NEI 03-08 Industry Materials Initiative

Refresher and Successes

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Underlying Premise and Challenge for Utilities

Primary system materials integrity is vital to plant performance and reliability

Reactor components operate in a harsh environment (temperature, stress, radiation, etc.)

Aging of plant system materials is complex and not always fully understood

Routine surveillances can mitigate some of these factors; however, some failures can be expected

Challenge: Find the next material vulnerability and address it before any safety issues occur

Operating Experience through 2002

Reactor Internals components:

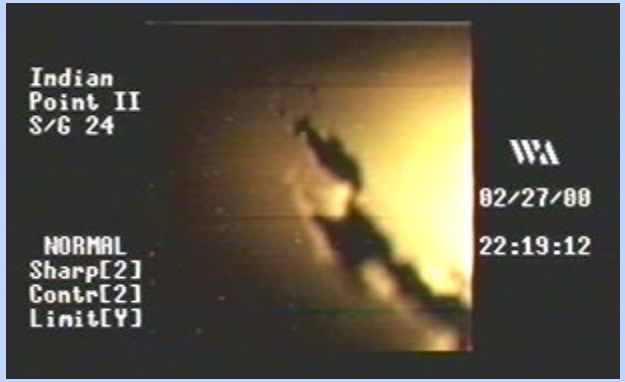
- BWR
  - Core shrouds
  - Core spray piping
  - Jet pump beams
  - Jet pump inlet piping
  - Top guides
  - Steam dryers
  - Fuel support castings
- PWR baffle bolts and split pins

Pressure boundary items:

- BWR recirculation piping
- BWR CRD stub tubes
- Steam Generator tubing
- Pressurizer heater sleeves
- Primary system full penetration butt welds
- PWR reactor vessel bottom mounted nozzles
- PWR CRDM head penetrations

Call to Action

- BWRs had programs dealing with IGSCC:
  - Piping covered by GL 88-01 and then BWRVIP-75; Reactor internals managed by BWRVIP program
- Series of PWR events motivated industry executives to take broad generic action



Indian Point (February 2000): SG tube leak hidden by noise in NDE signal

NRC Info Notice IN-00-09

V.C. Summer (Fall 2000): Crack in a hot leg nozzle to pipe weld

NRC IN-00-17

Various Sites Leaking PWR CRDM head penetrations

Davis Besse (March 2002): CRDM penetration leakage and head wastage

NRC Generic Letter GL-97-01,
IN-01-05, Bulletin BL-01-01, BL-02-01, BL-02-02,
Order EA-03-009, First Revised Order EA-03-009

NEI 03-08 Materials Initiative borne out of Operating Experience

Impact of Unexpected Operating Experience (OE)

- Unanticipated impacts of expected or unplanned materials degradation
  - Events were costly and seriously impact reliability, safety, and performance
    - Davis-Besse – more than $500M
    - Unplanned head replacement ~ $60M to $100M and up for each new head
    - Unanticipated RPV penetration repairs ~$65M
    - Lost generation daily replacement power
    - Increased dose exposure
  - Increased regulatory involvement and oversight
  - Quality of life of utility work force
- Something had to be done

Note: Costs are in 2002 dollars

Executive Direction to Identify and Address the Issues

- In August 2002 the Nuclear Strategic Industry Advisory Council (NSIAC) Executive Committee directed industry to:
  - Proactively address material issues
  - Assess the industry's materials programs to identify strengths, weaknesses, and make recommendations

What will fail next?

When will it fail?

Are replacement materials susceptible?

Must anticipate and stay ahead of problems!

