

Overview of Nuclear Regulatory Commission Activities Related to Materials Degradation

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July 21, 2012

Reactor Coolant System Pressure Boundary Issues

- Operating events
 - Alloy 600/82/182
 - Cold heads
 - Bottom heads
 - Dissimilar metal welds
 - Seal cap enclosures
- Pressure-temperature limits
 - Non-beltline
 - Risk-informed

Operating events

- Alloy 600/82/182 - **Reactor vessel head penetrations at cold head plants**
 - Primary water stress corrosion cracking at plants with low head temperatures in 2007, 2011, 2012
 - Current inspection requirements - 10 CFR 50.55a incorporates ASME Section XI, Code Case N-729
 - Finding of indications changes cold head plant inspection periodicity
 - NRR following inspection results to validate re-inspection periodicity requirements



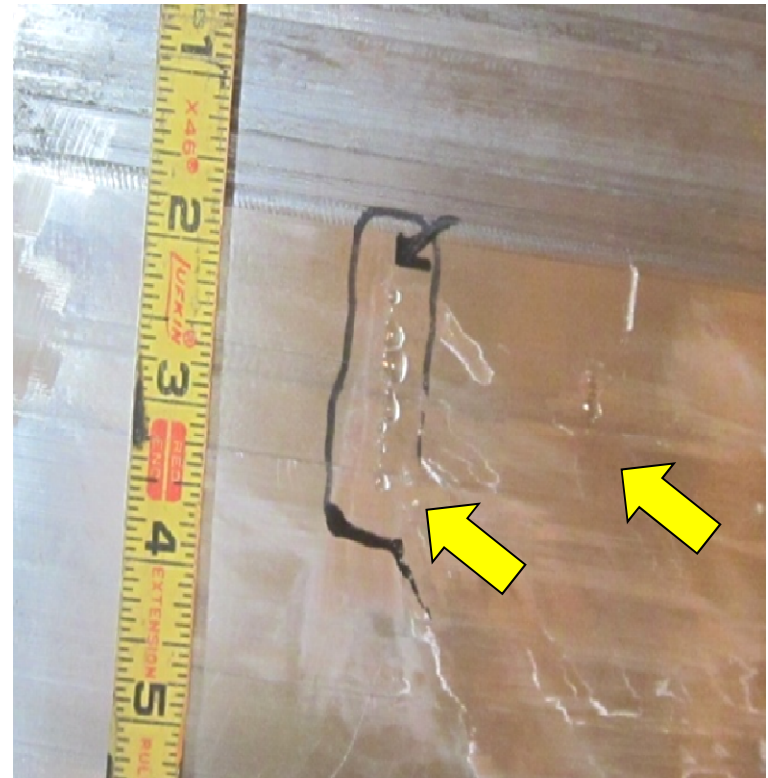
Operating events

- Alloy 600/82/182 - **Bottom head penetrations**
 - Probable second instance of PWSCC of Alloy 600/82/182 in bottom head penetrations
 - Current inspection requirements - 10 CFR 50.55a, incorporates ASME Section XI, Code Case N-722
 - » Visual inspection
 - NRC evaluating current requirements
 - Plants who plan to have internals removed and have access should consider performing volumetric inspection



Operating events

- Alloy 600/82/182 - **Dissimilar metal butt welds**
 - Current inspection requirements
 - 10 CFR 50.55a incorporates ASME Section XI, Code Case N-770
 - » Inspection coverage and periodicity requirements
 - Recent inspection missed large indications



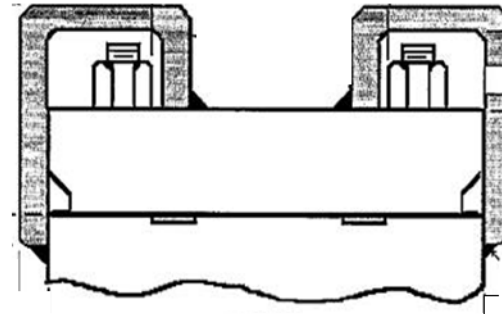
Operating events

- Alloy 600/82/182 - **Dissimilar metal butt welds**
 - NRC evaluating current implementation of inspection requirements
 - » Site-specific mock-ups
 - » Equipment qualification
 - » Encoded examinations



Operating events

- Seal Cap Enclosures
 - Installed on valves to capture gasket leakage
 - Obviates normal visual inspection of bolting
 - Inspection requirements
 - 10 CFR 50.55a
 - incorporates ASME
 - Section XI, IWA-1400(b)



Operating events

- Seal Cap Enclosures

- A-286 bolting

- » Operating experience includes instances of cracking
 - » Laboratory testing confirms susceptibility to stress corrosion cracking
 - » Actual environment more aggressive than any tested in the laboratory

- NRC evaluating industry activities



Pressure Boundary Integrity

- 10 CFR 50 Appendix G requires that pressure-temperature (P-T) limits be developed for all ferritic portions of the reactor coolant pressure boundary (RCPB):

