treated tubing.
----

1. Inspect 100% of the tubes in each SG during the first refueling outage following SG installationreplacement.

[2. After the first refueling outage following SG installation, inspect each steam generator at least every 24 effective full power months or at least every refueling outage (whichever results in more frequent inspections). In addition, inspect 100% of the tubes at sequential periods of 60 effective full power months beginning after the first refueling outage inspection following SG installation. Each 60 effective full power month inspection period may be extended up to 3 effective full power months to include a SG inspection outage in an inspection period and the subsequent inspection period begins at the conclusion of the included SG inspection outage. If a degradation assessment indicates the potential for a type of degradation to occur at a location not previously inspected with a technique capable of detecting this type of degradation at this location and that may satisfy the applicable tube repair criteria, the minimum number of locations inspected with such a capable inspection technique during the remainder of the inspection period may be prorated. The fraction of locations to be inspected for this potential type of degradation at this location at the end of the inspection period shall be no less than the ratio of the number of times the SG is scheduled to be inspected in the inspection period after the determination that a new form of degradation could potentially be occurring at this location divided by the total number of times the SG is scheduled to be inspected in the inspection period. ~~Inspect 100% of the tubes at sequential periods of 60 effective full power months. The first sequential period shall be considered to begin after the first inservice inspection of the SGs. No SG shall operate for more than 24 effective full power months or one refueling outage (whichever is less) without being inspected.]~~

[2. After the first refueling outage following SG installation, inspect each SG at least every 48 effective full power months or at least every other refueling outage (whichever results in more frequent inspections). In addition, the minimum number of tubes inspected at each scheduled inspection shall be the number of tubes in all SGs divided by the number of SG inspection outages scheduled in each inspection period as defined in a, b, and c below. If a degradation assessment indicates the potential for a type of degradation to occur at a location not previously inspected with a technique capable of detecting this type of degradation at this location and that may satisfy the applicable tube repair criteria, the minimum number of locations inspected with such a capable inspection technique during the remainder of the inspection period may be prorated. The fraction of locations to be inspected for this potential type of degradation at this location at the end of the inspection period shall be no less than the ratio of the number of times the SG is scheduled to be inspected in the inspection period after the determination that a new form of degradation could potentially be occurring at this location divided by the total number of times the SG is scheduled to be inspected in the inspection period. Each inspection period defined below may be extended up to 3 effective full power months to include a SG inspection outage in an inspection period and the subsequent inspection period begins at the conclusion of the included SG inspection outage.

------------------------------- Reviewer's Note ----------------------------------
A licensee may elect to retain historical and existing inspection period lengths in order to not revise those inspection periods.
----

a) After the first refueling outage following SG installation, inspect 100% of the tubes during the next 120 effective full power months. This constitutes the first inspection period;

b) During the next 96 effective full power months, inspect 100% of the tubes. This constitutes the second inspection period; and

c) During the remaining life of the SGs, inspect 100% of the tubes every 72 effective full power months. This constitutes the third and subsequent inspection periods.

~~Inspect 100% of the tubes at sequential periods of 120, 90, and, thereafter, 60 effective full power months. The first sequential period shall be considered to begin after the first inservice inspection of the SGs. In addition, inspect 50% of the tubes by the refueling outage nearest the midpoint of the period and the remaining 50% by the refueling outage nearest the end of the period. No SG shall operate for more than 48 effective full power months or two refueling outages (whichever is less) without being inspected.]~~

5.5 Programs and Manuals

5.5.9 Steam Generator (SG) Program (continued)

[2. After the first refueling outage following SG installation, inspect each SG at least every 72 effective full power months or at least every third refueling outage (whichever results in more frequent inspections). In addition, the minimum number of tubes inspected at each scheduled inspection shall be the number of tubes in all SGs divided by the number of SG inspection outages scheduled in each inspection period as defined in a, b, c and d below. If a degradation assessment indicates the potential for a type of degradation to occur at a location not previously inspected with a technique capable of detecting this type of degradation at this location and that may satisfy the applicable tube repair criteria, the minimum number of locations inspected with such a capable inspection technique during the remainder of the inspection period may be prorated. The fraction of locations to be inspected for this potential type of degradation at this location at the end of the inspection period shall be no less than the ratio of the number of times the SG is scheduled to be inspected in the inspection period after the determination that a new form of degradation could potentially be occurring at this location divided by the total number of times the SG is scheduled to be inspected in the inspection period. Each inspection period defined below may be extended up to 3 effective full power months to include a SG inspection outage in an inspection period and the subsequent inspection period begins at the conclusion of the included SG inspection outage.

