



# *Alloy 600 OE update*

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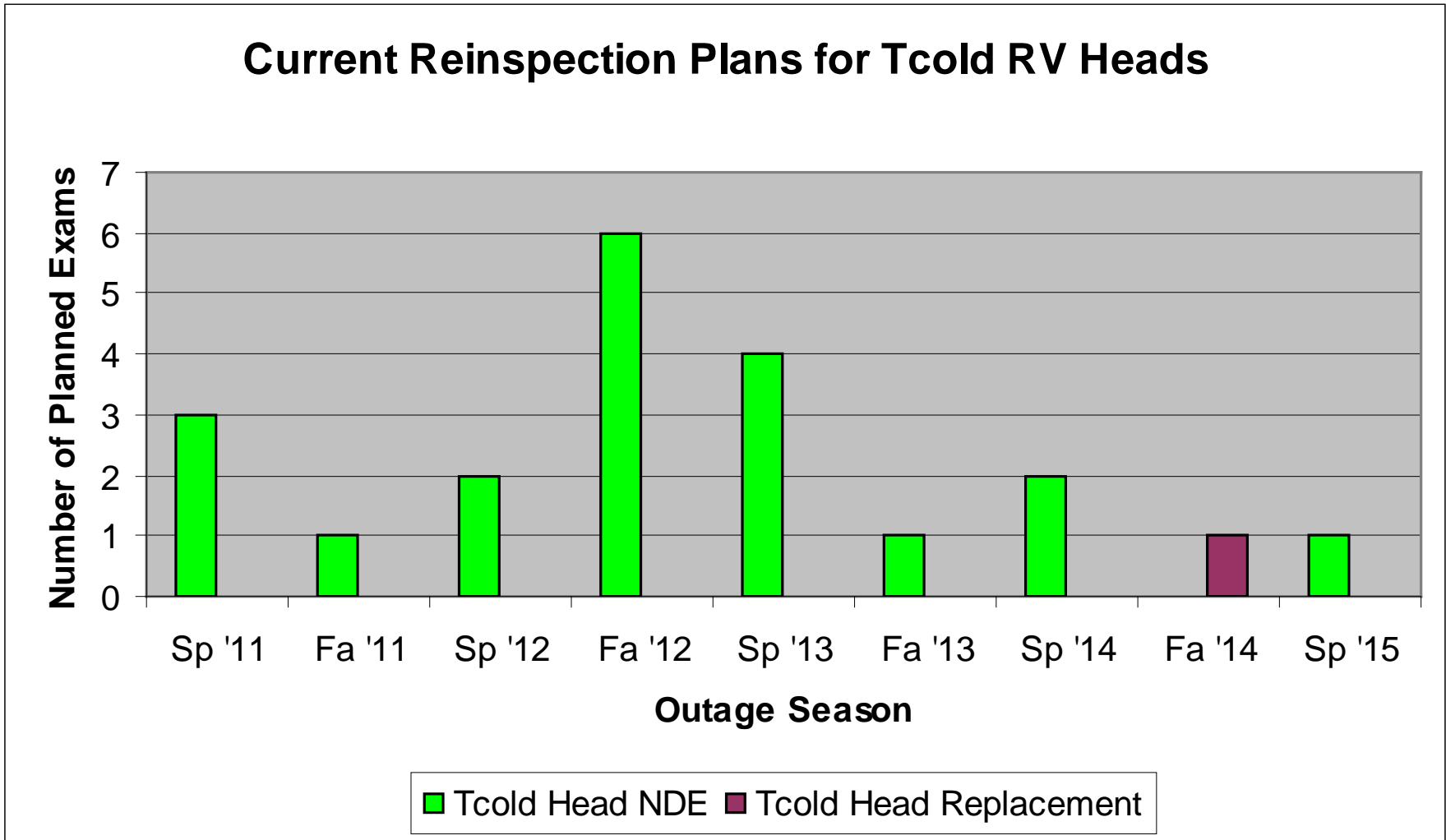
# *Alloy 600 OE update*

**T<sub>cold</sub> 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<sub>cold</sub> Head CRDM Reinspection Plans



# 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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