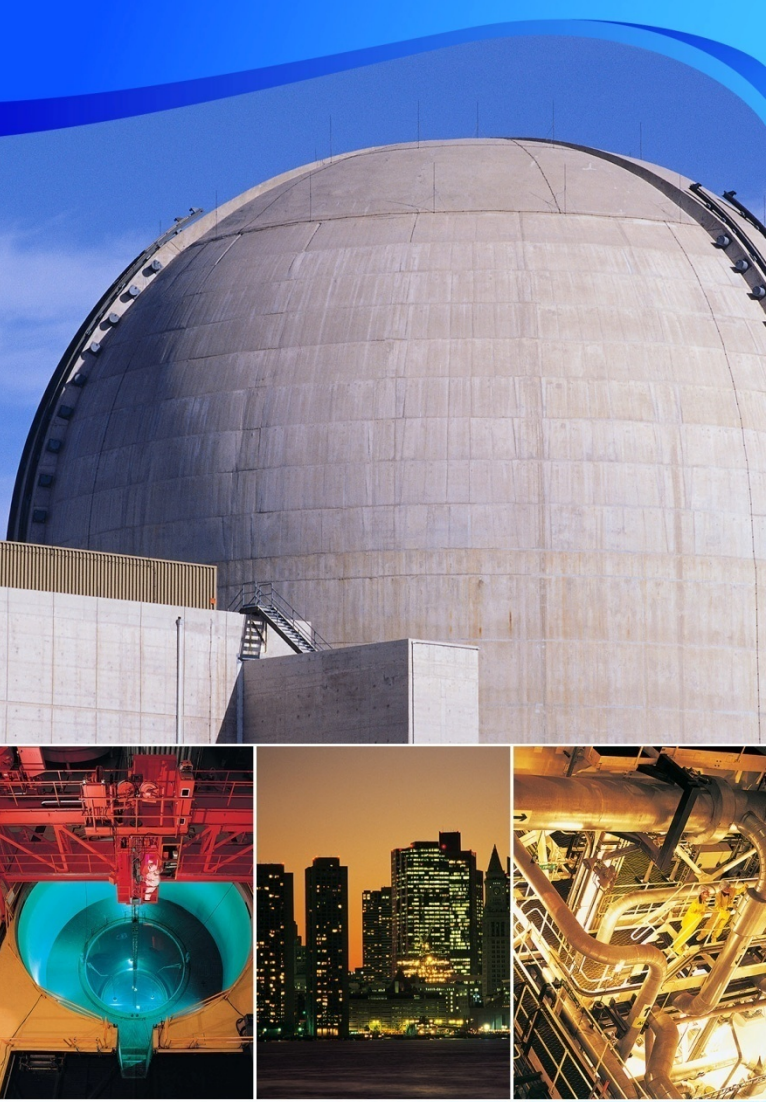

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Alloy 600 Inspection and Mitigation Dose Performance: 2008 Update

ISOE North American ALARA Symposium/EPRI Radiation Protection Conference

January 12th-14th

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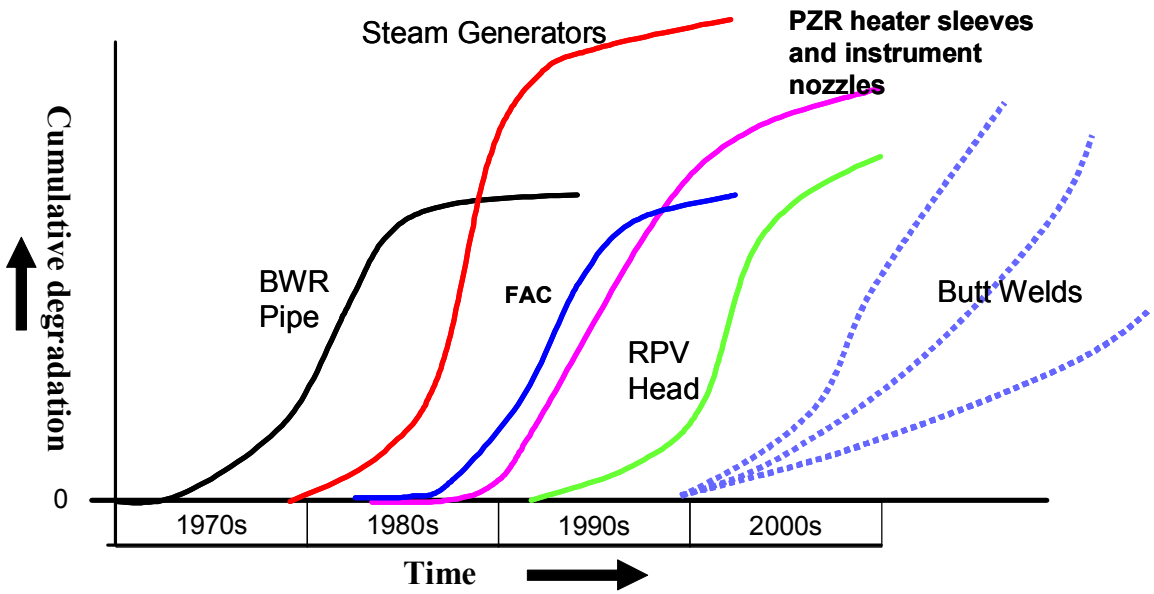
On Behalf of Dennis Hussey