-------------------------------- Reviewer's Note ----------------------------------
A licensee may elect to retain historical and existing inspection period lengths in order to not revise those inspection periods.
----

a) After the first refueling outage following SG installation, inspect 100% of the tubes during the next 144 effective full power months. This constitutes the first inspection period;

b) During the next 120 effective full power months, inspect 100% of the tubes. This constitutes the second inspection period;

c) During the next 96 effective full power months, inspect 100% of the tubes. This constitutes the third inspection period; and

d) During the remaining life of the SGs, inspect 100% of the tubes every 72 effective full power months. This constitutes the fourth and subsequent inspection periods.

~~Inspect 100% of the tubes at sequential periods of 144, 108, 72, and, thereafter, 60 effective full power months. The first sequential period shall be considered to begin after the first inservice inspection of the~~

~~SGs. In addition, inspect 50% of the tubes by the refueling outage nearest the midpoint of the period and the remaining 50% by the refueling outage nearest the end of the period. No SG shall operate for more than 72 effective full power months or three refueling outages (whichever is less) without being inspected.]~~

3. If crack indications are found in any SG tube, then the next inspection for each affected and potentially affected SG for the degradation mechanism that caused the crack indication shall not exceed 24 effective full power months or one refueling outage (whichever results in more frequent inspections~~is less~~). If definitive information, such as from examination of a pulled tube, diagnostic non-destructive testing, or engineering evaluation indicates that a crack-like indication is not associated with a crack(s), then the indication need not be treated as a crack.

e. Provisions for monitoring operational primary to secondary LEAKAGE.

[f. Provisions for SG tube repair methods. Steam generator tube repair methods shall provide the means to reestablish the RCS pressure boundary integrity of SG tubes without removing the tube from service. For the purposes of these Specifications, tube plugging is not a repair. All acceptable tube repair methods are listed below.

-------------------------------------REVIEWER'S NOTE--------------------------------------
Tube repair methods currently permitted by plant technical specifications are to be listed here. The description of these tube repair methods should be equivalent to the descriptions in current technical specifications. If there are no approved tube repair methods, this section should not be used.
----

1. . . .]

5.5.10 Secondary Water Chemistry Program

This program provides controls for monitoring secondary water chemistry to inhibit SG tube degradation and low pressure turbine disc stress corrosion cracking. The program shall include:

a. Identification of a sampling schedule for the critical variables and control points for these variables, 5.6 Reporting Requirements

5.6.5 Post Accident Monitoring Report

When a report is required by Condition B or F of LCO 3.3.[11], "Post Accident Monitoring (PAM) Instrumentation," a report shall be submitted within the following 14 days. The report shall outline the preplanned alternate method of monitoring, the cause of the inoperability, and the plans and schedule for restoring the instrumentation channels of the Function to OPERABLE status.

5.6.6 Tendon Surveillance Report

[Any abnormal degradation of the containment structure detected during the tests required by the Pre-stressed Concrete Containment Tendon Surveillance Program shall be reported to the NRC within 30 days. The report shall include a description of the tendon condition, the condition of the concrete (especially at tendon anchorages), the inspection procedures, the tolerances on cracking, and the corrective action taken.]

5.6.7 Steam Generator Tube Inspection Report

A report shall be submitted within 180 days after the initial entry into MODE 4 following completion of an inspection performed in accordance with the Specification 5.5.9, "Steam Generator (SG) Program." The report shall include:

a. The scope of inspections performed on each SG,

b. ~~Active D~~Ddegradation mechanisms found,

c. Nondestructive examination techniques utilized for each degradation mechanism,

d. Location, orientation (if linear), and measured sizes (if available) of service induced indications,

e. Number of tubes plugged [or repaired] during the inspection outage for each ~~active~~ degradation mechanism,

f. The number and percentage of tubes plugged [or repaired] to date, and the effective plugging percentage in each steam generator~~Total number and percentage of tubes plugged [or repaired] to date~~,

g. The results of condition monitoring, including the results of tube pulls and in-situ testing,

~~[h. The effective plugging percentage for all plugging [and tube repairs] in each SG, and]~~

[h~~i~~. Repair method utilized and the number of tubes repaired by each repair method.]

