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OAK RIDGE NATIONAL LABORATORY
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FOR THE U. S. DEPARTMENT OF ENERGY

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October 22, 1993

Mr. Michael E. Mayfield
Division of Engineering
Mail Stop NL/S217C
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mike:

Irradiation Effects Information on A508 Class 3 Steel

In response to your recent urgent inquiry regarding information on A508 class 3 steel, I have checked with the HSSI staff and examined what literature, meeting minutes, etc., that I have been able to find in the short time available. It turns out that while we do not have a great deal of information which has been developed directly within the NRC-funded programs, we do have access to a fair bit overall.

First, within the HSSI program we have obtained several tons of A508 class 3 steel. This was due to the recognition, by Al Taboada when he was program monitor, that there would come a time when the NRC would want to extensively examine its embrittlement behavior for advanced LWR applications. We had already tried to obtain small quantities for other government-funded research and realized how hard A508 class 3 steel was to obtain in small amounts or in short times. When the opportunity appeared to obtain some inexpensive, highly pedigreed, reactor-grade A508 class 3 steel from the WPPS vessels which were being scrapped, we jumped at it.

The HSSI program also recently finished irradiating a number of Charpy specimens from a different heat of A508 class 3 which we obtained from the DOE-funded Modular High-Temperature Gas-Cooled Reactor (MHTGR) program. The specimens were included in the first large Midland weld metal irradiation capsule upon direction from Ed Hackett when he was program monitor. It had become apparent shortly before that capsule was completed that extra space for a number of Charpy specimens was unexpectedly available. The A508 class 3 steel was one of several materials included and again it was to develop information for future needs. The specimens should be tested this winter following disassembly of the capsule.

Another HSSI program activity involving A508 class 3 steel was initiated with your approval when we accepted the residual irradiation-temperature-effects specimens left over from the canceled DOE-funded New Production Reactor program. These included the tensile specimens of the same A508 class 3 heats which were investigated in the MHTGR program. In that program, an extensive study of the effects of irradiation temperature on embrittlement of A508 class 3 was performed. Since many of the same staff members at ORNL that were involved in that study are now involved with the HSSI program we have ready access to all of the relevant results and will incorporate them into our current NRC-funded research.

The last activity within the HSSI program involves collaboration with the Italian regulatory agency, ENEA. Several years ago, the ENEA began an extensive investigation into the embrittlement behavior of A508 class 3 steel including impact, tensile, fracture toughness and crack-arrest behavior. Much of the irradiation and testing was done in the United States by the Battelle Institute in Columbus. Unfortunately, their irradiation testing facilities were closed before the work was completed. Recognizing the future need for information on A508 class 3 embrittlement, Chuck Serpan and Al Taboada included the testing of the residual specimens into the HSSI program in exchange for full access to the results of the Italian research program. These specimens were received at ORNL last year and should be tested in FY94.

Internationally, A508 class 3 steel is widely used for vessel fabrication. Its embrittlement behavior is being investigated by several countries. Through NRC-funded interactions with the foreign pressure vessel community, we have access to a great deal of information on A508 class 3. The Japanese results have been discussed during the JAPEIC-USNRC Specialized Topic Workshops held in 1990 and 1991. The very extensive French data base on A508 class 3 is just now becoming available through the recent NRC-led efforts to establish a multi-national surveillance data base for irradiation-embrittlement correlation development. Lastly, A508 class 3 was extensively examined in Phase 3 of the IAEA Coordinated Research Program on irradiation effects on advanced pressure vessel steels. The preliminary results of this effort were reported as recently as last month during the IAEA Irradiation Specialists Meeting in Paris, that was attended by Allen Hiser, Keith Wichman, and myself.

In addition to the sources described above, it would be valuable to examine any additional information which may have been developed under Ed Wooldridge's Pressure Vessel Safety Research for Advanced Reactors Program (L2241). Lastly, while its access is still restricted, I would assume that there may be information of value about the embrittlement response of A508 class 3 steel that has been developed in the Naval reactors program.

While it is true that we do not have nearly as much information on or experience with A508 class 3 steel as we have with A508 class 2 or A533 grade B class 1 steel for vessel applications, there is an extensive data base available for analysis of its acceptability for use in advanced reactors.

If you have any further questions in this area or wish to discuss what we might be able to do to help programmatically, please let me know.

Sincerely,

Bill

William R. Corwin, Manager
Heavy-Section Steel Irradiation Program

WRC:rar

Attachment

cc/att: H. W. Hayden, Jr.
C. E. Pugh
File-NoRC

ALWR CODE DEVELOPMENT & ASSESSMENT MISSION STATEMENT

Current RES T/H code development emphasis is on analysis requirements for AP600 & SBWR Focus initially is on SBLOCA & other design basis transients that activate new safety systems. ALWR code development should not impair "robustness" of codes for non-ALWR applications. The ALWR T/H code and transient specific missions are as follows:

1) RELAP5/MOD3 :
   - AP600 SBLOCA spectrum, MSLB, SGTR, LOFW
   - SBWR SBLOCA spectrum, MSLB, LOFW
2) RAMONA-4B :
   - SBWR stability
3) TRAC P :
   - AP600 LBLOCA (possibly IBLOCA & assymetric SBLOCA)

Since the containment plays a vital role in both ALWR passive safety systems, the CONTAIN code is being linked to the RELAP5 code for both designs, in order to better represent containment features. CONTAIN as linked to RELAP5 will be assessed insofar as it affects RCS design basis transient & accident behavior.

RELAP5 applications will be limited to one-dimensional analyses unless it can be clearly demonstrated that cross-flow simulation of multi-dimensional effects is adequate. TRAC-P will be the code of choice for applications where multi-dimensional effects are important.

Follow-on activities will explore effects of multiple failures. This work must be consistent with ongoing NRR work on active failures and ALWR PRA's