



ELECTRIC POWER
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EPRI Radiation Management Program: Support of RP2020 Program

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Radiation Management, Fuel Reliability, -
Chemistry



Overview

EPRI Support of RP2020

Source Term Reduction

Boiling Water Reactor Highlights

- Dose Rate Trends

Pressurized Water Reactor Highlights

- Dose Rate Trends

Radiation Protection Technology Demonstrations

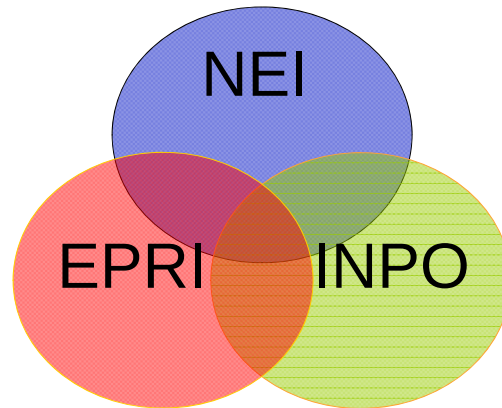
RP2020 Mission

Reshape radiological protection at nuclear power plants to achieve significant improvements in safety performance and cost-effectiveness.

Partners in Creating RP 2020

Radiation Protection Managers

Chief Nuclear Officers



NEI = Policy

INPO = Performance

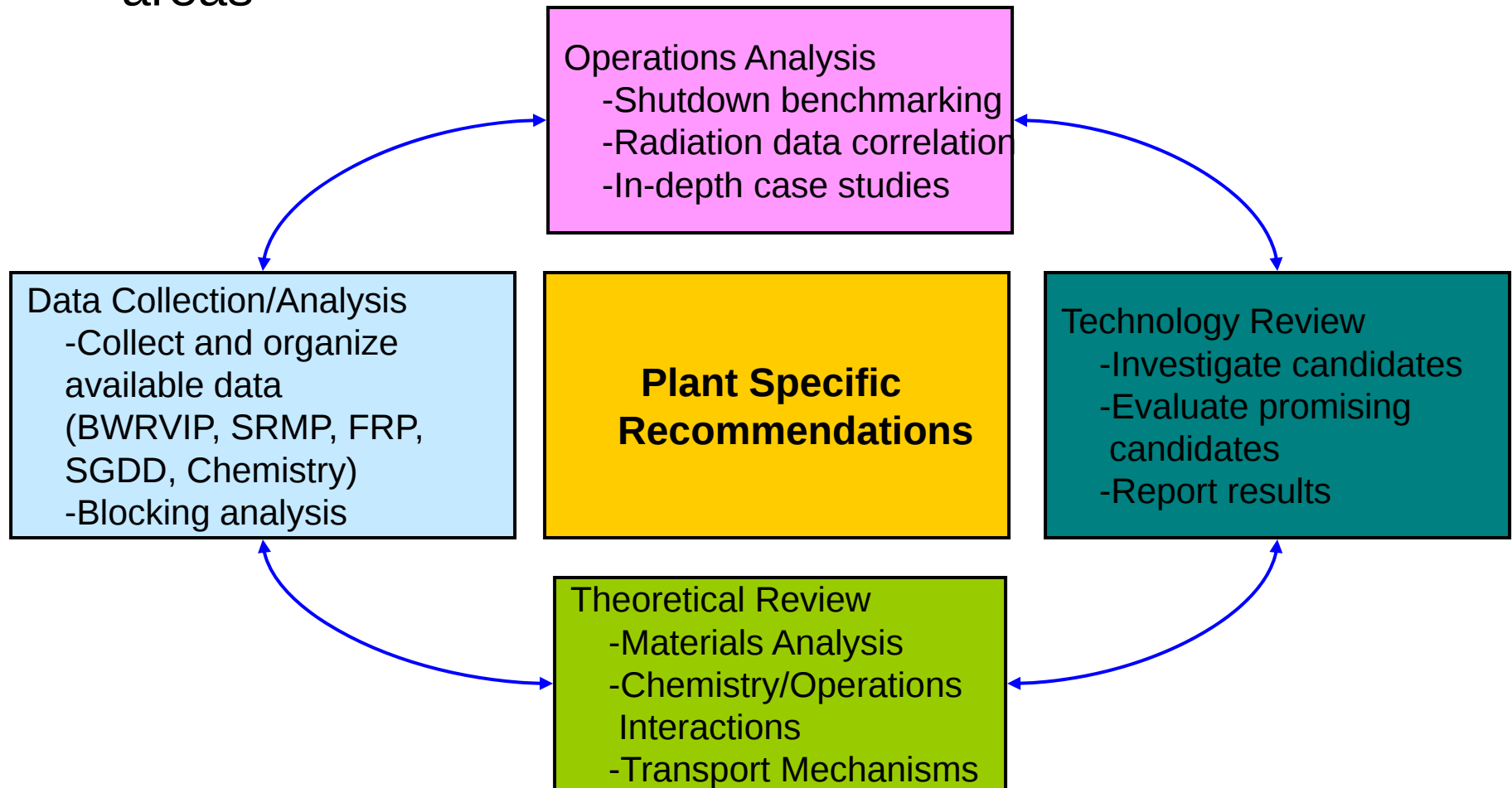
EPRI = Research

RP2020 Strategies and EPRI Status

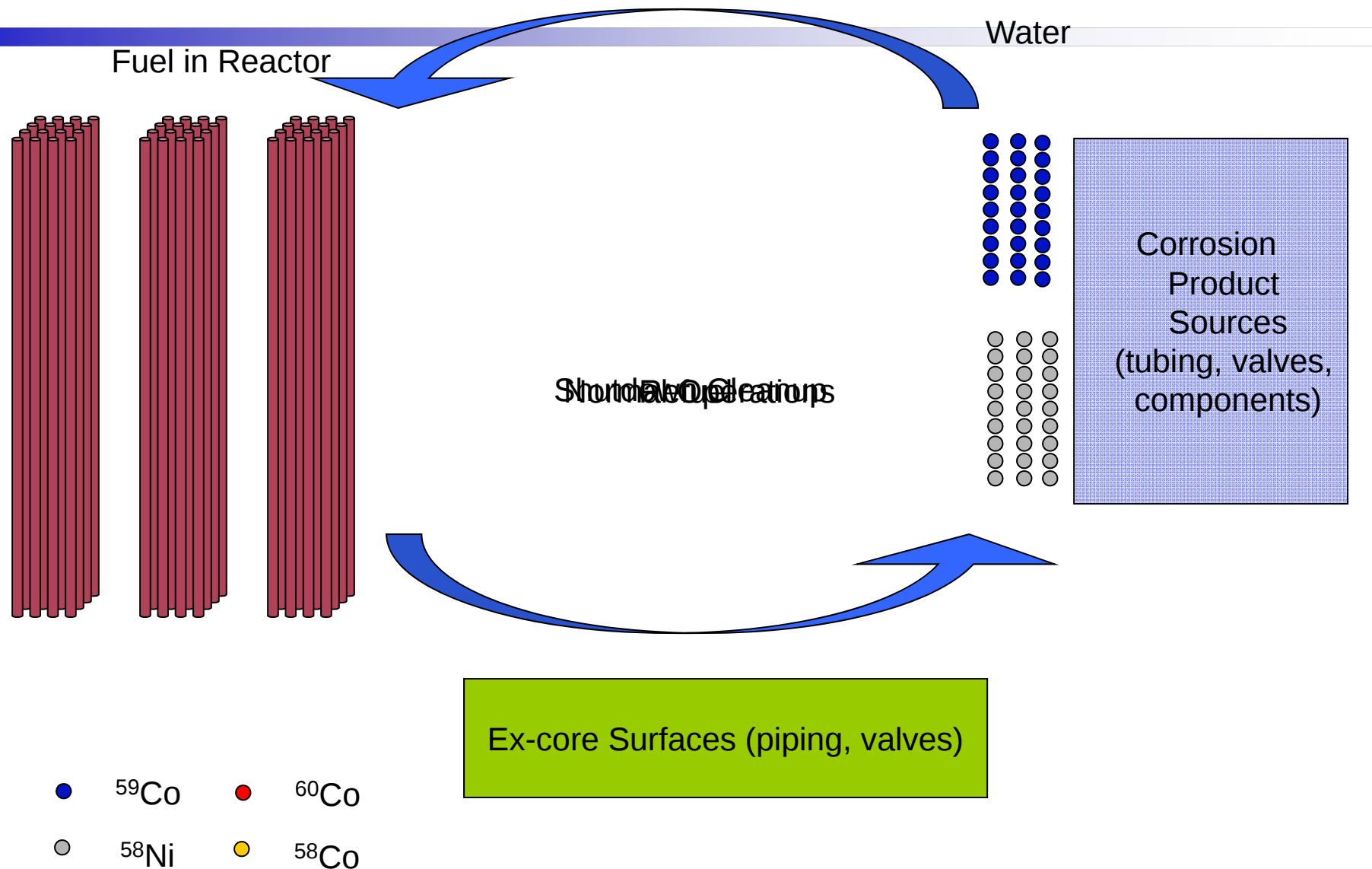
- **Reduce radiation fields—EPRI**
- **Improve technologies utilization—EPRI**
- Standardize RP criteria & practices—ALL
- Redefine RP roles/responsibilities—
NEI/INPO/EPRI
- Influence RP regulations—NEI