Key Conclusions from Materials Programs Self Assessment

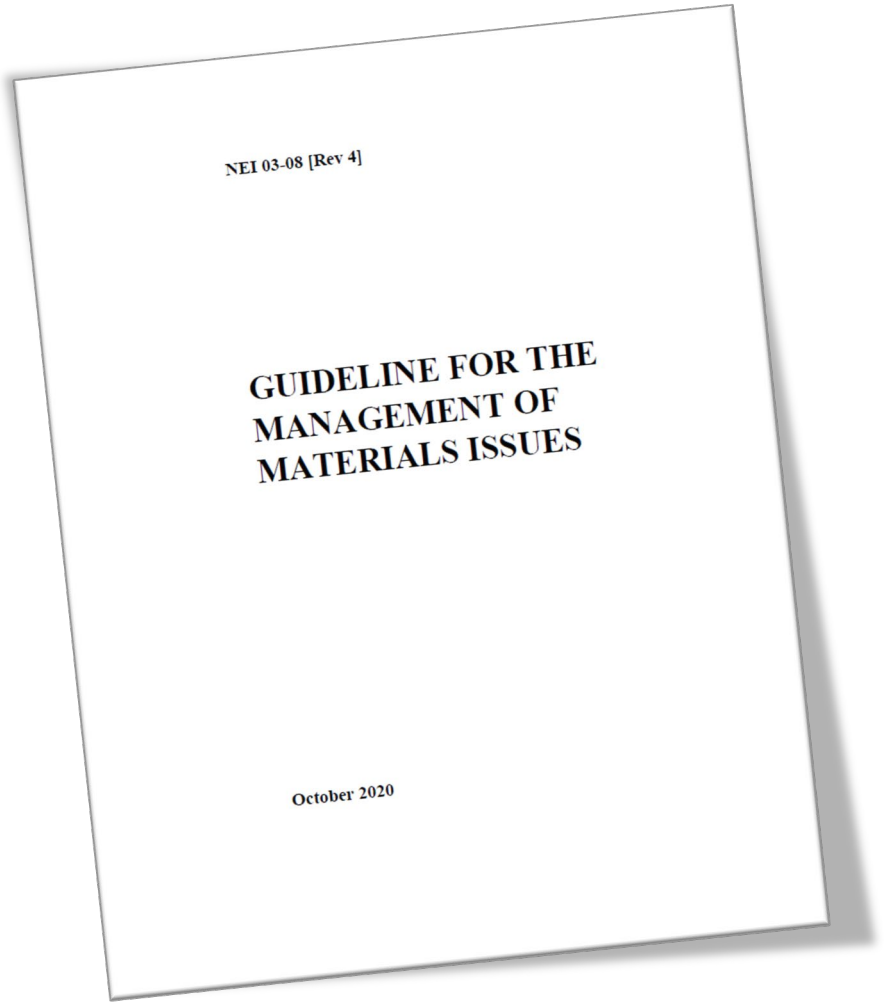
Recommendation: Define a NSIAC Initiative to address materials aging management

What is an NSIAC Initiative?

- Formal agreement among the utility companies' Chief Nuclear Officers (CNOs) that form the Nuclear Strategic Issues Advisory Committee (NSIAC) to follow a defined policy
  - Requires 80% vote of the NSIAC for approval
- Binding industry commitment at CNO level for full implementation
  - Not a formal regulatory commitment
  - Provides regulatory credibility
  - Deviation process involves an informal regulatory commitment

NEI 03-08, Guideline for the Management of Materials Issues

- Documents the Materials Initiative and defines the scope
- Establishes policy - ***Each licensee will endorse, support and meet the intent of NEI 03-08***
- Defines roles, and responsibilities
  - Executive / Management oversight
  - Issue Programs (IPs)
  - Utilities
- Approved unanimously by NSIAC in May 2003
- Initiative was effective January 2, 2004



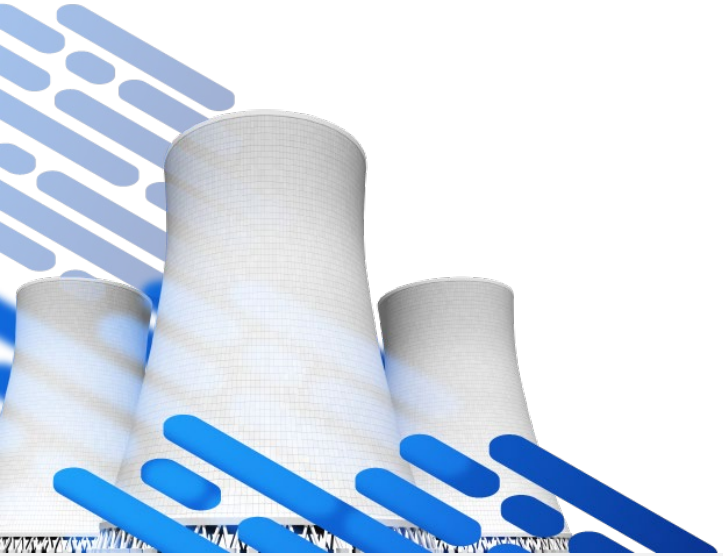
Current version is Revision 4, effective October 2020

