



Reactor Materials Aging Management Issues

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Agenda

- **Operating Reactor Issues**
 - **J. Lubinski**
- **License Renewal Activities**
 - **B. Holian**
- **Research Activities**
 - **M. Case**

Operating Reactor Issues

John Lubinski

Acting Division Director

Division of Component Integrity

Office of Nuclear Reactor Regulation

Established Regulatory Programs

- **Reactor vessel integrity**
- **Reactor vessel head penetrations**
- **PWR dissimilar metal butt welds**
- **BWR reactor vessel internals**
- **Steam generators**

Industry and Standards Interactions

- **Industry materials initiative NEI 03-08**
- **Industry materials program technical and executive meetings**
- **ASME Code interactions**

Current Focus

- **Primary water stress corrosion cracking**
- **Ultrasonic testing in lieu of radiography**
- **High-density polyethylene piping**
- **PWR reactor internals issues**
- **License renewal interfaces**

Materials Issue Regulatory Programs

- **Established processes to address materials degradation issues**
- **Positive industry interactions on materials issues**
- **Proactively addressing potential materials issues**

License Renewal Activities

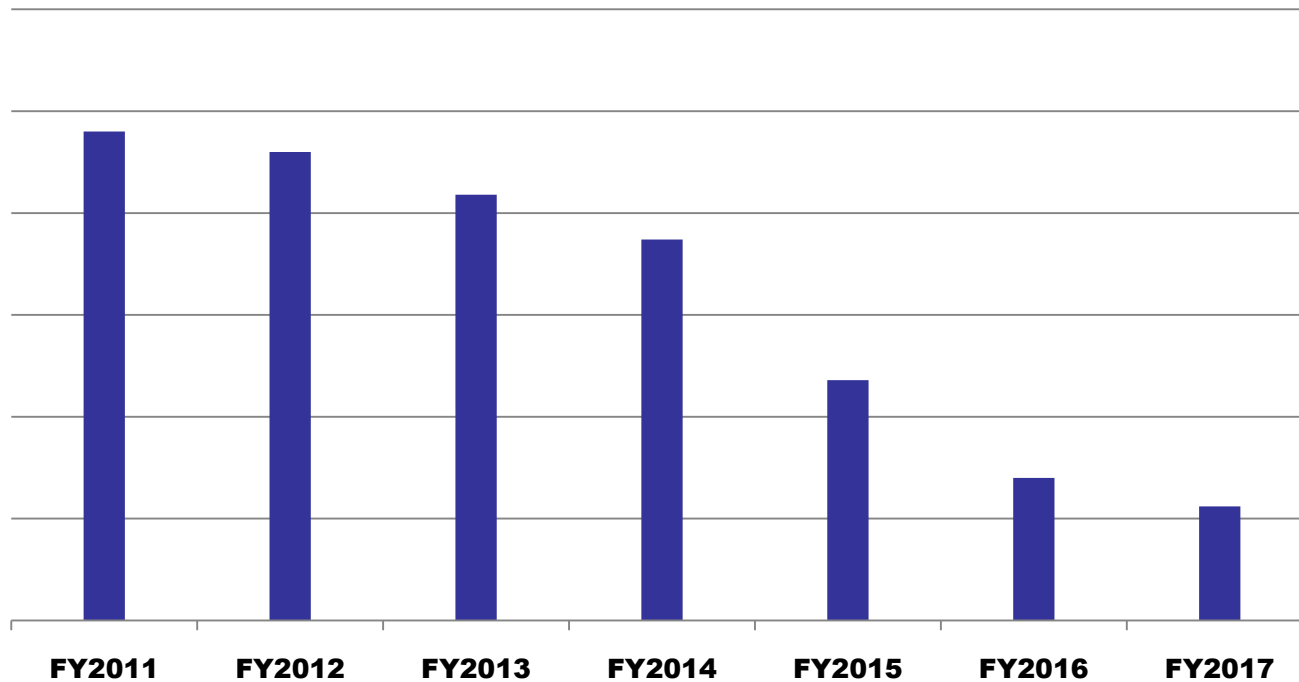
Brian E. Holian

Division Director

Division of License Renewal

Office of Nuclear Reactor Regulation

License Renewal Workload



Status of License Renewal

- **62 licenses renewed**
- **20 under review**
- **20 scheduled**
- **2 not scheduled**

