



# **MRP RPV Surveillance Programs and Research Initiatives**

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**MRP – NRC Technical Meeting**

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# Agenda

- Atom Probe Tomography (APT) Examination of Selected High-fluence PWR Surveillance Materials
- Coordinated PWR Reactor Vessel Surveillance Program (CRVSP) (MRP-326) Update
- PWR Supplemental Surveillance Program (PSSP)

# APT on PWR Surveillance Specimens

- Under joint EPRI-CRIEPI research agreement, CRIEPI (Japan) to perform atom probe tomography (APT) on selected high-fluence PWR surveillance specimens
  - CRIEPI & BWRVIP have had similar program for many years
- Objective:
  - Identify microstructural changes in highly irradiated LAS specimens
  - Identify new embrittlement mechanisms (if any)

# APT on PWR Surveillance Specimens

- Specimens of interest

Plant / Capsule	Fluence (10 <sup>19</sup> n/cm <sup>2</sup> )	Base Metal Heat	Cu wt. %	Ni wt. %	Weld Type	Heat	Cu wt. %	Ni wt. %
Farley 1 / Z	8.47	--	--	--	Linde 0091	33A277	0.14	0.19
Farley 2 / <b>V</b>	<b>8.73</b>	SA-533B-1 (C7466-1)	0.2	0.6	SMAW	BOLA	0.03	0.9
Kewaunee / T	5.62	SA-508-2	0.06	0.75	Linde 1092	1P3571	0.22	0.72
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Maine Yankee / A35	6.11				Linde 1092	1P3571	0.36	0.78

- Contributing plants may have Regulatory commitments to retain tested surveillance specimens
- MRP can facilitate Plant Regulatory interaction
  - Staff interaction needed to define regulatory expectations

# **MRP Programs to Generate High-Fluence PWR Surveillance Data**

# Options for Obtaining More High-fluence PWR Surveillance Data

- Test CLB capsules at a higher fluence (CRVSP)
- Test additional existing high fluence spare or supplemental PWR capsules
  - Generally inefficient due to limited materials of interest per capsule
  - Reduces capsules available for subsequent license renewal
- Design, fabricate, irradiate and test a targeted capsule(s) (PSSP)
  - Allows selection of optimum materials to attain goals
  - Requires larger initial capital outlay, but highly information-efficient
- MRP is working projects to accomplish first and third options

# **Coordinated PWR Reactor Vessel Surveillance Program (CRVSP)**

# Coordinated Reactor Vessel Surveillance Program (CRVSP)

- *Coordinated PWR Reactor Vessel Surveillance Program (MRP-326)*
  - Produces high fluence data ( $3\text{-}10 \times 10^{19} \text{ n/cm}^2$ ) from remaining Appendix H capsules by 2025 to support future ETC development
    - CRVSP defers capsules only if can attain  $>3\text{E}+19 \text{ n/cm}^2$  by 2025
  - Implemented as a “Needed” guidance under NEI 03-08
    - ~~45~~ 13 plant schedules affected
      - Interim guidance under consideration to not require 2 plants to accelerate capsule tests
- Requires NRC approval to implement schedule changes
  - Follow existing protocols for 10CFR50 Appendix H changes
  - Plant submittals sequenced to distribute review load
    - Submission of the request fulfills *Needed* action
  - Future change requests will be evaluated by NRC Staff



# CRVSP Results

- Number of total capsules to be tested by 2025 at or above the stated fluence (~~red~~ assumes approval of Interim Guidance)

Fluence (n/cm <sup>2</sup> )	Pre- CRVSP	CRVSP
$\geq 3.0 \times 10^{19}$	25	<del>34</del> 29
$\geq 6.0 \times 10^{19}$	7	12
$\geq 8.0 \times 10^{19}$	1	<del>6</del> 5
$\geq 9.0 \times 10^{19}$	0	2

- CRVSP will increase fluence levels of many remaining capsules

# **PWR Supplemental Surveillance Program (PSSP)**

# PWR Supplemental Surveillance Program (PSSP)

- Design/Fabricate/Irradiate a supplemental surveillance capsule(s) containing previously-irradiated PWR materials
  - Specimens can be reconstituted (ASTM E1253) either before or after irradiation and then tested
  - Goal: Obtain 15-30 new high-fluence TTS data
- Materials selected based on information value to the PWR ETC
- For research use, not plant-specific surveillance
  - Plants would not revise P-T operating curves from PSSP data
- NRC approval will be required to use surveillance material
  - MRP can facilitate Plant Regulatory interaction
    - Staff interaction needed to define regulatory expectations

# PSSP Design and Planning

- Optional PSSP approaches
  - Fabricate 1 capsule containing inserts that are reconstituted after further irradiation
    - Lower initial cost but higher lifetime cost and higher risk to success
  - Fabricate 2 capsules, reconstitute specimens before capsule fabrication
    - Redundancy reduces risk from host plant issues
    - Allows for different fluence increments
- PSSP development spread over 3 years, 2012-2014
  - Planning for host plants and materials has started
- Goal: insert capsule(s) in 2014
  - Irradiate ~9 years

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