NEI 03-08 Materials Initiative Objective and Purpose

- The objective is to assure safe, reliable and efficient operation of the U.S. nuclear power plants in the management of materials issues.
- The purpose of this Initiative is to:
  - Provide a consistent management process
  - Provide for **prioritization of materials issues**
  - Provide for **proactive approaches**
  - Provide for integrated and coordinated approaches to materials issues
- Utility actions required by this Initiative include:
  - Commitment of executive leadership and technical personnel
  - Commitment of funds for materials issues within the scope of this Initiative
    - High priority, emergent, and long-term issues
  - Commitment to implement applicable guidance documents
  - Provide for oversight of implementation

NEI 03-08 Scope and Issue Programs

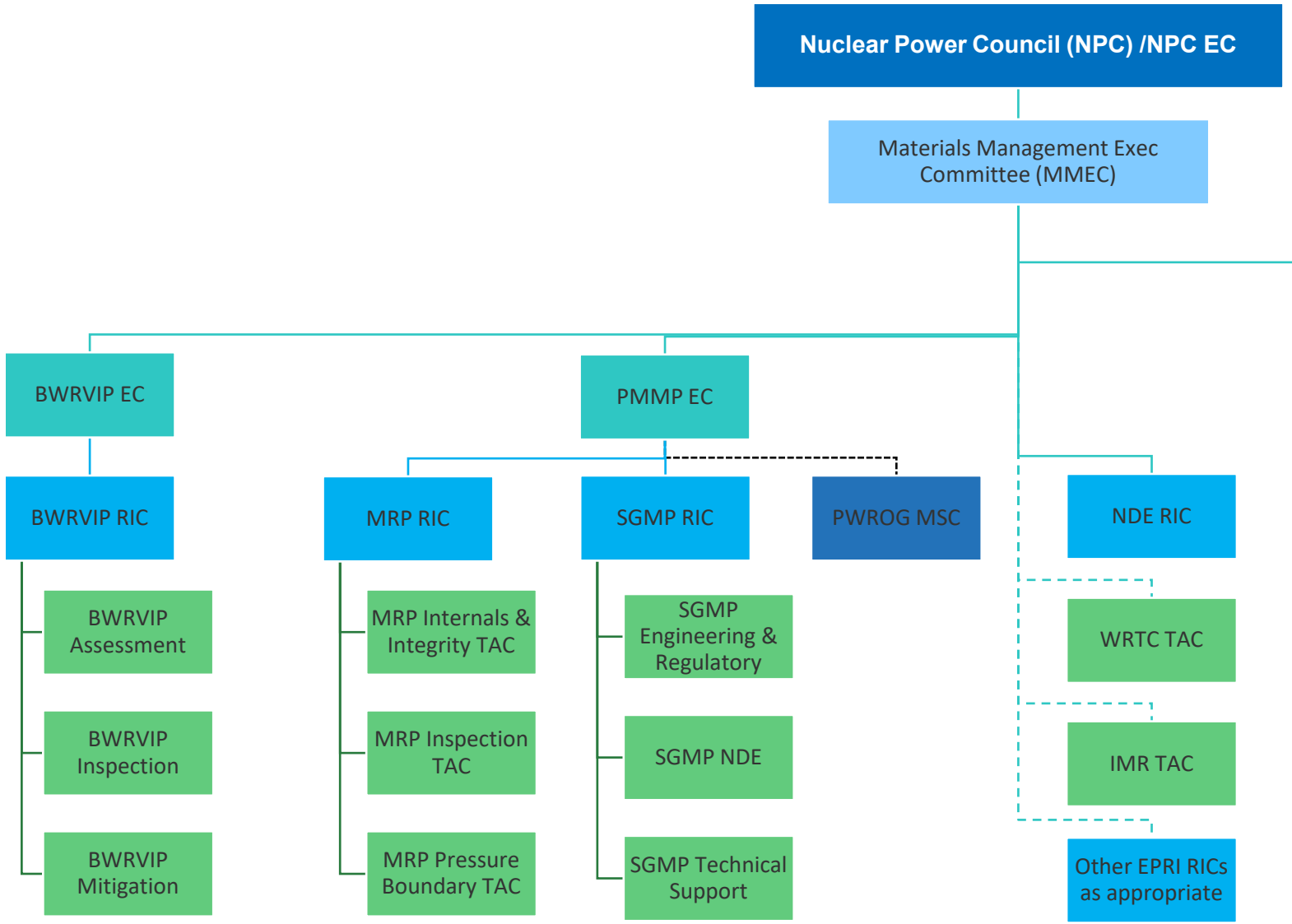
- Scope
  - Reactor internals
  - Primary system pressure boundary components
  - Related NDE, chemistry and corrosion controls
  - Other as directed by NSIAC



