Regulatory Perspective on Recent Steam Generator Issues

35th EPRI Steam Generator NDE Workshop
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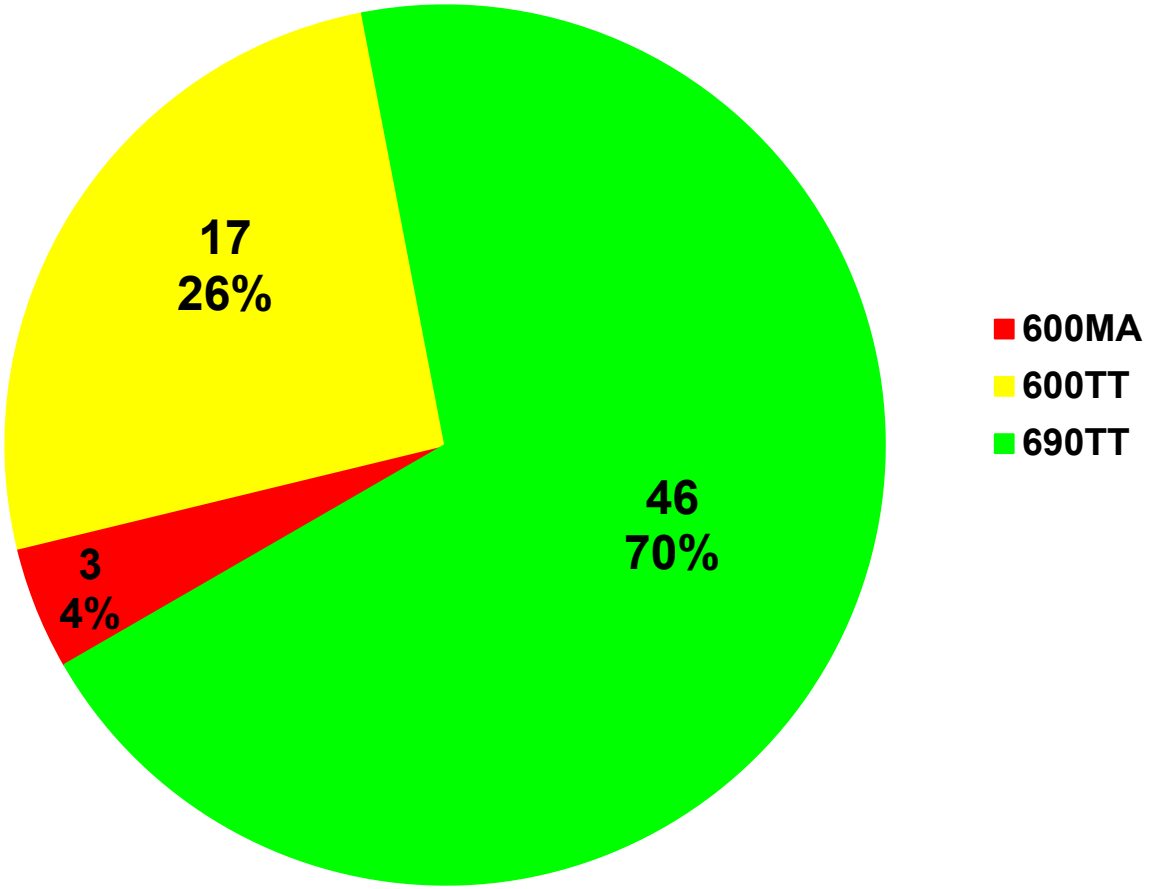
