UNITED STATES
NUCLEAR REGULATORY COMMISSION
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October 17, 2016

MEMORANDUM TO: John Lubinski, Director
Division of Engineering
Office of Nuclear Reactor Regulation

FROM: Brian E. Thomas, Director ***/RA/***
Division of Engineering
Office of Nuclear Regulatory Research

SUBJECT: TRANSMITTAL OF A TECHNICAL PAPER ENTITLED "PROBABILISTIC FRACTURE MECHANICS EVALUATIONS THAT CONSIDER NOZZLES IN THE EXTENDED BELTLINE REGION OF REACTOR PRESSURE VESSELS" IN SUPPORT OF NRR USER NEED REQUEST NRR-2014-007

The Office of Nuclear Regulatory Research (RES) has completed a technical paper (attached) entitled, *"Probabilistic Fracture Mechanics Evaluations that Consider Nozzles in the Extended Beltline Region of Reactor Pressure Vessels,"* (ADAMS Accession: ML16273A005), which documents work performed under Task 2.1 of User Need Request NRR-2014-007, "Reactor Pressure Vessel Integrity Issues." Work under Task 2.1 supports the development of the technical basis for a potential risk-informed revision of Appendix G to 10 CFR Part 50. The paper, which also was presented at the American Society for Mechanical Engineers (ASME) conference on Pressure Vessels and Piping (PVP), completes the staff's work associated with the development of technical basic to support 10CFR50, Appendix G in accordance with SECY-16-0009.

For reasons of both practicality and conservatism, safety analyses of the reactor pressure vessel (RPV) typically focus on analyses of only the materials that most limit the operation of the RPV. Conventionally these materials have been assumed to be those in the RPV shell (sometimes called "beltline") area that are the most sensitive to irradiation embrittlement. However it has been recognized that while materials in the nozzle region do not experience significant irradiation embrittlement, they are subjected to higher stresses than those in the shell due to the stress concentration effect produced by the nozzle.

The paper summarizes a scoping study undertaken to assess if there are situations where the stress concentration effects outweigh embrittlement effects on the RPV, thereby causing nozzle materials to be more limiting. Major conclusions from the study, which focused exclusively on pressurized water reactors (PWRs), are as follows:

- For pressure/temperature (P-T) limits established following the procedures of the ASME Code, which are incorporated into 10 CFR Part 50 Appendix G by reference, materials in the nozzle region could be limiting if the level of embrittlement in the RPV shell is low. These evaluations include the long-practiced conservatism of basing P-T limits on flaw sizes much larger than are actually encountered in RPV service.

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- Probabilistic fracture mechanics calculations performed using the FAVOR (standing for Fracture Analysis of Vessels, Oak Ridge) computer code showed that for the population of flaw sizes that are encountered in RPV service, it is exceedingly unlikely that materials in the nozzle region could be limiting.

Due to the priorities established in SECY-16-0009 (ML16028A189), "Recommendations Resulting from the Integrated Prioritization and Re-Baselining of Agency Activities," further work in this technical area has been suspended.

Staff from the Division of Engineering in NRR reviewed this PVP paper; they did not offer comments but stated that it is acceptable to place this document into ADAMS and consider it a product of NRR-UNR-2014-007. Nonetheless, please feel free to notify the responsible RES contact if you have any questions concerning the impending public release of this technical paper.

If additional information is required, please contact Mark Kirk of my staff at 301-251-7631 or mtk@nrc.gov.

Enclosure:
As stated

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