Industry Challenges and Successes

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Materials Initiative: NEI 03 – 08

- Genesis of today's industry materials focus
- Establishes policy, protocols and governance
- Defines roles, responsibilities and expectations
- Provides requirement for consistent implementation of industry I&E guidelines
- Establishes oversight committees and responsibilities
- Elevates expectation for industry to be proactive and strategic in management for RCS material integrity
- Provides forum to share OE, LLs, ideas and to develop the plans for industry actions on RCS material issues

NEI 03-08: Strategic Plan

- Safe, reliable and efficient operation of the U.S. NPPs in management of materials issues
- Multiple programs aligned into one team
  - Common goals and objectives
  - Executive leadership and oversight
- Aligned industry priorities
  - MDM and IMT gaps
  - Industry Roadmaps

NEI 03-08: Guidelines Implementation

- Key products in the overall strategy
- Methodical development effort
- Graded approach
  - Mandatory, Needed, Good Practice
- Deviation process
  - Exceptions documented, reviewed, reported
- INPO – Oversight role in industry's pursuit of highest standards

Focus Areas and Challenges

- Environmental effects on fracture resistance
- Environmental effects on fatigue life
- SCC of Ni-base alloys and stainless steels
- Effect of fluence on SCC susceptibility and crack growth rates
- Effect of fluence on reactor vessels
- PWR reactor internals inspections
- Alloy 52 welding issues

Recent Operating Experience

- Degradation due to flow induced vibration in jet pump components
- Unique indications found in BWR core shrouds
- Baffle barrel bolt heads and lock tabs found on core support plate
- T_{cold} RPVCH PWSCC indications in PWRs CRDMs
- Significant wear in replacement 690 steam generators
- Leakage encapsulation devices installed on Class 1 and 2 valves to arrest or prevent leakage at the body to bonnet flange
- Flaws not identified during a manual UT examination
- Cracks identified in J-groove weld at bottom mounted nozzle (non-US plant)
- Corrosion under cladding in steam generator lower head (non-US plant)

Successes

- Proactive, long-term perspective on materials issues
- Teamwork and collaboration among U.S. utilities, vendors, NSSS, and international partners
- Executive engagement and leadership for all industry material programs
- Stable and consistent funding for high priority and long term issues
- Sharing OE, lessons learned and emergent issues – U.S. and International
- Numerous guidelines developed to address industry needs
  - Guidelines serve as bases for ASME Code Cases
  - Others guidelines go beyond minimum code requirements
  - > 50 Mandatory and Needed guidelines
- NRC interactions (plant specific and industry generic)

Alloy 600 in PWR

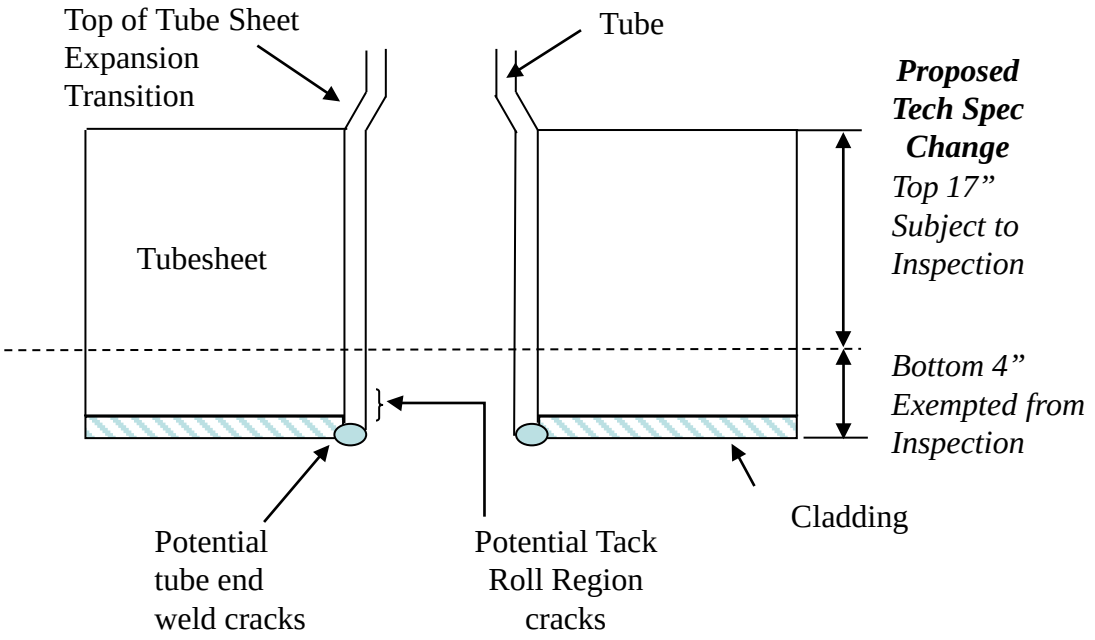
- ~2000 - 2005
  - Major impetus for and early focus of Materials Initiative
  - Significant source of financial and operational risk
  - Intensive regulatory focus
- 2012
  - Cooperative environment between industry and regulator
  - Comprehensive inspection guidance through industry, regulatory, and ASME Code actions
  - Expanding set of mitigation options for Alloy 600
  - Developed and have available an arguably mature set of replacement and repair options