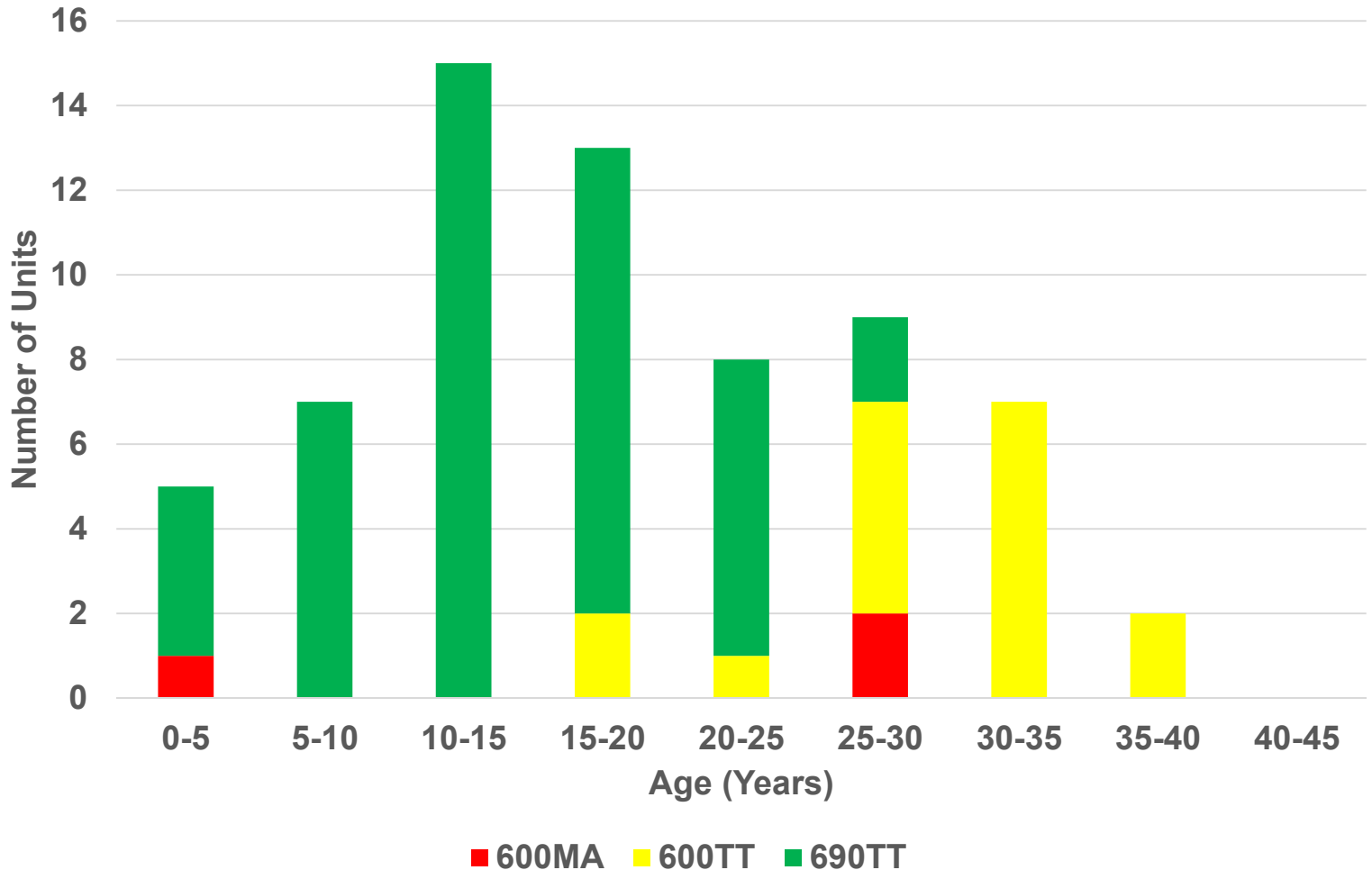
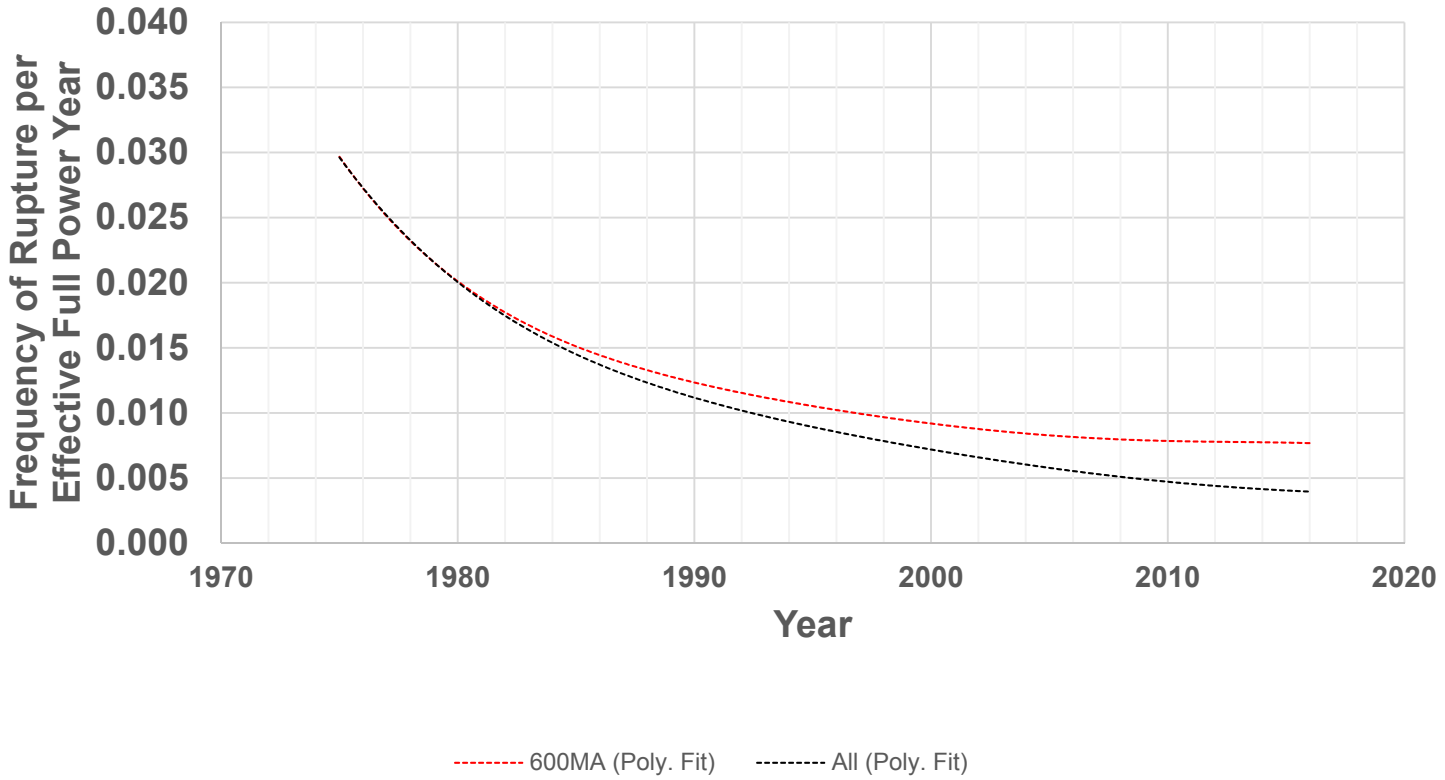
U.S. Tube Material Distribution, Number of Units (2016)