Overview

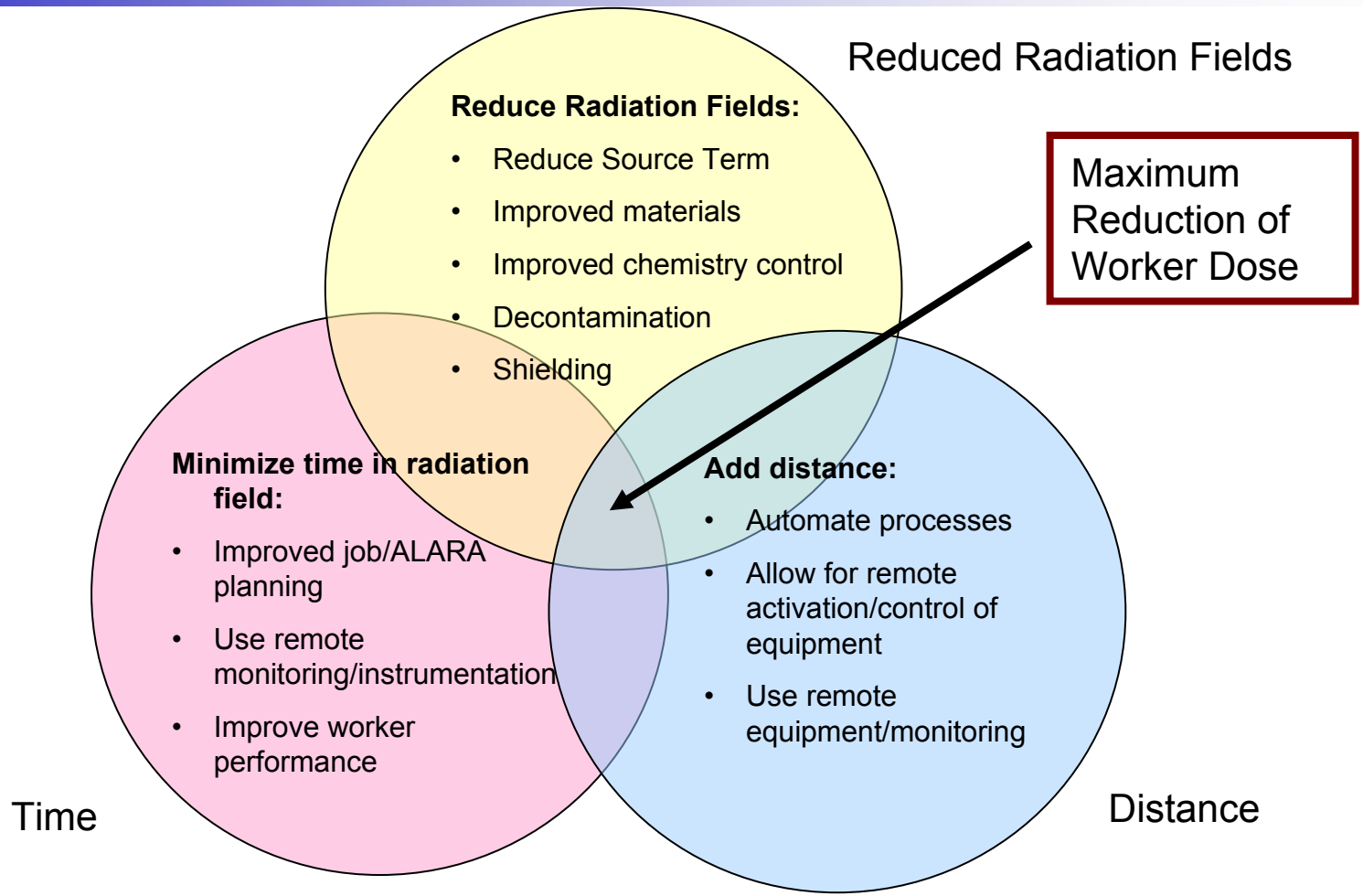
- Alloy 600 history
- Current inspection challenges
  - Inspection techniques
  - Mitigation techniques
- Local source term reduction methods
- Benchmarking
- Conclusions

