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Protecting People and the Environment

Overview of Spent Fuel Pool Neutron Absorbing Material Degradation

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Public Meeting on Neutron Absorbing Material Degradation

October 4, 2012

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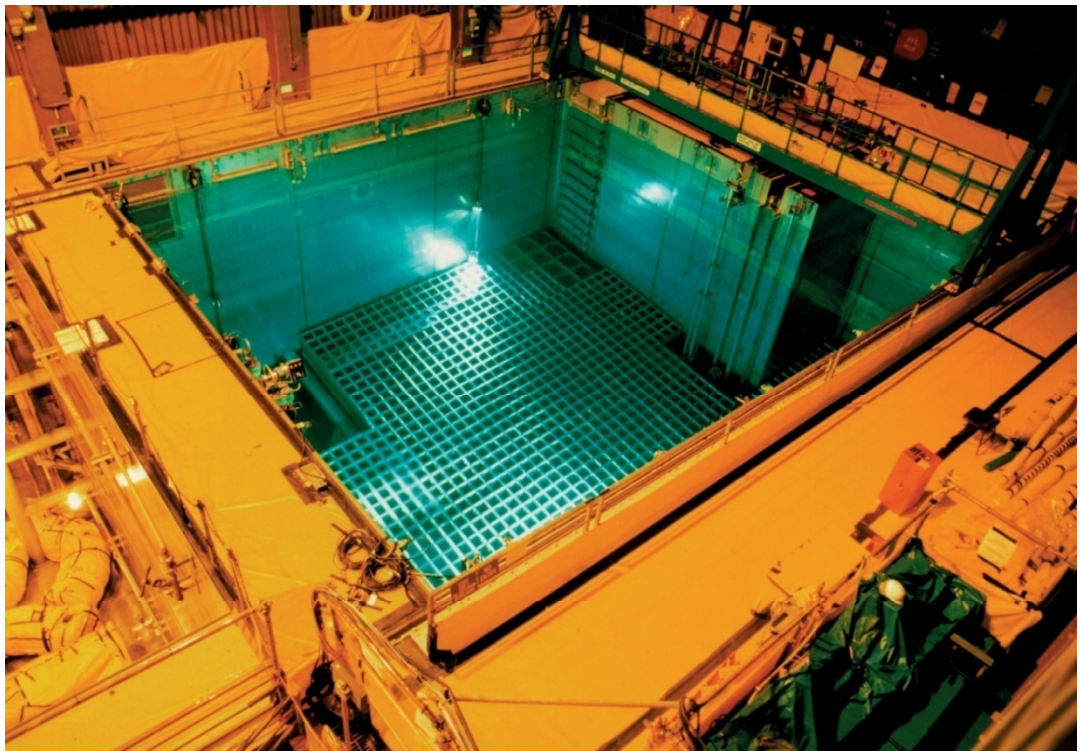
Overview

- Safety Significance
- Material Types
- Historical Issues
- Recent Events
- Staff Observations
- NRC Questions
- NRC Actions
- Knowledge Base
- Surveillance Methodologies



Picture: Spent Fuel Pool

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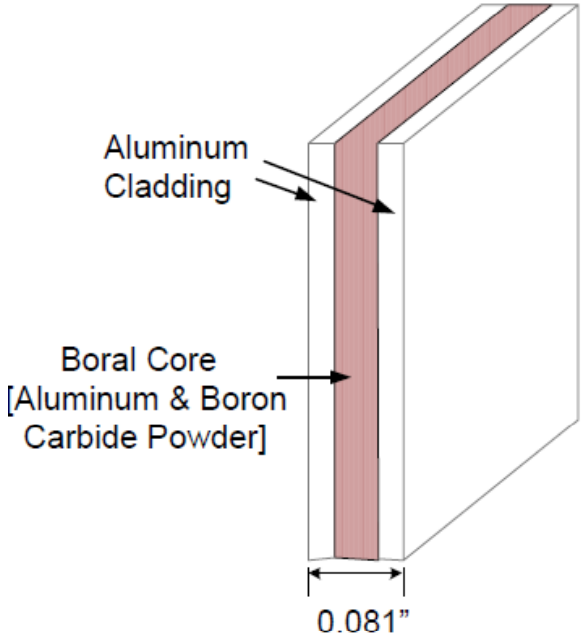
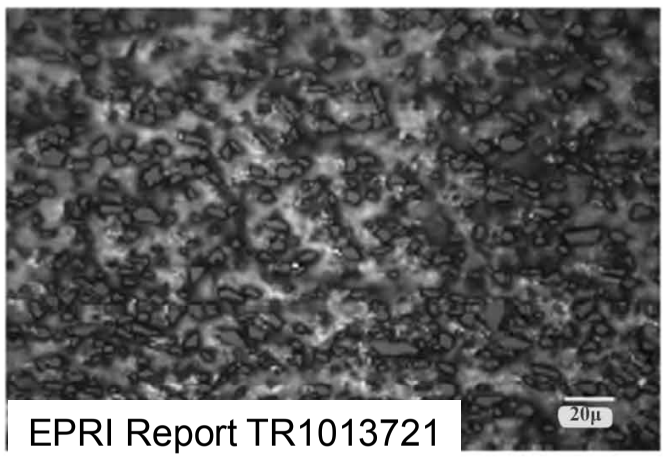
Safety Significance

