

June 28, 2001

MEMORANDUM TO: Keith R. Wichman, Chief
Structural Integrity and Metallurgy Section
Materials and Chemical Engineering Branch
Division of Engineering
Office of Nuclear Reactor Regulation

Edwin M. Hackett, Assistant Chief
Materials Engineering Branch
Division of Engineering Technology
Office of Nuclear Regulatory Research

FROM: James Medoff, Materials Engineer */ra/*
Structural Integrity and Metallurgy Section
Materials and Chemical Engineering Branch
Division of Engineering
Office of Nuclear Reactor Regulation

Cayatano Santos, Materials Engineer */ra/*
Materials Engineering Branch
Division of Engineering Technology
Office of Nuclear Regulatory Research

SUBJECT: TRIP REPORT FOR TRAVEL TO IAEA SPECIALISTS MEETING ON
IRRADIATION DAMAGE AND MITIGATION, MAY 14-17, 2001, IN
GLOUCESTER, ENGLAND, UNITED KINGDOM

On May 14-17, 2001, the International Atomic Energy Agency (IAEA) held its "Specialist Meeting on Irradiation Damage and Mitigation" in Gloucester, England. The IAEA conducts this international symposium for the purpose of discussing the results of most current research on irradiation induced embrittlement of ferritic and low alloy steel materials. The participants in the meeting consisted of professors and engineers from Europe, Asia, North America, and South America, and represented academic, research, regulatory and corporate based organizations. Attachment 1 to this report provides the official list of participants in the meeting. Participants representing the NRC at the meeting included Mr. James Medoff of the Office of Nuclear

CONTACTS: James Medoff, EMCB
(301) 415-2715

Cayatano Santos, MEB
(301) 415-6004

Reactor Regulation, Mr. Cayatano Santos of the Office of Nuclear Regulatory Research, and Mr. Randy Nanstad, an NRC contractor from the Oakridge National Laboratory.

The IAEA Organizing Committee broke the meeting down into the following sessions:

- Session 1 - Programs and Surveillance 1
- Session 2 - Surveillance 2, Irradiation, Re-Irradiation, and Techniques 1
- Session 3 - Irradiation Effects
- Session 4 - Irradiation, Annealing, and Re-Irradiation
- Session 5 - Mechanical Properties
- Session 6 - Operational and Service Life Aspects
- Session 7 - Meeting Conclusions

The IAEA organizing committee for the meeting also arranged for a tour of the “hot” and “cold” cell fracture toughness testing and microscopy facilities at British Nuclear Fuels Limited (BNFL). Since BNFL has purchased Westinghouse Electric Corporation, BNFL may be using these facilities for some of the Charpy impact testing on surveillance specimens that are tested as part of the reactor vessel material surveillance programs for Westinghouse and Combustion Engineering designed facilities.

Mr. Medoff presented a paper, “Activities by the US Nuclear Regulatory Commission and US Nuclear Power Industry to Assure the Integrity of Reactor Pressure Vessels in US Nuclear Power Plants.” This paper summarized the NRC’s current methods for calculating adjusted nil-ductility reference temperatures for ferritic and low alloy steel materials used to fabricate the Reactor Pressure Vessels (RPVs) and other components of the US reactor coolant pressure boundaries, and the activities of the Combustion Engineering Owners Group (CEOG), Babcock and Wilcox Owners Group (BWOOG), and Boiling Water Reactor Vessel and Internals Project (BWRVIP) to collect, compile, and report alloying and surveillance data on behalf of their member utilities and plants. This paper also served to clarify the technical information discussed in Regulatory Guide 1.99, Revision 2, “Radiation Embrittlement of Reactor Vessel Materials” (May 1988), and in NUREG-1511, Supplement 2, “Reactor Pressure Vessel Status Report” (September 2000). Mr. Nanstad presented two papers at the meeting: (1) “Re-evaluation and Analysis of the VVER-440 RPV Standard Surveillance Programme Results,” and (2) “Effect of Post-Weld Heat Treatment Temperature and Cooling Rate on Matrix Copper Level and Charpy Toughness of Pressure Vessel Steel Welds.”

A significant number of the papers presented at the meeting focused on the effects of irradiation on the integrity of ferritic steels used to fabricate VVER-400 and VVER-1000 reactors in Eastern Europe. The Eastern European block countries currently correlate the predicted shift in adjusted reference temperature to a simple function of the estimated neutron fluence for the reactor vessel (i.e., to a function of $f^{1/3}$). The studies on the VVER-400 and VVER-1000 materials focused on adjusting the correlation functions to account for the effects of phosphorous, nickel, chromium and manganese on the adjusted reference temperature shift. The results of many of the studies suggest that high phosphorous levels may reduce the ability of bulk copper to remain in solid solution with the base metal matrix and may promote precipitation of copper phosphates at the grain boundaries of the steels. However, this concern does not appear to be a significantly relevant issue for U.S. RPVs, as the phosphorous levels of ferritic steels used in the fabrication of US RPVs tend to be low (typically less than 0.015 wt-%).

Other studies discussed the feasibility of applying master curve technology to the structural integrity assessments for reactor vessel materials. Since Mr. Medoff and Mr. Nanstad presented papers at the meeting, the NRC is scheduled to receive a copy of the meeting proceedings. Attachment 2 provides the overall summary and conclusions from the meeting.

Attachment 3 provides a list of all the papers presented over the 4-day meetings. The staff may be particularly interested in paper # 37, "Application of Master Curve Fracture Toughness for Reactor Pressure Vessel Integrity Assessments in the USA." Copies of these papers may be obtained from Mr. Medoff or Mr. Santos upon request.

Attachments: As stated

Other studies discussed the feasibility of applying master curve technology to the structural integrity assessments for reactor vessel materials. Since Mr. Medoff and Mr. Nanstad presented papers at the meeting, the NRC is scheduled to receive a copy of the meeting proceedings. Attachment 2 provides the overall summary and conclusions from the meeting.

Attachment 3 provides a list of all the papers presented over the 4-day meetings. The staff may be particularly interested in paper # 37, "Application of Master Curve Fracture Toughness for Reactor Pressure Vessel Integrity Assessments in the USA." Copies of these papers may be obtained from Mr. Medoff or Mr. Santos upon request.

Attachments: As stated

Distribution:

EMCB RF	MMitchell	SMalik	JDunnLee
JRStrosnider	AThadani	ALee	RHauber
TECollins	CFairbanks	MMayfield	
WHBateman	AHiser	BJElliot	
NCChokshi	RZimmerman	MKirk	

DOCUMENT NAME: G:\EMCB\Medoff\IAEA Trip Report.wpd

INDICATE IN BOX: "C"=COPY W/O ATTACHMENT/ENCLOSURE, "E"=COPY W/ATT/ENCL, "N"=NO COPY

OFFICE	EMCB:DE	E	EMCB:DE	E	MEB:DET	E	MEB:DET	E
NAME	JMedoff:jxm		KRWichman:krw		CSantos:cs		EMHackett:emh	
DATE	06 / 28 /01		06 / 28 /01		06 / 28 /01		06 / 28 /01	

OFFICIAL RECORD COPY