Alloy 600 Cracking History

- EPRI Report 1016771
- Cracking first observed in BWRs
- PWR observations in
  - Steam generator tubing failures
  - RPV Heads
- PZR and dissimilar metal welds now a concern

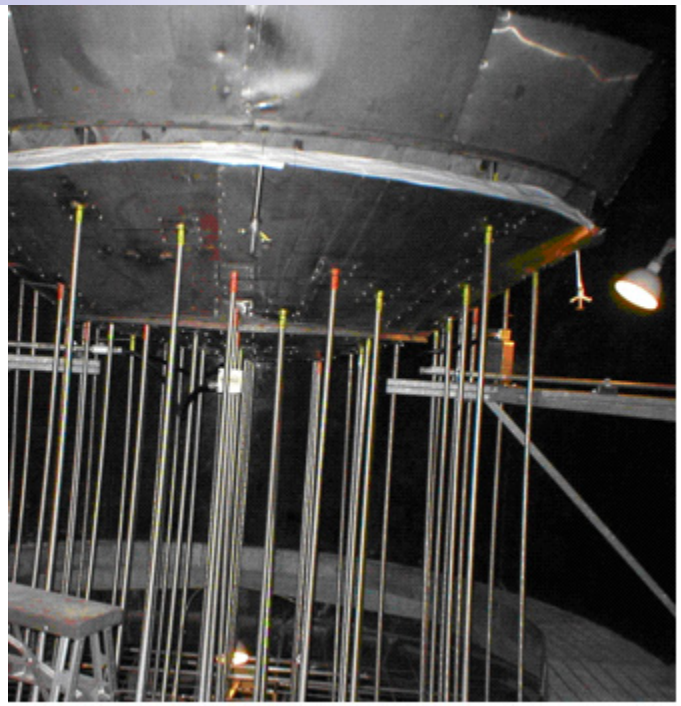


ALARA Principles to Reduce Alloy 600 Worker Dose



Current Inspection Challenges

- RPV Challenges
  - Interior nozzle to shell inspections are needed
  - Ultrasonic technologies employed
  - If indication is found, workers are required to manually verify/repair
- Steam Generator Challenges
  - Nozzle dams
  - Equipment failure of eddy current tests
- RPV Internals
  - Most technologies are remote
  - Water cleanliness is a key concern

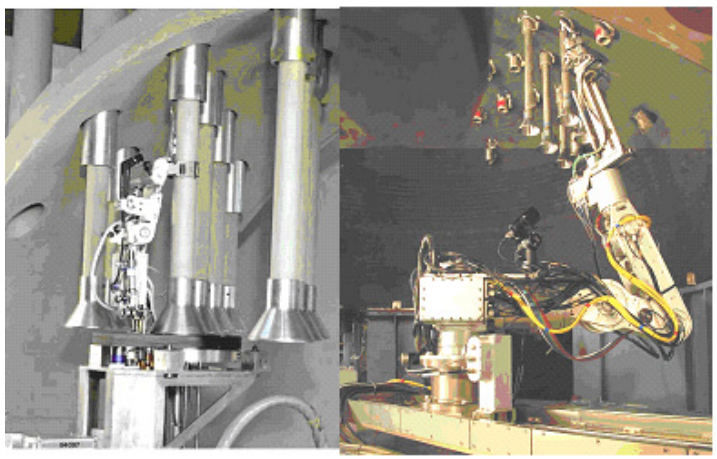


RPV Bottom Mounted Nozzles

Inspection Technologies
Phased Array Inspection

Inspection Technique Comparison 14” Nozzle (from WSI)