- Prevent the occurrence of any inadvertent criticality events in the SFP
- Neutron absorbing materials have a direct impact on safety
  - Unidentified and unmitigated degradation poses a criticality and safety concern
  - Challenges compliance with NRC subcriticality requirements: 10 CFR 50.68 and GDC 62
- NRC staff has identified this issue as potentially safety significant

Material Types

- Most popular at US plants
  - Aluminum Boron Carbide Cermet
    - BORAL®
  - Non-metal Matrix Composites
    - Boraflex
    - Carborundum
  - Metal Matrix Composites
    - METAMIC®
- New Metal Matrix Composites
  - Bortec®
  - Alcan Composite

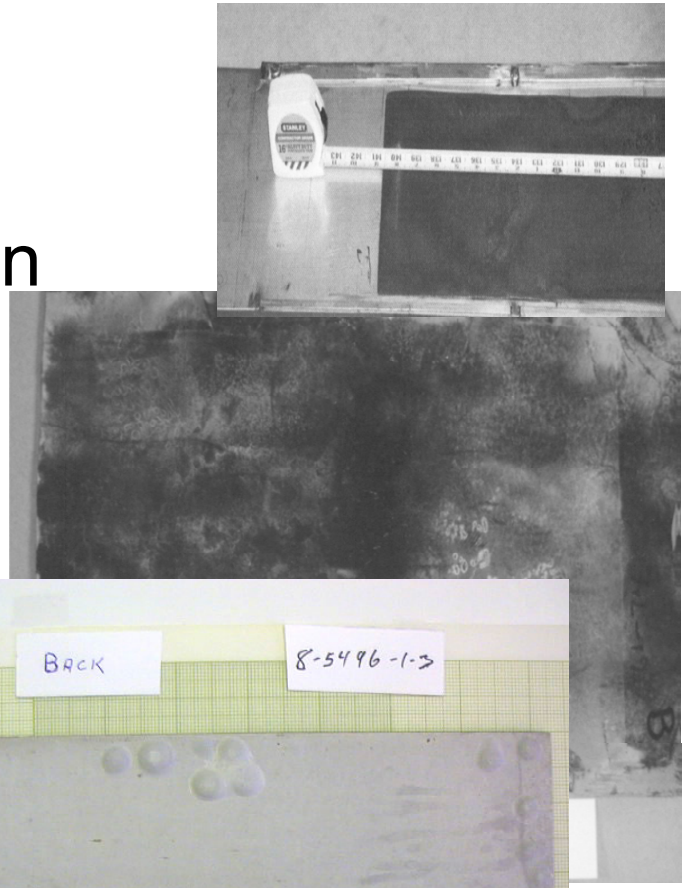


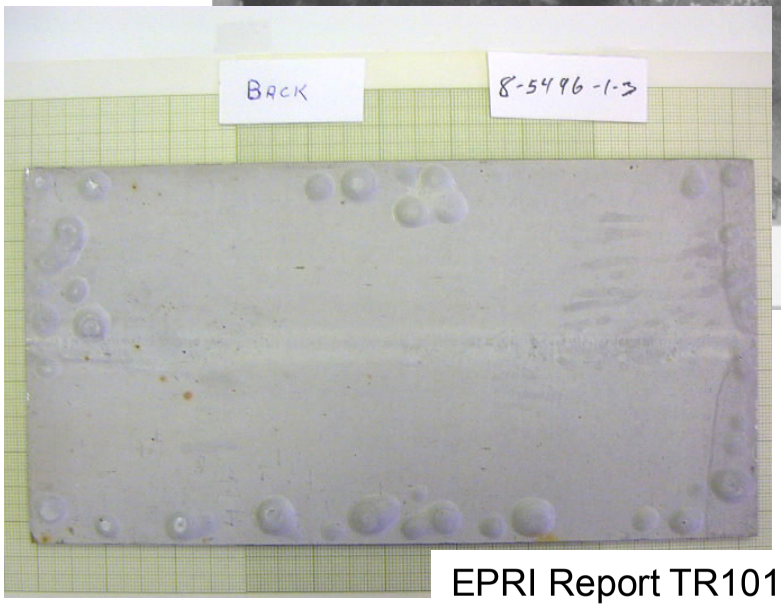


Pictures: BORAL® cross-section and Bortec® micrograph

Historical Issues

- Boraflex (1970s-1980s)
  - Silica polymer matrix degradation
  - INs: 87-43, 93-70, 95-38
  - GL 96-04: Maintain 5% margin
- BORAL® (1980's)
  - Blistering & bulging
  - IN 83-29





