Global Expertise • One Voice
Delivering Your Nuclear Promise

2018 Materials Programs Technical Information Exchange Meeting
PWROG Materials Committee Update

Chris Wax, PWROG MSC Chair (APS)

May 22, 2018

Washington, DC

PRESSURIZED WATER REACTOR OWNERS GROUP

PWR Owners Group MSC Agenda

- PWROG MSC Key Focus Areas for 2018/2019
- Future PWROG Meetings
- MSC PWROG Core/Planning Team Organization and Key Contacts

PWROG MSC Key Focus Areas for 2018/2019 (1/10)

Scale and Impact of Uncertainty in Fluence Determinations for Reactor Vessel Internals

- The purpose of this ongoing program is to investigate the factors contributing to the uncertainty in the calculation of the fluence for the reactor vessel internals
  - The project intends to demonstrate that the fluence calculation uncertainty for internals does not change the individual MRP-227 component categorization for defining actions needed to manage material aging in the reactor vessel internals
  - The PWROG plans to submit a topical report (early 2021) to address NRC fluence uncertainty related Regulatory Questions/RAIs

PWROG MSC Key Focus Areas for 2018/2019 (2/10)

Qualification/Refinement of Fluence Determination in Non-Traditional Reactor Vessel Beltline Locations

- The purpose of this ongoing program is to collect supplementary neutron fluence/activity measurements in the extended beltline regions of operating PWRs
  - The project intends to provide;
    - a basis for refinement of the fluence analysis methodology from 2D to 3D modeling
    - a basis for confirmation of the fluence uncertainty in extended beltline locations in a manner similar to Regulatory Guide (RG) 1.190
  - The project will provide a consistent, documented industry position on the extended beltline, and distributed costs, in keeping with the 'Nuclear Promise'.

PWROG MSC Key Focus Areas for 2018/2019 (3/10)

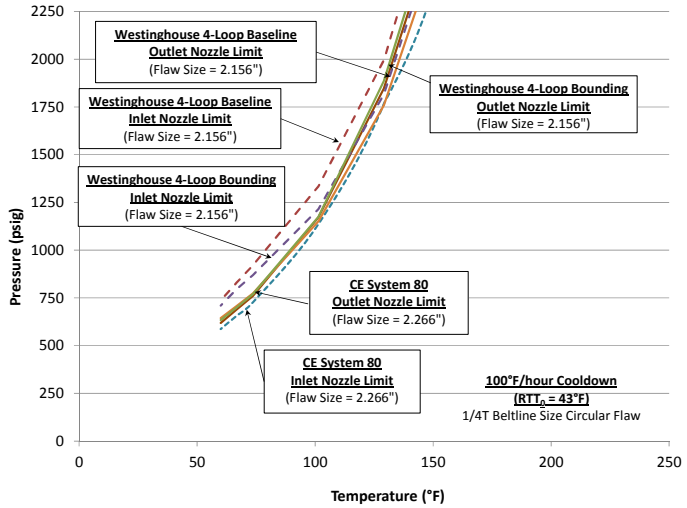
Demonstrate Appendix G Margins for PWR RPV Nozzles and Beltline

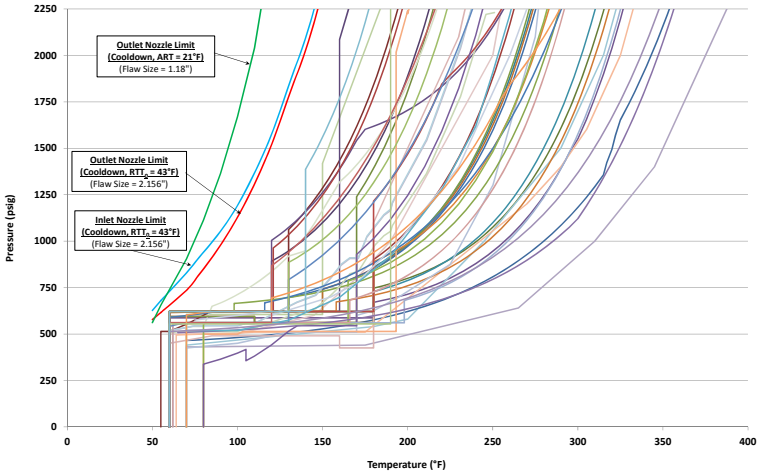
- The purpose of this ongoing program is to demonstrate that the RPV nozzle corner pressure-temperature (P-T) limit curves are bounded by the licensed traditional P-T limit curves for the US PWRs
  - The intent of the program is to justify the use of the RPV beltline & flange region as the limiting region to be used for P-T curves thereby demonstrating that current approved methodologies comply with Appendix G
    - WCAP-14040-A , CE NPSD-683-A, and BAW-10046A
- PWROG-15109-NP, "PWR Pressure Vessel Nozzle Appendix G Evaluation" was submitted to the NRC for review in March 2018

