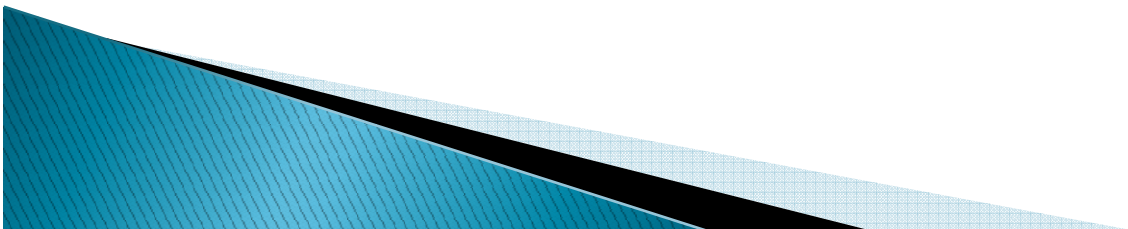


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Wall Thinning Due to Erosion Mechanisms

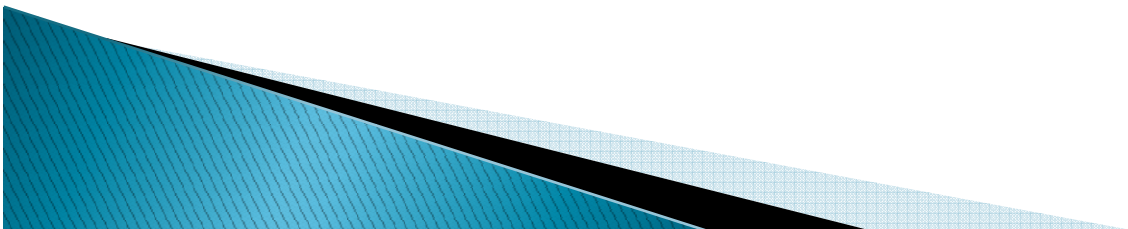
J. A. Gavula, DLR/RAPB
June 28, 2012



Presentation Overview

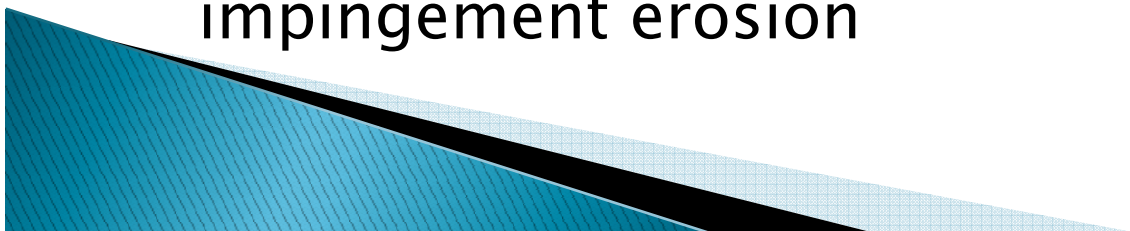


- ▶ Operating experience for erosion
- ▶ Operating experience in license renewal
- ▶ NRC guidance for managing erosion
- ▶ Industry guidance for managing erosion
- ▶ Interim Staff Guidance 2012-01 discussion



Operating Experience – Erosion

- ▶ 2009 Quad Cities – primary containment inoperable due to cavitation in CS min flow line
- ▶ 2007 Dresden – HPCI through-wall leak due to erosion of FAC-resistant material
- ▶ 2006 Duane Arnold – RHRSW pumps inoperable due to erosion of motor coolers
- ▶ 2006 Peach Bottom – HPCI through-wall leak in full flow test line to torus due to cavitation and abrasive erosion
- ▶ 2004 Prairie Island – containment cooling inoperable due to erosion in coolers
- ▶ 1999 Point Beach – feedwater heater rupture due to impingement erosion



Operating Experience in License Renewal Reviews



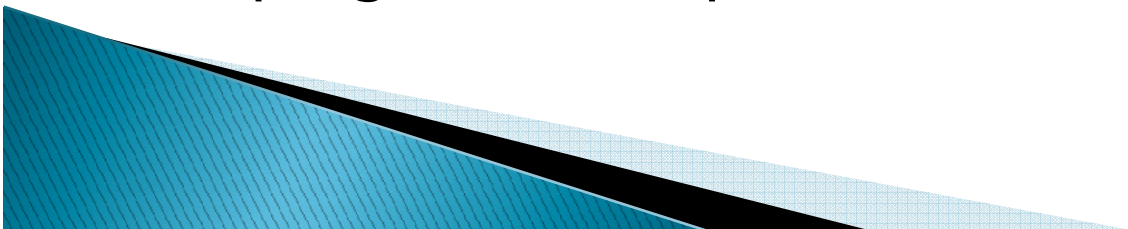
- ▶ Duane Arnold identified erosion in auxiliary systems. Not included in LRA. Has periodic UT monitoring.
- ▶ Palo Verde identified cavitation in stainless safety injection line during surveillance. Not included in LRA. Periodically replaces line.
- ▶ Columbia has cavitation in service water system during pump start and stop. Included in LRA. Has periodic UT monitoring.
- ▶ South Texas has cavitation in essential service water system throttle valve. Not included in LRA. Has periodic UT monitoring.
- ▶ Limerick has cavitation in closed cooling water system. Not included in LRA. Confirming that corrective actions have eliminated problem.



