

January 7, 2014

Dennis Madison
Southern Nuclear
Chairman, BWR Vessel
and Internals Project
3420 Hillview Avenue
Palo Alto, CA 94304-1395

SUBJECT: SECOND REQUEST FOR ADDITIONAL INFORMATION RELATED TO
BWRVIP [BOILING WATER REACTOR (BWR) VESSEL INTERNALS
PROJECT]-100, REVISION 1, "BWR VESSEL INTERNALS PROJECT -
UPDATED ASSESSMENT OF THE FRACTURE TOUGHNESS OF
IRRADIATED STAINLESS STEEL FOR BWR CORE SHROUDS"
(TAC NO. ME8329)

Dear Mr. Madison:

By letter dated February 7, 2012, the Electric Power Research Institute (EPRI) submitted for U.S. Nuclear Regulatory Commission (NRC) staff review topical report BWRVIP-100, Revision 1, "BWR Vessel and Internals Project - Updated Assessment of the Fracture Toughness of Irradiated Stainless Steel for BWR Core Shrouds" (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12044A187). By letter dated August 22, 2012, the NRC staff transmitted request for additional information (RAI) questions (ADAMS Accession No. ML12164A862) and on May 23, 2013, EPRI provided its responses to the RAI questions (ADAMS Accession No. ML13156A386).

The NRC staff completed its review of these RAI responses, and has identified additional areas for which information is needed to complete the review. The additional RAI question is enclosed to this letter.

In an email dated November 20, 2013, Mr. Larry Steinert, representing the BWRVIP agreed that the NRC staff will receive the response to the enclosed RAI question by June 30, 2014. If you have any questions regarding the enclosed RAI question, please contact me at 301-415-7297.

Sincerely,

/RA/

Joseph J. Holonich, Sr. Project Manager
Licensing Processes Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Project No. 704

Enclosure:
RAI question

Dennis Madison
Southern Nuclear
Chairman, BWR Vessel
and Internals Project
3420 Hillview Avenue
Palo Alto, CA 94304-1395

SUBJECT: SECOND REQUEST FOR ADDITIONAL INFORMATION RELATED TO
BWRVIP [BOILING WATER REACTOR (BWR) VESSEL INTERNALS
PROJECT]-100, REVISION 1, "BWR VESSEL INTERNALS PROJECT -
UPDATED ASSESSMENT OF THE FRACTURE TOUGHNESS OF
IRRADIATED STAINLESS STEEL FOR BWR CORE SHROUDS"
(TAC NO. ME8329)

Dear Mr. Madison:

By letter dated February 7, 2012, the Electric Power Research Institute (EPRI) submitted for U.S. Nuclear Regulatory Commission (NRC) staff review topical report BWRVIP-100, Revision 1, "BWR Vessel and Internals Project - Updated Assessment of the Fracture Toughness of Irradiated Stainless Steel for BWR Core Shrouds" (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12044A187). By letter dated August 22, 2012, the NRC staff transmitted request for additional information (RAI) questions (ADAMS Accession No. ML12164A862) and on May 23, 2013, EPRI provided its responses to the RAI questions (ADAMS Accession No. ML13156A386).

The NRC staff completed its review of these RAI responses, and has identified additional areas for which information is needed to complete the review. The additional RAI question is enclosed to this letter.

In an email dated November 20, 2013, Mr. Larry Steinert, representing the BWRVIP agreed that the NRC staff will receive the response to the enclosed RAI question by June 30, 2014. If you have any questions regarding the enclosed RAI question, please contact me at 301-415-7297.

Sincerely,

/RA/

Joseph J. Holonich, Sr. Project Manager
Licensing Processes Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Project No. 704

Enclosure:
RAI question

DISTRIBUTION:

PUBLIC
RidsNrrLADBaxley
RidsNrrDeEvib
AMendiola

RidsNroOd
RidsOgcMailCenter
RidsResOd
PLPB R/F

RidsNrrDpr
RidsAcrrAcnwMailCenter
SRosenberg

JHolonich
JPholer
RidsNrrDprPlpb

ADAMS Accession No.: ML13205A289

NRR-106

OFFICE	PLPB/PM	PLPB/LA	DE/EVIB/BC	PLPB/BC	PLPB/PM
NAME	JHolonich	DBaxley	SRosenberg	AMendiola	JHolonich
DATE	01/06/2014	12/31/2013	01/06/2014	01/07/2014	01/07/2014

OFFICIAL RECORD COPY

SECOND REQUEST FOR ADDITIONAL INFORMATION RELATED TO
BWRVIP-100, REVISION 1, BWR [BOILING WATER REACTOR] VESSEL
INTERNALS PROJECT - UPDATED ASSESSEMENT OF THE FRACTURE TOUGHNESS OF
IRRADIATED STAINLESS STEEL FOR BWR CORE SHROUDS
ELECTRIC POWER RESEARCH INSTITUTE
PROJECT NO. 704

RAI 8

NUREG/CR-6428 (Ref. 1) defined a lower-bound J-R curve for fully-saturated thermally aged, non-irradiated Type 308 and 316 SMAW welds as $J=40+83.5\Delta a^{0.643}$. The BWRVIP-100, Revision 1 model predicts higher fracture toughness than the Reference 1 curve, even at low fluence (3×10^{20} n/cm²).

O'Donnell et al. (Ref. 2) reports several results, including some from earlier work, for austenitic stainless steel welds irradiated to 4 -5 dpa that had low, flat J-R curves that would not be bounded by the BWRVIP-100, Revision 1 model. The welds were not thermally aged. NUREG/CR-7027 (Ref. 3) presents an alternate lower bound curve for fracture toughness of irradiated austenitic stainless steel welds and cast austenitic stainless steels. This curve is also more conservative than the BWRVIP-100, Revision 1 model.

Although the studies described above do not report on testing of welds subject to both thermal aging and irradiation, the results suggest that either thermal aging or irradiation independently can produce fracture toughness in austenitic stainless steel welds that would not be bounded by the BWRVIP-100, Revision 1 model.

Requested Information

Discuss and disposition the results of the studies cited above with respect to the BWRVIP-100, Revision 1 fracture toughness model. Propose changes as necessary to ensure that the BWRVIP-100, Revision 1 model is conservative for evaluation of core shroud cracking located in the weld metal.

References

1. NUREG/CR-6428, Effects of Thermal Aging on Fracture Toughness and Charpy-Impact Strength of Stainless Steel Pipe Welds, April 30, 1996 (ADAMS Accession No. ML052360567).
2. O'Donnell, I. J. et al, "The Fracture Toughness Behavior of Austenitic Steels and Weld Metal Including the Effects of Thermal Ageing and Irradiation," in Int. J. Pres. Ves. & Piping 65 (1996), pp. 209-220, Elsevier Science Limited.
3. NUREG/CR-7027, "Degradation of LWR Core Internal Materials Due to Neutron Irradiation," December 31, 2010 (ADAMS Accession No. ML102790482).

ENCLOSURE