Source Term Reduction Program Strategy

- EPRI Source Term Reduction Program focuses on four areas



Source Term Activation and Transport



Source Term Magnitude By Location

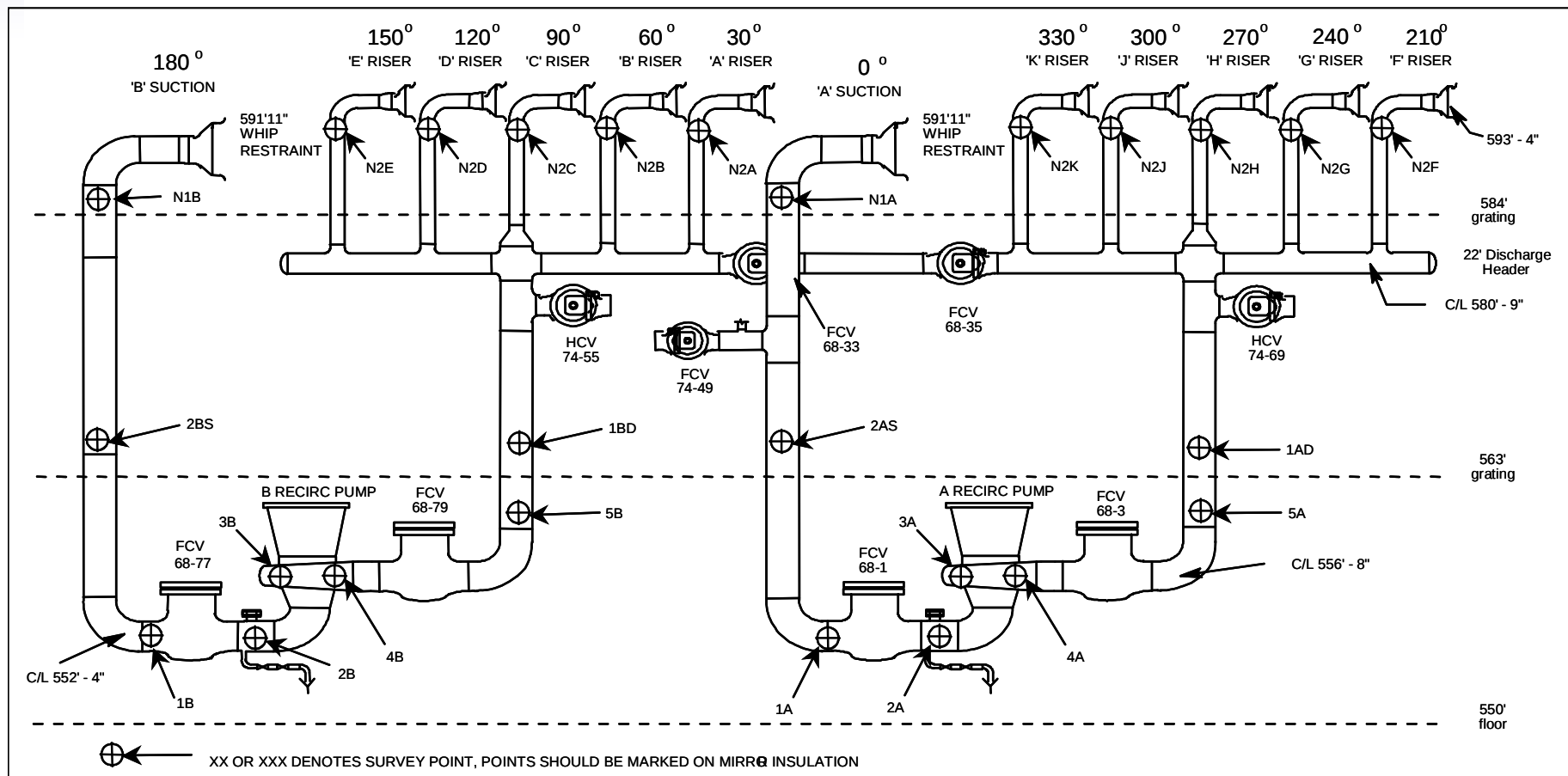
PWR Example

Location	Surface Loading (uCi/cm ²)	Total Curies
Fuel	Co-58 = 250 Co-60 = 12	~10,000-15,000 Ci Co-58 ~500-750 Ci Co-60
Removal During Shutdown	N/A	500-5000 Ci Co-58 5-50 Ci Co-60
Ex-core Surfaces (including piping, channel heads)	Co-58 = 8 Co-60 = 3	~150-200 Ci Co-58 ~ 70 Ci Co-60

BWR Source Term Reduction Project

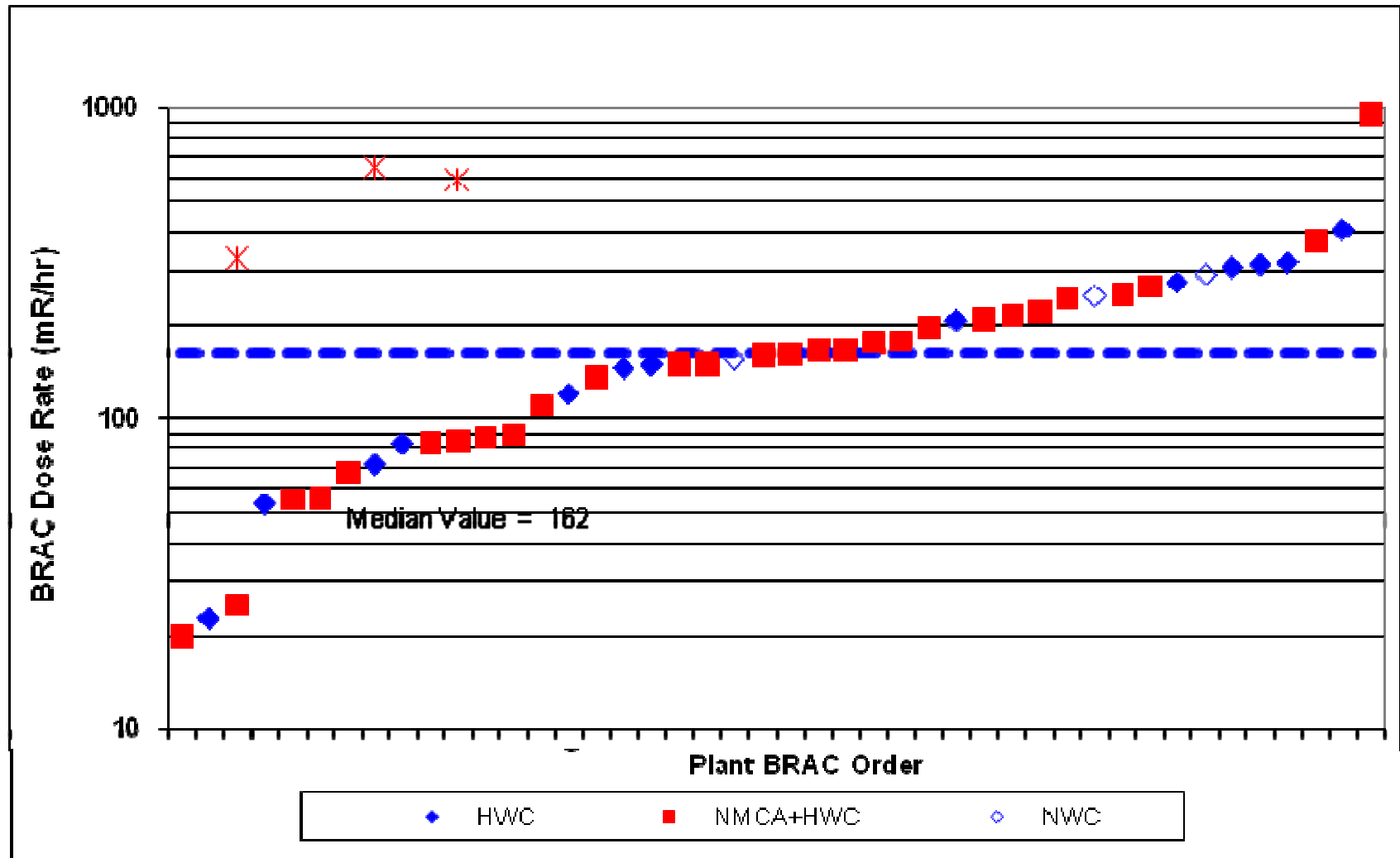
- BWR Source Term Reduction – Estimating Cobalt Transport to the Reactor (Report #1018371)
- Goals of Project
 - Identify how plants measure cobalt
 - Target cobalt sources
 - Benchmark cobalt transport to reactor
 - Quantify removal and releases during shutdown and normal operations

