



Alloy 600 OE update

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Industry-NRC Tech Update Meeting
July 20, 2012
Rockville, MD

Alloy 600 OE update

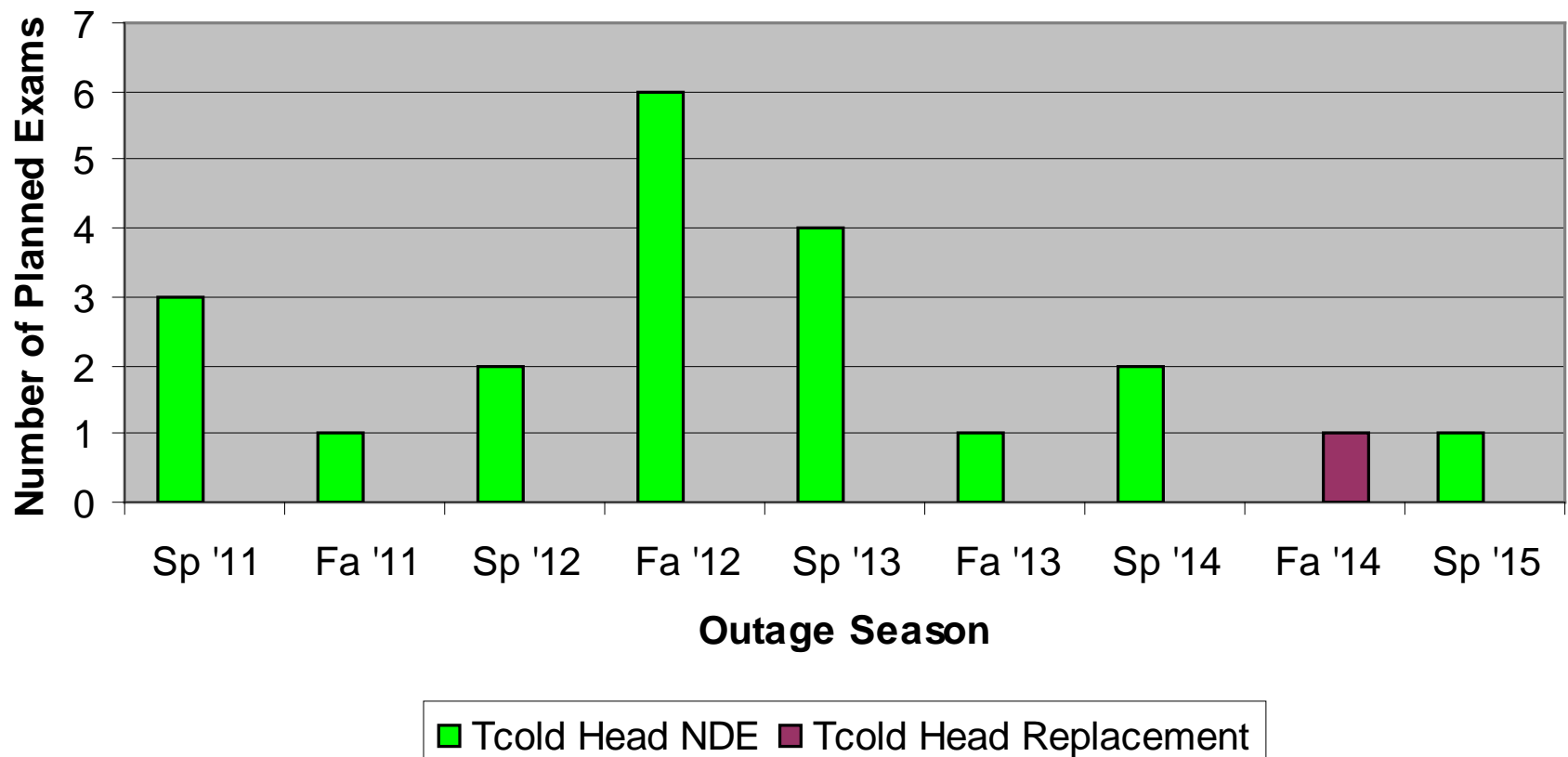
T_{cold} RV Heads

Acknowledgements

- A detailed assessment of the U.S. inspection experience for Alloy 600 top head nozzles through 2011 has been previously provided:
 - *MRP Letter 2011-034, dated December 21, 2011, NRC ADAMS Accession No. ML12009A042*
- An overview presentation including spring 2012 inspection findings was made July 19, 2012 at the International BWR & PWR Materials Reliability Conference
 - *PWR Reactor Vessel Top Head Alloy 600 CRDM Nozzle Inspection Experience**

T_{cold} Head CRDM Reinspection Plans

Current Reinspection Plans for Tcold RV Heads



Recent Inspection Results Summary

Flaws Detected in Heads Operating at Tcold (i.e., Cold Heads)

- PWSCC indications have been detected in four U.S. cold heads:
 - 2007 in one CRDM nozzle
 - associated with lack-of-fusion defects
 - 2011 in four CRDM nozzles
 - Included some base metal flaws not connected to the weld
 - 2012 in four CRDM nozzles
 - 2012 in one CRDM nozzle
- This apparent PWSCC degradation was detected in its relatively early stages
 - with modest numbers of nozzles affected by part-depth cracking
 - often located below the weld, where the nozzle tube is inside (not directly a part of the pressure boundary)

Assessment of Inspection Results

- Plant experience to date indicates a somewhat higher probability of crack initiation for cold heads than assumed in the MRP safety assessments published in 2004
 - However, it is concluded to have an acceptably small effect on the probability of nozzle ejection per MRP-105
 - Inspection results since 2004 confirm that the MRP-105 approach includes rather significant sources of conservatism
- Current reinspection requirements have been effective in detecting the PWSCC reported across the fleet in a timely fashion, before the degradation produces flaws of safety significance

Conclusions

- The time-at-temperature approach (EDY and RIY) has been effective to prioritize baseline NDE inspections and set NDE inspection intervals
- Material and fabrication factors are also apparent in the inspection results
- ASME Code Case N-729-1 inspection requirements for Alloy 600 top head nozzles are still concluded to be conservative and adequate to ensure nuclear safety with respect to the PWSCC degradation concern
- Industry will continue to closely monitor and assess inspection results, particularly for Tcold heads, against the relevant technical bases

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Bottom Mounted Nozzle Degradation OE

Bottom Mounted Nozzle OE

- **Tracking recent foreign OE on BMN**
 - Additional evaluation results expected ~August
 - BMN volumetric exam schedule requested from subject utility as background information (# units by outage season)
 - Factor in other inspection results
- **This OE is significant and will be evaluated for**
 - Impact on current inspection guidance
 - ASME CC N-722-1 (limited technical basis)
 - MRP-206 - *Inspection and Evaluation Guidelines for Reactor Vessel Bottom-Mounted Nozzles in U.S. PWR Plants*
 - Strategic planning considering possible future inspection findings

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