	Manual Conventional	Automated Conventional	Phased Array
Probes	10 – 15	8 - 10	1
Scans	15 – 20	12 – 15	4 - 6
Personnel	1	3	1
Examination Time (at weld)	5 + hrs	11 + hours	**< 2 hours**
Personnel Exposure	Greatest	Less than manual	Least



Automated conventional inspection

Phased array

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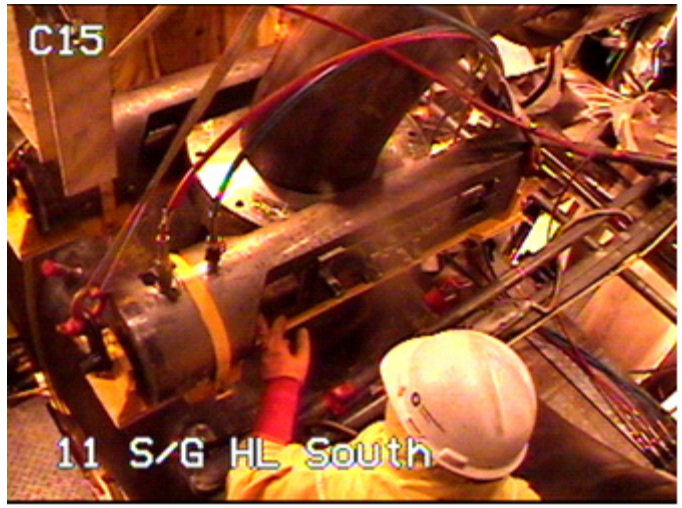
Mitigation Technologies

- Several methods to reduce stresses in materials are in development
  - Overlays/inlays
  - Mechanical Stress Improvement Process (MSIP)
- Surface treatment techniques
  - Shot peening
  - Water jet peening
  - Laser peening



MSIP at Calvert Cliffs

Mitigation Technology Comparison

Technology	Advantages	Disadvantages
Manual Weld Overlay	-adaptable to complex configurations	-Labor intensive -Weld quality impacted by welder experience
Automated Weld Overlay	-Possible reduction in total time at worksite (dose reduction) -Better quality end product	-Cannot be used for all applications (configurations) -Higher cost than manual options
Remote Weld Overlay	-In theory dose not require continuous local oversight -Better quality weld (reduction in post weld prep and false positive indications	-Cannot be applied for all locations/pipe diameters -Higher cost than manual options
Weld Inlay	-Can be done with cavity flooded -Significantly less dose than outside pipe overlay (up to factor of 10 reduction)	-~8 units do not have outside pipe options -Requires cavity bridge use
Mechanical Stress Improvement Process (MSIP)	-Reduced time at weld (dose reduction) -Zero application failures to date	-Requires equipment rigging at work site -Cannot be applied at all locations and pipe diameters

Local Source Term Reduction Initiatives

- Alternate Charging Path with “Clean” Water into Pressurizer
  - Flush spray line and surge line with clean/low activity water
  - Surge line and lower pressurizer filled with clean/low activity water (shielding)
- Hydrolazing internals
  - ANO hydrolazed a portion of pressurizer internals
  - Significant reduction in dose fields at bottom of pressurizer
- Catawba letdown pipe decontamination
  - More details in an earlier paper

Benchmarking Experiences: *BWR Technologies and Experience*

- Consulted with several areas to understand BWR experiences:
  - BWR station personnel
  - NDE subject matter experts
  - Vendors