BASES

APPLICABLE SAFETY ANALYSES

The steam generator tube rupture (SGTR) accident is the limiting design basis event for SG tubes and avoiding an SGTR is the basis for this Specification. The analysis of a SGTR event assumes a bounding primary to secondary LEAKAGE rate equal to the operational LEAKAGE rate limits in LCO 3.4.13, "RCS Operational LEAKAGE," plus the leakage rate associated with a double-ended rupture of a single tube. The accident analysis for a SGTR assumes the contaminated secondary fluid is only briefly released to the atmosphere via safety valves and the majority is discharged to the main condenser.

The analysis for design basis accidents and transients other than a SGTR assume the SG tubes retain their structural integrity (i.e., they are assumed not to rupture.) In these analyses, the steam discharge to the atmosphere is based on the total primary to secondary LEAKAGE from all SGs of [1 gallon per minute] or is assumed to increase to [1 gallon per minute] as a result of accident induced conditions. For accidents that do not involve fuel damage, the primary coolant activity level of DOSE EQUIVALENT I-131 is assumed to be equal to the LCO 3.4.16, "RCS Specific Activity," limits. For accidents that assume fuel damage, the primary coolant activity is a function of the amount of activity released from the damaged fuel. The dose consequences of these events are within the limits of GDC 19 (Ref. 2), 10 CFR 100 (Ref. 3) or the NRC approved licensing basis (e.g., a small fraction of these limits).

Steam generator tube integrity satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).

LCO

The LCO requires that SG tube integrity be maintained. The LCO also requires that all SG tubes that satisfy the plugging [or repair] criteria be plugged [or repaired] in accordance with the Steam Generator Program.

During an SG inspection, any inspected tube that satisfies the Steam Generator Program plugging [or repair] criteria is [repaired or] removed from service by plugging. If a tube was determined to satisfy the plugging [or repair criteria] but was not plugged [or repaired], the tube may still have tube integrity.

In the context of this Specification, a SG tube is defined as the entire length of the tube, including the tube wall [and any repairs made to it], between the tube-to-tubesheet weld at the tube inlet and the tube-to-tubesheet weld at the tube outlet. The tube-to-tubesheet weld is not considered part of the tube.

A SG tube has tube integrity when it satisfies the SG performance criteria. The SG performance criteria are defined in Specification 5.5.9, "Steam Generator Program," and describe acceptable SG tube performance. The Steam Generator Program also provides the evaluation process for determining conformance with the SG performance criteria.

BASES

LCO (continued)

The operational LEAKAGE performance criterion provides an observable indication of SG tube conditions during plant operation. The limit on operational LEAKAGE is contained in LCO 3.4.13, "RCS Operational LEAKAGE," and limits primary to secondary LEAKAGE through any one SG to 150 gallons per day. This limit is based on the assumption that a single crack leaking this amount would not propagate to a SGTR under the stress conditions of a LOCA or a main steam line break. If this amount of LEAKAGE is due to more than one crack, the cracks are very small, and the above assumption is conservative.

APPLICABILITY

Steam generator tube integrity is challenged when the pressure differential across the tubes is large. Large differential pressures across SG tubes can only be experienced in MODE 1, 2, 3, or 4.

RCS conditions are far less challenging in MODES 5 and 6 than during MODES 1, 2, 3, and 4. In MODES 5 and 6, primary to secondary differential pressure is low, resulting in lower stresses and reduced potential for LEAKAGE.

ACTIONS

The ACTIONS are modified by a Note clarifying that the Conditions may be entered independently for each SG tube. This is acceptable because the Required Actions provide appropriate compensatory actions for each affected SG tube. Complying with the Required Actions may allow for continued operation, and subsequent affected SG tubes are governed by subsequent Condition entry and application of associated Required Actions.

A.1 and A.2

Condition A applies if it is discovered that one or more SG tubes examined in an inservice inspection satisfy the tube plugging [or repair] criteria but were not plugged [or repaired] in accordance with the Steam Generator Program as required by SR 3.4.18.2. An evaluation of SG tube integrity of the affected tube(s) must be made. Steam generator tube integrity is based on meeting the SG performance criteria described in the Steam Generator Program. The SG plugging [or repair]criteria define limits on SG tube degradation that allow for flaw growth between inspections while still providing assurance that the SG performance criteria will continue to be met. In order to determine if a SG tube that should have been plugged [or repaired] has tube integrity, an evaluation must be completed that demonstrates that the SG performance criteria will continue to be met until the next refueling outage or SG tube inspection. The tube integrity

SURVEILLANCE REQUIREMENTS (continued)

The Steam Generator Program determines the scope of the inspection and the methods used to determine whether the tubes contain flaws satisfying the tube plugging [or repair] criteria. Inspection scope (i.e., which tubes or areas of tubing within the SG are to be inspected) is a function of existing and potential degradation locations. The Steam Generator Program also specifies the inspection methods to be used to find potential degradation. Inspection methods are a function of degradation morphology, non-destructive examination (NDE) technique capabilities, and inspection locations.