PWROG MSC Key Focus Areas for 2018/2019 (4/10)

Demonstrate Appendix G Margins for PWR RPV Nozzles and Beltline (2/3)

- Provided report to EPRI for a 3rd party review
  - A thorough review was provided and all comments were addressed
    - The report is more robust and should make NRC review easier
- Pre-submittal meeting held Monday May 22, 2017
  - The staff considered comparing a 3D FEA with a small flaw P-T curve to the 1/4T beltline curve as comparing apples and oranges and was uncomfortable with this approach
    - Report now includes originally postulated small flaws and 2.1" flaws (comparable to beltline 1/4T size) using Appendix G SIF solution for various limiting geometries
  - Also gathered all the US PWR CD curves to show a more convincing story





PWROG MSC Key Focus Areas for 2018/2019 (5/10)

Demonstrate Appendix G Margins for PWR RPV Nozzles and Beltline (3/3)

- **Final Report Excerpts PWROG-15109-NP**
  - The conservatively-derived generic nozzle Appendix G P-T limit curves were compared to all the NRC approved P-T limit curves for the U.S. PWR fleet
  - The results demonstrated that nozzle P-T limit curves were bounded in every case by the NRC approved U.S. PWR P-T limit curves. The nozzle P-T limit curve results are applicable through 60 years of operation
  - With licensee evaluation of SLR or other operational changes, updated nozzle fluence projections can be compared to the values used in this work for applicability. If the projected nozzle corner fluence remains less than the screening criterion of 4.28×10^{17} n/cm^2, then this analysis is applicable.
  - Based on the results of this detailed conservative assessment, the current licensed traditional U.S. PWR P-T limit curves that have used the NRC approved methods of developing P-T limit curves (WCAP-14040-A, Rev. 4, CE NPSD-683-A, Rev. 06 and BAW-10046A, Rev. 2) bound the nozzle P-T limit curves

PWROG MSC Key Focus Areas for 2018/2019 (6/10)

Transitioning RV Integrity to Direct Fracture Toughness

- The purpose of this ongoing program is to develop an acceptable method for any licensee to use irradiated fracture toughness data to improve or demonstrate margin in P-T curves.
  - The project intends to:
    - Reduce the number of P-T curve submittals by demonstrating margin of existing curves
    - Reduce uncertainty by providing irradiated fracture toughness data on more limiting materials
- Concept presented to NRC in March 2016
  - NRC feedback incorporated and updated plan presented at August 2016 EPRI Materials Reliability Conference

PWROG MSC Key Focus Areas for 2018/2019 (7/10)

Transitioning RV Integrity to Direct Fracture Toughness (2/2)

- Preparation of Topical Report
  - Follows to extent possible previously approved precedents and methods
    - "Safety Evaluation by the Office of Nuclear Reactor Regulation Regarding Amendment of the Kewaunee Nuclear Power Plant License to Include the Use of a Master Curve-Based Methodology for Reactor Pressure Vessel Integrity Assessment," May 2001
    - "Initial RT_{NDT} of Linde 80 Weld Materials," BAW-2308, Rev. 2-A, March 2008
    - NRC approved code case N-629
    - 10CFR50.61a
    - RG 1.99R2 adjustment methods
  - Topical report with basis is under preparation
    - Pre-submittal meeting Spring 2019
    - Submittal planned for Summer 2019

PWROG MSC Key Focus Areas for 2018/2019 (8/10)

Development of Generic Recommendations to Address ID-Initiated and OD-Initiated SCC of PWR Stainless Steel Pressure Boundary Components

- The purpose of this completed program was to proactively address SCC of pressure boundary stainless steel to ensure it is not a safety concern
  - Several cases of leakage due to SCC of stainless steel
    - MRP-236 OE Report
    - NRC Information Notice 2011-04
- Two reports provided to the PWROG MSC, PWROG-17067-NP and PWROG-17054-NP

PWROG MSC Key Focus Areas for 2018/2019 (9/10)

- *PWROG-17067-NP, Revision 0, "Resource Guide for Selecting Weld Locations for Inspection to Address ID-Initiated SCC of Stainless Steel Piping"*
  - Identified locations of interest by developing a SCC susceptibility screening criteria and then applying it to all stainless steel piping locations with a high consequence of rupture
  - Determined locations of interest are adequately addressed by existing inspection requirements (RI-ISI and/or ASME Section XI Category B-J with one-time GALL inspection for small-bore piping) based on
    - Weld locations of interest are part of the piping lines encompassed by the coverage bounds of the existing requirements
    - OE indicates SCC in the weld locations of interest is rare
    - In the unlikely event of SCC, it would be addressed before becoming a safety concern
  - Resource guide is provided for consideration when selecting weld locations to inspection to satisfy existing inspection requirements

