

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

April 27, 2004

NRC INFORMATION NOTICE 2004-09: CORROSION OF STEEL CONTAINMENT AND
CONTAINMENT LINER

Addressees:

All holders of operating licenses for nuclear power reactors except those who have permanently ceased operation and have certified that fuel has been permanently removed from the reactor vessel.

Purpose:

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to recent occurrences of corrosion in freestanding metallic containments and in liner plates of reinforced and pre-stressed concrete containments. It is expected that recipients will review this information for applicability to their facilities and consider actions, as appropriate. However, the suggestions in this information notice are not NRC requirements; therefore, no specific action or written response is required.

Background:

As discussed in Information Notice 97-10, "Liner Plate Corrosion in Concrete Containments," the containment liners have safety factors well above the theoretically calculated strains. Any corrosion (metal thinning) of the liner plate or freestanding metallic containment could change the failure threshold of the containment under a challenging environmental or accident condition. Thinning changes the geometry of the containment shell or liner plate, which may reduce the design margin of safety against postulated accident and environmental loads. Recent experience has shown that the integrity of the moisture barrier seal at the floor-to-liner or floor-to-containment junction is important in avoiding conditions favorable to corrosion and thinning of the containment liner plate material.

Description of Circumstances:

Inspections of containment at the floor level, as well as at higher elevations, have identified various degrees of corrosion and containment plate thinning. This is a partial listing of such occurrences.

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Corrosion of freestanding metallic containment

- In July of 2002, at the Davis-Besse Nuclear Power Station, the NRC identified corrosion where the containment meets the floor. The licensee subsequently performed ultrasonic examinations to confirm that the freestanding metal containment had not been corroded below the minimum design thickness. The licensee subsequently installed a moisture barrier at the containment-to-floor junction to prevent moisture intrusion (NRC Inspection Report 50-346/02-09, ADAMS Accession No. ML022560237).
- In May of 2002, at the Sequoyah Nuclear Plant, Unit 2, the NRC identified areas of the steel containment vessel (SCV) with degraded coatings and rust (NRC Inspection Report 50-328/02-02, ADAMS Accession No. ML022070149). One of the floor drains was clogged in the annulus area (1.5 m [5 feet] wide) between the SCV and the reinforced concrete shield building. Localized water ponding at the clogged drain had come in contact with a section of the SCV, causing deterioration of the SCV coatings and rusting of the SCV. This SCV is restricted for access due to the close proximity between the SCV and the emergency gas treatment system (EGTS) duct work. After reviewing NRC Information Notice 89-79, the licensee had identified the problem in 1990, but the corrective action was inadequate. Since the identification in 2002, additional corrective actions have been implemented by the licensee. These actions consist of the removal of the EGTS duct work on both Unit 1 and Unit 2 to allow the SCV area behind the EGTS duct work to be cleaned and recoated. Also the licensee has identified this SCV area behind the EGTS duct work for periodic visual examination.
- In November of 2001, at the Dresden Unit 2 Nuclear Power Station, the licensee identified an area of missing coating and primer encircling the drywell shell adjacent to the basement floor. The area was 5-10 cm (2-4 inches) wide. In this area, the base metal of the drywell shell was found to be corroded. However, based on ultrasonic and visual examinations, the degraded area was found to be within the corrosion allowance for the drywell shell. The shell coating was repaired in this area to prevent further degradation (Inservice Inspection Summary Report, Fall 2001 Inspection Period, ADAMS Accession No. ML020450608).

Corrosion of containment liner plate

- In March of 2001, at the D. C. Cook Nuclear Power Plant, the licensee discovered a through-wall hole in the containment liner plate. Surface preparation for further inspection of a weld repair of the liner plate dislodged the repair material, leaving a hole. The hole was repaired. However, further examination of the repair area indicated corrosion of the liner from the embedded side of the liner. The cause of this corrosion was found to be a wire brush handle lodged in the concrete at the interface with the liner. The licensee replaced an area about 30 cm (12 inches) square in the liner plate and performed a local leak rate test as part of the corrective action (AEP:NRC:2612-01: "Response to NRC Request for Additional Information Regarding License Amendment Request for One-Time Extension of Containment Integrated Leakage Rate Test Interval," November 11, 2002, ADAMS Accession No. ML023170524).