The Steam Generator Program defines the Frequency of SR 3.4.18.1. The Frequency is determined by the operational assessment and other limits in the SG examination guidelines (Ref. 6). The Steam Generator Program uses information on existing degradations and growth rates to determine an inspection Frequency that provides reasonable assurance that the tubing will meet the SG performance criteria at the next scheduled inspection. In addition, Specification 5.5.9 contains prescriptive requirements concerning inspection intervals to provide added assurance that the SG performance criteria will be met between scheduled inspections. If crack indications are found in any SG tube, the maximum inspection interval for all affected and potentially affected SGs is restricted by Specification 5.5.9 until subsequent inspections support extending the inspection interval.

SR 3.4.18.2

During an SG inspection, any inspected tube that satisfies the Steam Generator Program plugging [or repair] criteria is [repaired or] removed from service by plugging. The tube plugging [or repair] criteria delineated in Specification 5.5.9 are intended to ensure that tubes accepted for continued service satisfy the SG performance criteria with allowance for error in the flaw size measurement and for future flaw growth. In addition, the tube plugging [or repair] criteria, in conjunction with other elements of the Steam Generator Program, ensure that the SG performance criteria will continue to be met until the next inspection of the subject tube(s). Reference 1 provides guidance for performing operational assessments to verify that the tubes remaining in service will continue to meet the SG performance criteria.

[Steam generator tube repairs are only performed using approved repair methods as described in the Steam Generator Program.]

The Frequency of prior to entering MODE 4 following a SG inspection ensures that the Surveillance has been completed and all tubes meeting

the plugging [or repair] criteria are plugged [or repaired] prior to subjecting the SG tubes to significant primary to secondary pressure differential.

Attachment 1

Model Application for Adoption of TSTF-510

[DATE] 10 CFR 50.90

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

SUBJECT: PLANT NAME
DOCKET NO. 50-[xxx]
Application to Revise Technical Specifications to Adopt TSTF-510, "Revision to Steam Generator Program Inspection Frequencies and Tube Sample Selection," Using The Consolidated Line Item Improvement Process

Dear Sir or Madam:

Pursuant to 10 CFR 50.90, [LICENSEE] is submitting a request for an amendment to the Technical Specifications (TS) for [PLANT NAME, UNIT NOS.].

The proposed amendment would modify TS requirements regarding steam generator tube inspections and reporting as described in TSTF-510, Revision 2, "Revision to Steam Generator Program Inspection Frequencies and Tube Sample Selection."

Attachment 1 provides a description and assessment of the proposed changes, the requested confirmation of applicability, and plant-specific verifications. Attachment 2 provides the existing TS pages marked up to show the proposed changes. [Attachment 3 provides revised (clean) TS pages.] Attachment [4] provides existing TS Bases pages marked up to show the proposed changes.

Approval of the proposed amendment is requested by [date]. Once approved, the amendment shall be implemented within [ ] days.

In accordance with 10 CFR 50.91, a copy of this application, with attachments, is being provided to the designated [STATE] Official.

[In accordance with 10 CFR 50.30(b), a license amendment request must be executed in a signed original under oath or affirmation. This can be accomplished by attaching a notarized affidavit confirming the signature authority of the signatory, or by including the following statement in the cover letter: "I declare under penalty of perjury that the foregoing is true and correct. Executed on (date)." The alternative statement is pursuant to 28 USC 1746. It does not require notarization.]

If you should have any questions regarding this submittal, please contact [NAME, TELEPHONE NUMBER].