*“This appendix specifies fracture toughness requirements for ferritic materials of **pressure-retaining components of the reactor coolant pressure boundary** of light water nuclear power reactors to provide adequate margins of safety...”*

- Reactor vessel
 - Beltline > fluence
 - Nozzles and flanges > high stresses
- Balance of RCPB > Lowest service temperature



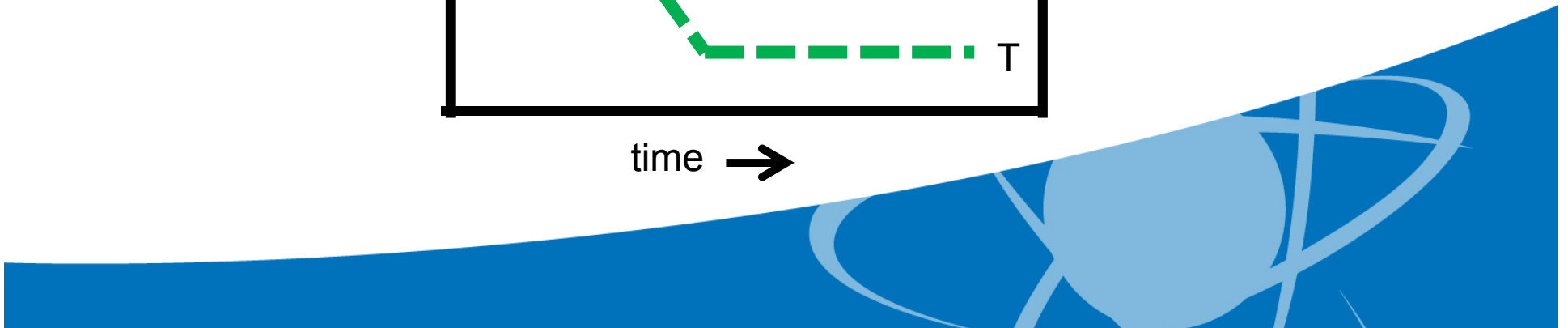
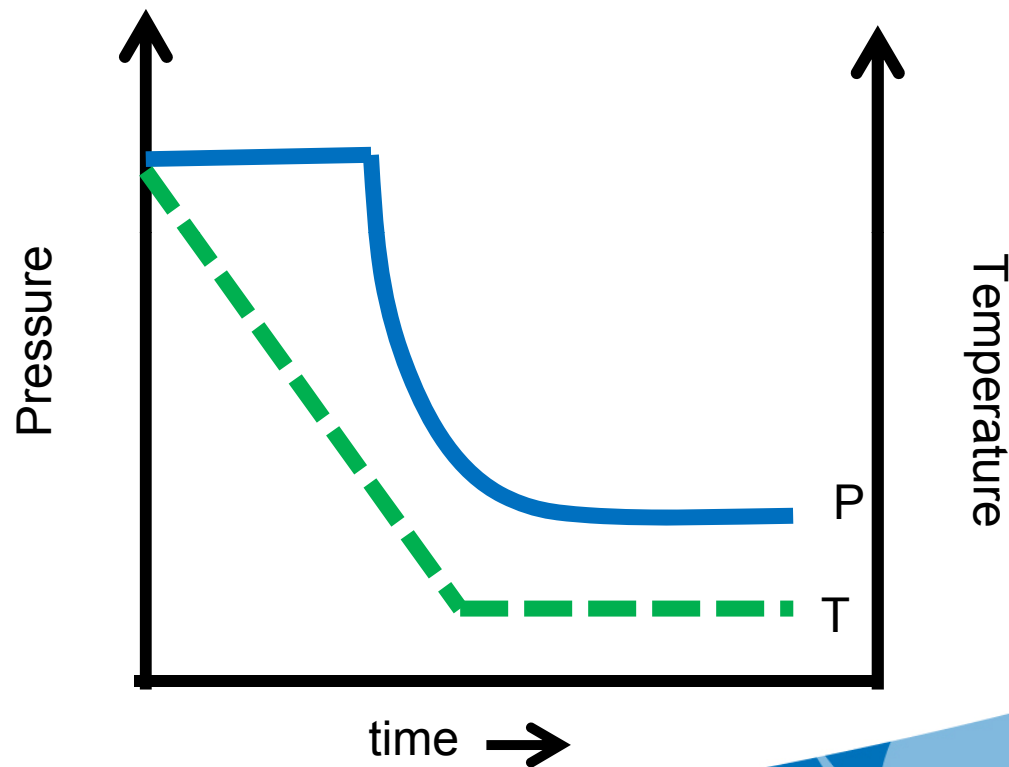
Pressure Boundary Integrity

- 10 CFR 50, Appendix G
 - Risk informing ASME, Section XI, Appendix G
 - Probabilistic fracture mechanics evaluation
 - » Included surface breaking flaws
 - » Relatively high conditional probabilities of failure under certain circumstances
 - » Following industry activities