- Issue Programs (IPs)
  - EPRI
    - BWR Vessel & Internals Project (BWRVIP)
    - Materials Reliability Project (MRP)
    - Steam Generator Management Program (SGMP)
    - Nondestructive Examination Program (NDE)
    - Water Chemistry Control Program (WCC)
  - PWR Owners Group Materials Committee (MSC)

Note: some program names have changed since inception

Materials Organizational Structure



- Call to maintain industry communication and coordination per NEI 03-08
- MAPC members to include:
  - CNO as chair to coordinate with NSIAC
  - Executive and Technical chairs of the Materials Programs
  - At-large members for fleet representation
  - INPO and NEI representatives

NEI 03-08 Expectations

Materials Issue Programs

- Identifying, prioritizing, and resolving issues
  - Communicating
  - Managing regulatory interface
  - Developing guidance
  - Reviewing deviations
  - Self assessments and performance metrics
- Process for addressing emergent materials issues
- Process for screening whether revised or replacement aging management guidance may be implemented without NRC review and approval when the guidance it is replacing was previously NRC approved
  - See NEI 03-08, Appendix C

- **Utility responsibilities** (shall)
  - Maintain an RCS Materials Degradation Management Program
  - Implement “Mandatory” and “Needed” IP guidance
  - Participate in Issue Programs
  - Apply appropriate focus on materials issues
  - Communicate materials Operating Experience (OE)
    - ***Utilities shall communicate new materials issues with generic significance to the industry in order to allow an evaluation of the generic aspects of the information in a timely manner.***

NEI 03-08 sets an expectation for proactive materials aging and degradation management

NEI 03-08 Implementation Requirements

- NEI 03-08 guidance is classified as follows:

Mandatory

To be implemented at all plants where applicable

Substantial safety impacts, high risk, threat to continued operation (shall)

Needed

To be implemented whenever possible, but alternative approaches are acceptable

Reliability concern, moderate risk, significant financial impact on entire industry (should)

Good Practice

Implementation is expected to provide significant operational and reliability benefits, but the extent of use is at the discretion of the individual plant or utility

Reflects an industry standard of performance (may)

NEI 03-08 Implementation Requirements

- In practice, “Mandatory” and “Needed” guidance is required unless a formal deviation disposition is processed (similar to a ASME Code Relief Request)
  - The only difference for a deviation from “Mandatory” guidance versus one from “Needed” guidance is that deviating from “Mandatory” guidance requires independent 3rd party concurrence

Deviations to NEI 03-08 Guidance – Utility Actions

- When a utility determines that:
  - "Mandatory" or "Needed" work product elements will not be fully implemented or will not be implemented in a manner consistent with their intent, or when
  - A work product will not be implemented within the timeframe specified by the responsible Industry IP,

- A technical justification for deviation shall be developed and retained with the utility's program documentation or owner-controlled tracking systems (CAP)
  - In addition, deviation from "Mandatory" and "Needed" work product elements shall receive final concurrence from the responsible utility executive
  - "Mandatory" deviations additionally require concurrence by a knowledgeable materials expert independent of the utility justifying the deviation

- Note that for "Good Practice" elements no written justification for deviations is necessary

Deviations to NEI 03-08 Guidance – Utility Actions (cont'd)

- Timing for reporting deviations
  - To the responsible Issue Program
    - The utility shall notify the responsible IP of any obstacles or questions associated with conformance to Mandatory or Needed guideline elements as soon as practical after these concerns are identified
    - If a deviation justification is prepared, the approved deviation shall be sent to the responsible IP as soon as possible but no later than 45 days after approval by the utility executive
  - To the NRC
    - The notification should occur at about the same time as the justification for deviation is sent to the IP