BRAC Measurement Points



BRAC Radiation Fields (June 2008)

Mitigation Strategy



BWR Conclusions

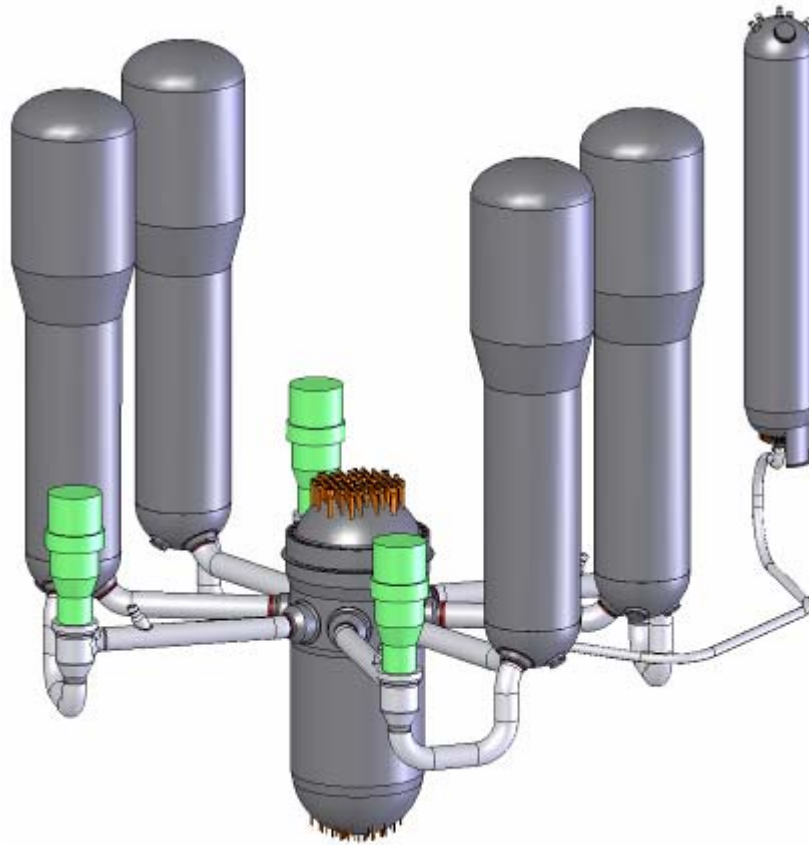
- Low radiation fields can be obtained regardless of mitigation strategy
 - Proper sequence of decontamination, mitigation strategy and zinc required

PWR Source Term Reduction

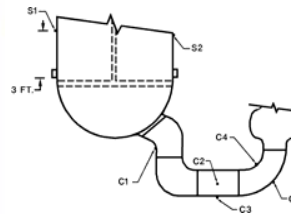
Technology Evaluations—Report 1016767

- Key Results
 - Zinc continues to show significant radiation benefits
 - pH effects noticed when comparing before and after PWR Primary Guidelines
 - Ringhals, San Onofre report benefits of elevated pH
 - Comanche Peak 1 and 2 do not show clear benefits
 - Long term benefits of electropolishing are noted