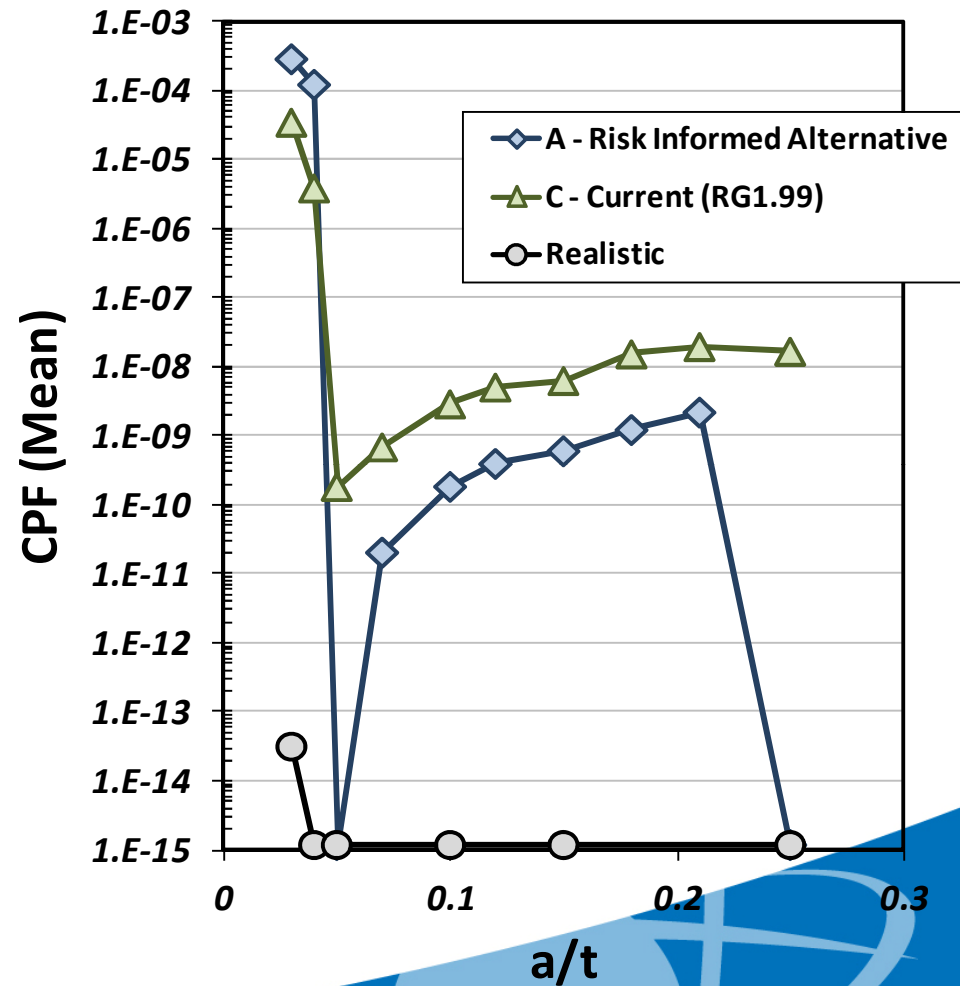
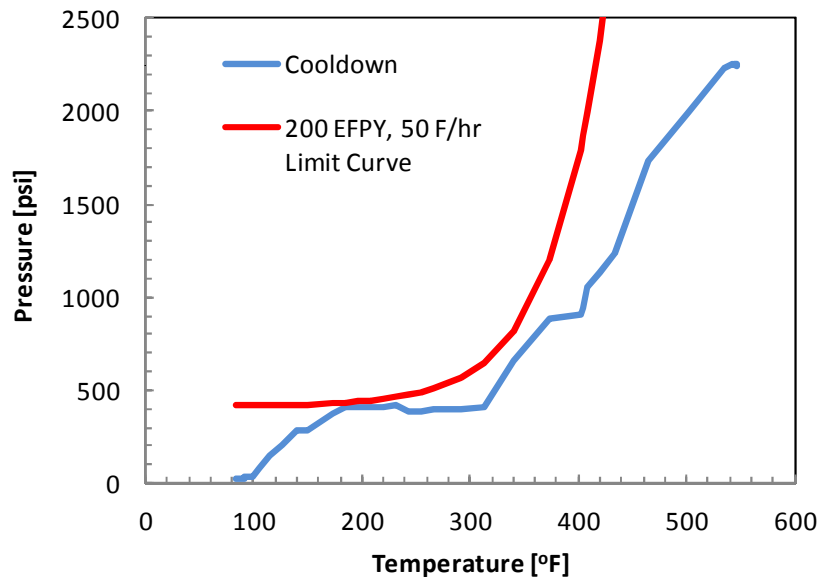
Pressure Boundary Integrity

- 10 CFR 50, Appendix G



Pressure Boundary Integrity

- Only shallow surface breaking flaws have non-zero CPF



a/t

Additional items of interest

- Welding alloys 52/152
 - Field welding issues
- Other