Examples of Materials Issues

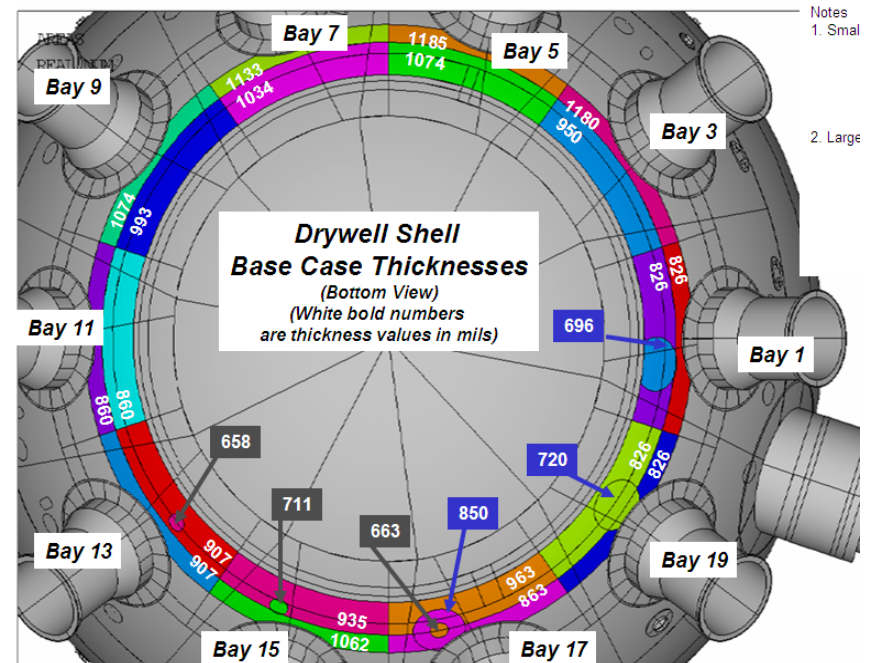
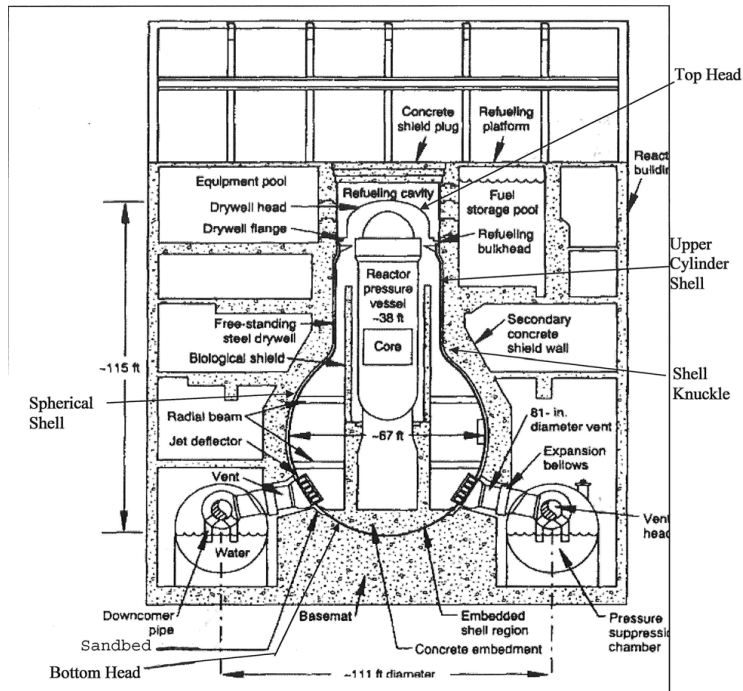
Metal Fatigue

- **On-site audits identified issues with simplified stress calculations**
 - **Issued generic correspondence**
- **License renewal reviews include environmental effects**

