NUCLEAR ENERGY INSTITUTE

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September 9, 2005

Dr. Brian W. Sheron
Associate Director, Project Licensing and Technical Analysis
U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: NEI 97-06, *Steam Generator Program Guidelines*, Revision 2

PROJECT NUMBER: 689

Dear Dr. Sheron:

Revision 1 of NEI 97-06 *Steam Generator Program Guidelines* was issued in January of 2001. Since that time, NEI has worked with the NRC to resolve comments on our steam generator program requirements and to develop a Generic License Change Package (GLCP) addressing the regulatory aspects of program implementation. The steam generator program GLCP was approved in the form of TSTF-449 revision 4 earlier this year. NEI 97-06 revision 2 is consistent with TSTF-449 revision 4 and also incorporates additional changes developed by the industry as part of our continuing effort to improve steam generator program guidance. The purpose of this letter is to transmit Revision 2 to you for your information.

NEI 97-06 revision 2 was approved by the Nuclear Strategic Issues Advisory Committee (NSIAC) on August 18, 2005. Implementation of NEI 97-06 Revision 2 must be completed by March 2, 2006.

A list of changes included in revision 2 appears in the revision summary at the front of the document. The most significant changes are described in Enclosure 1.

Revision 2 also contains a number of open references. The open references result from text within NEI 97-06 that point to information that will be contained in several of the EPRI Steam Generator Program guidelines in their next revision. This situation is intentional. The EPRI Steam Generator Examination Guideline and the Integrity Assessment Guideline revisions are in process, but will not be complete for several months. Since NEI 97-06 revision 1 and the GLCP are not

consistent, and since many plants are submitting requests for licensing amendments to adopt the GLCP, it was important to publish revision 2 of NEI 97-06 as soon as possible; not waiting for the guideline revisions. Enclosure 2 contains a description of these open references. The EPRI SGMP will issue interim guidance on these subjects in the near future.

A copy of Revision 2 to NEI 97-06 is provided as Enclosure 3.

If you have any questions regarding these matters, please contact me (202-739-8080; am@nei.org) or Jim Riley (202-739-8137; jhr@nei.org).

Sincerely,

Alexander Marion

Enclosures

c: Mr. Michael E. Mayfield, U. S. Nuclear Regulatory Commission
Mr. William H. Bateman, U. S. Nuclear Regulatory Commission
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Mr. Emmett L. Murphy, U. S. Nuclear Regulatory Commission

Revision 1 Changes

- "Mandatory" and "Shall" Elements — The "Mandatory" and "Shall" elements of NEI 97-06, as defined by NEI 03-08, *Guideline for the Management of Materials Issues*, and the SGMP Administrative Procedures, have been identified within the text of the document and listed in section 4. The following convention has been used:
  - "Mandatory" elements are preceded with the words "It is mandatory that".
  - "Shall" elements are denoted by the word "shall".
  - Recommendations are preceded by the words "It is recommended that".

- Reference to the New Steam Generator Program Technical Specifications — Appropriate text was added to clearly show that NEI 97-06 defines the Steam Generator Program referred to in TSTF-449.

- NEI 03-08 — Reference to NEI 03-08 and the industry's "Materials Initiative" was added.

- Structural Integrity Performance Criteria — The structural integrity performance criterion (SIPC) was changed to address the effect of bending loads on structural integrity and to allow for the possibility of a collapse mode of tube failure. The revised SIPC was introduced to the industry in a January 17, 2005 SGMP interim guidance letter.

- Accident Induced Leakage Performance Criteria — The accident-induced leakage criterion now states that leakage is to be assessed for "any design basis accident" as opposed to "the limiting design basis accident". This change was made to address a possible misinterpretation of the criterion and is not substantive as it reflects the current accepted approach to integrity assessments.

  In addition, specific reference to the administrative technical specifications for approved alternate repair criteria was added in place of the general reference to the plant licensing basis that was in the revision 1 version of the accident induced leakage performance criterion. This change reflects the technical specification version of the criterion and list of approved alternate repair criteria.

- Integrity versus Support Elements — NEI 97-06, Revision 2 was reorganized to remove the distinction between Steam Generator Program "Integrity Elements" and "Support Elements." This distinction was made in revision 1 to delineate the sections of the document that were NRC

commitments as referenced in the GLCP cover letter. The GLCP cover letter was eventually changed to remove this approach, so the distinction is no longer necessary.

- Requirement for Justifying Deviations — Guidance for justifying deviations from NEI 97-06 and its referenced EPRI Guidelines was removed from NEI 97-06. The guidance is now included in Section 2 of the EPRI SGMP Administrative Procedures.

- Reporting Requirements — The NRC reporting requirements were changed to establish consistency with TSTF-449. Note that NEI 97-06 revision 2 states that the reporting requirements embodied within TSTF-449 are expected to be followed in addition to your plant's existing technical specification reporting requirements.

  The section on external, non-regulatory, reports has been expanded. This additional information is necessary to ensure good communication of operating experience within the industry.

- Integrity Assessment Details — Some of the detailed guidance in the integrity assessment section (3.3) was removed; instead revision 2 references the appropriate EPRI steam generator guidelines. The same approach is used in the Degradation Assessment and Inspection sections (3.1 and 3.2). This change reflects the fact that the referenced guidelines are more mature than was the case at the time of NEI 97-06 revision 1 and are the proper repositories for this information.

- Management Expectations — A paragraph on management expectations regarding steam generator program implementation was added to section 1.3.

- Contractor Oversight — A section on expectations for Contractor Oversight (3.10) has been added.

- Definitions — Several definitions were changed to address comments or to clarify their meaning. The changes include the definitions of Collapse, Repair Methods, Significant Loads, Primary and Secondary Stress.

NEI 97-06 Revision 2 Open References

Section	NEI 97-06 Change	Document	Comment
3.1	Degradation Assessments: EPRI *Steam Generator Integrity Assessment Guidelines* [6] and EPRI *PWR Steam Generator Examination Guidelines* [2] provide guidance for Degradation Assessments.	IA G/L, Exam G/L	While not as complete as the next revision will be, Chapter 3 of the Integrity Assessment Guidelines, Revision 1 provides guidance for performing Degradation Assessments. Revision 6 of the Examination Guidelines, Section 5.2 provides additional guidance.
3.3	Integrity Assessment: "The EPRI *Steam Generator Integrity Assessment Guidelines* [6] shall be used to determine the evaluation methods, margins, and uncertainty considerations used to evaluate tube integrity."	IA GL	Revision 1 of the Integrity Assessment Guidelines, Chapters 8 and 9 provide guidance on methods and uncertainty considerations. The safety margins and performance criteria have been revised by TSTF 449 and NEI 97-06 Rev. 2. These new margins and performance criteria shall apply to future assessments.
3.3	Integrity Assessment: Section 3.1.3 in rev 1 used to require that licensees complete an Operational Assessment (OA) within 90 days of startup. This was removed from 97-06 with the intention of including the requirement in the IA G/L. In general, the old section 3.1.3 was reduced with the intention of adding the details that were removed to the IA guideline.	IA G/L	The Integrity Guidelines Revision 1 Chapter 1.5 states, *"The results of operational assessment determine the allowable run time for the upcoming period."* In addition, Chapter 1.6 has a requirement to perform a preliminary OA, *"A preliminary operational assessment (see Chapter 9) is performed before startup by factoring the degradation growth rate into integrity and leakage analysis."* The preliminary OA establishes a safe run time with available information until such time as the final OA can establish the final run time with all necessary information.

