

MEMORANDUM TO: R. W. Borchardt
Executive Director for Operations

FROM: Eric J. Leeds, Director
Office of Nuclear Reactor Regulation

SUBJECT: COMPLETION OF GENERIC SAFETY ISSUE 163,
MULTIPLE STEAM GENERATOR TUBE LEAKAGE”

The Office of Nuclear Reactor Regulation (NRR) has completed its technical assessment of Generic Safety Issue (GSI) 163, “Multiple Steam Generator Tube Leakage.” This assessment resulted in the enclosed technical report, which will be made publicly available. The NRC opened GSI 163 to address a concern of an NRC staff member in a Differing Professional Opinion (DPO) dated December 23, 1991 and March 27, 1992 (References 1 and 2) relating to the potential for a main steam line break accident to cause significant primary-to-secondary leakage leading to core damage. The DPO was prompted by widespread outer diameter stress corrosion cracking (ODSCC) at the steam generator (SG) tube support plates at the Trojan plant, which the DPO’s author claimed could not be reliably detected, and by the staff’s approval of alternate repair criteria (ARC) which would allow many tubes known to contain such cracks to remain in service.

In accordance with Management Directive 6.4, “Generic Issues Program,” the staff screened the issue and classified it as GSI 163 on June 16, 1992 (Reference 3). The principal assertion addressed by GSI 163 was the potential for multiple SG tube leaks during a non-isolatable main steam line break (MSLB) outside containment can lead to core damage that could result from the loss of all primary system coolant and safety injection fluid in the refueling water storage tank (RWST). The technical work conducted to address this issue supports its closure with no changes to existing regulations or guidance.

Although GSI 163 was opened in response to the DPO concerns in References 1 and 2, resolution of GSI 163 is separate from resolution of the DPO. The DPO concerns were reviewed by an Advisory Committee for Reactor Safeguards (ACRS) Ad Hoc Subcommittee that served as the DPO review panel. The Subcommittee’s conclusions and recommendations were endorsed by the ACRS and transmitted to the NRC Executive Director for Operations (EDO) on February 1, 2001 (References 4 and 5). In a memorandum to the DPO author dated March 5, 2001 (Reference 6), the NRC EDO stated that the concerns raised in the DPO were dispositioned and the DPO was closed. The ACRS conclusions and recommendations were addressed as part of the SG Action Plan (SGAP). The SGAP is documented in Reference 7, and the status of this program is periodically updated in Reference 8.

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The SGAP is documented in Reference 7, and the status of this program is periodically updated in Reference 8. To address the GSI concern, the staff evaluated the adequacy and effectiveness of industry practice and regulatory requirements relating to the management of SG tube integrity to ensure that all tubes will exhibit acceptable structural margins against burst or rupture under normal operating conditions and design basis accidents (DBAs) (including MSLB), and that leakage from one or multiple tubes under DBAs will be limited to very small amounts, consistent with the applicable regulations for offsite and control room dose. As part of this effort, the staff considered the conclusions and recommendations of the ACRS Ad Hoc Subcommittee (Reference 5) and the staff's follow up actions taken in response to these findings under the SGAP.

As of September 30, 2007, new performance-based technical specification (TS) requirements were in place and being implemented at all US pressurized water reactors (PWRs). These requirements are the culmination of years of work between the NRC staff and the industry to develop a generic template for new TS requirements incorporating a programmatic, performance-based approach for ensuring SG tube integrity (Reference 9). The new TS requirements were adopted voluntarily by each PWR licensee, consistent with the generic template, and are not the result of an NRC backfit. These requirements are intended to ensure that all tubes exhibit adequate structural margins against burst or rupture for the spectrum of normal operating and DBA conditions, consistent with the original design basis. These requirements also are intended to ensure that total leakage from tubes at a plant will not exceed values assumed in licensing bases accident analyses, even if no tubes actually rupture under these conditions. In addition, licensees are required to periodically demonstrate that these structural margin and accident leakage criteria are satisfied for all tubes or, if not met, to report the occurrence in accordance with 10 CFR 50.72/73.

Although these are new TS requirements, the basic elements of the required performance-based approach have been in use by US PWR licensees since 2000 as part of the industry's NEI 97-06 initiative. NEI 97-06 itself was an evolutionary development since tube inspection technologies, inspection practices, and tube integrity management practices had been undergoing significant improvement since the mid-1970s. These improvements have contributed significantly to improved SG tube integrity performance during this period. Improved water chemistry practices and the increasing number of PWRs with steam generators of improved design and more stress corrosion crack resistant tubing have also contributed to this trend. Since adoption of the NEI 97-06 performance-based strategy in licensee SG programs and the corresponding availability of more complete information concerning instances of failure to satisfy SG tube integrity performance criteria, actual incidences of failure to meet these criteria have been infrequent. This experience provides strong evidence that the potential for one or more tube ruptures (or leakage from multiple tubes totaling tube rupture proportions) under normal operating conditions or DBAs is well within that assumed in NRC risk studies to date.

