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UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555-0001

November 20, 1997

NRC INFORMATION NOTICE 97-79: POTENTIAL INCONSISTENCY IN THE ASSESSMENT OF THE RADIOLOGICAL CONSEQUENCES OF A MAIN STEAM LINE BREAK ASSOCIATED WITH THE IMPLEMENTATION OF STEAM GENERATOR TUBE VOLTAGE-BASED REPAIR CRITERIA

Addressees

All holders of operating licenses for pressurized-water reactors (PWRs) implementing a steam generator (SG) tube voltage-based repair criteria in accordance with the guidance presented in Generic Letter (GL) 95-05, "Voltage-Based Repair Criteria for Westinghouse Steam Generator Tubes Affected by Outside Diameter Stress Corrosion Cracking," issued August 3, 1995 (Accession Number 9507310085).

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to notify addressees of a potential inconsistency in the assessment of the radiological consequences of a main steam line break (MSLB) associated with the implementation of a SG tube voltage-based repair criteria. 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 staff issued GL 95-05 to give guidance to licensees who sought a license amendment to the plant technical specifications (TS) to implement voltage-based SG tube repair criteria. The criteria apply specifically to outside diameter stress corrosion cracking (ODSCC) at the tube-to-tube support plate intersections in Westinghouse-designed SGs having drilled-hole tube support plates (TSPs) and alloy 600 SG tubing. The voltage-based repair criteria allow a certain population of SG tube indications to remain in service. Licensees must ensure that degraded SG tubes accepted for continued service will retain adequate structural and leakage integrity during normal operating, transient, and postulated accident conditions.

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The MSLB event was identified as the bounding accident condition for degraded SG tubes with ODSCC indications located at the TSPs. The radiological consequences of a MSLB originate from the releases from the faulted SG (the one experiencing the steam line break) and from the steaming operations associated with the removal of decay heat through the intact SGs (those that have not experienced the steam line break). Offsite consequences only occur if there is primary-to-secondary leakage concurrent with radioactivity in the reactor coolant. If either one of these is absent, there are no offsite dose consequences associated with a MSLB.

In their submittals requesting a license amendment to implement voltage-based SG tube repair criteria, licensees provide an assessment of the radiological consequences associated with a MSLB, which determines the maximum allowable primary-to-secondary SG tube leakage and the reactor coolant system dose equivalent iodine levels. Most of the expected leakage will be from the ODSCC indications left in service under the voltage-based repair criteria. Thus, the projected end-of-cycle (EOC) SG tube leakage licensees calculate as part of the voltage-based repair criteria methodology contributes to the maximum allowable primary-to-secondary leakage. The projected leakage is based, in part, on the use of two models associated with voltage-based SG tube repair criteria: the "probability of leakage" model and the "conditional leak rate" model. The probability of leakage model correlates the probability of leakage, given a MSLB, to the eddy current bobbin coil voltage response of a SG tube indication. The conditional leak rate model correlates the leak rate at MSLB conditions to the bobbin coil voltage response of a SG tube indication. Licensees have usually found it necessary to include in the same license amendment request to implement voltage-based SG tube repair criteria an additional request to reduce the TS values for the maximum instantaneous and the 48-hour dose equivalent iodine (DEI) levels in the reactor coolant. With a reduction in the DEI levels, the maximum allowable primary-to-secondary leakage can be increased while maintaining acceptable radiological consequences.

Approval of the license amendment to implement voltage-based repair criteria requires, in part, that the radiological consequences associated with a MSLB meet General Design Criterion 19 of Appendix A to 10 CFR Part 50 and the acceptance criteria of Appendix A, "Radiological Consequences of Main Steam Line Failures Outside Containment of a PWR," to Standard Review Plan 15.1.5.

Description of Circumstances

In a July 23, 1997 meeting, the licensee for the Braidwood Nuclear Power Station informed the NRC staff that, upon review of the leakage and dose calculations, the licensee noted the radiological consequences of a MSLB are based on a primary-to-secondary mass flow rate which is calculated from the volumetric leak rate at operating temperature. This leak rate is used as a maximum allowable projected EOC SG tube leakage. In contrast, the projected EOC SG tube leakage calculation yields a volumetric leak rate at room temperature. The two leak rate values cannot be compared without correcting for the difference in water density between reactor operating temperature and room temperature. At Braidwood, the licensee had incorrectly believed that the maximum allowable volumetric leak rate was calculated for room temperature when it was actually calculated at operating temperature. Correcting the room temperature projected leak rates to operating temperature increases their magnitude so that they may approach and possibly exceed the maximum allowable leak rate.