Section	NEI 97-06 Change	Document	Comment
			SGMP will issue interim guidance maintaining the requirements on OA timing originally contained in NEI 97-06 rev 1. Revision 2 of the Integrity Assessment guidelines will also provide guidance on this item.
3.6	Secondary side integrity: "Additional guidance is provided in the EPRI *Steam Generator Integrity Assessment Guidelines.*" Provide additional guidance on maintenance of SG secondary side integrity in the IA G/L	IA G/L	NEI 97-06, Revision 2 discusses maintenance of SG secondary-side integrity and states that additional guidance is provided in the Integrity Guidelines. Chapter 1.5 of the Integrity Guidelines, Revision 1 states that integrity assessments include, *"all steam generator components which are part of the primary pressure boundary (e.g., tubing, tube plugs, sleeves and other repairs). It also includes loose parts and secondary side structural supports (e.g., tube support plates) that may, if severely degraded in some manner, compromise pressure retaining components of the steam generator."* Chapter 3.3 states, *"To provide appropriate outage planning, approximately three months prior to an anticipated refueling outage in which steam generators will be inspected, previously identified and potential degradation forms on both the secondary and primary sides of the steam generator that affect tubing, support structures, pressure and leak*

Section	NEI 97-06 Change	Document	Comment
			boundaries should be identified as to location and possible extent." Revision 2 of the Integrity Assessment Guidelines will provide additional guidance; however, until this revision is published, the Examination Guidelines provide a list of considerations while performing assessment on the secondary side. A May 24, 2005 INPO letter on steam generator tube damage from loose parts provides additional suggestions for inclusion into these assessments.
3.9.1	Loose parts and foreign objects: "A record of these evaluations (secondary side inspections) shall be maintained in accordance with the provisions in the *PWR Steam Generator Examination Guidelines [2]."* ... "Additional guidance on secondary side inspections is provided in the *PWR Steam Generator Examination Guidelines [2]."* In general, during the development of the GLCP industry promised the NRC that it would enhance our guidance on inspecting for loose parts. Loose parts were seen as	Exam G/L	NEI 97-06, Revision 2 states that foreign objects left in the SG should be evaluated to show that they will not cause unacceptable tube damage and that the evaluation shall be maintained in accordance with the SG Examination Guidelines. Revision 6 of the SG Examination Guidelines provides some guidance on the evaluation of objects left in the SG in sections 3.8 and 6.10.3. In addition, future revision to the Integrity Guidelines should include relevant information.

Section	NEI 97-06 Change	Document	Comment
	the potential downfall of extended inspection intervals.		
3.10	Contractor oversight: "Additional guidance on contractor oversight can be found in the EPRI steam generator guidelines that govern the activity."	IA G/L, Exam G/L, In Situ G/L	NEI 97-06, Revision 2 discusses contractor oversight and states that additional guidance on contractor oversight can be found in the EPRI SG guidelines that govern the activity. In general, the utility engineer is responsible for integrity assessments. While this work may be contracted out, the utility engineer shall be knowledgeable enough to ensure that inputs and conclusions are correct. The SG Examination Guidelines include additional guidance in section 6.9. Integrity Guidelines Revision 2 will provide this guidance.
3.12.2.2	External reporting requirements: "Detailed reporting requirements [to the SGMP] are contained in the governing EPRI SGMP guidelines."	All SG G/L are affected	There is no list of reporting requirements detailed in Integrity Guidelines Revision 1; however, reporting requirements that are not contained in NEI 97-06 and are required by the Integrity Guidelines are contained within its Chapters (i.e., DA, CM, OA). Revision 2 will have a more complete listing of all external reporting requirements. Revision 6 of the SG Exam Guidelines contains information in section 2.3.

Section	NEI 97-06 Change	Document	Comment
App B	Definitions: A number of definitions were developed or changed during the development of the GLCP, namely: Collapse, Normal Steady State Full Power Operation, Primary Stress, Repair Methods, Secondary Stress, and Significant Loads. These need to be incorporated into the appropriate guidelines.	IA G/L	These definitions will be included in the Integrity Assessment Guidelines. Meanwhile, the definitions are located in NEI 97-06 and TSTF 449.

NEI 97-06 [Rev 2]

Steam Generator Program Guidelines

May 2005

NEI 97-06 [Rev 2]

Nuclear Energy Institute

Steam Generator Program Guidelines

May 2005

Nuclear Energy Institute, 1776 I Street N. W., Suite 400, Washington D.C. (202.739.8000)

ACKNOWLEDGEMENTS

The Nuclear Energy Institute (NEI) Steam Generator Task Force developed the *Steam Generator Program Guideline* with oversight provided by the NEI Steam Generator Issues Working Group and the Steam Generator Management Project Issues Integration Group (IIG). We appreciate those industry contributors who reviewed and commented on this document to improve its technical content and its clarity.

NEI also wishes to thank EPRI. EPRI, through the Steam Generator Management Project, developed the steam generator guidelines referenced in this document.

NOTICE

REVISION SUMMARY

Revision	Description of Changes
0	Initial issue
1	Most significant changes: • Removed the term "Directive Guidelines" • Reorganized to differentiate between Steam Generator Program "Integrity Elements" and "Support Elements" • Added guidance for justifying deviations from NEI 97-06 and its referenced EPRI Guidelines added • Changes made to the guideline revision protocol including approval, industry notification and the role of the NEI Review Board. • Changed the structural integrity and accident induced leakage performance criterion. • Changed and clarified the NRC reporting requirements • Added definitions for Burst, Normal Full Power Operations, Limiting Design Basis Accident and Steam Generator Tubing.
2	Most significant changes: • Defined and listed the "Mandatory" and "Shall" requirements. • Changed the structural integrity and accident induced leakage performance criterion. • Added references to the new generic SG technical specifications (TSTF-449) • Removed the distinction between Steam Generator Program "Integrity Elements" and "Support Elements" • Delineated management responsibilities for the Steam Generator Program • Reduced the detail in the Degradation Assessment and Integrity Assessment sections and referenced the governing EPRI Guidelines • Added a section on Contractor Oversight • Added information on the NSIAC SG and Materials Initiatives • Removed guidance for justifying deviations from NEI 97-06 and its referenced EPRI Guidelines. Now included in SGMP Administrative Procedures. • Revised the NRC reporting requirements to be consistent with existing licensee technical specifications and the new generic SG technical specifications (TSTF-449) • Expanded industry reporting requirements • Added definitions for Collapse, Repair Methods, and Significant Loads and revised the definitions of Primary and Secondary Stress • Reorganized and moved sections 3.7 through 3.12

EXECUTIVE SUMMARY

NEI 97-06 establishes a framework for structuring and strengthening existing Steam Generator Programs. It provides the fundamental elements expected to be included in a Steam Generator Program. These elements incorporate a balance of prevention, inspection, evaluation, repair and leakage monitoring measures.

NEI 97-06 and its referenced EPRI guidelines are the documents that define "The Steam Generator Program" referred to in steam generator technical specifications that implement TSTF-449 [16]. Licensees are expected to change their technical specifications consistent with NEI 97-06 and its associated regulatory framework in TSTF-449.

