April 17, 2003

MEMORANDUM TO: William H. Bateman, Branch Chief
Electrical, Mechanical and Chemical Engineering Branch
Division of Engineering
Office of Nuclear Reactor Regulation

FROM: Leonard D. Wert, Acting Branch Chief ***/RA/***
Materials Engineering Branch
Division of Engineering Technology
Office of Nuclear Regulatory Research

SUBJECT: NETWORK FOR EVALUATING STRUCTURAL COMPONENTS (NESC-IV) PROJECT INTERIM REPORT ON AN INVESTIGATION OF THE TRANSFERABILITY OF MASTER CURVE TECHNOLOGY TO SHALLOW FLAWS IN REACTOR PRESSURE VESSEL APPLICATIONS

Attached please find an interim report entitled, "An Investigation of the Transferability of Master Curve Technology to Shallow Flaws in Reactor Pressure Vessel Applications," for an European Commission (EC) project, NESC-IV (Network for Evaluating Structural Components, Fourth project). A portion of this EC-sponsored cooperative research program was carried out at ORNL under RES funding. Publication of this NESC-IV interim report is a RES operating plan milestone under activity 1A1ABB.

This interim report, together with a successful completion of the NESC-IV project, will assist in reducing unnecessary regulatory burden on stakeholders by removing unnecessary conservatisms in structural integrity margins of safety for reactor pressure vessel belt-line region materials. The results from the NESC-IV project are applicable to PWR and BWR industry submittals on reactor pressure vessel integrity assessments under normal heatup and cooldown pressure-temperature operational transients, and for potential pressurized thermal shock conditions in PWRs.

The NESC-IV project is a combined experimental and analytical program to develop validated analysis methods for transferring fracture toughness data generated on unaxially-loaded standard test specimens to shallow flaws in reactor pressure vessel welds that are under biaxial stress-state in the lower ductile-to-brittle fracture transition temperature region. The testing program has utilized material removed from an unused reactor pressure vessel. In Part A, six clad-cruciform specimens containing shallow surface-breaking flaws located in weld material were successfully tested. For Part B, a further four uniaxial-beam tests were performed using an innovative test piece design with a simulated embedded flaw.

The present interim report provides detailed description of the tests conducted, the materials characterization testing and the pre-test fracture mechanics analyses. It forms the basis for the post-test analyses that are currently in progress. A primary goal for the report is to provide NESC partners with all information needed to perform post-test fracture analyses of the NESC-IV experiments. The Chapter 2 of the report provides a summary of the NESC-IV problem statement and related work packages. This is followed by descriptions of work performed on materials characterization (Chapter 3), component design and fabrication (Chapter 4), pretest analysis (Chapter 5), the testing program (Chapter 6) and plans for post-test assessment (Chapter 7).

Post-test assessments, interpretations of results and implications for treatment of shallow flaws in RPVs will be presented in a follow-on final report for the NESC-IV project that is expected to be completed in 2004.

The LWR industry submittals have not used the advanced methodology that is being developed for the treatment of shallow-flaw fracture toughness of RPV beltline materials. The present interim report, together with the final NESC-IV project report, will provide test data and techniques for development of a comprehensive structural integrity assessment methodology for use by the licensees and the NRC staff. The uncertainties in the developed test data are being addressed by performing multiples tests under similar loading conditions. The present research draws upon the earlier work carried out ORNL under RES support on master curve methodology development for uniaxially-loaded laboratory fracture toughness test specimens and the biaxially-loaded cruciform fracture toughness test-specimen development.

If additional information is required, please contact Shah N. Malik (SNM) of my staff on 415-6007.

Attachment: As stated

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