The summary for this meeting was issued on August 25, 1997 and is available in the Public Document Room. Based on discussions with Westinghouse and Nuclear Energy Institute personnel, the staff believes that other licensees, in their license amendment requests for implementation of the voltage-based SG tube repair criteria, have also performed assessments of the radiological consequences of a MSLB without correcting for these density differences.

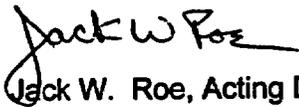
Discussion

In assessing the radiological consequences of a MSLB, it is typically assumed that all of the primary-to-secondary leakage from the faulted SG flashes and is released offsite with no partitioning. The quantity of radioactivity released is typically calculated by multiplying the mass released from the break by the TS value for radioactivity in reactor coolant. The mass released is found by first determining the volumetric flow rate of the primary-to-secondary leak. The volumetric flow rate consists of the sum of the TS value for allowable primary-to-secondary leakage and a maximum allowable primary-to-secondary leakage calculated so as to bound the projected EOC SG tube leakage due to the implementation of the voltage-based SG tube repair criteria. The volumetric flow rate is then multiplied by the density of water to obtain the mass released. Since density enters into this calculation, it is important that a consistent frame of reference be used in the dose assessment. If an incorrect frame of reference is used, the dose consequences could be underestimated by as much as 50 percent as a result of density differences between normal reactor operating conditions and standard temperature.

Upon implementation of the voltage-based repair criteria, licensees use the projected EOC voltage distribution of SG tube indications to calculate the projected EOC SG tube leakage due to a MSLB. The projected EOC SG tube leakage is then compared to the unit-specific maximum allowable primary-to-secondary leakage. If the projected SG tube leakage for the EOC conditions is less than the maximum allowable primary-to-secondary leakage, licensees need take no action. However, if the projected SG tube leakage for the EOC conditions is greater than the maximum allowable primary-to-secondary leakage, licensees need to take action.

If a licensee performed the comparison between its projected EOC SG tube leakage with the maximum allowable primary-to-secondary leakage without correcting for the density differences discussed above, licensees may find the density-corrected projected SG tube leakage at EOC conditions has already exceeded, or is projected to exceed at some point in the current operating cycle, the maximum allowable primary-to-secondary leakage limit. In such cases, the staff expects licensees to address appropriate reportability, TS, and operability issues.

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


Jack W. Roe, Acting Director
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Tech Editor reviewed and concurred on 9/5/97.

*See previous concurrence.

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LIST OF RECENTLY ISSUED
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Information Notice No.	Subject	Date of Issuance	Issued to
97-78	Crediting of Operator Actions in Place of Automatic Actions and Modifications of Operator Actions, Including Response Times	10/23/97	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
97-77	Exemptions from the Requirements of Section 70.24 of Title 10 of the <u>Code of Federal Regulations</u>	10/10/97	All holders of OLs for nuclear power reactors
97-76	Degraded Throttle Valves in Emergency Core Cooling System Resulting from Cavitation-Induced Erosion During a Loss-of-Coolant Accident	10/30/97	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
97-75	Enforcement Sanctions Issued as a Result of Deliberate Violations of NRC Requirements	09/24/97	All U.S. Nuclear Regulatory Commission licensees

OL = Operating License
CP = Construction Permit

volumetric flow rate consists of the sum of the TS value for allowable primary-to-secondary leakage and the MSLB-induced primary-to-secondary leakage calculated as part of the voltage-based SG tube repair criteria. The volumetric flow rate is then multiplied by the density of water to obtain the mass released. Since density enters into this calculation, it is important that a consistent frame of reference be used in the dose assessment. If an incorrect frame of reference is used, the dose consequences could be underestimated by as much as 50 percent as a result of density differences between normal reactor operating conditions and standard temperature.

Upon implementation of the voltage-based repair criteria, licensees use the projected end-of-cycle (EOC) voltage distribution of SG tube indications to calculate the conditional MSLB primary-to-secondary leakage. The projected EOC voltage distribution is based, in part, on the beginning-of-cycle voltage distribution of SG tube indications left in service and a voltage growth distribution. The calculated conditional MSLB leakage and the resultant dose consequences are therefore dependent on the time in the cycle for which the calculations are performed. Even if an incorrect frame of reference was used and thus the dose consequences were underestimated, a given plant may have sufficient margin that it is not exceeding the acceptance criteria associated with the license amendment implementing the voltage-based repair criteria. However, because of the time-dependent nature of SG tube degradation, it is possible that some plants will operate outside of their licensing basis by the end of cycle if the radiological assessment of the dose consequences was performed without correcting for water density differences.

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