This document contains "mandatory" and "shall" requirements as established in the *SGMP Administrative Procedures* [11] (consistent with the industry's Materials Initiative as defined in NEI 03-08, *Management of Materials Issues [14]*). A summary of these requirements is provided in Section 4.

This guideline refers licensees to EPRI Steam Generator guidelines for the detailed development of these programmatic attributes. EPRI will maintain these guidelines through the Steam Generator Management Project consensus process.

The intent of this document is to bring consistency in application of industry guidelines relative to managing Steam Generator Programs. This document and those it references recognize the need for flexibility within each plant-specific program to adjust for the degree of degradation experienced and expected improvements in techniques for managing tube degradation.

Section 1, "Introduction", provides a background, discusses regulatory interface, licensee responsibilities, and the EPRI steam generator guidelines.

Section 2, "Performance Criteria", defines the performance criteria that licensees use to measure tube integrity. Meeting the performance criteria provides reasonable assurance that the steam generator tubing remains capable of fulfilling its intended safety function of maintaining RCPB integrity.

Section 3, "Steam Generator Program", discusses the program elements and implementing guidance for strengthening existing Steam Generator Programs.

Section 4, "Summary of Steam Generator Program Requirements", summarizes the "mandatory" and "shall" elements contained within NEI 97-06.

TABLE OF CONTENTS

STEAM GENERATOR PROGRAM GUIDELINES

1 INTRODUCTION

1.1 PURPOSE

The purpose of this document is to establish the framework for the Steam Generator Program. The framework offered in this document incorporates a balance of prevention, inspection, evaluation, repair and leakage monitoring measures. Additionally, this document establishes performance criteria that define steam generator tube integrity and that can be used under the Maintenance Rule.

This document contains "mandatory" and "shall" requirements as defined in the EPRI *Steam Generator Management Program Administrative Procedures* [11]. These requirements are summarized in Section 4.0.

NEI 97-06 is the subject of the industry's Steam Generator Initiative and is also consistent with the intent of the industry's Materials Initiative as defined in NEI 03-08, *Management of Materials Issues* [14]. It is mandatory that every PWR licensee revise its Steam Generator Program consistent with NEI 97-06 Revision 2.

In addition, every licensee shall change its technical specifications consistent with NEI 97-06 and its associated regulatory framework in TSTF-449. NEI 97-06 and its referenced EPRI guidelines are the documents that define The Steam Generator Program referred to in steam generator technical specifications that implement TSTF-449.

1.2 BACKGROUND

The program elements described in this document are evidence of the nuclear industry's commitment to safe and reliable steam generator operation. These elements focus on issues relative to the management and repair of steam generator tubing. For more than two decades, the industry has expended considerable resources developing guidance on structuring Steam Generator Programs to meet the challenges posed by tube degradation.

Chemistry control is an example of the industry's commitment to the resolution and management of steam generator degradation. By the mid-1970s, licensees were plugging tubes at a rate that would exceed steam generator 40-year-life design margins. The dominant damage form at that time was tube wastage. The industry corrected this by changing to an all-volatile water chemistry control. This, however, resulted in conditions conducive to corrosion of the carbon steel support plates, which led to tubing deformation as a result of denting and cracking with the same unacceptable rate of tube plugging. The industry, working through EPRI, met these challenges by implementing Steam Generator Programs with aggressive improvements in control

of secondary-side water chemistry and upgrades in secondary-side equipment, thus essentially eliminating both wastage and denting. The industry incorporated these successful programmatic strategies in the EPRI *Secondary Water Chemistry Guidelines* and associated supporting documents. These chemistry guidelines have proven to be the cornerstone of the industry's effort to maintain acceptable steam generator performance.

Over time, the industry's Steam Generator Programs have matured to include improvements in programmatic features, such as non-destructive examination, primary-to-secondary leakage monitoring, and degradation-specific management. These and other program elements have been incorporated into a series of EPRI Steam Generator Program Guidelines. Building on the collective expertise of the industry, the EPRI Steam Generator Management Project (SGMP) oversees the maintenance of these guidelines to incorporate technological and programmatic improvements.

Recognizing the importance of steam generators on safe plant operations, NEI 97-06 was developed as a framework for a comprehensive Steam Generator Program that used the EPRI SGMP Guidelines as its technical foundation. The NEI Nuclear Strategic Issues Advisory Committee (NSIAC) used NEI 97-06 as the basis of the following industry initiative on Steam Generator Programs, which was approved on December 16, 1997 [15].

> *"Each licensee will evaluate its existing Steam Generator Program and, where necessary, revise and strengthen program attributes to meet the intent of the guidance provided in NEI 97-06, Steam Generator Program Guidelines, no later than the first refueling outage starting after January 1, 1999."*

In accordance with the NSIAC charter, each NEI member company PWR licensee is committed to adopt this initiative.

1.3 LICENSEE RESPONSIBILITIES

It is mandatory that each PWR licensee adopt the performance criteria contained in Section 2. The performance criteria are (1) Structural Integrity, (2) Accident-Induced Leakage and (3) Operational Leakage. Further, it is mandatory that each PWR licensee evaluate its existing program elements against those described in Section 3 and revise and strengthen its program, where necessary, to meet the intent of this document and the referenced EPRI guidelines.

When NEI 97-06 is revised, NEI shall distribute the new document to its members. The NEI transmittal letter shall state the date by which implementation of the revision is required and the importance ("mandatory" or "needed") of completing the implementation by the date specified. The NEI 97-06 document, or transmittal letter, shall also provide a listing of sections that have been revised along with the technical basis for the revision.

Revision 2 of NEI 97-06 incorporates the improvements identified during the development of the Steam Generator Generic License Change Package and the resolution of technical issues raised by the NRC since the issuance of Revision 0. It is mandatory that every PWR licensee revise its

Steam Generator Program consistent with NEI 97-06 Revision 2. In addition, every licensee shall change its technical specifications consistent with NEI 97-06 and its associated regulatory framework in TSTF-449. Each licensee shall ensure that existing regulatory requirements are met during implementation of NEI 97-06.

Nuclear station management is responsible for providing sufficient resources for implementation of a Steam Generator Program. Specific management responsibilities shall consider the following:

- Establish and support a utility-managed steam generator management committee that addresses the following functional areas: chemistry, ISI/NDE, engineering, quality assurance, planning, health physics, operations, outage management, and maintenance.
- Develop a knowledgeable steam generator organization with sufficient responsibility, authority, and resources to implement the Steam Generator Program.
- Support continuity of personnel within the steam generator organization.
- Encourage initiative and long-term outlook, with respect to problem solving, within the steam generator engineering organization.
- Support frequent and open interchange of experience and technology with other utilities, nuclear steam supply system (NSSS) vendors, examination vendors, and appropriate industry issue programs, research, and regulatory organizations.
- Establish coordination interfaces between design organizations and the steam generator organization to ensure that plant modifications do not unduly hinder SG NDE and repair efforts.

1.4 REGULATORY REQUIREMENTS

The following section addresses NRC requirements that licensees consider in the development and implementation of the plant-specific Steam Generator Program.

1.4.1 10 CFR Part 50 Appendix A, *General Design Criteria for Nuclear Power Plants, and Appendix B, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants.*

General Design Criteria (GDC) 1, 2, 4, 14, 30, 31 and 32 of 10 CFR Part 50, Appendix A, define requirements for the reactor coolant pressure boundary (RCPB) with respect to structural and leakage integrity. Steam generator tubing and tube repairs constitute a major fraction of the RCPB 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.