- In February and March of 1998, at the D. C. Cook Nuclear Power Plant, the licensee identified corrosion (pitting) of the containment liner at the moisture barrier seal areas of both units. At Unit 1, the licensee identified more than 60 areas in which the thickness (1 cm [3/8 inch] nominally) of the steel liner plate had been reduced below the minimum design thickness value of (0.6 cm [0.25 inch]). The licensee subsequently installed a new liner-to-floor moisture barrier seal (Licensee Event Report 50-315/98011-02, NUDOCS Accession No. 9809040123* and NRC Inspection Report 50-315/99026, ADAMS Accession No. ML003677533).
- In fall 2003, at the Surry Power Station, Unit 2, NRC inspectors found degraded coatings and rust on the containment liner at the junction of the metal liner and interior concrete floor. The inspectors also discovered that the moisture barrier at the junction between the metal liner plate and interior concrete floor was degraded. Review of the records of previous inspections performed by licensee personnel in 2000, 2002, and 2003 revealed that the licensee had not identified the degraded moisture barrier (caulking), but had identified the degraded coatings. (NRC Inspection Report 50-281/2003-05, ADAMS Accession No. ML040280056).
- In October of 1999, at the Palisades Plant, the licensee discovered that a floor-to-liner moisture barrier seal had never been installed and used a thin metal blade as a probe, confirming the presence of moisture in the crevice. Subsequently, the licensee used a borescope to identify areas of liner corrosion. The licensee determined that the corrosion had not yet appreciably degraded the liner in this area and installed a new liner-to-floor moisture barrier seal.
- In May of 1999, at the Brunswick Steam Electric Plant, Unit 2, the licensee identified three areas in the drywell liner where corrosion had penetrated the liner. These areas were at the 5.5, 16, and 21 m (18, 52, and 70 feet) elevations. At the 16 m elevation, the wall had corroded from the outside to the inside surface. At the 21 m elevation, the wall had corroded from the inside to the outside surface. At the 5.5 m elevation, the direction of the through-wall corrosion could not be determined. The liner corrosion was a result of foreign materials embedded in the concrete containment adjacent to the liner. One hole in the liner was adjacent to a leather work glove found buried in the concrete, while the other two hole locations were adjacent to wood found buried in the concrete (NRC Inspection Report 50-324/99-03, NUDOCS No. 9906170114*).
- In December, 1996, at the H.B. Robinson Steam Electric Plant, Unit 2, an NRC inspector identified degraded caulking and insulation sheathing panels during a containment walkdown. The vertical portion of the containment liner at Robinson is protected by Vinylcel insulation, a polyvinyl chloride material, and a metal sheathing material. The licensee determined that a portion of this insulation sheathing material was loose and that some of the caulking between the sheathing panels was

*These documents are available in the NRC Legacy Library. The legacy documents are stored on microfiche in the NRC Public Documents Room. Copies may be made for a fee.

deteriorated. After examination during subsequent refueling outages, the licensee determined that the protective coating for the containment liner was degraded and that while some corrosion of the containment liner had occurred, the liner met design requirements. The licensee restored the coating and insulation panels (NRC Inspection Reports 50-261/96-14, NUDOCS Accession No 9702110115* and 50-261/98-02, NUDOCS Accession No. 9805050171*).

Discussion:

An amendment to Section 50.55a of Title 10 of the Code of Federal Regulations (10 CFR 50.55a) (61 FR 41303) became effective September 9, 1996. This amendment requires the use of Subsections IWE and IWL of Section XI of the ASME Boiler and Pressure Vessel Code to perform inservice inspections of containment components. These subsections provide detailed requirements for inservice inspection of Class MC pressure-retaining components and their integral attachments and of metallic shells and penetration liners of Class CC pressure-retaining components and their integral attachments. Inspection of concrete containment shell and steel liner plate in accordance with 10 CFR 50.55a involves consideration of potential corrosion areas. Such inspection includes examination, evaluation, repair, and replacement of corroded areas of the liner plate.

As a result of these required containment inservice inspections, licensees have found that over time, the existing floor-to-containment seal can degrade, allowing moisture into the crevice between the containment liner plate and floor. Small amounts of stagnant water behind the floor seal area promote pitting corrosion. To identify corrosion in this area, licensees have had to remove the original floor seal and either excavate the concrete or do a visual inspection aided by fiber optics. Licensee corrective actions for this condition have typically included inspections to determine the extent of corrosion, evaluations of containment integrity, and installation of new floor-to-containment moisture seal barriers.

In some instances, corrosion has been found at higher elevations of the liner plates. Generally, the instances of such corrosion have been associated with foreign objects (wooden pieces, workers' gloves, wire brush handles, etc.) lodged between the liner plate and the concrete. As the corrosion is initiated in the areas not visible during visual examinations, such instances of corrosion were found when corrosion had penetrated through the liner thickness. Some licensees have performed ultrasonic examination of the suspect areas (areas of obvious bulging, hollow sound, etc.) to detect such corroded areas.

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Related Generic Communications:

NRC Information Notice 97-29, "Containment Inspection Rule"

NRC Information Notice 89-79, "Degraded Coatings and Corrosion of Steel Containment Vessels"

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

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LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
2004-08	Reactor Coolant Pressure Boundary Leakage Attributable to Propagation of Cracking in Reactor Vessel Nozzle Welds	04/22/2004	All holders of operating licenses for nuclear power boiling-water reactors (BWRs), except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel.
2004-07	Plugging of Safety Injection Pump Lubrication Oil Coolers with Lakewood	04/07/2004	All holders of operating licenses or construction permits for nuclear power reactors, except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel.
2004-06	Loss of Feedwater Isokinetic Sampling Probes at Dresden Units 2 and 3	03/26/2004	All holders of operating licenses for nuclear power reactors except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel.
2004-05	Spent Fuel Pool Leakage to Onsite Groundwater	03/03/2004	All holders of operating licenses for nuclear power reactors (except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel) and for research and test reactors, and all holders of fuel storage licenses and construction permits.

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