



Boric Acid Corrosion Testing Program: Industry Perspective

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Background (1/3)

- Boric Acid Corrosion of Low Alloy Steel at Alloy 600 CRDM Penetrations is a Long-Standing Issue
 - Leakage at CRDM penetrations first observed at Bugey 3 in 1991
 - Leakage and/or minor wastage observed at other plants
 - Significant Wastage Observed at Davis Besse in 2002 Prompted Revision to Inspection Guidance/Regulations
 - NRC Order EA-03-009
 - MRP 117
 - ASME Code Case N-729 (now codified in 10CFR50.55a)
- **No leakage has been observed in Reactor Vessel Penetrations since inspections have been instituted**

Background (2/3)

- Lack of *Directly* Relevant Data Available to Support Development of Inspection Guidance in 2002
- Industry Began a Comprehensive BAC Test Program in 2004 to:
 - Improve understanding of fundamental factors controlling BAC through bench-scale testing
 - Improve mechanistic understanding of BAC
 - Mockup testing under prototypical conditions to provide directly relevant data
 - Typical geometry, temperatures, flow rates and coolant chemistry
 - Include Bottom Mounted Instrument Nozzle penetrations in program

Background (3/3)

- Conclusions from Results:
 - Results support current inspection intervals: structurally significant wastage will not occur between inspections at currently prescribed intervals
 - Results support current inspection methods: visual inspection is a reliable technique for detection of leakage, even at low flow rates



BMN Test 5: 0.006 GPM leakage
Boric Acid Deposits Visible after 24 hours

Boric Acid Deposits versus Wastage

- At 1500 ppm boron, leakage of 0.01 GPM equates to 600 pounds of boric acid in 18 months
 - 6.9 cubic feet at full density
 - 11,900 in³
 - 0.5 in³ readily detected by visual inspection (MRP-167)
 - Corresponding wastage 3 in³ or less
 - Not structurally significant



CRDM Tests at 0.01 GPM; 1500 ppm B
Volumetric corrosion rate 0.10 to 2.1 in³/yr
32 day test = 35 lb boric acid

Boric Acid Corrosion Test Program Timeline



- IMT Gap: P-AS-01 Boric Acid Corrosion of Carbon and Low Alloy Steels (High Priority)
 - Gap will be closed with completion of activities this year

Use of Results

- Support Current Damage Predictions
- Enhance Technical Basis for Current Inspection Requirements
 - Supports use of visual inspections to ensure safety significant damage does not occur between inspections
 - Supports extended volumetric inspection intervals for mitigated CRDM penetrations
- Update Boric Acid Corrosion Guidebook (MRP-58)
 - Last revision 2001
 - Revise Guidebook to update operational experience and incorporate test results

Overall Conclusion

- Current Inspection Programs and Industry Practices are Effective in Ensuring Conditions Leading to Structurally Significant Boric Acid Corrosion Do Not Occur
 - Volumetric inspections to provide detection of flaws before leakage occurs
 - Visual inspections to provide early detection of leakage
 - Maintaining cleanliness of potentially affected areas
 - Coolant system leakage monitoring
- Conclusion Supported By Operating Experience Over the Last 10 Years

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