General Design Criteria (GDC) 19 of 10 CFR Part 50, Appendix A, defines requirements for the control room and for the radiation protection of the operators working within it. Accidents involving the leakage or burst of steam generator tubing comprise a challenge to the habitability of the control room. Steam generator tubing and associated repair techniques and components, such as plugs and sleeves, must be capable of maintaining reactor coolant inventory and pressure in order to prevent excessive leakage and the resulting radiation doses to the control room operator.

Nuclear power plants licensed to operate prior to the effective date of 10 CFR 50, Appendix A (1971) are committed to the Proposed Appendix A to 10 CFR 50, General Design Criteria for Nuclear Power Plants, published in the Federal Register on July 11, 1967, which is similar to 10 CFR 50, Appendix A. Plant specific commitments to the Draft General Design Criteria are defined in the licensing bases for such plants.

10 CFR 50, Appendix B, establishes quality assurance requirements for the design, construction and operation of safety-related components. The pertinent requirements of this appendix apply to all activities affecting the safety-related functions of these components; these include, in part, inspecting, testing, operating and maintaining. Criteria IX, XI, and XVI of Appendix B apply to the steam generator tube integrity program.

1.4.2 10 CFR § 50.65, *Maintenance Rule*

Under the Maintenance Rule, licensees classify steam generators as risk significant components because they are relied on to remain functional during and after design basis events. It is recommended that the performance criteria in Section 2 of this document be used to demonstrate that the condition of the steam generator "is being effectively controlled through the performance of appropriate preventive maintenance" (Maintenance Rule §(a)(2)). This guideline and the referenced EPRI guidelines define a Steam Generator Program that provides the appropriate preventive maintenance that meets the intent of the Maintenance Rule. NUMARC 93-01 [1] offers guidance for implementing the Maintenance Rule should a licensee elect to incorporate additional monitoring goals beyond the scope of this document.

1.4.3 10 CFR § 50.72, *Immediate Notification Requirements for Operating Nuclear Power Reactors, and § 50.73, Licensee Event Report System*

Failure to meet a performance criterion means that degradation of a safety barrier has occurred. The reporting requirements of §50.72 and §50.73 are applicable.

Compliance with the steam generator performance criteria is required by the steam generator tube integrity technical specification included in TSTF-449. If a licensee has adopted this technical specification, 50.72 and 50.73 apply directly.

1.4.4 10 CFR § 100, *Reactor Site Criteria*

10 CFR § 100 establishes reactor-siting criteria, particularly with respect to the risk of public exposure to the release of radioactive fission products. Accidents involving the leakage or burst of steam generator tubing may comprise a challenge to containment and therefore involve an increased risk of radioactive release. Steam generator tubing and associated repair techniques and components, such as plugs and sleeves, must be capable of maintaining reactor coolant inventory and pressure in order to prevent excessive leakage.

1.4.5 Alternate Source Term

For plants implementing the alternate source term methodology discussed in Regulatory Guide 1.183, the dose guidelines of 10 CFR 100 do not apply. Instead, 10 CFR 50.67 provides the dose guidelines for analyses performed using the alternate source term methodology.

1.4.6 Plant Technical Specifications

Primary-to-Secondary Leakage Plant technical specifications include a requirement to shut down when primary-to-secondary leakage exceeds an established threshold.

In addition, for plants that have adopted steam generator tube integrity technical specifications consistent with those in TSTF-449 [16], the technical specifications include specific requirements for steam generator tube integrity and Steam Generator Programs. TSTF-449 establishes NEI 97-06 and its associated guidelines as "The Steam Generator Program."

1.5 EPRI Steam Generator Guidelines

The requirements in the EPRI guidelines represent a consensus of the steam generator industry and are experience-based in that they are achievable with available technology. Preparation and approval of all EPRI Steam Generator Guidelines is governed by Reference 11.

The EPRI Guidelines that form the basis of steam generator program requirements are:

1. *PWR Steam Generator Examination Guidelines [2]*
2. *PWR Primary-to-Secondary Leak Guidelines [3]*
3. *PWR Secondary Water Chemistry Guidelines [4]*
4. *PWR Primary Water Chemistry Guidelines [5]*
5. *Steam Generator Integrity Assessment Guidelines [6]*
6. *Steam Generator In Situ Pressure Test Guidelines [7]*

The Steam Generator Programs of all PWR licensees shall meet the applicable sections of the above six guidelines. In order to ensure that the requirements of these guidelines are clearly communicated, as the guidelines are revised, they shall identify "mandatory" or "shall" requirements using the guidance in Reference 11.

From time to time, new conditions may arise that change guideline requirements or that are not addressed within the guidelines. In these cases, the SGMP may issue Interim Guidance Letters [11]. The requirements in Interim Guidance Letters shall be identified as "mandatory" or "shall" in the same manner as the guidelines. The Steam Generator Programs of all PWR licensees shall meet the applicable sections of Interim Guidance Letters.

While it is recognized that specific site experience and steam generator design may require adaptation of select requirements within the referenced EPRI Steam Generator Guidelines, the overall program elements are independent of steam generator design and apply to both first and second generation steam generators. When a licensee's Steam Generator Program deviates from "mandatory" or "shall" requirements in the applicable guideline, a technical justification for deviation shall be written and approved. The technical justification shall provide the basis for the determination that the proposed deviation meets the intent established by the applicable documents. Requirements for preparing and approving deviations are included in Reference 11.

It is recommended that the NEI Steam Generator Review Board be consulted if questions arise on the interpretation of the EPRI guidelines. Such questions should be addressed and resolved before implementation in the Steam Generator Program. Operation of the NEI Steam Generator Review Board is governed by Reference 11.

When an EPRI Guideline is revised or interim guidance is issued, EPRI SGMP notifies SGMP members and NEI. NEI notifies U.S. PWR licensees who are not members of SGMP. It is recommended that the SGMP transmittal letter or the guideline document provide a listing of the revised sections of the guideline and the technical basis for each revision to the document's mandatory elements. Licensees shall modify their Steam Generator Programs during the time frame specified by EPRI SGMP.

NEI and the SGMP have committed to submit revisions to NEI 97-06, its referenced EPRI Guidelines, and review board interpretations to the NRC for information.

2 PERFORMANCE CRITERIA

The steam generator (SG) tubes in pressurized water reactors have a number of important safety functions. These tubes are an integral part of the reactor coolant pressure boundary (RCPB) and, as such, are relied upon to maintain the primary system's pressure and inventory. As part of the RCPB, 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. The SG tubes are also relied upon to isolate the radioactive fission products in the primary coolant from the secondary system.

The steam generator performance criteria identify the standards against which performance is to be measured. Performance criteria used for steam generators are based on tube structural integrity, accident-induced leakage, and operational leakage as defined below. Meeting the performance criteria provides reasonable assurance that the steam generator tubing remains capable of fulfilling its specific safety function of maintaining RCPB integrity.

2.1 STRUCTURAL INTEGRITY PERFORMANCE CRITERION

The structural integrity performance criterion is the following:

> *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, 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.*

The structural performance criterion is based on ensuring that there is reasonable assurance that a steam generator tube will not burst during normal operation or postulated accident conditions. Section 3.3 of this guideline establishes the essential elements to meet this performance criterion.