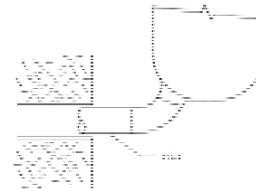
Westinghouse SRMP Monitoring Points



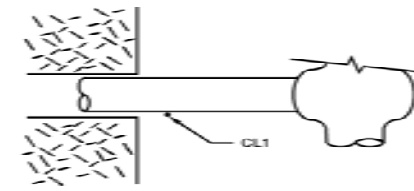
Loop piping



Crossover piping and SG

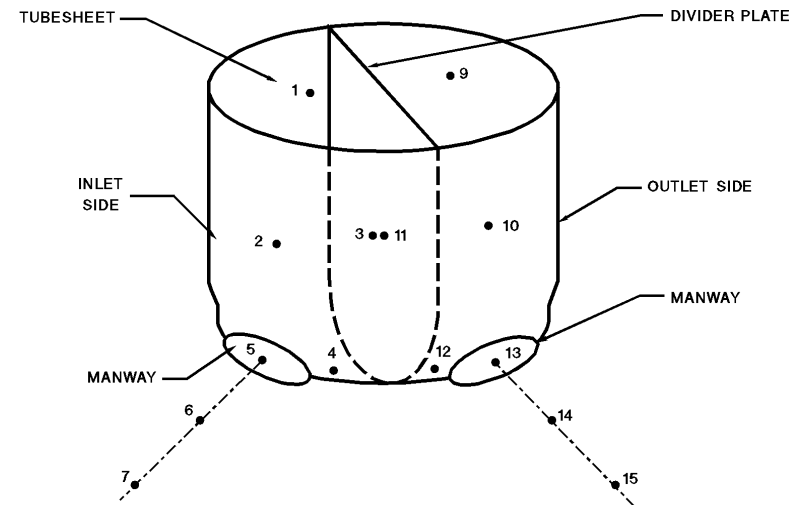