BWR Drywell

- **Issue**
 - **Corrosion of drywell shell has reduced wall thickness**
- **Status**
 - **Thickness measurements verify acceptability**
 - **Restored and coated**
 - **Commitments to thickness verifications**

BWR Drywell



Drywell Shell

Before



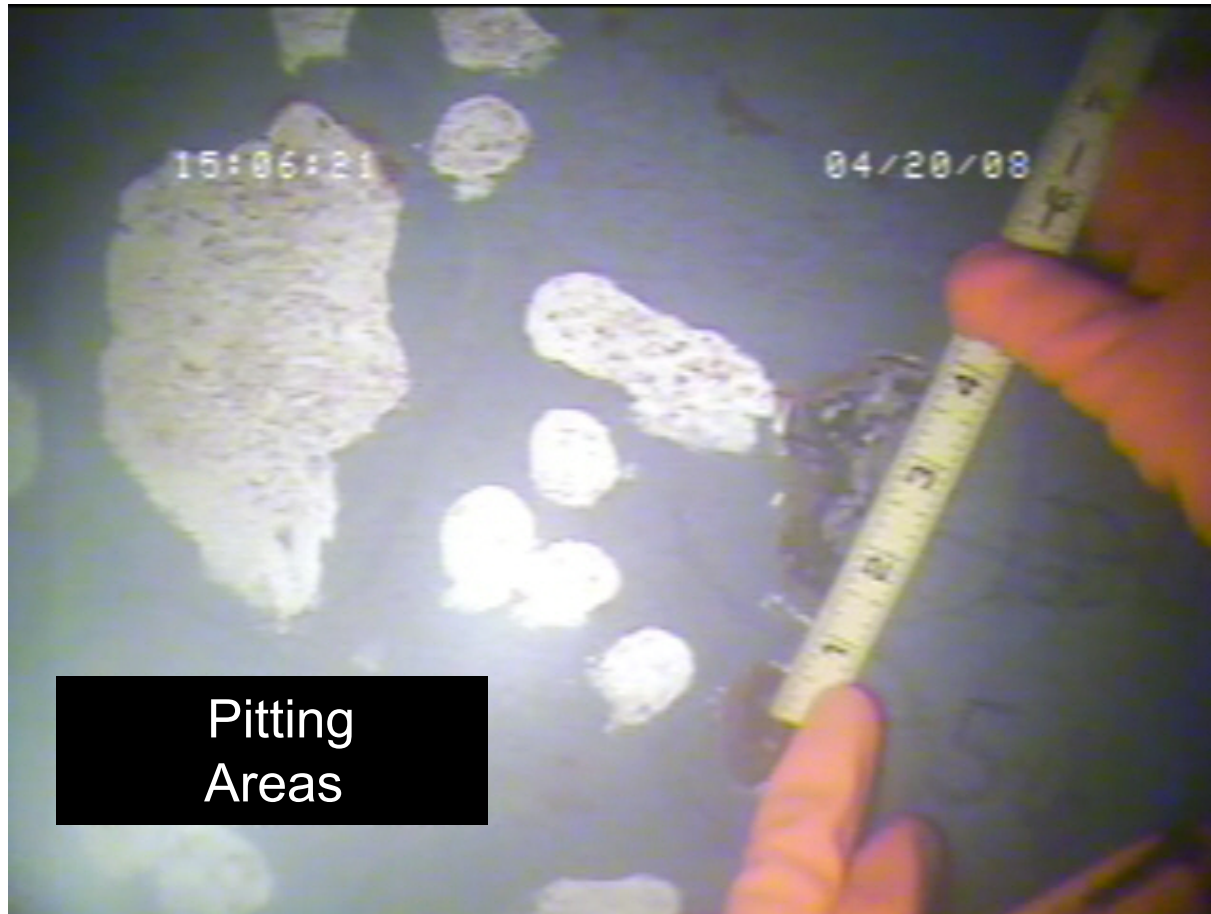
After



Torus Pitting

- **Issue**
 - **History of degradation and repairs may challenge integrity**
- **Status**
 - **Commitments for cleaning, re-coating, and continued inspection**