The EPRI *Steam Generator Integrity Assessment Guidelines* [6] offer guidance for the evaluation methods, required margins and adjustments, and the typical inputs and assumptions used to determine tube integrity. It stresses that the tube integrity assessments account for input variability and uncertainties so as to provide a conservative assessment of the condition of the tubing relative to the performance criteria.

2.2 Accident-Induced Leakage Performance Criterion

The accident-induced leakage performance criterion is the following:

> *The primary to secondary-accident induced leakage rate for any design basis accident, other than a steam generator tube rupture, shall not exceed the leakage rate assumed in the accident analysis in terms of total leakage rate for all steam generators and leakage rate for an individual steam generator. Leakage is not to exceed 1 gpm per steam generator, except for specific types of degradation at specific locations when implementing alternate repair criteria as documented in the Steam Generator Program technical specifications.*

Primary-to-secondary leakage is a factor in the dose releases outside containment resulting from a limiting design basis accident. The potential primary-to-secondary leak rate during postulated design basis accidents shall not exceed the offsite radiological dose consequences required by 10 CFR Part 100 guidelines or the radiological consequences to control room personnel required by GDC-19, or other NRC-approved licensing basis.

In most cases when calculating offsite doses, the safety analysis for the limiting design basis accident assumes 1 gpm primary-to-secondary leakage as an initial condition. The pressure and temperature conditions used in the determination of the accident induced leakage rate shall be consistent with the conditions assumed in the accident analysis. Plant-specific assumptions for accident-induced leakage are defined in each licensee's licensing basis.

NRC probabilistic safety analysis sensitivity studies have shown that severe accident risk may be sensitive to certain design basis parameters such as 1 gpm accident induced leakage. As a result, leakage greater than a plant's design basis or 1 gpm per steam generator is not allowed without prior NRC approval.

2.3 Operational Leakage Performance Criterion

The operational leakage performance criterion is the following:

> *The RCS operational primary-to-secondary leakage through any one steam generator shall be limited to 150 gallons per day.*

The operational leakage performance criterion is consistent with the primary-to-secondary leakage limit in the RCS Operational Leakage technical specification.

The operational leakage performance criterion provides a defense-in-depth added margin against tube rupture under accident conditions with resulting larger margins against rupture under normal operating conditions. Plant-specific degradation mechanisms may exist which require a plant to implement reduced operational leakage limits.

The *PWR Primary-to-Secondary Leak Guidelines* [3] provide reasonable assurance that the operational leakage performance criterion will be met. Measurement and detection methods and associated actions shall adhere to the intent of these guidelines.

3 STEAM GENERATOR PROGRAM

The purpose of a Steam Generator Program is to ensure tube integrity. The program contains a balance of prevention, inspection, evaluation and repair, and leakage monitoring measures. NEI 97-06 and its referenced EPRI guidelines are the documents that define The Steam Generator Program referred to in steam generator technical specifications that implement TSTF-449. Licensees shall document and implement their Steam Generator Program through plant procedures and other licensee-controlled documents. The major program elements are discussed below.

3.1 DEGRADATION ASSESSMENT

Prior to planned steam generator inspections, licensees shall perform a Degradation Assessment. The assessment shall address the reactor coolant pressure boundary within the steam generator, e.g., plugs, sleeves, tubes and the components that support the pressure boundary, such as secondary-side components. The assessment shall consider operating experience from other similar steam generators. EPRI *Steam Generator Integrity Assessment Guidelines* [6] and EPRI *PWR Steam Generator Examination Guidelines* [2] provide guidance for Degradation Assessments.

The purpose of the assessment is to identify degradation mechanisms and inspection techniques prior to the SG outage. Some of the important features of the Degradation Assessment include:

- Choosing techniques to test for degradation based on the probability of detection and sizing capability
- Establishing the number of tubes to be inspected
- Establishing the structural limits
- Establishing the flaw growth rate or a plan to establish the flaw growth rate.

3.2 INSPECTION

Each licensee shall plan inspections according to the expected tube degradation and follow the inspection guidelines contained in the latest revision of the EPRI *PWR Steam Generator Examination Guidelines* [2].

Some of the important features of steam generator tube inspections include:

- Sampling as supported by the degradation and integrity assessment
- Obtaining the information necessary to develop degradation, condition monitoring and operational assessments
- Qualifying the inspection program by determining the accuracy and defining the elements for enhancing NDE system performance, including technique, analysis, field analysis feedback, human performance and process controls.

3.3 INTEGRITY ASSESSMENT

Licensees shall assess tube integrity after each steam generator inspection. The assessment includes:

- Condition Monitoring – A backward-looking assessment which confirms that adequate steam generator tube integrity has been maintained during the previous operating period.
- Operational Assessment – A forward-looking assessment which demonstrates that the tube integrity performance criteria will be met throughout the next operating period.

These assessments account for uncertainties to provide a conservative assessment of the condition of the tubing relative to the performance criteria. The EPRI *Steam Generator Integrity Assessment Guidelines* [6] shall be used to determine the evaluation methods, margins, and uncertainty considerations used to evaluate tube integrity.

Licensees may use activities such as in-situ pressure testing or pulling tubes as a direct means of verifying that performance criteria have been satisfied. The EPRI *Steam Generator In Situ Pressure Test Guidelines* [7] shall be used for guidance on screening criteria for candidate tube selection, as well as for test methods and testing parameters. The EPRI *Steam Generator Tubing Burst Testing and Leak Rate Testing Guidelines* [17] provide further guidance on pulled tube examinations.

If a licensee determines that the structural integrity or accident leakage performance criteria have not been satisfied during the prior operating period, an evaluation of causal factors for failing to meet the criteria shall be performed and corrective measures shall be taken. In this event, the licensee takes actions in accordance with plant procedures and technical specifications, including notifying the NRC as applicable. If a risk-based assessment is necessary, guidance may be found in Regulatory Guide 1.174, *An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis* [13].

3.4 STEAM GENERATOR TUBE PLUGGING AND REPAIRS

Licensees shall qualify and implement plugging and repair methods in accordance with industry standards. The qualification of the plugging and repair techniques considers the specific steam generator conditions and mockup testing. Repair methods are those means used to reestablish the RCS pressure boundary integrity of steam generator tubes without removing the tube from service. Plugging a steam generator tube is not a repair. The purpose of a repair is typically to reestablish or replace the reactor coolant pressure boundary; a plug removes a tube from service.

It is recommended that licensees clearly identify engineering prerequisites and plant conditions prior to performing the plugging or repair. Process controls shall be identified to ensure proper performance of the plugging and repair including the consideration of post maintenance testing. Additionally, licensees shall perform a pre-service inspection of the plugging or repair consistent with the latest revision of the EPRI *PWR Steam Generator Examination Guidelines* [2].

The EPRI *PWR Steam Generator Tube Plug Assessment Document* [8] and the EPRI *PWR Sleeving Assessment Document* [9] provide further guidance for maintenance and repair of tubing.

Alternate repair criteria and repair methods shall be reviewed and approved by the NRC prior to implementation. New plugging designs or methods do not require prior approval by the NRC.

3.5 PRIMARY-TO-SECONDARY LEAK MONITORING

Licensees shall establish primary-to-secondary leak monitoring procedures in accordance with the EPRI PWR *Primary-to-Secondary Leak Guidelines* [3] and in accordance with the Operational Leakage criterion contained in section 2.3.