Deviations to NEI 03-08 Guidance – IP Actions

- Upon receipt of a submitted deviation, the applicable IP shall post the deviation on their website in a timely manner (e.g., within two months)
- The applicable TAC, or a team of cognizant utility and EPRI personnel from the applicable IP, will review each deviation in accordance with Section 8, Deviations, of NEI 03-08, Appendix B. The review includes the following considerations:
  - A determination as to any impact of the deviation on existing guidance
  - Technical sufficiency of the deviation basis. This review is not intended to constitute an independent review or an approval but is a general overview of the technical merits of the justification.
  - Generic applicability – generically applicable issues are reviewed for potential interim guidance or information letters
  - If the deviation contains insufficient detail, the review team may request additional information from the utility
- The IP shall notify the following organizations of deviations found to be technically insufficient and the reasons for that conclusion:
  - The utility that wrote the deviation
  - The applicable IP EOC for follow up with the responsible utility to address the insufficiently justified deviation
- The IP reports a summary of deviations to the applicable EC annually

Systematic Approach to Prioritizing Industry Issues

Materials Degradation Matrix

MDM

Every material, every potential degradation mechanism, and status of knowledge

- Mapped to 80 years of operation
- Covers BWR, PWR, CANDU, & VVER

Revision 5: 3002030559

Issue Management Tables

IMT

Every component/material, failure modes, mitigation, repair/ replacement, I&E Guidance → Knowledge Gaps identified and prioritized

- Covers BWR, PWR, CANDU, & VVER

PWR: 3002018255 (MRP-205, R4)

BWR: 3002018319 (BWRVIP-167, R4)

VVER: 3002021033 (MRP-471)

CANDU: 3002031002 (IMR-101)

US NRC Feedback on the NEI 03-08 Materials Initiative

- NEI 03-08 Revision 3 was transmitted to US NRC in March 2017
  - US NRC issued a "thank you" letter to NEI in April 2017
    - *NRC quote: "We find that the NEI 03-08 program is a valuable component in achieving **safe operation** of nuclear power plants." -John Lubinski*

- In 2023, NRC evaluated two options for action in their LIC-504 Risk Informed Safety Assessment of the French stainless steel piping stress corrosion cracking issue:
  - Option 1: **Establish targeted inspections** and revision of inspection requirements for these piping locations
  - Option 2: **Take No Action** but continue to monitor industry action
    - NRC chose Option 2 noting in a 2/21/2024 presentation:
      - "With the implementation of the [industry] NEI 03-08 "needed" recommendation, the locations most susceptible in the non-isolable piping will be inspected with a SCC qualified technique
        - Safety margins and performance monitoring will be maintained"

Since 2004, no Bulletins, Generic Letters*, or Orders were issued for industry materials issues

* GL 2006-01 issued to confirm utilities timeline for implementing industry/NRC developed TSTF-449 Rev 4

NEI 03-08 Materials Initiative Accomplishments

Integrated industry strategic plan for materials

Achieved a high level of industry integration, coordination, alignment, and communication on material issues

Established a process for prioritizing projects, budgets, and planning

Predictable funding for materials R&D

Engaged INPO as an active participant

Defined expectations and protocols for industry actions upon discovery of an emergent issue

Established consistent process for deviations and communication with NRC

Executive level interactions between industry and senior NRC management

Successful at closing materials issues and gaps

Fewer unexpected materials related transients

NEI 03-08 Benefit to U.S. and International Members

- Assures the Materials Programs are **well integrated**
- **Consistent** technical **quality and rigor** built into the work and products of the IPs
- Confidence that senior **management perspectives are included**, and programs will be **living programs**
- NEI 03-08 programs have effectively resolved / **manage generic issues** and gained **USNRC acceptance**
- Documents are **recognized world-wide** as **aging management tools**
  - Referenced in USNRC Generic Aging Lessons Learned (**GALL**)
  - Also recognized IAEA's International Generic Aging Lessons Learned report (**IGALL**)
- Shows the Materials Programs are an **excellent platform** from which to develop **plant** and **country specific aging management programs**


Questions?

Materials Management Policy Statement

- "… the industry will ensure that its management of materials degradation and aging is ***forward-looking and coordinated*** to the maximum extent practical. Additionally, the industry will ***continue to*** rapidly identify, react and ***effectively respond to emerging issues***. The associated work will be managed to emphasize safety and operational risk significance as the first priority, appropriately balancing long term aging management and cost as additional considerations. To that end, as issues are identified and as work is planned, the groups involved in funding, managing and providing program oversight will ensure that the ***safety and operational risk significance of each issue is fully established prior to final disposition***."

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