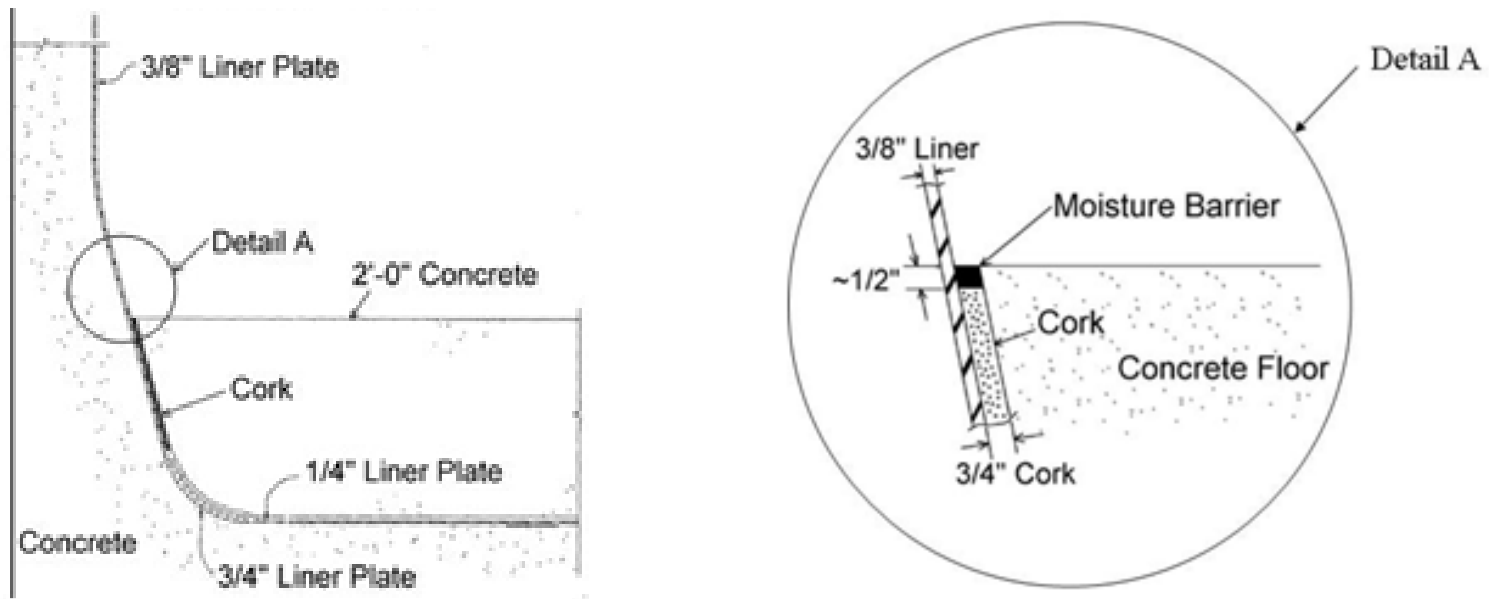
Torus Pitting



Containment Liner Issues

- **Issue**
 - **Corrosion (internal and external) and bulges**
- **Status**
 - **Structural analyses verify integrity**
 - **Commitments to enhanced volumetric and visual examinations**