Primary-to-secondary leak monitoring is an important defense-in-depth measure that assists plant staff in monitoring overall tube integrity during operation. Monitoring gives operators information needed to safely respond to situations in which tube integrity becomes impaired and significant leakage or tube failure occurs. Additionally, operational leakage is an important tool for assessing the effectiveness of a Steam Generator Program. Plants shall assess any observed operational leakage to determine if adjustments to the inspection program or integrity assessments are warranted.

It is recommended that appropriate training be provided for personnel who respond to primary-to-secondary leakage events.

3.6 MAINTENANCE OF STEAM GENERATOR SECONDARY-SIDE INTEGRITY

Secondary-side steam generator components that are susceptible to degradation shall be monitored if their failure could prevent the steam generator from fulfilling its intended safety-related function. It is recommended that the monitoring include design reviews, an assessment of potential degradation mechanisms, industry experience for applicability, and inspections, as necessary, to ensure degradation of these components does not threaten tube structural and leakage integrity or the ability of the plant to achieve and maintain safe shutdown. Additional guidance is provided in the EPRI *Steam Generator Integrity Assessment Guidelines* [6].

3.7 SECONDARY-SIDE WATER CHEMISTRY

Each licensee shall have procedures for monitoring and controlling secondary-side water chemistry to inhibit secondary-side corrosion-induced degradation in accordance with the EPRI *PWR Secondary Water Chemistry Guidelines* [4].

3.8 PRIMARY-SIDE WATER CHEMISTRY

Each licensee shall have procedures for monitoring and controlling primary-side water chemistry to inhibit primary-side corrosion-induced degradation in accordance with the EPRI *PWR Primary Water Chemistry Guidelines* [5].

3.9 FOREIGN MATERIAL EXCLUSION

Each licensee shall have procedures to monitor for loose parts and control of foreign objects to inhibit fretting and wear degradation of the tubing.

3.9.1 Secondary-Side Visual Inspection

The program shall define when secondary-side visual inspections are to be performed, the scope of inspection, and the inspection procedures and methodology to be used. It is recommended that loose parts or foreign objects be removed from the steam generators, unless it is shown by evaluation that these objects will not cause unacceptable tube damage or the affected tubes have been removed from service. A record of these evaluations shall be maintained in accordance with the provisions in the *PWR Steam Generator Examination Guidelines [2].* It is recommended that tubes that may have been damaged by loose parts or foreign objects be inspected non-destructively. These tubes shall be plugged or repaired if the repair criteria are exceeded.

Additional guidance on secondary side inspections is provided in the *PWR Steam Generator Examination Guidelines [2]*

3.9.2 Control and Monitoring of Foreign Objects and Loose Parts

The program shall include procedures to preclude the introduction of foreign objects into either the primary or secondary side of the steam generator whenever it is opened (e.g., for inspections, maintenance, repairs, and modifications).

It is recommended that such procedures include, as a minimum:

- Detailed accountability for all tools and equipment used during any activity when the primary or secondary side is open
- Appropriate controls and accountability for foreign objects such as eyeglasses and personal dosimetry
- Cleanliness requirements
- Accountability for components and parts removed from the internals of major components (e.g., reassembly of cut and removed components).

It is recommended that licensees have alarm response procedures for the loose part monitoring system.

It is recommended that the potential for introduction of loose parts or foreign objects from secondary-side systems also be considered.

3.10 CONTRACTOR OVERSIGHT

The licensee shall perform oversight of contracted work. When the licensee contracts portions of the Steam Generator Program work scope, the responsibility for program implementation and compliance with requirements always remains with the licensee. It is the licensee's responsibility to plan, direct, and evaluate all steam generator activities. It is imperative that the licensee oversee not only the contractual, but also the technical aspects of any contracted work. Critical aspects of this oversight include but are not limited to the following:

- Review and approve the scope of work to be performed by a contractor
- Review and approval of the Degradation Assessment
- Review and approval of the contractor's examination procedures
- Monitoring of the contractor's examination work in progress
- Review and approval of the contractor's deliverables
- Review and approval of the tube integrity assessment (CM/OA) and associated support documents.

Additional guidance on contractor oversight can be found in the EPRI steam generator guidelines that govern the activity.

3.11 SELF-ASSESSMENT

Licensees shall perform self-assessments regarding the steam generator management program. This review shall be performed by knowledgeable utility personnel or a contractor with independent experts selected by the licensee on a periodic basis. An INPO assessment can be used as an adjunct to the self-assessment. It is recommended that the self-assessment identify areas for program improvement, along with program strengths. The assessment, or a combination of assessments, shall include all of the major program elements described in Section 3.

3.12 REPORTING

3.12.1 Reports to the NRC

Licensees shall submit the following reports to the NRC:

- Reports required by plant technical specifications
- Reports consistent with those delineated in TSTF-449, *Steam Generator Tube Integrity* Technical Specification [16]
- If a performance criterion is exceeded, reports required by 10CFR50.72 and 50.73 including a root cause evaluation identifying the performance criterion exceeded and an Operational Assessment establishing the basis for the next operating cycle.

3.12.2 Non-Regulatory Reports

Non-regulatory reports include internal reports that document information within the plant's Steam Generator Program and external reports intended to be shared with other utilities.

3.12.2.1 Internal Reports

Internal reports include Degradation Assessments, tube Integrity Assessments, NDE results, and results of self-assessments. Internal reports shall be retained as plant records.

3.12.2.2 External Reports

External reports are necessary to share information on degradation mechanisms, NDE technique applications, operating experience, and other items. This experience is shared through the EPRI SGMP and various reports. Reports shall be submitted to the EPRI SGMP on the following items:

- Any confirmed tube degradation of a type or in a location that has not been previously experienced in a U.S. steam generator
- In situ tests that result in leakage or burst
- NDE and metallurgical data on any pulled SG tubes
- Any approved technical justifications for deviation from NEI 97-06 and its referenced EPRI Guidelines
- Any significant SG operating experience that has generic implications for the industry
- SG inspection results (submitted to the EPRI SGMP Steam Generator Degradation Database).

Detailed reporting requirements are contained in the governing EPRI SGMP guidelines.

4 SUMMARY OF STEAM GENERATOR PROGRAM REQUIREMENTS

The following table summarizes the "mandatory" and "shall" elements contained within this document.

Category	Section	Requirement
Mandatory	1.1 and 1.3	It is mandatory that every PWR licensee revise its Steam Generator Program consistent with NEI-97-06 Revision 2.
Shall	1.1 and 1.3	In addition, every licensee shall change its technical specifications consistent with NEI 97-06 and its associated regulatory framework in TSTF-449.
Shall	1.2	*Each licensee will evaluate its existing Steam Generator Program and, where necessary, revise and strengthen program attributes to meet the intent of the guidance provided in NEI 97-06, Steam Generator Program Guidelines, no later than the first refueling outage starting after January 1, 1999.*
Mandatory	1.3	It is mandatory that each PWR licensee adopt the performance criteria contained in Section 2.
Mandatory	1.3	Further, it is mandatory that each PWR licensee evaluate its existing program elements against those described in Section 3 and revise and strengthen its program, where necessary, to meet the intent of this document and the referenced EPRI guidelines.
Shall	1.3	When NEI 97-06 is revised, NEI shall distribute the new document to its members. The NEI transmittal letter shall state the date by which implementation of the revision is required and the importance ("mandatory" or "needed") of completing the implementation by the date specified. The NEI 97-06 document, or transmittal letter, shall also provide a listing of sections that have been revised along with the technical basis for the revision.
Shall	1.3	Each licensee shall ensure that existing regulatory requirements are met during implementation of NEI 97-06.