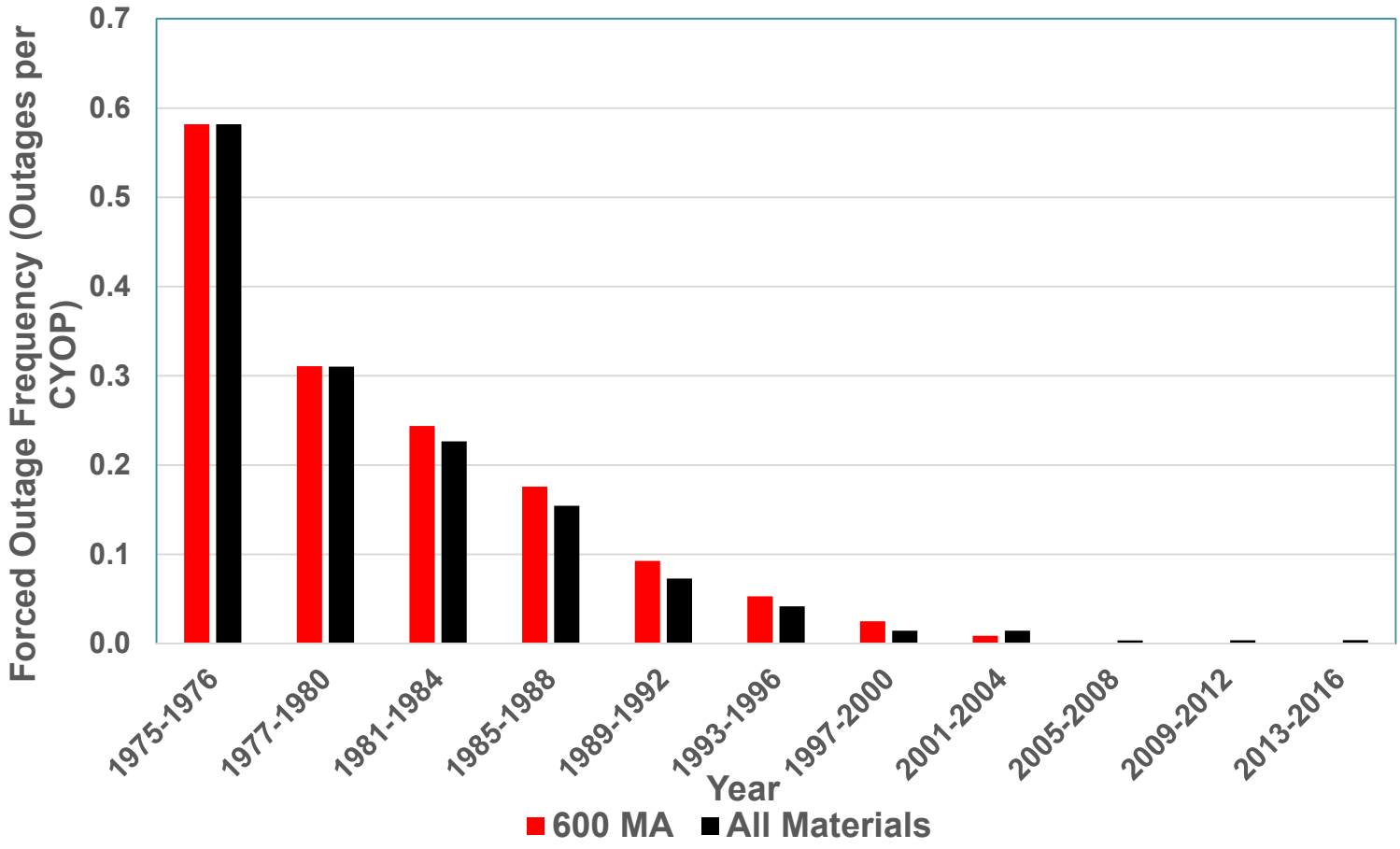
Age of U.S. Steam Generators



Frequency of U.S. Tube Ruptures



Primary-to-Secondary Leakage Forced Outage Frequency



SG Performance Trends

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- Since 2003, one loss of tube integrity: San Onofre Unit 3 in 2012
- Few outages due to primary-to-secondary leakage or loose parts in last decade

Alloy 600 Units

- Mill Annealed Alloy 600 (600MA) – 3 units including Watts Bar 2
- Thermally treated Alloy 600 (600TT) – 17 units
  - Wear at support structures
  - Cracking at a variety of locations – but less than 150 tubes plugged for cracks (excluding tube-end cracks)

Alloy 690 Units

- Thermally treated Alloy 690 (690TT) – 46 units
  - Wear at support structures
  - South Texas 1

Regulatory Focus

- Revision of steam generator Standard Review Plan (SRP) section to address lessons learned from San Onofre
  - Published for public comment in Federal Register on April 22, 2016 – No comments received
  - Accession Numbers for steam generator SRP section: ML070380192, ML16029A367, ML16029A374 (original, revised, redline/strikeout versions)
  - Guidance is qualitative and two-tiered
    - Operation within bounds of currently operating SGs is acceptable
    - Operation outside the bounds of currently operating SGs may require more detailed evaluation and/or testing

Regulatory Focus (cont'd)

- Tube-to-Tubesheet Weld Issue
  - Regulatory Issue Summary 2016-02, March 23, 2016
    - Replacement AREVA (design control)
    - Some replacement B&W Canada steam generators (full compliance with American Society of Mechanical Engineers Code (beyond IWB-4350 and IWB-5274))
