July 8, 2005

MEMORANDUM TO: Ledyard B. Marsh, Director
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

FROM: Richard J. Barrett, Director ***/RA/ Michele G. Evans for/***
Division of Engineering Technology
Office of Nuclear Regulatory Research

SUBJECT: FINAL DRAFT NUREG/CR, "CRACK GROWTH RATES OF IRRADIATED AUSTENITIC STAINLESS STEEL WELD HEAT AFFECTED ZONE IN BWR ENVIRONMENTS"

Attached is a copy of a NUREG/CR authored by staff at Argonne National Laboratory. This report contains crack growth rate data and fracture surface examinations from cyclic loading and stress-corrosion cracking tests in the heat-affected zone of 304L and 304 stainless steels welds, irradiated and tested in simulated boiling water reactor (BWR) coolant environments. This study is important since core shroud cracks generally emanate from heat-affected zones of the stainless steel exposed to irradiation and BWR coolants. The effects of material composition, irradiation and water chemistry on growth rates are discussed.

The results described in this report pertain to stainless steels irradiated to about 0.75 dpa - just exceeding the consensus threshold for the onset of irradiation susceptibility of about 0.3 to 0.5 dpa. Indeed, the crack growth rates exhibit a significant increase in crack growth rates as a result, generally residing a factor of 2X lower than, to 5X above the NUREG-0313 reference line, which was positioned as an upper bound describing stress-corrosion crack growth rates for non-irriadiated stainless steels in BWR water with elevated oxygen content, including heat-affected zone effects and influences of materials chemistry. Materials chemistry effects or post-welding heat treatment produce small differences within this range. However, these growth rates are in the same range as growth rates measured in irradiated, wrought stainless steels, suggesting that the effects are due mostly to irradiation, rather than the microstructural effects of heat-affected zone formation. A beneficial effect of reducing the corrosion potential, by reducing the dissolved oxygen content of the simulated coolant, reduced the crack growth rates for all the materials that were tested. All of these results are commensurate with data obtained by other laboratories (principally in Europe and Japan).

The impetus for this research on irradiation-assisted stress-corrosion cracking comes from User Need Request NRR-2002-026, and this topic is an especially important consideration during the review of license applications. We are requesting that cognizant staff from your office review this draft NUREG/CR, and provide us with comments within four weeks.

Attachment: As stated

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