Hot leg piping



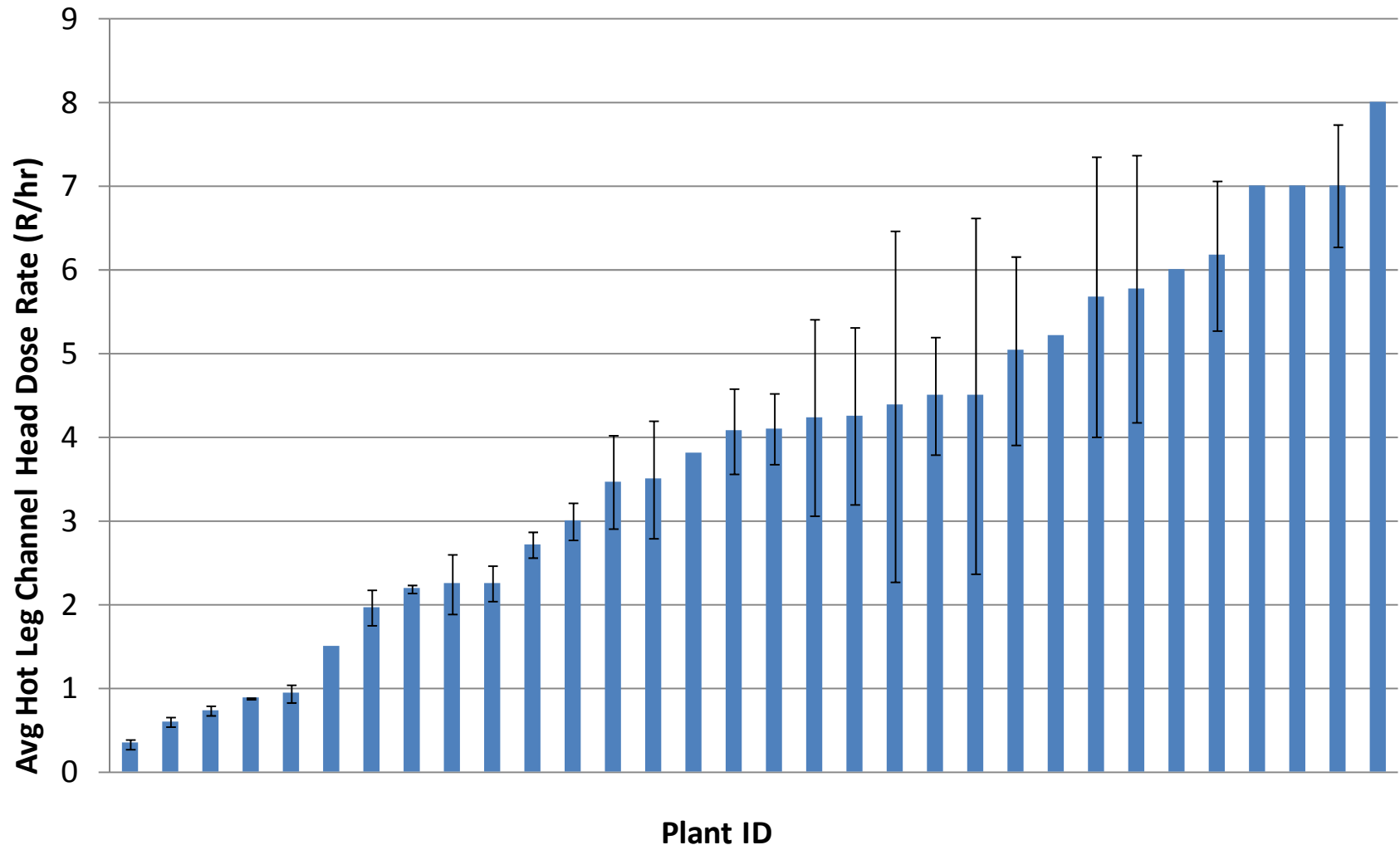
Cold leg piping

Steam Generator Channel Head



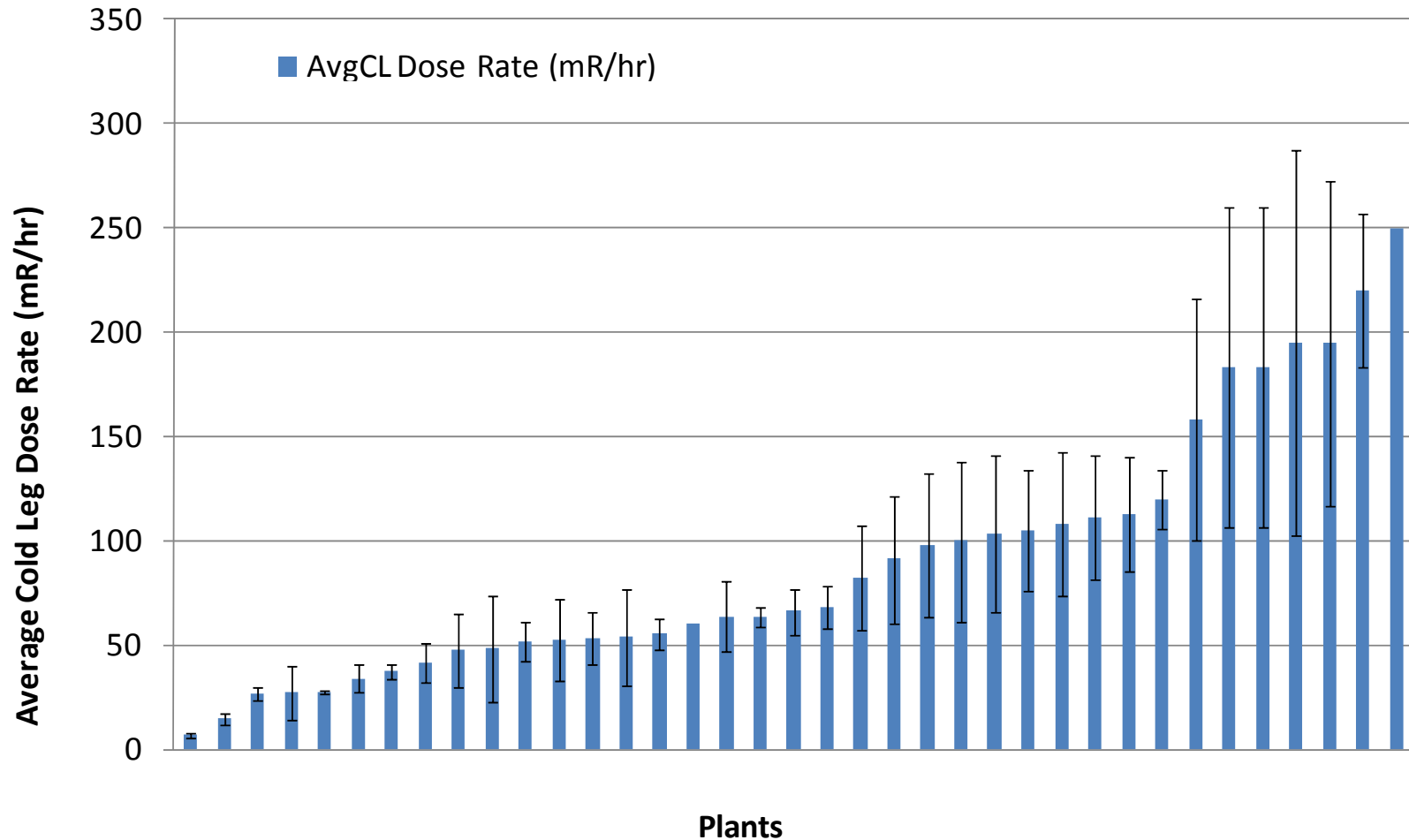
SRMP: PWR Center Channel Head Hot Leg