NRC Guidance for Erosion

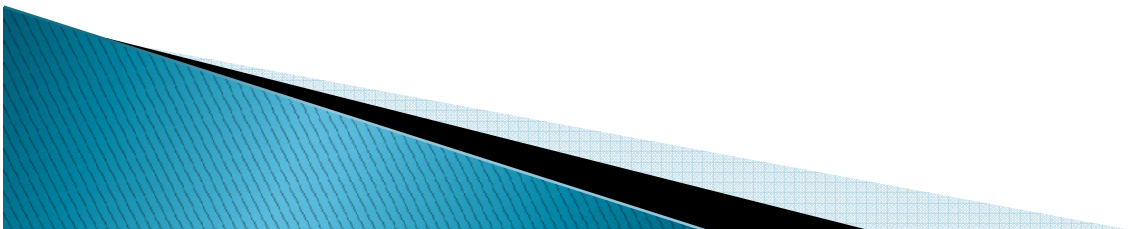


- ▶ NRC guidance for managing erosion mechanisms is largely absent
 - Although GALL Report defines “erosion” and includes it as one cause of loss of material, it does not contain aging management review (AMR) items for piping components that cite loss of material due to erosion.
 - Several aging management programs (AMPs) discuss detection of erosion, but only the Open–Cycle Cooling Water AMP includes erosion in the program description.



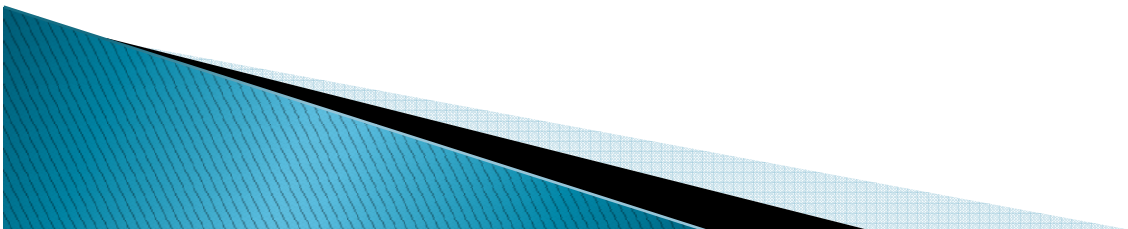
Industry Guidance

- ▶ EPRI 1010639, “Mechanical Tools” states loss of material due to cavitation erosion is a design issue and is not an applicable aging effect for license renewal. However, the report:
 - states that it is assumed that cavitation will be detected and corrected during initial license period.
 - acknowledges that, for infrequent operation, resolution may need to be addressed in the aging management review.



Aging Management Strategies for Erosion

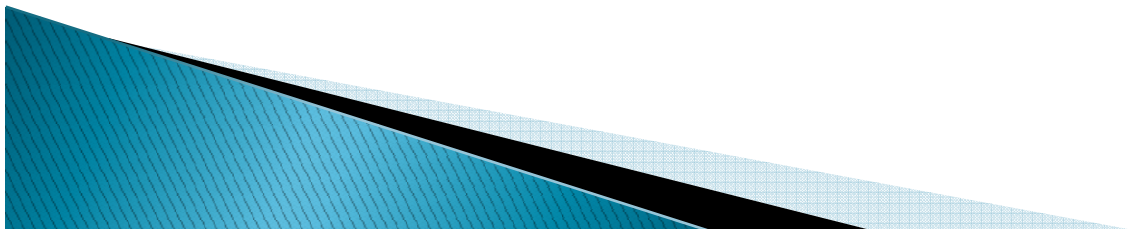
- ▶ If replacement strategy for erosion-susceptible items uses a scheduled frequency (based on a design analysis), no aging management is necessary.
- ▶ If other strategies are used, such as monitoring wall thickness and scheduling replacement based on the results of these periodic exams, these items should be managed for aging and the new ISG is applicable.



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Wall Thinning Due to Erosion Mechanisms

- ▶ Clarifies and documents staff position
- ▶ Revises definitions in GALL Tables IX.E & IX.F:
 - Wall thinning – includes FAC and erosion mechanisms
 - Erosion – different mechanisms include cavitation, flashing, droplet impingement and solid particle impingement
 - Flow-accelerated corrosion – oxide film removal by chemical dissolution, with transport by water movement
- ▶ Adds new AMR line items to tables in GALL Report and SRP-LR to address erosion mechanisms in piping and components



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- ▶ Changes to GALL AMP XI.M17, “Flow–Accelerated Corrosion”
 - allows the FAC program to manage erosion mechanisms using existing EPRI guidance for “susceptible–not–modeled” approach in NSAC–202L
 - refers to EPRI 1011231, “Recommendations for Controlling Cavitation, Flashing, Liquid Droplet Impingement, and Solid Particle Erosion.”
 - cautions for replacement material – none are completely erosion resistant
 - includes additional operating experience examples