Containment Liner Interface Degradation



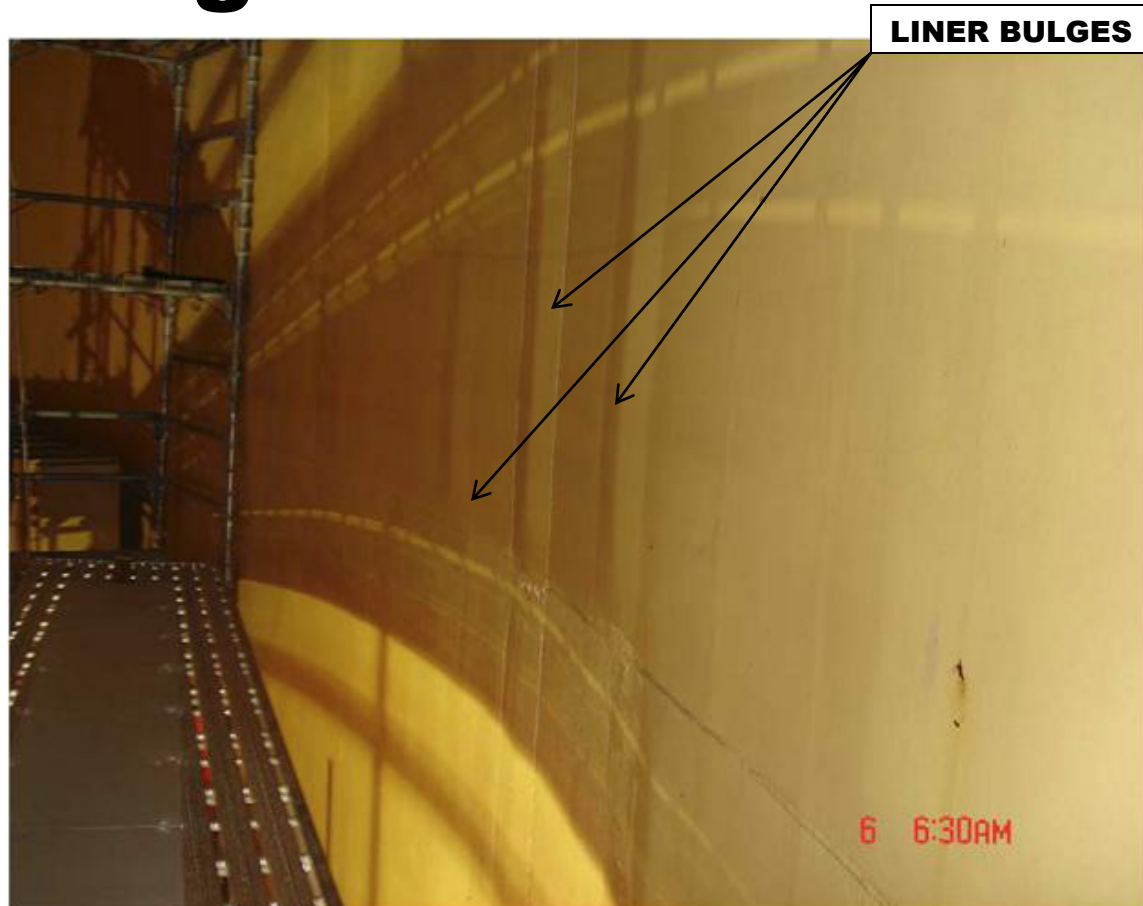
Containment Liner Corrosion



Degraded Containment Liner



Liner Bulges



Underground and Buried Piping

- **Issue**

- **Degradation can occur in limited access and buried piping – internal and external causes**

- **Status**

- **Commitments to augmented examinations and development of enhanced inspection techniques**
- **Credit for preventive measures**