Most Recent Available Cycle



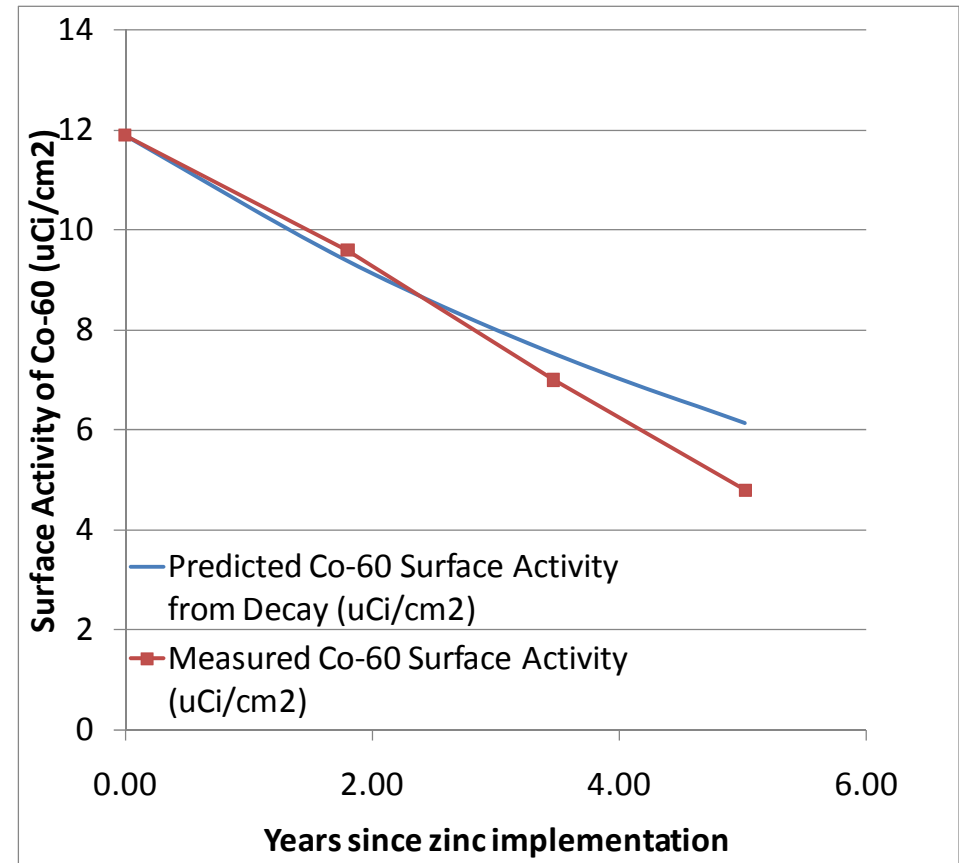
SRMP: PWR Loop Piping Cold Leg

Most Recent Available Cycle



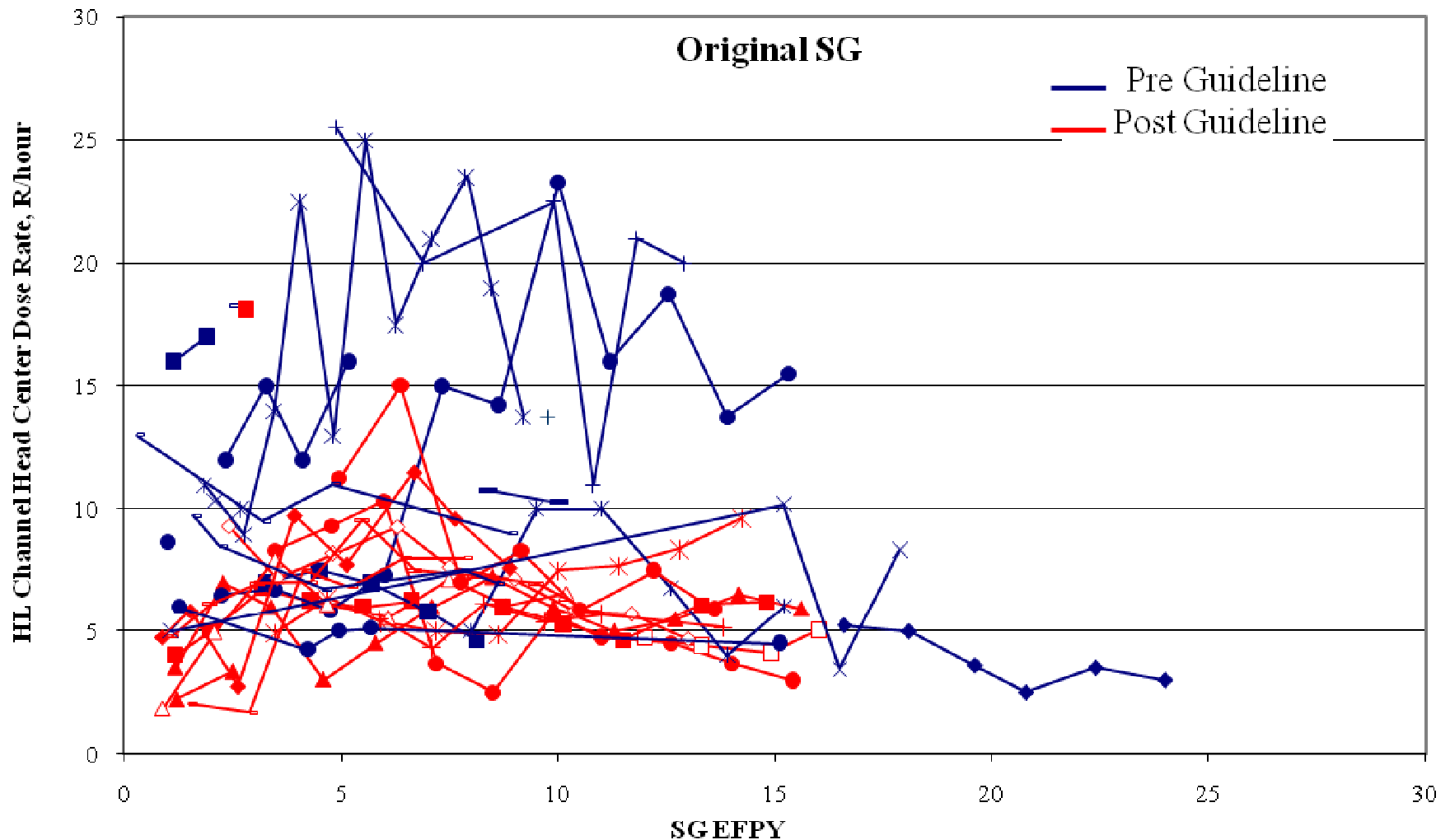
Zinc Injection Impact on Radiation Fields