The staff has completed all SGAP tasks that were opened to address the ACRS Ad Hoc Subcommittee's conclusions and recommendations stemming from their review of the DPO concerns relating to voltage-based ARCs, damage progression mechanisms, and iodine spiking. Based on the results of these tasks, the staff concludes that the DPO concerns relating to these issues are not substantiated and that no changes to existing requirements are needed to ensure public health and safety. The ACRS has concurred with the closure of these issues. In response to ACRS Ad Hoc Subcommittee's conclusions and recommendations, the staff is continuing to evaluate risk issues associated with accident sequences involving ruptured/leaking SG tubes as part of SGAP Tasks 3.4 and 3.5. These studies are nearing completion and are

not expected to identify needed changes to existing requirements for managing SG tube integrity and are, therefore, outside the scope of GSI 163.

The staff met with the ACRS Subcommittees on Materials and Metallurgy and Thermal-Hydraulics, on XXXXX XX, 2009 and with the main Committee on XXXXX XX, 2009 to discuss the staff's technical basis for resolution of GSI 163. In a letter dated XXXXX XX, 2009, to R.W. Borchardt, NRC Executive Director for Operations, the ACRS agreed [...] (Reference 10). Therefore, the ACRS supports the closeout of GSI 163.

Based on the above, the staff concludes that the technical specification requirements relating to SG tube integrity provide reasonable assurance that all tubes will exhibit acceptable structural margins against burst or rupture under normal operating conditions and DBAs (including MSLB), and that leakage from one or multiple tubes under DBAs will be limited to very small amounts, consistent with the applicable regulations for offsite and control room dose. Thus, the staff concludes that the GSI principal assertion and related concerns in the DPO are not substantiated, that no changes to existing regulations or guidance are needed, and that the GSI is closed.

References

1. Memorandum from T. Speis to J. Hopenfeld, "Your Differing Professional Opinion Dated 12/23/91" (ADAMS Accession No. 9212290195), US NRC, February 19, 1992. This memorandum encloses (Enclosure 1) J. Hopenfeld's Differing Professional Opinion dated December 23, 1991.
2. Memorandum from J. Hopenfeld to E. Beckjord, "A New Generic Issue: Multiple Steam Generator Leakage" (ADAMS Accession No. ML003709116), US NRC, March 27, 1992.
3. Memorandum from E. Beckjord to T. Murley, "A New Generic Issue: Multiple Steam Generator Tube Leakage" (ADAMS Accession No. 9212040356), US NRC, June 16, 1992.
4. Letter from D. Powers (ACRS) to W. Travers (NRC), "Differing Professional Opinion on Steam Generator Tube Integrity" (ADAMS Accession No. ML010780125), February 1, 2001.
5. NUREG-1740, "Voltage Based Alternative Repair Criteria, A Report to the Advisory Committee on Reactor Safeguards by Ad Hoc Subcommittee on a Differing Professional Opinion" (ADAMS Accession No. ML010750315), February 2001.
6. Memorandum from W. Travers to J. Hopenfeld, "Differing Professional Opinion On Steam Generator Tube Integrity Issues" (ADAMS Accession No. ML010660353), USNRC, March 5, 2001.
7. Memorandum from S. J. Collins and A. C. Thadani to W. Travers, "Steam Generator Action Plan Revisions to Address Differing Professional Opinion on Steam Generator Tube Integrity" (ADAMS Accession No. ML011300073, US NRC, May 11, 2001.
8. <http://www.nrc.gov/reactors/action-plans/nrr-task-action-plans.html>

9. Federal Register, "Notice of Availability of Model Application Concerning Technical Specification; Improvement To Modify Requirements Regarding Steam Generator Tube Integrity; Using the Consolidated Line Item Improvement Process," Volume 70, Page 24126, May 6, 2005.
10. To be issued.

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9. Federal Register, "Notice of Availability of Model Application Concerning Technical Specification; Improvement To Modify Requirements Regarding Steam Generator Tube Integrity; Using the Consolidated Line Item Improvement Process," Volume 70, Page 24126, May 6, 2005.
10. To be issued.

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