Underground Piping



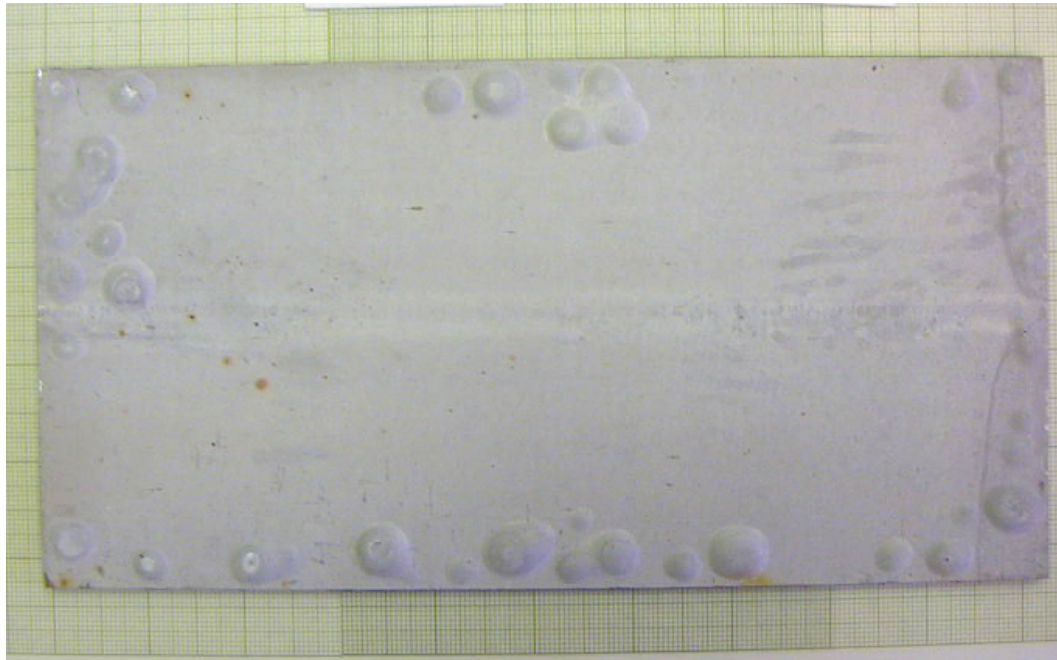
Buried Piping



Neutron Absorber Blistering

- **Issue**
 - **Blistering and other degradation can affect criticality assumptions**
- **Status**
 - **Commitments for enhanced examinations of test samples or in-situ measurements**

Neutron Absorber Blistering



Electrical Cable Submergence

- **Issue**
 - **Audits identify underground cables subject to wet environment**
- **Status**
 - **Inspection program to verify that licensees are maintaining cables dry**
 - **NRC improving electrical testing guidance**