- Several examples of positive impact of zinc
- Diablo Canyon 1 is most striking
 - Cobalt-60 decay curve is followed
 - Implies no additional activity deposition



For Diablo Canyon 1, since zinc injection, Cobalt-60 surface loading follows Co-60 decay curve at Diablo Canyon 1

Impacts of PWR Primary Chemistry Guidelines on Dose Rates



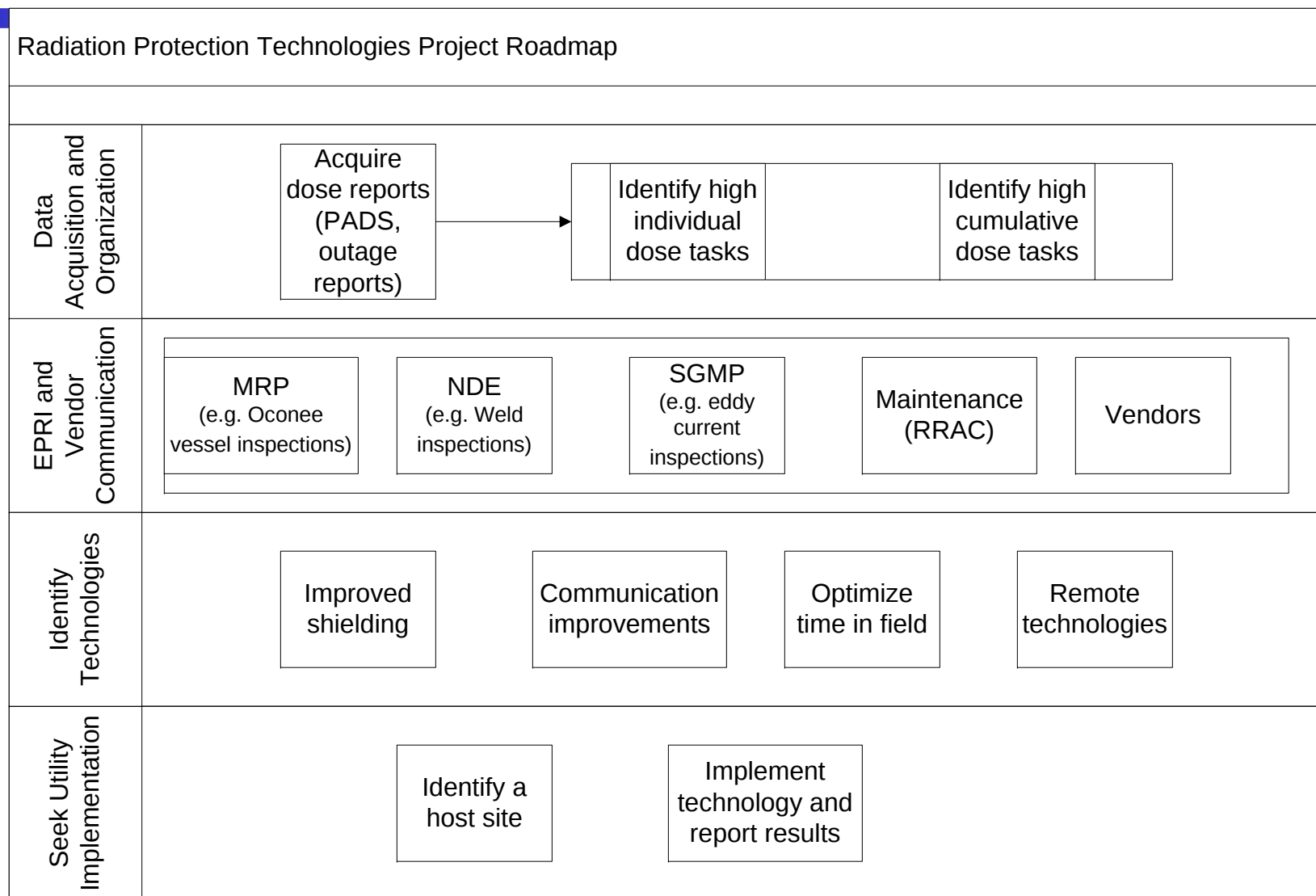
PWR Summary/Conclusions

- Zinc appears to be the strongest option to reduce ex-core dose rates
- pH has an impact, but mechanism is under investigation

RP 2020 Technologies

- Project has strategic and tactical parallel paths
 - Task Dose Benchmarking
 - Technology Identification and Demonstrations