Sincerely,

[Name, Title]

Attachments:
1. Description and Assessment
2. Proposed Technical Specification Changes (Mark-Up)
3. Revised Technical Specification Pages
4. Proposed Technical Specification Bases Changes (Mark-Up)

cc: NRC Project Manager
NRC Regional Office
NRC Resident Inspector
State Contact

ATTACHMENT 1 - DESCRIPTION AND ASSESSMENT

1.0 DESCRIPTION

The proposed change revises Specification 5.5.9, "Steam Generator (SG) Program" and 5.6.7, "Steam Generator Tube Inspection Report." The proposed changes are needed to address implementation issues associated with the inspection periods, and address other administrative changes and clarifications.

The proposed amendment is consistent with TSTF-510, Revision 2, "Revision to Steam Generator Program Inspection Frequencies and Tube Sample Selection."

2.0 ASSESSMENT

2.1 Applicability of Published Safety Evaluation

[LICENSEE] has reviewed TSTF-510, Revision 2, "Revision to Steam Generator Program Inspection Frequencies and Tube Sample Selection," and the model safety evaluation dated [DATE] as part of the Federal Register Notice for Comment. [As described in the subsequent paragraphs,][LICENSEE] has concluded that the justifications presented in TSTF-510 and the model safety evaluation prepared by the NRC staff are applicable to [PLANT, UNIT NOS.] and justify this amendment for the incorporation of the changes to the [PLANT] TS.

2.2 Optional Changes and Variations

[LICENSEE is not proposing any variations or deviations from the TS changes described in the TSTF-510, Revision 2, or the applicable parts of the NRC staff's model safety evaluation dated [DATE].] [LICENSEE is proposing the following variations from the TS changes described in the TSTF-510, Revision 2, or the applicable parts of the NRC staff's model safety evaluation dated [DATE].]

[The [PLANT] TS utilize different [numbering][and][titles] than the Standard Technical Specifications on which TSTF-510 was based. Specifically, [describe differences between the plant-specific TS numbering and/or titles and the TSTF-510 numbering and titles.] These differences are administrative and do not affect the applicability of TSTF-510 to the [PLANT] TS.]

3.0 REGULATORY ANALYSIS

3.1 No Significant Hazards Consideration Determination

[PLANT NAME, UNIT NOS.] requests adoption of an approved change to the standard technical specifications (STS) into the plant specific technical specifications (TS), to revise the Specification 5.5.9, "Steam Generator (SG) Program," 5.6.7, "Steam Generator Tube

Inspection Report," and LCO [3.4.20], "Steam Generator Tube Integrity," to address inspection periods and other administrative changes and clarifications.

As required by 10 CFR 50.91(a), an analysis of the issue of no significant hazards consideration is presented below:

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

   Response: No.

   The proposed change revises the Steam Generator (SG) Program to modify the frequency of verification of SG tube integrity and SG tube sample selection. A steam generator tube rupture (SGTR) event is one of the design basis accidents that are analyzed as part of a plant's licensing basis. The proposed SG tube inspection frequency and sample selection criteria will continue to ensure that the SG tubes are inspected such that the probability of a SGTR is not increased. The consequences of a SGTR are bounded by the conservative assumptions in the design basis accident analysis. The proposed change will not cause the consequences of a SGTR to exceed those assumptions. Therefore, it is concluded that this change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

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

   Response: No.

   The proposed changes to the Steam Generator Program will not introduce any adverse changes to the plant design basis or postulated accidents resulting from potential tube degradation. The proposed change does not affect the design of the SGs or their method of operation. In addition, the proposed change does not impact any other plant system or component.

   Therefore, it is concluded that this change does not create the possibility of a new or different kind of accident from any accident previously evaluated.

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

   Response: No.

   The SG tubes in pressurized water reactors are an integral part of the reactor coolant pressure boundary and, as such, are relied upon to maintain the primary system's pressure and inventory. As part of the reactor coolant pressure boundary, the SG tubes are unique in that they are also relied upon as a heat transfer surface between the primary and secondary systems such that residual heat can be removed from the primary system. In addition, the SG tubes also isolate the radioactive fission products in the primary coolant from the secondary system. In summary, the safety function of a SG is maintained by ensuring the integrity of its tubes.

Steam generator tube integrity is a function of the design, environment, and the physical condition of the tube. The proposed change does not affect tube design or operating environment. The proposed change will continue to require monitoring of the physical condition of the SG tubes such that there will not be a reduction in the margin of safety compared to the current requirements.

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

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

4.0 ENVIRONMENTAL EVALUATION

The proposed change would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, or would change an inspection or surveillance requirement. However, the proposed change does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed change meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed change.