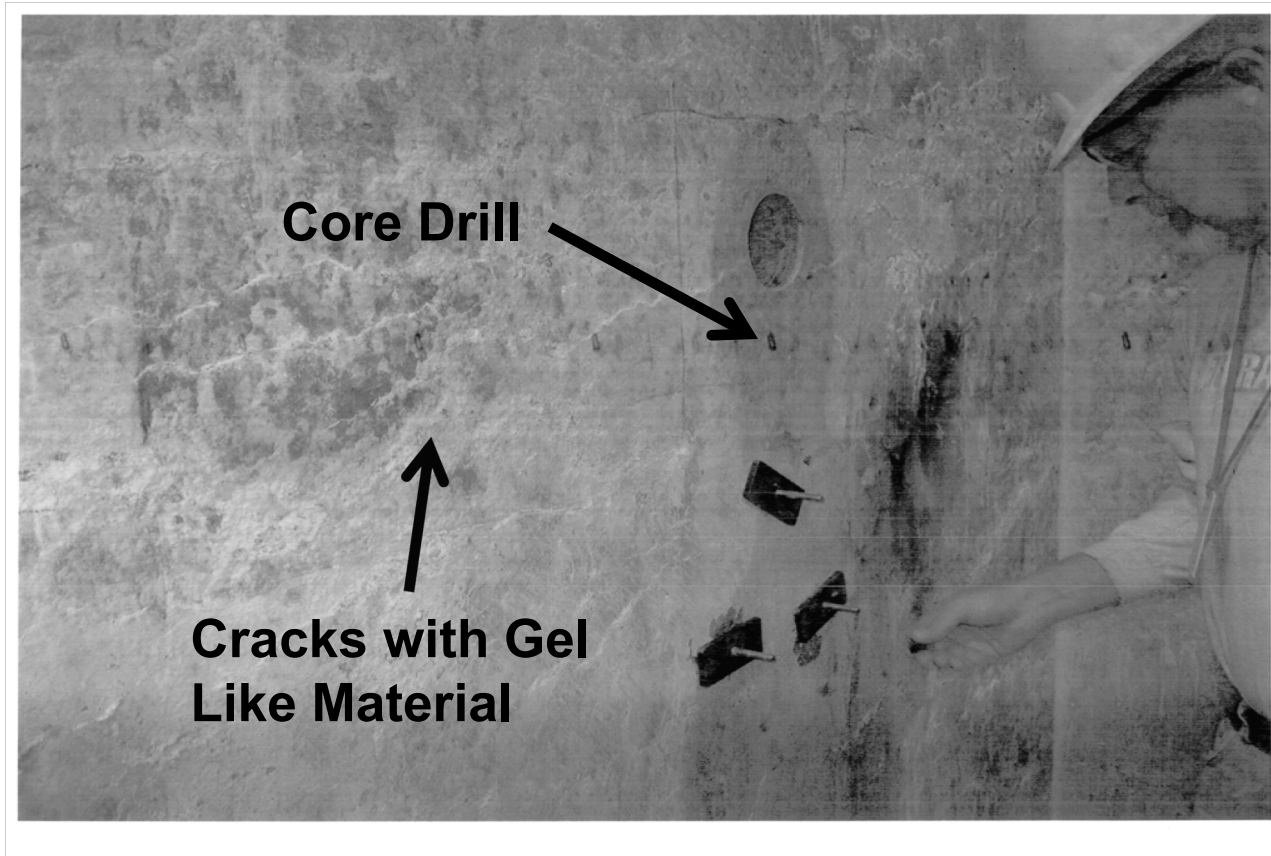
Electrical Cable Submergence



Concrete Issues

- **Issue**
 - **Cracks and spalling create integrity concerns**
- **Status**
 - **Enhanced commitments for examinations and criteria for repair**

Concrete Degradation



“Representative” Good Material Condition

- **Issue: “No issue”**





License Renewal Guidance

- **Generic Aging Lessons Learned and Standard Review Plan**
 - **Extensive internal and external stakeholder involvement**
 - **Updated Aging Management Programs**
 - **Some industry feedback on “process”**
- **Generic Environmental Impact Statement**

Aging Management Program

- **Buried Piping (AMP XI.M41)**

Material	Preventive Action	Inspections
Steel	C	1
Copper	D	2
Aluminum	E	2

Regional and Advisory Committee Contributions

- **Inspections**
 - **During application review**
 - **Prior to period of extended operation**
- **Advisory Committee on Reactor Safeguards**
 - **Independent Review of Application and Safety Review**

Preparation for Potential Subsequent Renewals

- **RES assistance**
- **Public workshops**
- **Assess need for new or different aging management programs**
- **Guidance documents for subsequent renewals**

License Renewal Conclusions

- **Program is highlighting current issues**
- **Guidance updates (GALL) and inspections are effective**
- **Gauging effectiveness and preparing for the future**

Research Activities

Michael Case

Division Director

Division of Engineering

Office of Nuclear Regulatory Research

Ongoing Programs

- **Reactor pressure vessel and piping integrity**
- **Non-destructive examination**
- **Steam generator tube integrity**
- **Environmentally-assisted degradation**
- **Extremely Low Probability of (Pipe) Rupture**

Responding to Current Focus Activities

- **Containment liner degradation**
- **Neutron absorber degradation in spent fuel pools**
- **High-density polyethylene piping**
- **Project example: Davis Besse replacement vessel head cracking**

Extending Research to Long Term Operation

- **Evaluate impact of prolonged exposure to reactor environmental conditions**
- **Extend scope of current programs**
- **Identify new materials degradation issues**

Identification of Materials Degradation Issues for Extended Operation

- **Integration of PMDA into GALL report**
- **Expanded Materials Degradation Assessment**
- **Evaluation of AMPs**

Identification of Materials Degradation Issues for Extended Operation (cont.)

- **Collaborative activities**
 - **Department of Energy**
 - **Electric Power Research Institute**
 - **International organizations**
- **Recovery of ex-plant materials**

Potential Technical Challenges Areas for Extended Operations

- **Reactor pressure vessel and internals**
- **Electrical cable insulation**
- **Concrete structures performance**
- **Buried and submerged structures**

Materials Research Programs

Conclusions

- **Most materials research directly supports operating reactors**
- **Operating reactor research informs extended operation**
- **Targeted activities identify and evaluate challenges that are unique to extended operation**

Acronyms

- **AMP – Aging Management Program**
- **ASME - American Society of Mechanical Engineers**
- **BWR – Boiling Water Reactor**
- **GALL – Generic Aging Lessons Learned (report)**

Acronyms

- **NEI – Nuclear Energy Institute**
- **PMDA – Proactive Materials Degradation Assessment**
- **PWR – Pressurized Water Reactor**
- **RES – Office of Nuclear Regulatory Research**