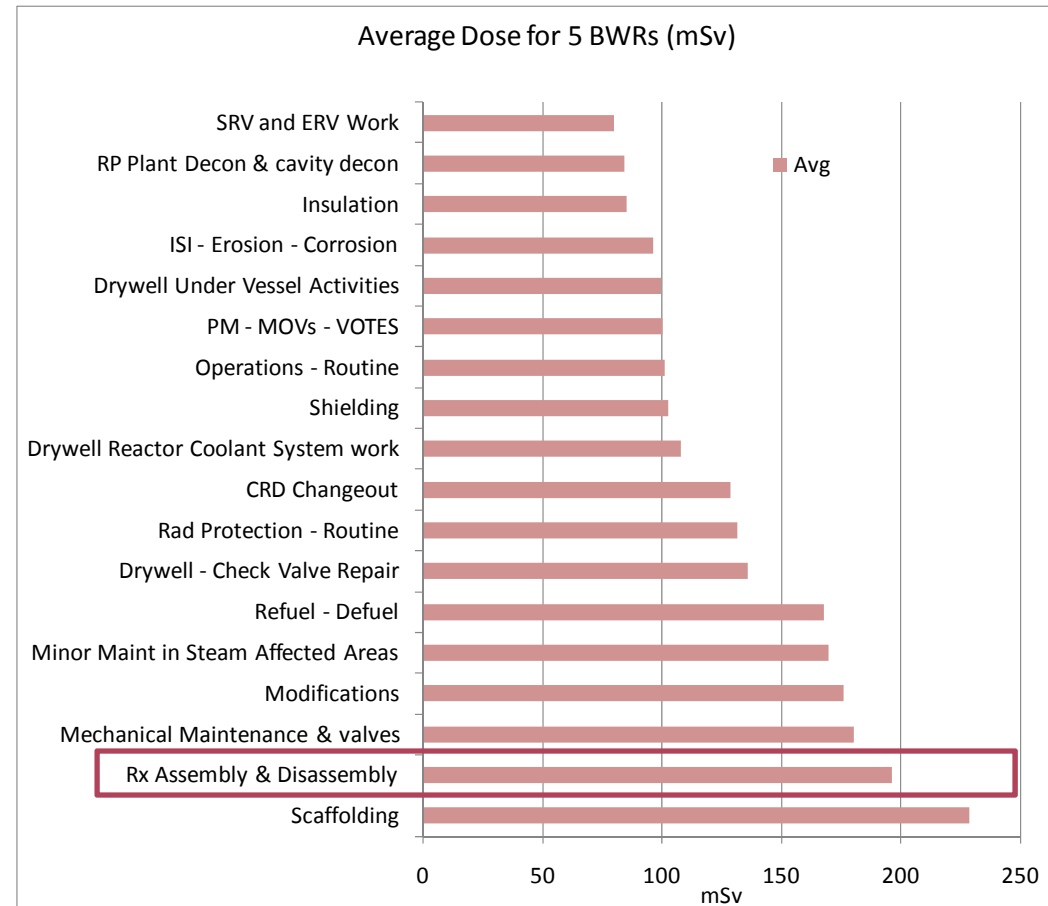
RP Technology Implementation Roadmap



Technology Implementation Example

Identify the Task/Individuals

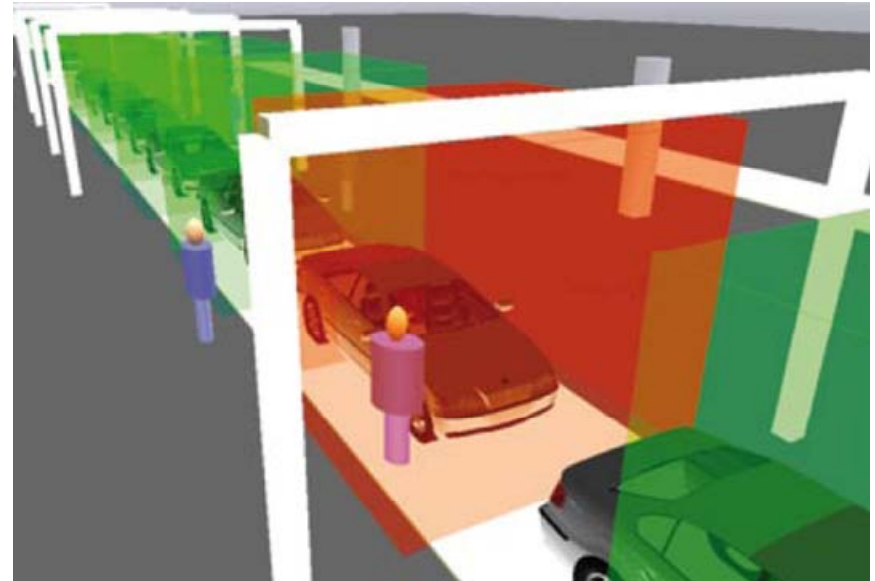
- Reactor Assembly/Disassembly is a high dose task
 - High dose rates
 - Many tasks
 - stud tensioners
 - CRD work
 - Shielding difficulties
- Preliminary results show high effective dose rates
 - cumulative dose/work hours



Technology Implementation Example

Select Candidate Technology

- Real Time Location Sensors to assess efficiency
 - Reports 3-D position to 3 cm resolution
 - Use it to
 - Determine work flow path
 - Identify unnecessary personnel exposure
 - Identify possible parallel tasks



RP 2020 Technology Implementation

Part II: Technology Demonstrations

- Utilities are already trying new technologies
- Technology list is in development
- For viable candidates, goal is to co-fund demonstration

Remote Technologies

Remote welding and sanding

Remote monitoring (fiber penetration)

Wireless remote monitoring

Bluetooth communications technology

Decontamination

Local system decontaminations

Control Rod Drive Flushing Tool

Cavity decontamination with peroxide

Dry vacuuming of vaults

Shielding

Shielding mats for refuel bridge

Permanent shielding on aux building systems

Moldable shielding

Novel Technologies

RadBall TM

Valve seat replacements

Replacement fiber insulation with reflective insulation

Location Tracking

Technology Conclusions

- EPRI is actively seeking new technology demonstrations
 - International collaboration is welcome
 - Please contact Dennis Hussey, dhussey@epri.com
- Check www.epri.com for Radiation Management Program
 - Many publicly available reports