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

March 13, 1997

NRC INFORMATION NOTICE 97-10: LINER PLATE CORROSION IN CONCRETE CONTAINMENTS

Addressees

All holders of operating licenses or construction permits for power reactors.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to occurrences of corrosion in the liner plates of reinforced and pre-stressed concrete containments, and to detrimental effects such corrosion could have on containment reliability and availability under design-basis and beyond-design-basis events. It is expected that recipients will review this information for applicability to their facilities and consider actions, as appropriate. However, suggestions contained in this information notice are not NRC requirements; therefore, no specific action or written response is required.

Background

Criterion 16 of the General Design Criteria of 10 CFR Part 50 requires that the reactor containment and associated systems shall be provided to establish an essentially leaktight barrier against the uncontrolled release of radioactivity to the environment. To meet this leak-tightness requirement, the inside surfaces of concrete containments are lined with thin metallic plates, generally between 6.2 mm (1/4 in.) and 9.5 mm (3/8 in.) thick. The liner plates are attached to the concrete by means of stud anchors or structural rolled shapes or both.

The design process assumes that the liner plates do not carry loads. However, the normal loads, such as from concrete shrinkage, creep and thermal changes, imposed on the concrete containment structure are transferred to the liner plates through the anchorage system. Internal pressure and temperature loads are directly applied to the liner plate. Thus, under design-basis conditions, the liner plate could experience significant strains. Section III, Division 2 of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (also called American Concrete Institute Standard 359), "Code for Concrete Reactor Vessels and Containments," allows liner tensile strains up to 0.004 cm/cm (inch/inch) of material for normal operating stresses, and up to 0.01 cm/cm (inch/inch) for stresses resulting from the postulated environmental and accident conditions. American Society for Testing and Materials (ASTM) Standard A516 (or equivalent) steel is typically used in the

construction of containments. The minimum ultimate tensile strain of the liner material is 0.2 cm/cm (inch/inch). Thus, there is a minimum safety factor of 20 above the theoretically calculated liner strains.

Any corrosion (metal thinning) of the liner plate could change the failure threshold of the liner plate under a challenging environmental or accident condition. Thinning changes the geometry of the liner plate, creating different transitions and strain concentration conditions. This may reduce the design margin of safety against postulated accident and environmental loads.

Description of Circumstances

Inspections of containment liners have shown various degrees of corrosion.

- In January 1993, an NRC inspector pointed out corrosion of the drywell liner at Unit 2 of the Brunswick plant. The liner was corroded at various spots at the junction of the base floor and the liner. A subsequent examination of Unit 1 showed similar corrosion.

- During the NRC staff's structural assessment review in June 1992, the staff noted peeled coating and spots of liner corrosion at Trojan (not operating) and at Beaver Valley Unit 1.

- Before integrated leak rate testing of the containment at Salem Unit 2 in 1993, the licensee's staff noted minor corrosion of the containment liner.

- During the NRC staff's structural assessment review in April 1992, discoloration of the vertical portion of the containment liner was observed at an insulation joint at Robinson Unit 2.

Discussion

Of the five occurrences cited above, four (Trojan and Beaver Valley Unit 1, Salem Unit 2, and Robinson Unit 2) were found to be benign from the standpoint of safety. However, the licensees were sensitized to the conditions for future monitoring and repairs, as appropriate. Corrosion of the liner plate at Brunswick Units 1 and 2 was significant from the standpoint of safety. The sealing material along the circumference at the junction of the drywell wall and the bottom floor had significantly degraded from the water accumulation at the junction. The liner plate was found to have pitted significantly (as much as 50 percent of the original thickness) at various locations along the circumference. Before the restart of the two Brunswick units, the licensee cleaned the joint areas, repaired the pitted liner plate areas, and resealed the entire gap at the junction with dense silicone elastomer. The repair of the pitted areas consisted of (1) welding the pitted areas, (2) examining the repaired areas in accordance with the ASME Section III, Division 2, and (3) recoating the repaired areas.

Corrosion of a liner plate can occur at a number of places where the metal can be exposed to moisture, or where moisture can condense (behind insulation) or accumulate. Potential locations for liner plate corrosion are (1) the junction of the containment cylinder and intermediate floors and basemat concrete (PWRs and Mark III BWRs), (2) the junction of the drywell and the base or intermediate concrete floors (Mark I, Mark II concrete containments), (3) adjacent to crane girder rails and supports attached to the liner plate (concrete containments), (4) water-soaked areas where carbon steel liner plate is used (Mark II and Mark III containments), and (5) behind insulation and ice-condenser baskets.

An amendment to 10 CFR 50.55a became effective September 9, 1996. This amendment, by endorsing the use of Subsections IWE and IWL of Section XI of the ASME Boiler and Pressure Vessel Code, provides detailed requirements for inservice inspection of containment structures. Inspection (which includes examination, evaluation, repair, and replacement) of concrete containment liner plate in accordance with the 10 CFR 50.55a requirements involves consideration of the potential corrosion areas.

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Thomas T. Martin, Director
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Information Notice No.	Subject	Date of Issuance	Issued to
97-09	Inadequate Main Steam Safety Valve (MSSV) Setpoints and Performance Issues Associated with Long MSSV Inlet Piping	03/12/97	All holders of OLs or CPs for nuclear power reactors
97-08	Potential Failures for General Electric Magne-Blast Circuit Breaker Subcomponents	03/12/97	All holders of OLs or CPs for nuclear power reactors
97-07	Problems Identified During Generic Letter 89-10 Closeout Inspections	03/06/97	All holders of OLs or CPs for nuclear power reactors
97-06	Weaknesses in Plant-Specific Emergency Operating Procedures for Refilling the Secondary Side of Dry Once-Through Steam Generators	03/04/97	All holders of OLs or CPs for nuclear power reactors with with once-through steam generators
91-85, Rev. 1	Potential Failures of Thermostatic Control Valves or Diesel Generator Jacket Cooling Water	02/27/97	All holders of OLs or CPs for nuclear power reactors
97-05	Offsite Notification Capabilities	02/27/97	All holders of OLs or CPs for nuclear power reactors and test and research reactors

OL = Operating License
CP = Construction Permit

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original signed by M.M. Slosson

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