- NRC staff may verify adequacy of corrective actions

Regulatory Focus (cont'd)

- Preservice Inspection Requirements
  - Establish steam generator preservice inspection requirements in 10 CFR 50.55a
  - Public meeting on March 2, 2016 to discuss proposed wording in 50.55a
  - Staff is considering comments provided during public meeting as it finalizes the revision to 50.55a
    - Scheduled to be issued by end of 2016

Regulatory Focus (cont'd)

- License Renewal Interim Staff Guidance Related to Divider Plates, Tube-to-Tubesheet welds, and Channel Heads
  - May result in no longer requiring one-time verification inspections if bounded by industry analyses and visually inspect channel head region each outage in which steam generator primary side maintenance is performed.
  - Public comment period ended July 7, 2016

Regulatory Focus (cont'd)

- Public meeting tentatively scheduled between the NRC staff and industry's Steam Generator Task Force on August 17th
  - Implementation of accident induced leakage performance criteria
  - Sizing of flaws in the U-bend region

Research Activities

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- Effects of probe wear on sizing flaws
- U-bends: Inspection and Integrity
- Equivalent Rectangular Crack Method

Summary

- Very good steam generator performance

- Several activities over the next year
  - Finalize review guidance in response to lessons learned from San Onofre
  - Tubesheet joint design – verification of corrective action
  - Interim Staff Guidance on divider plates, tube-to-tubesheet welds, and channel heads