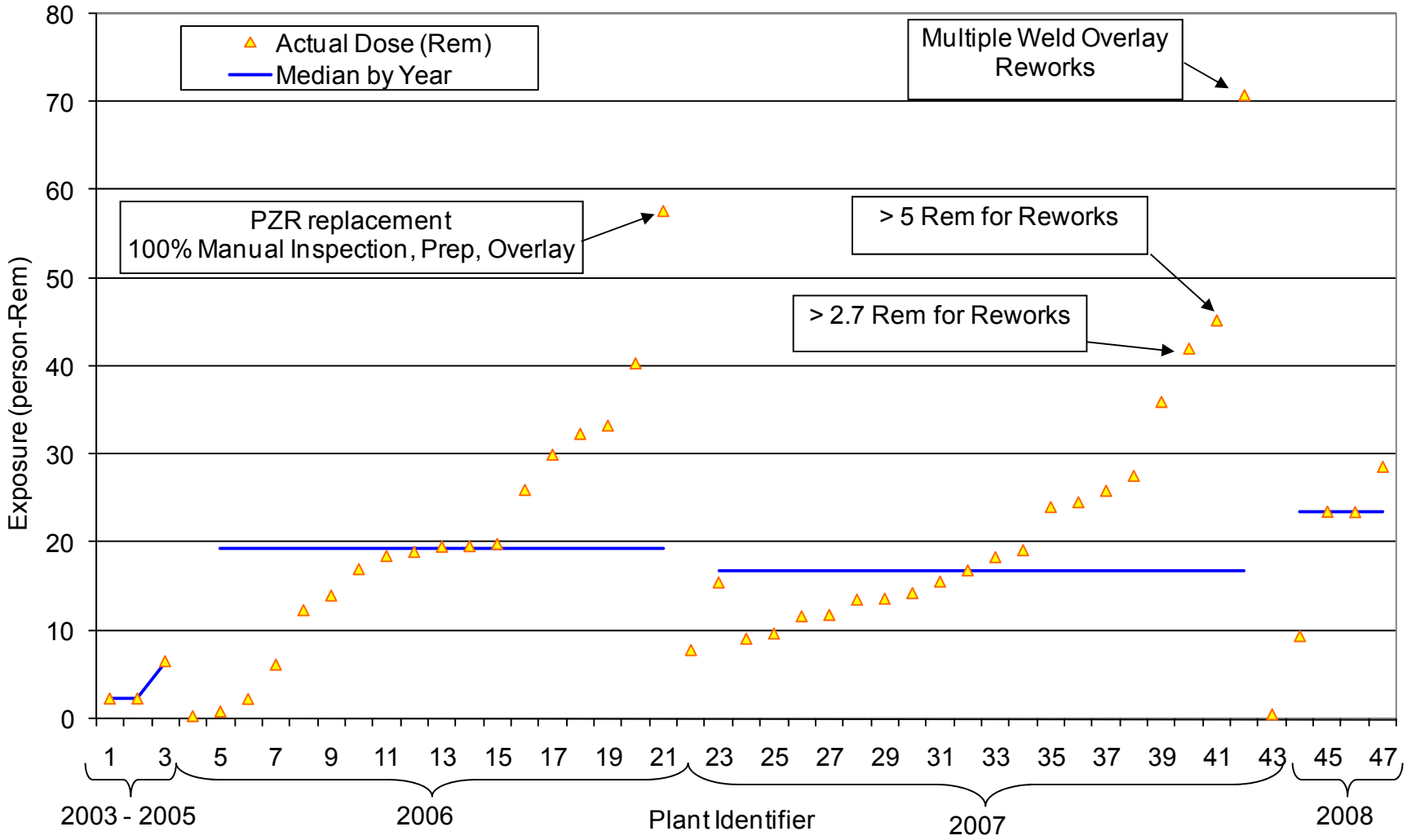
- Conclusions:
  - BWR and PWR weld inspection and repair technology is the same
  - ALARA initiatives were similar
  - Some PWR technology improvements resulted from earlier BWR work
  - Merits continued monitoring

EPRI Benchmarking of Alloy 600 Tasks

- Alloy 600 Inspection Tasks collected
  - Most PWR utilities reported
  - Lessons-learned compiled
  - Details about
    - Mockup design and implementation
    - Job site preparation
    - Shielding package installation
    - Work processes
- Summary of Alloy 600 Exposure tasks included in EPRI Report

PZR Heater Penetration Sleeve Shields

Benchmarking Alloy 600 Mitigation Exposure
Sorted by year, lowest to highest



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Conclusions

- Alloy 600 Inspections/Mitigation will continue to be a challenge
- Much work is in development to
  - Improve materials mitigation methods
  - Develop remote and automatic technologies
  - Facilitate technology transfer to upcoming inspections
- Benchmarking efforts will continue