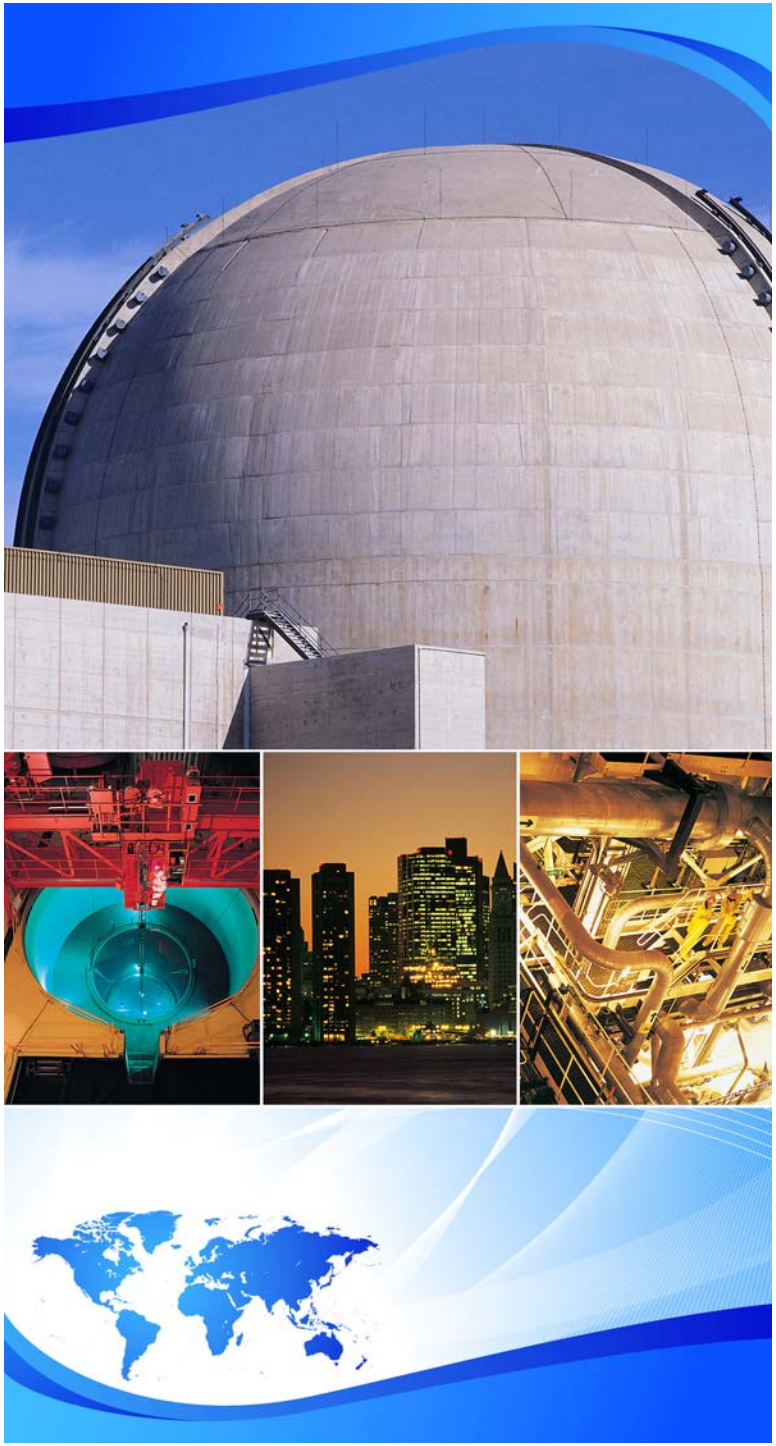


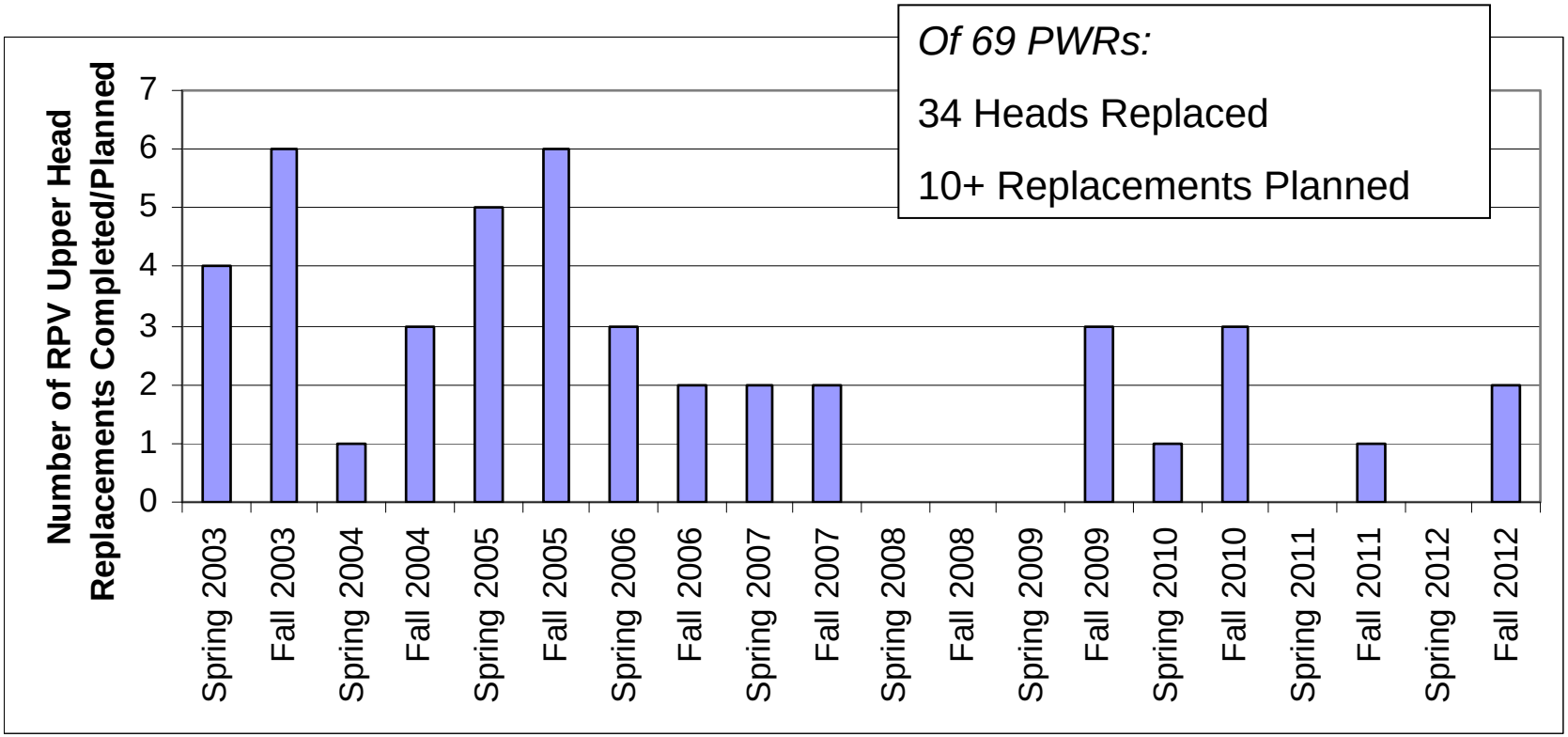
ELECTRIC POWER RESEARCH INSTITUTE

New Plants: Stress Corrosion Cracking of Alloys 690/52/152

Industry/NRC Alloy 690/52/152 Meeting
Rockville, MD
August 6-7, 2009

Al Ahluwalia, EPRI MRP

U.S. Replacements Completed & Planned



U.S. RPV upper head replacements completed/planned by outage season

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SCC of Thick-wall A690/52/152 RCS Components Existing versus New Plants

- EPRI MRP focus on existing plants (primarily RPVH CRDM Penetrations in replacement heads)
- EPRI ANT focus on new plants (CRDM and other?)
- MRP and ANT objectives are complementary

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SCC of Thick-wall A690/52/152 RCS Components Issue for New Plants

- Ongoing EPRI (MRP/PSCR) research demonstrates general SCC superiority of A690/52/152 over A600/82/182 (primarily for RPV CRDM penetrations) but it also indicates that:
  - *some microstructures and thermo-mechanical processing (cold work, HAZ) can reduce SCC superiority of A690 significantly*
  - *ductility dip cracking (DDC) and hot cracking of Alloy 52 (and 52M) can be confused with SCC in operating plants. Also, there is concern if such cracking can promote SCC.*
- These technical gaps need to be addressed by:
  - *improvement of material specifications (re-melting, sampling, heat treatment etc.)*
  - *guidance on fabrication/installation procedures (straightening, welding, grinding, weld repair)*
  - *development of improved (SCC and DDC resistant) weld materials and welding methods*
  - *Conducting SCC research to demonstrate resulting A690/52/152 superiority*
- MRP/PSCR have a key role in above work (SCC research and resulting guidance), in coordination with WRTC

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SCC of Thick-wall A690/52/152 RCS Components Needed Work for New Plants

