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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

MAR. 1 9 1996

MEMORANDUM TO: Jack E. Rosenthal, Chief
Reactor Analysis Branch
Safety Programs Division
Office for Analysis and Evaluation of Operational Data

FROM: Jack R. Strosnider, Chief
Materials and Chemical Engineering Branch
Office of Nuclear Reactor Regulation

SUBJECT: ASSESSMENT OF INSPECTION RESULTS FOR D.C. COOK UNIT 2 REACTOR VESSEL UPPER HEAD PENETRATION

References:

(a) Memorandum to Jack R. Strosnider from Jack E. Rosenthal, "Assessment of Inspection Results for D.C. Cook Unit 2 Reactor Vessel Upper Head Penetration," October 25, 1995

(b) Structural Integrity Evaluation of Reactor Vessel Upper Head Penetrations to Support Continued Operation: D.C. Cook, Unit 2, WCAP-14118, Revision 1, 1994, Westinghouse Electric Corporation (Westinghouse Proprietary Document)

(c) Letter from Warren H. Bamford (Westinghouse Electric Corporation) to Robert Hermann (NRC), January 26, 1996.

(d) Teleconference, Warren Bamford (Westinghouse Electric Corporation), Keith Wichman, Robert Hermann, Edwin Hackett (NRC), February 12, 1996.

In reference (a) AEOD expressed concern with the primary water stress corrosion cracking (PWSCC) crack growth rates used in the analysis of the control rod drive (CRD) penetrations at D.C. Cook Unit 2. The Cook CRD structural integrity analysis was performed by the Westinghouse Electric Corporation and is documented in reference (b). The AEOD concern relates to the use of a crack growth model by P.M. Scott of Framatome and the contention that Westinghouse did not properly adjust for temperature variations in their application of the model to the Cook CRD penetrations. AEOD stated in reference (a) that the Westinghouse analysis "uses this model as if it were for crack growth evaluation at 330°C instead of 310°C and, therefore, provides non-conservative results for the flaw growth at the D.C. Cook Unit 2 operating temperature of 318°C". An independent "Flaw Growth Evaluation for D.C. Cook Unit 2, Penetration 75," conducted by the Idaho National Engineering Laboratory (INEL), was attached to reference (a) and provided the supporting technical basis for the disagreement with the Westinghouse analysis.

CONTACT: Ed Hackett, NRR/DE/EMCB (301) 415-2751

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The Materials and Chemical Engineering Branch (EMCB) has reviewed the concern with the crack growth rates and has discussed this issue with Mr. Warren Bamford, the principal author of the Westinghouse analysis, via references (c) and (d). In reference (c) (attached), Mr. Bamford states that the conclusions of reference (a) are incorrect for several reasons but primarily due to information on the development of the Scott model that was only available to Westinghouse via private communications with P.M. Scott. The key difference with the INEL analysis concerns the corrections applied to the model for cold work and temperature. The original data were generated at 330°C on Alloy 600 steam generator tubes that were flattened (cold worked) to produce the test samples. In reference (c), Mr. Bamford states that the crack growth rates from these tests were divided by a factor of 10 to account only for cold work effects. INEL had assumed that the factor of 10 correction was for both cold work and temperature (330°C to 310°C). Westinghouse used the crack growth rate equation corrected for cold work and then applied a temperature correction based on service experience to obtain the crack growth rate at 318°C for application to the D.C. Cook penetrations.

Additional support for the Westinghouse position that is documented in reference (c) includes independent verification of the Scott model by a third party and crack growth rate data from actual head penetration materials. The Westinghouse implementation of the Scott model bounded the data from 12 of 14 heats of material tested. The two heats which cracked at a faster rate than that predicted by the model were from a different vendor and used a different fabrication process than that used for D.C. Cook.

Based on our review of the available information, the Materials and Chemical Engineering Branch (EMCB) is satisfied that the crack growth rate equation derived in reference (b) should bound growth rates likely to be experienced at D.C. Cook Unit 2 to a reasonable degree of engineering certainty. EMCB will consider all pertinent experimental evidence, including the results of vendor and NRC-sponsored experimental investigations, in evaluating future submittals using Alloy 600 PWSCC crack growth rates. Practically useful crack growth rate information will also accrue from subsequent re-inspections of the CRD penetrations. EMCB also agrees that the crack growth rate is not critical to the overall safety evaluation for the CRD penetrations in that even if through-wall cracking did occur there is significant margin to the critical flaw length and detectable leakage would occur first.

Please contact Ed Hackett (415-2751) of my staff if you have any questions regarding this evaluation.

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