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

July 10, 1996

NRC INFORMATION NOTICE 96-09, SUPPLEMENT 1: DAMAGE IN FOREIGN STEAM GENERATOR INTERNALS

Addressees

All holders of operating licenses or construction permits for pressurized-water reactors (PWRs).

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to the most recent findings of damage in steam generator internals, namely support plates and wrapper, at foreign PWR facilities. It is expected that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice are not NRC requirements; therefore, no specific action or written response is required.

Background

The NRC issued Information Notice (IN) 96-09 to alert addressees to findings of damage in steam generator internals, namely support plates and wrapper, at foreign PWR facilities. NRC has since learned of additional reports of damage mechanisms affecting the tube support plates in foreign steam generators.

Description of Circumstances

Foreign authorities have reported different tube support plate damage mechanisms affecting foreign units. The affected steam generators are similar but not identical to Westinghouse Model 51 steam generators. As previously documented in IN 96-09, the first of these damage mechanisms involved wastage of the uppermost support plate at a foreign facility, which was caused by misapplication of a chemical cleaning process. Also, U.S. industry representatives previously stated that chemical cleanings performed in the U.S. involve different cleaning agents and inhibitors than those used at the foreign facility and involve less risk for producing similar damage.

The second damage mechanism, also previously reported, involves broken tube support plate ligaments which affect the uppermost and, sometimes, the next lower tube support plates. The staff of at least eight foreign facilities have identified this damage mechanism in steam generators similar but not identical to Westinghouse Model 51 steam generators. These broken support plate ligaments occur near a radial seismic restraint and near an antirotation key and appear to date back to the initial startup of the affected plants. According to foreign authorities, the broken ligaments may be due to excessive

stress in the ligaments during the final thermal treatment of the monobloc steam generators, which is due, in turn, to a lack of clearances for differential thermal expansion between the support plates, wrapper, and seismic restraints.

IN 96-09 did not previously report a third damage mechanism to tube support plates. This mechanism appears to involve wastage that is not associated with chemical cleaning but that affects the tube support plates at a variety of elevations, including the flow distribution baffle plate. This phenomenon has affected support plate ligaments at four foreign plants with steam generators similar but not identical to Westinghouse Model 51 steam generators. The number of affected tube-to-support plate intersections ranged from 4 at one plant to 1500 at another. This damage mechanism is active (progressive) and apparently involves a corrosion or erosion-corrosion mechanism of undetermined origin.

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

NRC has also learned that cooling transients involving injection of a large quantity of auxiliary feedwater may be a key causal factor that led to the steam generator wrapper drop phenomenon observed at a foreign PWR facility and discussed in IN 96-09. These cooling transients are believed to have been particularly severe for two specific foreign 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. Temporary repairs have been implemented at the affected foreign PWR facility, and visual inspections are being performed at similar steam generators.

Discussion

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. The signal anomalies at the foreign units were present for several years before they were first identified. The steam generator tube support plates function to support the tubes against lateral displacement and vibration and to minimize bending moments in the tubes during accidents. Damage and/or cracking of the support plates can impair the ability of the support plates to perform this function and, thus, may potentially impair tube integrity. Vibration-induced fatigue

could be a potential problem if tube support plates are lost, particularly in areas of high secondary side cross flows.

The foreign experience highlights the potential for degradation mechanisms that may lead to support plate damage and/or cracking. As illustrated by the foreign experience, support plate signal anomalies during eddy current testing of the steam generator tubes may be indicative of support plate damage or ligament cracking. Video camera inspections on the secondary side of the steam generators may also provide useful information concerning the nature of support plate degradation.

The staff will continue to monitor information on support plate and wrapper damage as it becomes available from foreign authorities.

This information notice requires no specific action or written response. If there are any questions about the information in this notice, please contact one of the technical contacts listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

Brian K. Grimes, Acting Director
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Technical contacts: Sheri R. Peterson, NRR
(301) 415-1193
E-mail: srp@nrc.gov

Eric J. Benner, NRR
(301) 415-1171
E-mail: ejb@nrc.gov

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96-39	Estimates of Decay Heat Using ANS 5.1 Decay Heat Standard May Vary Significantly	07/05/96	All holders of OLs or CPs for nuclear power reactors
96-38	Results of Steam Generator Tube Examinations	06/21/96	All holders of OLs or CPs for pressurized water reactors
96-37	Inaccurate Reactor Water Level Indication and Inadvertent Draindown During Shutdown	06/18/96	All pressurized water reactor facilities holding an operating license or a construction permit
96-36	Degradation of Cooling Water Systems Due to Icing	06/12/96	All holders of OLs or CPs for nuclear power reactors
96-35	Failure of Safety Systems on Self-Shielded Irradiators Because of Inadequate Maintenance and Training	06/11/96	All U.S. Nuclear Regulatory Commission irradiator licensees and vendors
96-34	Hydrogen Gas Ignition during Closure Welding of a VSC-24 Multi-Assembly Sealed Basket	05/31/96	All holders of OLs or CPs for nuclear power reactors
96-33	Erroneous Data From Defective Thermocouple Results in a Fire	05/24/96	All material and fuel cycle licensees that monitor temperature with thermocouples
96-32	Implementation of 10 CFR 50.55a(g)(6)(ii)(A), "Augmented Examination of Reactor Vessel"	06/05/96	All holders of OLs or CPs for nuclear power reactors
96-31	Cross-Tied Safety Injection Accumulators	05/22/96	All holders of OLs or CPs for pressurized water reactors

OL = Operating License
CP = Construction Permit

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Original signed by Brian K. Grimes

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E-mail: srp@nrc.gov

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(301) 415-1171
E-mail: ejb@nrc.gov

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Tech Editor has reviewed and concurred on 05/10/96

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Based on the information available to the NRC staff, it is not yet known whether steam generators in the U.S are vulnerable to the type of wrapper damage observed at the foreign unit.

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