UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555

December 30, 1997

NRC GENERIC LETTER 97-06: DEGRADATION OF STEAM GENERATOR INTERNALS

Addressees

All holders of operating licenses for pressurized-water reactors (PWRs), except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this generic letter to (1) again alert addressees to the previously communicated findings of damage to steam generator internals, namely, tube support plates and tube bundle wrappers, at foreign PWR facilities; (2) alert addressees to recent findings of damage to steam generator tube support plates at a U.S. PWR facility; (3) emphasize to addressees the importance of performing comprehensive examinations of steam generator internals to ensure steam generator tube structural integrity is maintained in accordance with the requirements of Appendix B to 10 CFR Part 50; and (4) require all addressees to submit information that will enable the NRC staff to verify whether addressees' steam generator internals comply with and conform to the current licensing bases for their respective facilities.

Background

The NRC issued Information Notice (IN) 96-09 and IN 96-09, Supplement 1 to alert addressees to findings of damage to steam generator internals at foreign PWR facilities.

Description of Circumstances

Foreign authorities have reported various steam generator tube support plate damage mechanisms. The affected steam generators are similar, but not identical, to Westinghouse Model 51 steam generators. As previously documented in IN 96-09 and IN 96-09, Supplement 1, one damage mechanism involved the wastage of the uppermost support plate caused by the misapplication of a chemical cleaning process. A second damage mechanism involved broken tube support plate ligaments at the uppermost, and sometimes at the next lower, tube support plates. The support plate ligaments broke near a radial seismic restraint and near an antirotation key; the damage apparently dates back to initial startup of the affected plants. According to foreign authorities, the ligaments may have broken because of excessive stress

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during the final thermal treatment of the monobloc steam generators, which in turn was caused by inadequate clearance for differential thermal expansion between the support plates, wrapper, and seismic restraints.

As previously documented in IN 96-09, Supplement 1, a third damage mechanism involved wastage not associated with chemical cleaning and affected tube support plates at various elevations. This damage mechanism is active (progressive) and apparently involves a corrosion or erosion-corrosion mechanism of undetermined origin.

The staffs of potentially affected foreign reactors are currently inspecting steam generators for evidence of the various damage mechanisms, both visually and with eddy-current testing. Tubes without adequate lateral support are being plugged.

IN 96-09, Supplement 1, also documented that cooling transients involving the injection of large quantities of auxiliary feedwater may have been a key factor in the steam generator wrapper drop phenomenon observed at a foreign PWR facility. These cooling transients are believed to have been particularly severe for two units as a result of the use of a special operating procedure to accelerate the transition from hot to cold shutdown. The weight of the wrapper assembly and support plates is borne by six tenons mounted on the steam generator shell. The wrapper is nominally free to expand axially relative to the shell. However, it is postulated that an interference fit developed between the wrapper and the seismic restraints (mounted to the shell) as a result of differential thermal expansion associated with the cooling transients at the seventh support plate elevation. This interference fit prevented axial expansion of the wrapper, which led to excessive vertical bearing loads at the tenon supports, thus causing localized wrapper failure at this location and downward displacement of the wrapper (20 millimeters maximum). Poor quality wrapper support welds may also have contributed to this failure. Repairs have been made at the affected foreign PWR facility. Wrapper dropping is being monitored in all steam generators of similar design. The monitoring is performed through both online instrumentation and visual inspections during outages. In addition to the wrapper dropping problem, cracking of the wrapper above the original upper support was discovered at the same foreign unit. The cause of the cracking is not yet known.

At a U.S. PWR facility, degradation of steam generator tube eggcrate supports was discovered through secondary side visual inspections performed during the spring 1997 refueling outage. The licensee identified erosion corrosion as the damage mechanism; the cause is not yet known. The damage appears to be confined to the periphery and the untubed staywell region of the tube bundle. The eggcrate degradation at the periphery extends inward to the first one or two rows of tubes. The degradation at the staywell region primarily affects the support structures within the untubed section. Damage to the eggcrate supports was found in both steam generators on the hot and cold leg sides although the damage was more extensive on the hot leg side. No degradation of eggcrate supports was identified within the tube bundle.

Discussion

The reported foreign and U.S. experience highlights the potential for degradation mechanisms that may lead to tube support plate and tube bundle wrapper damage. The steam generator tube support plates support the tubes against lateral displacement and vibration and minimize bending moments in the tubes in the event of an accident. Support plate damage can impair the support plate's ability to perform this function and, thus, could potentially lead to the impairment of tube integrity. Vibration-induced fatigue could present a potential problem if tube support plates lose integrity, particularly in areas of high secondary side cross flows. As previously noted in IN 96-09, tube support plate signal anomalies found during eddy-current testing of the steam generator tubes may be indicative of support plate damage or ligament cracking. Certain visual and video camera inspections on the secondary side of a steam generator may also provide useful information concerning the degradation of steam generator internals. The NRC staff will continue to monitor information on tube support plate and tube bundle wrapper damage as it becomes available.

This letter also alerts addressees to the importance of performing comprehensive examinations of steam generator internals to ensure steam generator tube structural integrity is maintained in accordance with the requirements of Appendix B to 10 CFR Part 50. More specifically, Criterion XVI of Appendix B, "Corrective Action," requires, in part, that measures be established to assure that conditions adverse to quality are promptly identified and corrected.

