RIC 2011

Containment Liner Plate Corrosion

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Outline

- Regulatory Basis
- Containment Liner Corrosion Experience
  - Inside liner surface
  - Outer liner surface
- Recent NRC Activities – liner corrosion
- Path Forward

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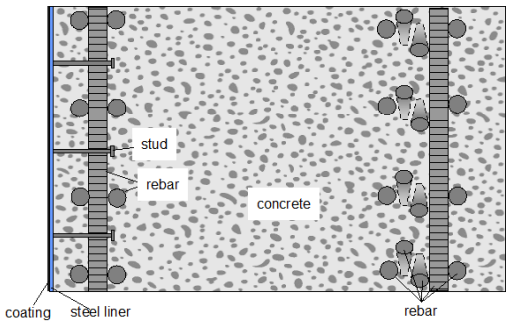
Containment Wall Cross Section Schematic



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Regulatory/Safety Basis

- Containment liner credited in many plants design basis as helping to ensure the containment provides a leak tight barrier to fission product release following an accident
- 10CRF 50.55a(g)(4)→ASME B&PV Code
  - Section XI, Subsection IWE (liners)
- Containment Leak Rate Testing (ILRT & LLRT)
  - 10 CFR 50, Appendix J
- Containment Structure Design -10 CFR 50 Appendix A – GDCs (1, 2, 4,16, 20)
- Plant Technical Specifications

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Liner Plate Corrosion-Inside Surface

- Operating experience indicates this is the more common degradation mode
- Typically found near the floor to wall joint
- Two key contributors:
  - Degraded coatings or moisture barrier
  - Locations where water can collect
- Strong inspection programs will detect corrosion before it challenges liner integrity
- Most recent example – Turkey Point Unit 3, 2010

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Liner Plate Corrosion – Outside Surface

- Since 1999, four cases in U.S. nuclear plants of through-wall liner corrosion initiating from the outside surface
- Most recent experience was Beaver Valley Unit 1, April 2009

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Liner Corrosion Challenges

- Visual exams performed in accordance with ASME B&PV Code Section XI, Subsection IWE, are unable to identify liner corrosion initiating from the outside until it penetrates the liner wall
- Current NDE techniques are not effective for large scale screening for foreign objects at the concrete/liner interface
- UT sampling can identify corrosion initiated at the liner OD but a full liner UT inspection is impractical

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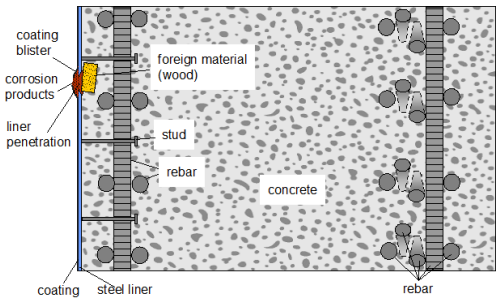
Containment Liner - Outside Surface Corrosion



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Recent NRC Containment Liner Corrosion Activities

- Due to its unique challenge, NRC staff is focusing on OD-initiated liner corrosion
- Issued Information Notice 2010-012 “Containment Liner Corrosion” in June 2010
- Discussed at ASME Section XI, Subsection IWE/IWL meeting and being tracked under generic containment degradation issue
- Enhanced NRC Refueling and Outage Activities Baseline Inspection Procedure to provide additional guidance regarding liner items
- NRC evaluation of operating experience and investigation into the corrosion mechanism
- Monitoring ongoing industry operating experience

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Ongoing Research Activities

- Task 1 - Evaluate historical information related to liner corrosion for U.S. and international plants
- Task 2 – Determine the corrosion mechanism related to through-wall liner corrosion
  - **Contracted Sandia National Laboratory to assemble an expert panel and conduct a workshop on liner corrosion (Sept. 2010)**
- Reports for Tasks 1 and 2 expected to be available to the public no later than May 2011

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Expert Panel Members

Member	Affiliation	Expertise
Dr. Jason Petti	Sandia National Laboratories	Containment structural integrity
Bryan Erler	ASME Board of Nuclear Codes and Standards	Containment design and construction
Professor Alberto Sagues	University of South Florida	Corrosion, concrete degradation
Dr. Dan Naus	Oak Ridge National Lab	Aging management, containment design and construction, NDE
Professor Richard Weyers	Virginia Tech	Corrosion, concrete degradation and repair
Dr. Neal Berke	W.R. Grace	Concrete aging and characterization
Henry Stephens *	EPRI	Containment design, NDE
Nathan Muthu *	EPRI	Containment liner NDE

* Non-panel member participant

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Expert Panel Tasking

- Expert panel asked for input to the following:
  - Identification of the liner corrosion mechanisms
  - Aging and environmental factors that affect the degradation of concrete containment structures and corrosion of steel
  - Methods to evaluate aging effects and degradation of concrete structures
  - Non-destructive evaluation methods to detect construction defects, and corrosion of the steel containment liner
  - Evaluation of construction practices and concrete defects on concrete degradation and steel corrosion
  - Summary of industrial experience using methods to prevent or mitigate concrete degradation and corrosion of steel in concrete
  - If applicable, future research to evaluate containment liner corrosion mechanisms

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Expert Panel – Preliminary Insights

- Construction defects (i.e., foreign objects) create the localized conditions that result in OD corrosion of the liner
- Local environment at liner, not global conditions (e.g., plant operation, climate) determine corrosion susceptibility
- Reinforced concrete containment construction more prone to have foreign materials left in place due to rebar congestion
- Current NDE methods not capable of detecting foreign objects at the liner/concrete interface
- Aging and concrete degradation have not been important factors in liner corrosion events to date
- No condition found resulted in the containment failing to meet the 10CFR50 Appendix J integrated leak rate test

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Path Forward

- Expect near term publication of NRC internal report and expert panel final report
- NRR-RES task force meetings to discuss report conclusions and recommendations
- Determine if additional research is necessary
- Continue to monitor plant operating experience
- Stay cognizant of potential EPRI program to evaluate NDE methods
- Re-evaluate and update NRC regulatory positions and programs, as appropriate

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