Category	Section	Requirement
Shall	1.3	Nuclear station management is responsible for providing sufficient resources for implementation of a Steam Generator Program. Specific management responsibilities shall consider the following: • Establish and support a utility-managed steam generator management committee that addresses the following functional areas: chemistry, ISI/NDE, engineering, quality assurance, planning, health physics, operations, outage management, and maintenance. • Develop a knowledgeable steam generator organization with sufficient responsibility, authority, and resources to implement the Steam Generator Program. • Support continuity of personnel within the steam generator organization. • Encourage initiative and long-term outlook, with respect to problem solving, within the steam generator engineering organization. • Support frequent and open interchange of experience and technology with other utilities, nuclear steam supply system (NSSS) vendors, examination vendors, and appropriate industry issue programs, research, and regulatory organizations. • Establish coordination interfaces between design organizations and the steam generator organization to ensure that plant modifications do not unduly hinder SG NDE and repair efforts.
Shall	1.5	The Steam Generator Programs of all PWR licensees shall meet the applicable sections of the above six guidelines.
Shall	1.5	In order to ensure that the requirements of these guidelines are clearly communicated, as the guidelines are revised, they shall identify "mandatory" or "shall" requirements using the guidance in Reference 11.
Shall	1.5	Letters shall be identified as "mandatory" or "shall" in the same manner as the guidelines. The Steam Generator Programs of all PWR licensees shall meet the applicable sections of Interim Guidance Letters
Shall	1.5	When a licensee's Steam Generator Program deviates from "mandatory" or "shall" requirements in the applicable guideline, a technical justification for deviation shall be written and approved. The technical justification shall provide the basis for the determination that the proposed deviation meets the intent established by the applicable documents.
Shall	1.5	Licensees shall modify their Steam Generator Programs during the time frame specified by EPRI SGMP.

Category	Section	Requirement
Shall	2.1	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.
Shall	2.2	The primary to secondary accident induced leakage rate for any design basis accident, other than a steam generator tube rupture, shall not exceed the leakage rate assumed in the accident analysis in terms of total leakage rate for all steam generators and leakage rate for an individual steam generator. Leakage is not to exceed 1 gpm per steam generator, except for specific types of degradation at specific locations when implementing alternate repair criteria as documented in the Steam Generator Program technical specifications.
Shall	2.2	The potential primary-to-secondary leak rate during postulated design basis accidents shall not exceed the offsite radiological dose consequences required by 10 CFR Part 100 guidelines or the radiological consequences to control room personnel required by GDC-19, or other NRC-approved licensing basis.
Shall	2.2	The pressure and temperature conditions used in the determination of the accident induced leakage rate shall be consistent with the conditions assumed in the accident analysis.
Shall	2.3	The RCS operational primary-to-secondary leakage through any one steam generator shall be limited to 150 gallons per day.
Shall	2.3	The PWR Primary-to-Secondary Leak Guidelines [3] provide reasonable assurance that the operational leakage performance criterion will be met. Measurement and detection methods and associated actions shall adhere to the intent of these guidelines

Category	Section	Requirement
Shall	3.0	Licensees shall document and implement their Steam Generator Program through plant procedures and other licensee controlled documents.
Shall	3.1	Prior to planned steam generator inspections, licensees shall perform a Degradation Assessment. The assessment shall address the reactor coolant pressure boundary within the steam generator, e.g., plugs, sleeves, tubes and the components that support the pressure boundary, such as secondary-side components. The assessment shall consider operating experience from other similar steam generators.
Shall	3.2	Each licensee shall plan inspections according to the expected tube degradation and follow the inspection guidelines contained in the latest revision of the EPRI *PWR Steam Generator Examination Guidelines* [2].
Shall	3.3	Licensees shall assess tube integrity after each steam generator inspection.
Shall	3.3	The EPRI *Steam Generator Integrity Assessment Guidelines* [6] shall be used to determine the evaluation methods, margins, and uncertainty considerations used to evaluate tube integrity.
Shall	3.3	The EPRI *Steam Generator In Situ Pressure Test Guidelines* [7] shall be used for guidance on screening criteria for candidate tube selection, as well as for test methods and testing parameters.
Shall	3.3	If a licensee determines that the structural integrity or accident leakage performance criteria have not been satisfied during the prior operating period, an evaluation of causal factors for failing to meet the criteria shall be performed and corrective measures shall be taken.
Shall	3.4	Licensees shall qualify and implement plugging and repair methods in accordance with industry standards.
Shall	3.4	Process controls shall be identified to ensure proper performance of the plugging and repair including the consideration of post maintenance testing. Additionally, licensees shall perform a pre-service inspection of the plugging or repair consistent with the latest revision of the EPRI *PWR Steam Generator Examination Guidelines* [2].
Shall	3.4	Alternate repair criteria and repair methods shall be reviewed and approved by the NRC prior to implementation.
Shall	3.5	Licensees shall establish primary-to-secondary leak monitoring procedures in accordance with the EPRI PWR *Primary-to-Secondary Leak Guidelines* [3] and in accordance with the Operational Leakage criterion contained in section 2.3.
Shall	3.5	Plants shall assess any observed operational leakage to determine if adjustments to the inspection program or integrity assessments are warranted.

Category	Section	Requirement
Shall	3.6	Secondary-side steam generator components that are susceptible to degradation shall be monitored if their failure could prevent the steam generator from fulfilling its intended safety-related function.
Shall	3.7	Each licensee shall have procedures for monitoring and controlling secondary-side water chemistry to inhibit secondary-side corrosion-induced degradation in accordance with the EPRI *PWR Secondary Water Chemistry Guidelines* [4].
Shall	3.8	Each licensee shall have procedures for monitoring and controlling primary-side water chemistry to inhibit primary-side corrosion-induced degradation in accordance with the EPRI *PWR Primary Water Chemistry Guidelines* [5].
Shall	3.9	Each licensee shall have procedures to monitor for loose parts and control of foreign objects to inhibit fretting and wear degradation of the tubing.
Shall	3.9.1	The program shall define when such inspections are to be performed, the scope of inspection, and the inspection procedures and methodology to be used.
Shall	3.9.1	A record of these evaluations shall be maintained in accordance with the provisions in the *PWR Steam Generator Examination Guidelines [2].*
Shall	3.9.1	These tubes shall be plugged or repaired if the repair criteria are exceeded.
Shall	3.9.2	The program shall include procedures to preclude the introduction of foreign objects into either the primary or secondary side of the steam generator whenever it is opened (e.g., for inspections, maintenance, repairs, and modifications).
Shall	3.10	The licensee shall perform oversight of contracted work.
Shall	3.11	Licensees shall perform self assessments regarding the steam generator management program. This review shall be performed by knowledgeable utility personnel or a contractor with independent experts selected by the licensee on a periodic basis.
Shall	3.11	The assessment, or a combination of assessments, shall include all of the major program elements described in Section 3.