Base Metal Alloy 690

- Characterize material forms (billets, rods, plates, tubes) and conduct SCC tests to identify deleterious microstructures (e.g. banding) and thermo-mechanical processing
  - Identify material production steps (e.g. re-melting) that influence SCC resistance
  - Quantify effect of fabrication/installation induced cold work on SCC resistance
  - Test vulnerability of HAZ to SCC (and improved welding processes)
  - Establish relevance of factors affecting SCC resistance to new plants
  - From above, revise guidance for material procurement and component fabrication/installation

Weld Metals Alloys 52 and 152

- Characterize welds and conduct SCC tests to
  - Examine role of weld defects in SCC initiation and growth
  - Establish SCC resistance of evolutionary A52 compositions to alleviate DDC and hot cracking
  - Investigate effect of welding procedures (and repairs including grinding) on SCC (e.g. minimize residual stresses and hot cracking)
  - From above, identify compositions and welding and repair procedures to maximize SCC resistance

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SCC of Thick-wall A690/52/152 RCS Components New Plants: Value

Deliverables

- Technical basis for inspection intervals
- Improved guidelines for material specification (base and weld metal) and for fabrication/installation/repair of thick-wall Flaw disposition curves
- Life prediction models to facilitate asset management

Highly Leveraged Research

- International collaboration in partnership with EPRI, NRC RES, US Naval Reactors contractors, EDF, UNESA, Rolls Royce, Ringhals, KAERI and more (multimillion dollar annually)
- New Plants personnel from NRC part of the collaboration
- DOE/EPRI Long Term Operation (80 year life) program

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