SG: H* Alternate Repair Criteria

Direct benefits to numerous operating units

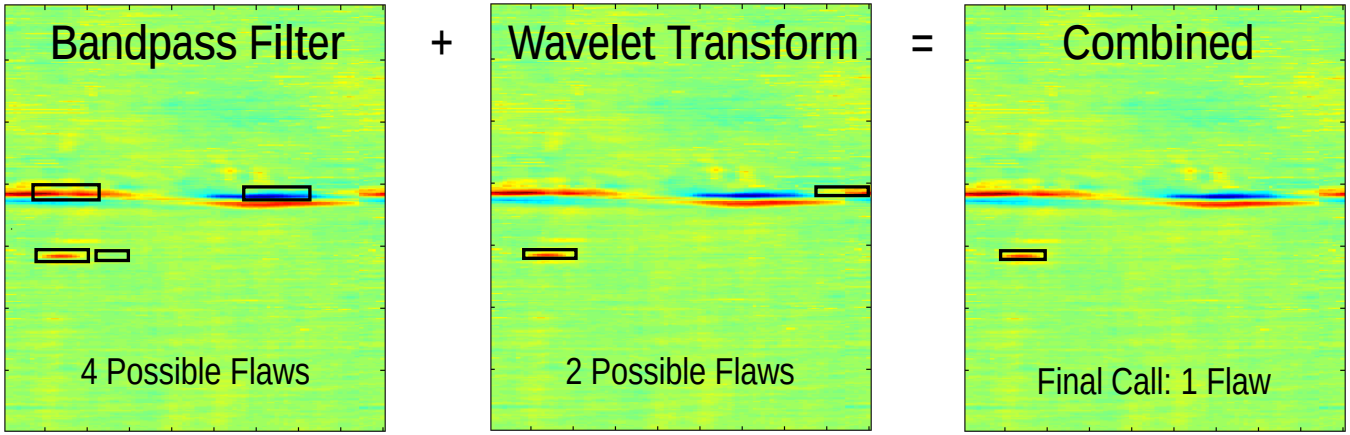
Potential impact to industry:

- Fewer SG tubes removed from service with H*



SG Tube Inspections: Automated Data Analysis

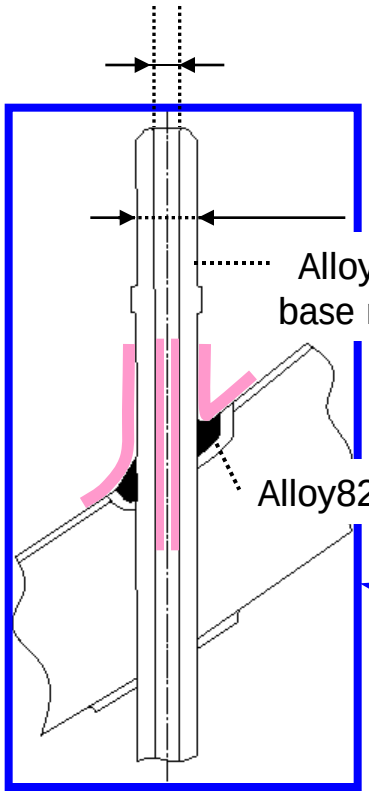
- Significant focus by EPRI to develop algorithms
- Single pass (1-party vs. 2-party analysis)
- High speed testing (rates increased 8 - 10 fold)
- Higher probability of detection and reduced overcalls
- Licensed to vendors and field deployed