Category	Section	Requirement
Shall	3.12.1	Licensees shall submit the following reports to the NRC • Reports required by plant technical specifications, • Reports consistent with those delineated in TSTF-449, *Steam Generator Tube Integrity* Technical Specifications [16], and • If a performance criterion is exceeded, reports required by 10CFR50.72 and 50.73 including a root cause evaluation identifying the performance criterion exceeded and an Operational Assessment establishing the basis for the next operating cycle.
Shall	3.12.2.1	Internal reports shall be retained as plant records.
Shall	3.12.2.2	Reports shall be submitted to the EPRI SGMP on the following items: • Any confirmed tube degradation of a type or in a location that has not previously been experienced in a US steam generator, • In situ tests that result in leakage or burst, • NDE and metallurgical data on any pulled SG tubes, • Any approved technical justifications for deviation from NEI 97-06 and its referenced EPRI Guidelines. and • Any significant SG operating experience that has generic implications for the industry • SG inspection results (submitted to the EPRI SGMP Steam Generator Degradation Data Base).

APPENDIX A

References

1. NUMARC 93-01, *Industry Guidelines for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants.*

2. *PWR Steam Generator Examination Guidelines**.

3. *PWR Primary-to-Secondary Leak Guidelines**.

4. *PWR Secondary Water Chemistry Guidelines **.

5. *PWR Primary Water Chemistry Guidelines**.

6. *Steam Generator Integrity Assessment Guidelines**.

7. *Steam Generator In Situ Pressure Test Guidelines**.

8. *PWR Steam Generator Tube Plug Assessment Document*, EPRI Report TR-109495 *.

9. *EPRI PWR Sleeving Assessment Document,* EPRI Report TR-105960 *.

10. NUREG 0844, *NRC Integrated Program for the Resolution of Unresolved Safety Issues A-3, A-4, and A-5 Regarding Steam Generator Tube Integrity* (September 1988).

11. *Steam Generator Management Program Administrative Procedures**.

12. *Voltage-Based Repair Criteria for Westinghouse Steam Generator Tubes Affected by Outside Diameter Stress Corrosion Cracking,* GL 95-05 (August 3, 1999).

13. *An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis,* Regulatory Guide 1.174 (July 1998).

14. NEI 03-08, *Management of Materials Issues.*

15. NEI Letter to APCs, December 17, 1997, Approval of Formal Industry Position on NEI 97-06, Rev. 0, *Steam Generator Program Guidelines*

16. Technical Specification Task Force letter to the NRC (TSTF 05-01), dated January 14, 2005, TSTF-449, Revision 3, "Steam Generator Tube Integrity"

17. Steam Generator Tubing Burst Testing and Leak Rate Testing Guidelines

* Latest revision approved by the SGMP.

APPENDIX B

List of Definitions

The following definitions are provided to ensure a uniform understanding of terms used in this guideline.

Accident-induced Leakage

The primary-to-secondary leakage occurring during postulated accidents other than a steam generator tube rupture when tube structural integrity is assumed. This includes the primary-to-secondary leakage rate existing immediately prior to the accident plus additional primary-to-secondary leakage induced during the accident.

Alternate Repair Criteria(ARC)

Alternate Repair Criteria (ARC) are tube repair criteria that may be implemented for a specific defect type as part of a Steam Generator Degradation Specific Management (SGDSM) program in lieu of the generally applicable depth-based criterion. (Plug on detection is not an ARC).

Burst

The gross structural failure of the tube wall. The condition typically corresponds to an unstable opening displacement (e.g., opening area increased in response to constant pressure) accompanied by ductile (plastic) tearing of the tube material at the ends of the degradation.

Collapse

For the load displacement curve for a given structure, collapse occurs at the top of the load versus displacement curve where the slope of the curve becomes zero.

Condition Monitoring

A comparison of the as-found inspection results against the performance criteria for structural integrity and accident leakage. Condition monitoring assessment is performed at the conclusion of each operating cycle.

Normal Steady State Full Power Operation

The conditions existing during MODE 1 operation at the maximum steady state reactor power as defined in the design or equipment specification. Changes in design parameters such as plugging or sleeving levels, primary or secondary modifications, or T_{hot} should be assessed and their effects on differential pressure included if significant.

Appendix B (Cont'd)

Operational Assessment

Forward looking evaluation of the steam generator tube conditions that is used to predict that the structural integrity and accident leakage performance will be acceptable during the next cycle. The operational assessment needs to consider factors such as NDE uncertainty, indication growth, and degradation-specific repair limits.

Performance Criteria

Criteria to provide reasonable assurance that the steam generator tubing has adequate structural and leakage integrity such that it remains capable of sustaining the conditions of normal operation, including anticipated operational occurrences, design basis accidents, external events, and natural phenomena.

Primary Stress

Primary stress is the stress component developed by an imposed loading that is necessary to satisfy the laws of equilibrium of external and internal forces and moments. The basic characteristic of primary stress is that it is not self-limiting (i.e., deformation will not result in a reduction in load)

Probability of Detection (POD)

Probability of Detection (POD) is a measure of NDE performance and is defined as the likelihood that a NDE system will detect a flaw. POD may be expressed as a function of the severity of degradation. For this case, POD is typically calculated by comparing destructive examination results with the predictions of the eddy current inspection (found or missed). Alternatively, POD may be expressed as a fraction of the total population of flaws that would be detected by the NDE system (e.g., POD=0.6 per Generic Letter 95-05 [12]).

Repair Criteria

Those NDE measured parameters at or beyond which the tube must be repaired using an approved repair method or removed from service by plugging.

Repair Methods

Those means used to re-establish the RCS pressure boundary integrity of SG tubes without removing the tube from service. Plugging a steam generator tube is not a repair.

Secondary Stress

Secondary stress is the stress component developed by the constraint of adjacent material or by self-constraint of the structure. Secondary stresses, by definition, are self-limiting in nature. The basic characteristic of a secondary stress is that local yielding or deformation will reduce (or eliminate) the load and resulting stress. In addition, failure from one application of a secondary stress is not expected to occur.

Appendix B (Cont'd)

Significant Loads

An accident loading condition other than differential pressure is considered significant when the addition of such loads in the assessment of the structural integrity performance criterion could cause a lower structural limit or limiting burst/collapse condition to be established.

Steam Generator Degradation-Specific Management (SGDSM)

The use of inspection and/or repair criteria developed for a specific degradation mechanism, e.g., outside diameter stress corrosion cracking at tube support plates.

Steam Generator Tubing

Steam generator tubing refers to the entire length of the tube, including the tube wall and any repairs to it, between the tube-to-tube sheet weld at the tube inlet and the tube-to-tube sheet weld at the tube outlet. The tube-to-tube sheet weld is not considered part of the tube.

APPENDIX C

List of Abbreviations and Acronyms

ARC	Alternate Repair Criteria
CFR	Code of Federal Regulations
CM	Condition Monitoring Assessment
GDC	General Design Criteria
GPD	Gallons Per Day
INPO	Institute of Nuclear Power Operations
MSLB	Main Steam Line Break
NDE	Non-Destructive Examination
NEI	Nuclear Energy Institute
NRC	Nuclear Regulatory Commission
NSSS	Nuclear Steam Supply System
ODSCC	Outer Diameter Stress Corrosion Cracking
OA	Operational Assessment
POD	Probability of Detection
PWR	Pressurized Water Reactor
PWSCC	Primary Water Stress Corrosion Cracking
RCPB	Reactor Coolant Pressure Boundary
SG	Steam Generator
SGMP	Steam Generator Management Project
SGTR	Steam Generator Tube Rupture