

April 27, 2012

MEMORANDUM TO: John R. Jolicoeur, Chief
Licensing Processes Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

FROM: Jonathan G. Rowley, Project Manager /RA/
Licensing Processes Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

SUBJECT: SUMMARY OF MARCH 28, 2012, MEETING WITH THE PRESSURIZED
WATER REACTOR OWNERS GROUP REGARDING A STUDY ON
EFFECTS OF EXTENDED BELTLINE IRRADIATION EMBRITTLEMENT
ON PRESSURE-TEMPERATURE LIMITS

On March 28, 2012, a category 2 public meeting was held between the U.S. Nuclear Regulatory Commission (NRC) staff and representatives of the Pressurized Water Reactor Owners Group (PWROG) at NRC Headquarters, One White Flint North, 11555 Rockville Pike, Rockville, Maryland.

The purpose of the meeting was to discuss the PWROG's technical approach to assess the effects of neutron embrittlement on the reactor vessel beyond the traditional beltline into the extended beltline region. The neutron embrittlement in the extended beltline region could have an effect on the pressure-temperature (P-T) limits. The PWROG wanted feedback from the NRC staff on its approach and assessment of reactor vessel nozzles adjacent to the active core.

The PWROG approach encompassed performing a scoping study of pressurized water reactor reactor vessel (RV) nozzles to understand the effects and trends between traditional beltline materials and nozzles in the extended beltline region on P-T limits. The outcomes of the scoping study will provide direction for future development.

P-T limit curves were developed for the traditional beltline and also developed for inlet and outlet nozzles for Westinghouse Electric Company (Westinghouse), Combustion Engineering, and Babcox & Wilcox designed plants for varying levels of embrittlement of the traditional beltline. Because nozzle material properties were lacking for many plants, Westinghouse developed generic nozzle material properties. Using the generic material properties, the results show that the nozzles are limiting for low embrittlement (traditional beltline) plants. When other licensing material properties were used, the nozzles were limiting for some portion of the P-T limits for the low, medium, and high embrittlement (traditional beltline) plants. It was concluded that this analysis should be further refined to develop screening criteria to determine when nozzles need to be considered in P-T limits. Additionally, including more nozzle material property data would likely improve the results.

The NRC staff provided the following feedback on the project:

- For P-T limits, there is a requirement to review all ferritic materials in the reactor coolant system (RCS) pressure boundary per Title 10 of the *Code of Federal Regulation* (10 CFR), Part 50, Appendix G, and NUREG-1801, Revision 2, “Generic Aging Lessons Learned (GALL) Report.”
 - Per the Electric Power Research Institute (EPRI), Boiling Water Reactor Vessel Internals Project SA-508 Class 2 forging data is available to all EPRI members.
 - There should be initial data available for nozzles or other discontinuities since they may be limiting during the initial operating times due to low neutron fluence in the beltline and stress concentration effects from the nozzles/discontinuities.
 - General Electric has used an NRC Branch Technical Position for calculating reference temperature nil ductility (RT_{NDT}) to get initial RT_{NDT} .
 - Are there any archived materials available for the nozzles?
 - In the NRC’s preliminary nozzle assessment performed in 2010 and presented at the American Society of Mechanical Engineers Code meeting, the methods and margins used in calculating adjusted reference nil ductility temperature for all materials were from Regulatory Guide 1.99, Revision 2.
- 10 CFR Part 50, Appendix G, requires that P-T limits be developed for the entire reactor coolant pressure boundary (RCPB), consisting of ferritic RCPB materials in the RV beltline as well as ferritic RCPB materials not in the RV beltline.
- It may be possible to postulate a smaller flaw size than one-quarter thickness for nozzles and include the use of Elastic-Plastic Fracture Mechanics to obtain better results with sufficient justification.
- A postulated smaller nozzle corner flaw size should also consider the use of a semi-elliptical flaw in addition to a circular flaw.
- Structural Integrity Associates’ Pressure-Temperature Limits Report Methodology Topical Report addresses nozzles. Revision 0 of the report is non-proprietary.

A list of attendees is enclosed. The presentations by the PWROG can be found in the Agencywide Documents Access and Management System at Accession No. ML12093A084.

Project No. 694

Enclosure:
List of Attendees

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DISTRIBUTION:
See attached page

ADAMS Accession Nos.: ML12116A087; Pkg.: ML12117A008; ML120470115 (Notice); ML12093A084 (Presentations) NRR-106

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NAME	JRowley	DBaxley	JJolicoeur	JRowley
DATE	4/27/2012	4/26/2012	4/27/2012	4/27/2012

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Memo to J. Jolicoeur from J. Rowley dated

SUMMARY OF MARCH 28, 2012, MEETING WITH THE PRESSURIZED WATER REACTOR OWNERS GROUP REGARDING A STUDY ON EFFECTS OF EXTENDED BELTLINE IRRADIATION EMBRITTLEMENT ON PRESSURE-TEMPERATURE LIMIT

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List of Attendees

**Public Meeting with the Pressurized Water Reactor Owners Group
Regarding Extended Beltline Irradiation Embrittlement Effects
on Pressure-Temperature Limits**

March 28, 2012

Name	Organization
Jonathan Rowley	NRC
Al Csontos	NRC
Gary Stevens	NRC
Carolyn Fairbanks	NRC
Stacey Rosenberg	NRC
Eric Focht	NRC
Michael Benson	NRC
Evelyn Gettys	NRC
Allen Hiser	NRC
Jeff Poehler	NRC
Rob Tregoning	NRC
Robert Hardies	NRC
Mark Kirk*	NRC
Jana Bergman	Sciencetech
Doug Killian	PWROG/AREVA NP
Kevin Holthaus	PWROG/Omaha Public Power District
Carol Heinecke	PWROG/Westinghouse Electric Company
Anees Udyawar	PWROG/Westinghouse Electric Company
Jim Molkenthin	PWROG/Westinghouse Electric Company
Ashok Nana	PWROG/AREVA NP
Matthew DeVan	PWROG/AREVA NP
Tim Wells	PWROG/Southern Nuclear Operating Company
Tim Hardin	PWROG/Electric Power Research Institute
Kenjiro Aono	Japanese Nuclear Energy Safety
Mike McDevitt*	Southern California Edison
Brian Hall*	Westinghouse Electric Company
Daniel Sommerville*	Structural Integrity Associates, Inc.

* participated via telephone

ENCLOSURE