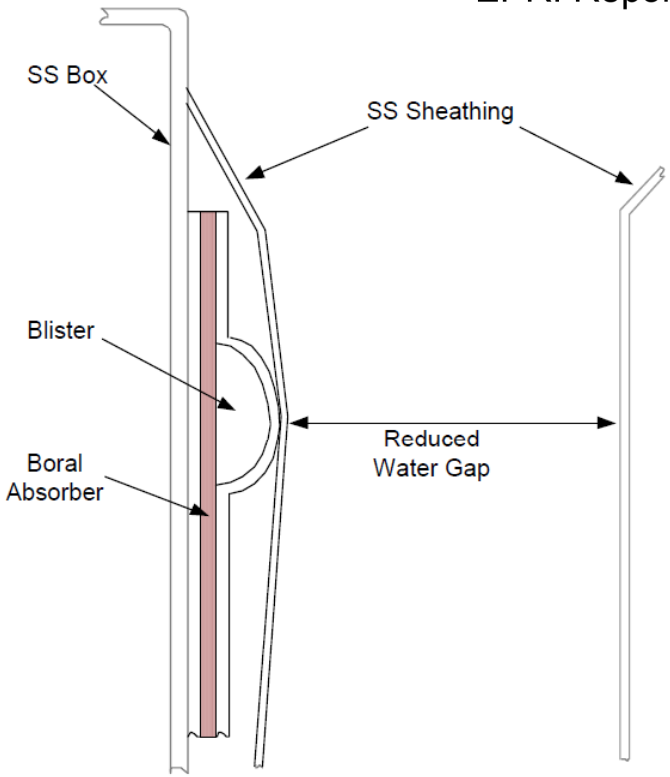
EPRI Report TR1013721

Pictures: In-service shrinkage and Boraflex removed from Spent Fuel Racks and Boral Blistering

Recent Events

- Carborundum, Palisades 2008
  - Stuck fuel assemblies
  - BADGER testing found up to 70% degradation
- BORAL®
  - Blistering
    - Seabrook 2003
    - Beaver Valley 2007
    - TMI 2008
  - Bulging
    - Susquehanna 2009

EPRI Report TR1013721



Picture: Carborundum microphotograph and example of Boral blister and bulge

Recent Events (con't)

- Boraflex
  - Turkey Point Unit 3, 2010
    - Areal density was less than the licensing basis
    - Ineffective implementation of corrective actions
    - Ineffective in identifying and mitigating degradation
  - Peach Bottom Unit 2, 2010
    - Panels degraded below the TS requirements
    - Ineffective implementation of corrective actions
    - Monitoring and mitigating the degradation not adequate
  - IN 12-13

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Staff Observations

- Surveillance program important to detect onset of degradation
- Effectiveness of surveillance monitoring programs impact management of the SFP
- Effective operating experience evaluation can lead to early identification
- Unknown degradation mechanisms and rates could result in reduced subcriticality margins.

NRC Questions

- Materials in each SFP and monitoring method
- Monitoring and mitigating the material degradation
- Degree of accuracy of in-situ neutron attenuation measurements
- Surveillance intervals to monitor degradation
- Material degradation affect on the criticality analysis

NRC Actions

- IN 09-26, LR-ISG 2009-01, update to GALL (NUREG 1801 Rev 2), and IN 12-13
- NRC evaluating material degradation mechanisms, surveillance techniques, and predictive modeling
  - Literature knowledge base
  - Confirmatory research on the surveillance methodology
  - Confirmatory research on the surveillance interval adequacy

Knowledge Base

- Current NRC state of knowledge
  - Commercial and decommissioned SFPs
  - Lists materials in each SFP
  - Periodically updated
- Issued public
  - Technical Letter Report: ML113550241
  - Spreadsheet: ML121090500

Surveillance Methodologies

- Boraflex methodologies (predictive code and in-situ method) examined
- Reports published
  - TLR on Boraflex, RACKLIFE, and BADGER methodologies: ML12216A307
  - TLR on BADGER tool: ML12254A064
- BADGER report pertains to all neutron absorbing materials