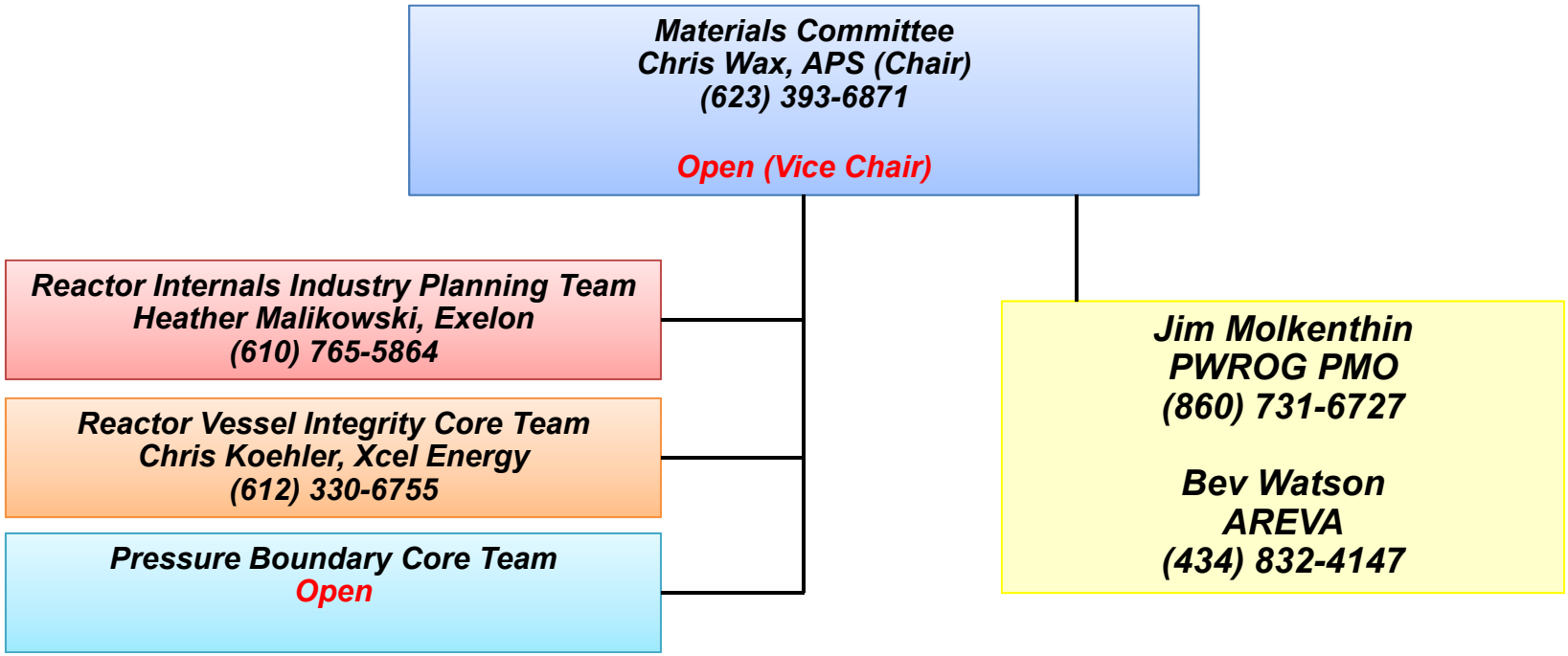
PWROG MSC Key Focus Areas for 2018/2019 (10/10)

- *PWROG-17054-NP, Revision 0, "Long-term Strategy for Identifying ODSCC of Stainless Steel Piping"*
  - ODSCC is not a safety concern
    - SCC susceptibility is not prevalent in locations with a high consequence of rupture
    - In the unlikely event of SCC in a high consequence location, it would be addressed before becoming a safety concern
  - NEI 03-08 Good Practice
    - Ensures a consistent level of awareness is communicated to appropriate plant organizations
    - Provides a consistent set of attributes for identifying and responding to SCC

Future PWROG Meetings

- June 12-14, 2018 PWROG General Session
- July 23-24, 2018 Steering and Executive Planning Meeting
- August 13-16, 2018 PWROG Joint PWROG Meetings
- October 2-4, 2018 PWROG General Session
- December 10-14, 2018 PWROG Joint PWROG Meetings

MSC PWROG Core/Planning Team Organization and Key Contacts



Questions?

The Materials Committee is established to provide a forum for the identification and resolution of materials issues including their development, modification and implementation to enhance the safe, efficient operation of PWR plants.

Global Expertise • One Voice •
Delivering Your Nuclear Promise
www.pwrog.com