Required Information

Within 90 days of the date of this generic letter, each addressee is required to provide a written report that includes the following information for its facility:

(1) Discussion of any program in place to detect degradation of steam generator internals and a description of the inspection plans, including the inspection scope, frequency, methods, and equipment.

The discussion should include the following information:

(a) Whether inspection records at the facility have been reviewed for indications of tube support plate signal anomalies from eddy-current testing of the steam generator tubes that may be indicative of support plate damage or ligament cracking. If the addressee has performed such a review, include a discussion of the findings.

(b) Whether visual or video camera inspections on the secondary side of the steam generators have been performed at the facility to gain information on the condition of steam generator internals (e.g., support plates, tube bundle wrappers, or other components). If the addressee has performed such inspections, include a discussion of the findings.

(c) Whether degradation of steam generator internals has been detected at the facility, and how the degradation was assessed and dispositioned.

(2) If the addressee currently has no program in place to detect degradation of steam generator internals, include a discussion and justification of the plans and schedule for establishing such a program, or why no program is needed.

Addressees are encouraged to work closely with industry groups on the coordination of inspections, evaluations, and repair options for all types of steam generator degradation that may be found.

The NRC is aware that the industry has developed generic guidance on performing steam generator inspections, and that this guidance is continually being updated. If an addressee intends to follow the guidance developed by the industry for this issue, reference to the relevant generic guidance documents is acceptable, and encouraged, as part of the response, as long as the referenced documents have been officially submitted to the NRC. However, additional plant-specific information will be needed.

NRC staff will review the responses to this generic letter and if concerns are identified, affected addressees will be notified.

Address the required written responses to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, D.C. 20555-0001, under oath or affirmation under the provisions of Section 182a, Atomic Energy Act of 1954, as amended, and 10 CFR 50.54(f).

Backfit Discussion

Under the provisions of Section 182a of the Atomic Energy Act of 1954, as amended, and 10 CFR 50.54(f), this generic letter transmits an information request for the purpose of verifying compliance with applicable existing regulatory requirements. Specifically, the requested information will enable the NRC staff to determine whether the condition of the addressees' steam generator internals comply with and conform to the current licensing bases for their respective facilities. In particular, the information would help the staff to ascertain whether the regulatory requirements pursuant to Appendix B to 10 CFR Part 50 are met.

No backfit is either intended or approved in the context of issuance of this generic letter. Therefore, the staff has not performed a backfit analysis.

Federal Register Notification

A notice of opportunity for public comment was published in the *Federal Register* on December 31, 1996 (61 FR 69116).

Paperwork Reduction Act Statement

This generic letter contains information collections that are subject to the Paperwork Reduction Act of 1995 (22 U.S.C. 3501 et seq.). These information collections were approved by the Office of Management and Budget, approval number 3150-0011, which expires on September 30, 2000.

The public reporting burden for this collection of information is estimated to average 80 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. The U.S. Nuclear Regulatory Commission is seeking public comment on the potential impact of the collection of information contained in the generic letter and on the following issues:

(1) Is the proposed collection of information necessary for the proper performance of the functions of the NRC, including whether the information will have practical utility?

(2) Is the estimate of burden accurate?

(3) Is there a way to enhance the quality, utility, and clarity of the information to be collected?

(4) How can the burden of the collection of information be minimized, including the use of automated collection techniques?

Send comments on any aspect of this collection of information, including suggestions for reducing this burden, to the Information and Records Management Branch, T-6F33, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202 (3150-0011), Office of Management and Budget, Washington, DC 20503.

The NRC may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

If you have any questions about this matter, please contact the technical contact listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

DB Matthews

for Jack W. Roe, Acting Director
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Attachment: List of Recently Issued NRC Generic Letters

Attachment filed in Jacket

LIST OF RECENTLY ISSUED GENERIC LETTERS

GENERIC LETTER	SUBJECT	DATE OF ISSUANCE	ISSUED TO
97-05	Steam Generator Tube Inspection Techniques	12/17/97	All holders of OLs for pressurized-water reactors, except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel
96-06, Sup. 1	Assurance of Equipment Operability and Containment Integrity During Design-Basis Accident Conditions	11/13/97	All holders of OLs for nuclear power reactors except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel
91-18, Rev. 1	Information to Licensees Regarding NRC Inspection Manual Section on Resolution of Degraded and Nonconforming Conditions	10/08/97	All holders of OLs for nuclear power and NPRs, including those power reactor licensees who have permanently ceased operations, and all holders of NPR licenses whose license no longer authorizes operation
97-04	Assurance of Sufficient Net Positive Suction Head for Emergency Core Cooling and Containment Heat Removal Pumps	10/07/97	All holders of OLs for nuclear power plants, except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel
97-03	Annual Financial Surety Update Requirements for Uranium Recovery Licensees	07/09/97	Uranium recovery licensees and state officials

OP = Operating License
CP = Construction Permit
NPR = Nuclear Power Reactors

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original signed by D.B. Matthews

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Attachment: List of Recently Issued NRC Generic Letters
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DOCUMENT NAME: 97-06.GL
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