Potential Peening Applications

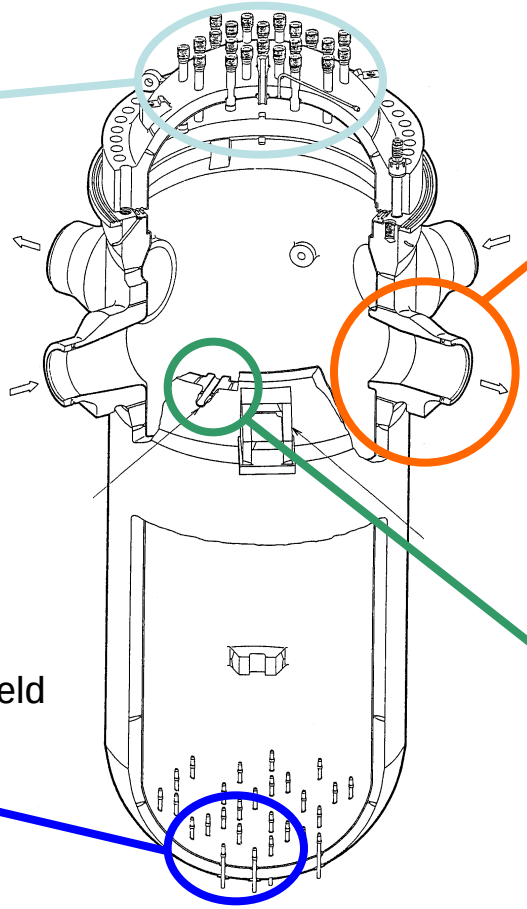
Reactor Closure Head Penetrations

- Nozzles and J-Welds

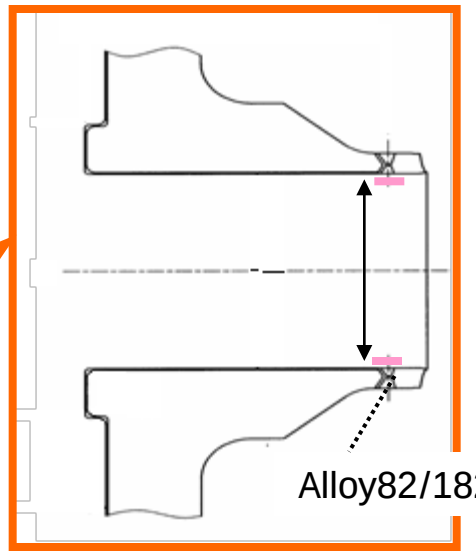


BMN penetrations

- Nozzles and J-Welds

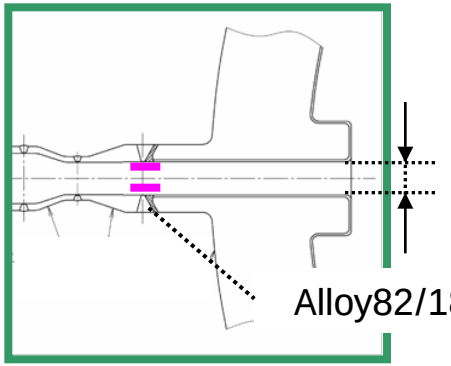


Reactor Vessel



Outlet / Inlet Nozzle Safe-end

- DM Butt-welds

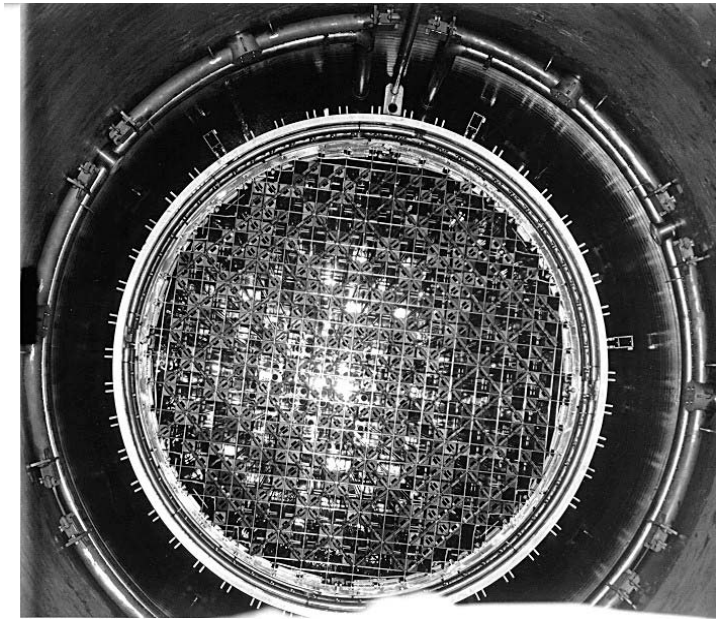


Safety Injection Nozzle safe-end

- DM Butt-welds

Inspection Optimization of BWR Internal Components

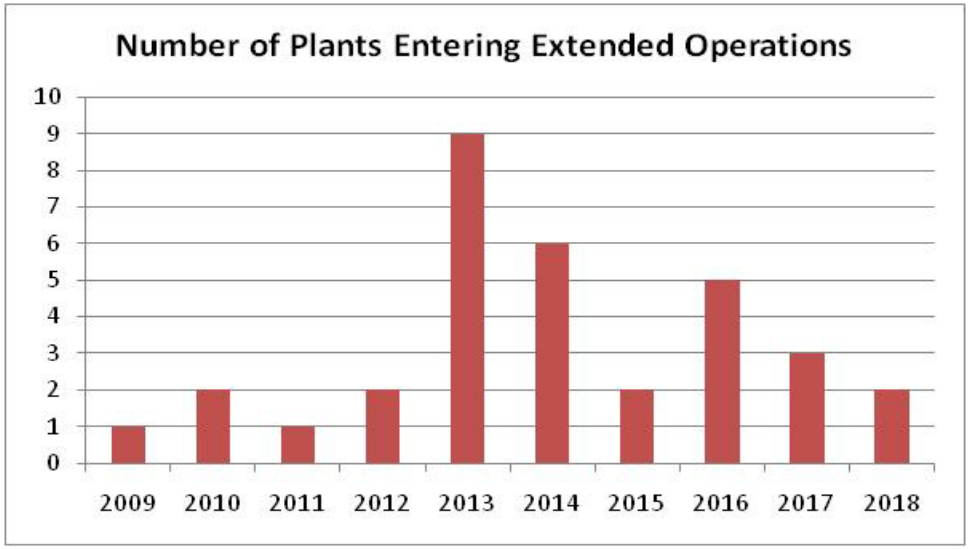
- Guidelines previously developed for all safety related components with incomplete understanding of degradation mechanisms and component susceptibilities
  - Typically no credit for mitigation (e.g., HWC, NMCA)
- BWRVIP produced strategy for optimization of core spray inspections leveraging over 20 years of inspection experience
  - Pending regulator approval
- Jet pump and shroud next in line



Up to 60% Reduction in Core Spray Inspections

Inspection of Internals in PWRs

- PWR Internals I & E Guidelines, MRP-227-A, Jan 2012
- Supports
  - License renewal commitments
  - Internals aging management
- Identifies
  - Components to be inspected
  - Timing of inspections



Experience to date shows limited internals degradation

Summary

- Industry has a comprehensive Materials Program for managing the effects of RCS materials aging
- Materials remains a key strategic area with broad support, commitment, and excellent teamwork
- Must remain proactive and avoid distractions and complacency