May 15, 2008

MEMORANDUM TO: Michele G. Evans, Director
Division of Component Integrity
Office of Nuclear Reactor Regulation

FROM: Jennifer L. Uhle, Director ***/RA/ S. Richards for***
Division of Engineering
Office of Nuclear Regulatory Research

SUBJECT: EXTERNAL REVIEWS OF EMBRITTLEMENT TREND CURVE DEVELOPMENT FOR REACTOR PRESSURE VESSEL MATERIALS

Information concerning the efforts of our staffs to develop an updated approach to estimating the effects of neutron irradiation embrittlement on reactor pressure vessel materials was recently transmitted to the Office of Nuclear Reactor Regulation (NRR); this information can be found at ADAMS Accession number ML081120474. This memorandum noted that a group of individuals external to the Nuclear Regulatory Commission was commissioned to critique these reports. The purpose of this letter is to provide to you the outcome of their reviews.

The following four individuals provided comments on the work of my staff:

- Professor Gary Was of the Department of Materials Science and Engineering at the University of Michigan: Professor Was serves as the Director of the Michigan Memorial Phoenix Energy Institute whose mission is to chart the path to a secure, affordable, and sustainable energy future. Additionally, Professor Was recently published a graduate-level textbook entitled "*Fundamentals of Radiation Materials Science: Metals and Alloys*" (© Springer-Verlag, 2007, ISBN 978-3-540-49471-3).

- Dr. Roger Stoller of the Oak Ridge National Laboratory (ORNL): Dr. Stoller is the chairman of the American Society for Testing and Materials (ASTM) Committee E10 on Nuclear Technology and Applications.

- Dr. Randy Nanstad, also of the ORNL: Dr. Nanstad was the principal investigator of the NRC's Heavy Section Steel Irradiation (HSSI) project.

- Professor G. Robert Odette of the Department of Mechanical and Environmental Engineering at the University of California at Santa Barbara: Professor Odette's work of over three decades has focused on understanding and developing models to predict the microstructural evolution and mechanical property changes that occur in structural alloys that are used in nuclear construction.

CONTACTS: Mark E. Kirk, RES/DE
(301) 415-6015

Enclosure A provides Professor Was' review, while Enclosure B provides the review of Dr. Nanstad, Dr. Soller, and Professor Odette. While the reviewers made many useful specific suggestions that my staff will take into consideration to improve their work, the outcome of these reviews may be briefly stated as follows:

1. The reviewers all agreed that the ΔT_{30} embrittlement trend curve developed by my staff as a fit to the domestic light water reactor surveillance database provided an appropriate and acceptable representation of both the empirical and physical trends manifest in these data.

2. There is a disparity of opinion among the reviewers as to the appropriate treatment of the potential high fluence effects on ΔT_{30} embrittlement trends. In the reports that were reviewed (ADAMS ML081120474) my staff recommended estimating ΔT_{30} embrittlement trends above fluences of $3x10^{19}$ n/cm^2 based on information drawn largely from test reactor irradiations (but also supported by more limited power reactor data). Professor Was agreed that the approach recommended by my staff is appropriate. However, Dr. Nanstad, Dr. Soller, and Professor Odette advised that the potential effects of neutron flux differences between test and power reactors may not be properly accounted for by the approach recommended by my staff. These reviewers recommended that time be allowed to perform additional research, to explore alternative approaches, and to raise this matter with the international community before regulatory guidance is provided on this matter.

My staff has determined that there is no significant safety implication of delaying, for a few years time, the provision of regulatory guidance on high fluence effects on ΔT_{30} embrittlement trends. Consequently in the coming months my staff will be working with both your staff and with the international expert community to develop a plan to address high fluence effects on ΔT_{30} embrittlement trends. Beyond this specific technical issue, my staff continues to work on embrittlement trend curves and on the development of a third revision to Regulatory Guide 1.99. By agreement with your staff our current focus is (a) development of a plan to address the issues raised by the experts' review, and (b) to synchronize our work on Regulatory Guide 1.99 with our work on risk-informing 10 CFR Part 50 Appendix G.

Finally, please note that we are placing this memorandum and all of its enclosures into ADAMS in the public domain to complete the information previously posted at ADAMS ML081120474. Public availability of this information is critical to my staffs' development of a plan to address high fluence effects on ΔT_{30} embrittlement trends.

Enclosures:
As stated

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Enclosures:
As stated

DISTRIBUTION:

R. Hardies	E. Focht	B. Elliott	M. Mitchell	S. Malik
C. Fairbanks	J. Uhle	N. Ray		

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