

August 28, 2002

MEMORANDUM TO: Richard J. Barrett, Director
Division of Engineering
Office of Nuclear Reactor Regulation

Michael E. Mayfield, Director
Division of Engineering Technology
Office of Nuclear Regulatory Research

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SUBJECT: FOREIGN TRIP REPORT - VISIT TO BABCOCK AND WILCOX
CANADA, JULY 9 AND 10, 2002

Attached is a report summarizing our trip to Ontario, Canada in which we visited the Babcock and Wilcox Canada (BWC) fabrication facility on July 9 and 10, 2002. This trip report is being provided to the appropriate Division Directors in the Office of Nuclear Regulatory Research and the Office of Nuclear Reactor Regulation.

Attachment: As stated

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NRC FOREIGN TRIP REPORT

Subject

Reactor pressure vessel (RPV) head and steam generator (SG) replacement design features; tour of Babcock and Wilcox Canada (BWC) fabrication facility.

Dates of Travel and Countries/Organizations Visited

July 9 and 10, 2002 - Meetings with representatives of BWC and Duke Power in Cambridge, Ontario.

Sensitivity

Not applicable.

Background/Purpose

NRR Purpose: The Babcock and Wilcox manufacturing facility is in the process of fabricating replacement steam generators and reactor vessel heads for Oconee as well as a reactor vessel head for Ginna. The purpose of this trip was for the staff to understand the design and fabrication of these components. Experience gained from this visit will increase participants efficiency and effectiveness with respect to interactions with various stakeholders regarding steam generator and reactor pressure vessel head replacements.

RES Purpose: NRR and RES are analyzing occurrences of vessel head penetration nozzle cracking in U.S. facilities. Several NRC bulletins have been issued requesting information. Attempts by the NRC staff to obtain PWR vessel head material property data and fabrication details such as welding techniques, weld sequences, and number of weld passes have generally not been fruitful. BWC and Duke Power agreed to meet with NRC staff and provide as much of this detailed information as possible.

NRC staff previously toured the manufacturing facility with regard to the replacement of recirculating SGs. These meetings and the tour provided an opportunity for the NRC staff to ask followup questions and observe once through steam generators in various states of construction.

Abstract

Representatives from BWC and Duke Power discussed the following with respect to the planned replacements: the schedule; engineering design aspects; and licensing issues. In addition, a plan was developed with the NRC staff to provide proprietary design and fabrication information.

In addition to these discussions, a tour of the fabrication facility was conducted. This tour provided the participants with a better understanding of the fabrication methods employed and the design of these components (through witnessing various stages of construction of the steam generators and the vessel head). The Oconee replacement steam generators represent the first replacement of the Babcock and Wilcox once through steam generators.

The meetings were successful. The NRC participants received a better appreciation of the design and fabrication challenges by witnessing the actual fabrication of these components. In addition, BWC and Duke Power provided responses to the NRC staff questions that had been transmitted prior to the meetings. BWC and Duke Power stated that they could provide detailed RPV replacement head design and fabrication information for use in developing an improved probabilistic model for performing time to failure from leakage relative to circumferential crack evaluations in control rod drive mechanisms (CRDMs). The probabilistic model will provide a means for the NRC staff to make an independent assessment of industry submittals on this topic.

Discussions

Representatives from BWC and Duke Power discussed the schedule for the planned replacements as well as engineering design aspects of the replacements. This included an overview of the materials for the major internal components, specific design considerations and improvements to minimize the potential for problems encountered in older vintage RPV heads and SGs, and a comparison of the overall characteristics relative to the original design presently in operation at Oconee (RPV heads and SGs).

To accurately analyze cracking of vessel head penetration nozzles, the following detailed information is needed regarding the J-groove weld preparation: size of cavity, buttering and stress relief, weld bead width and height, number of passes, and weld application orientation. Much of this information along with the qualification is only available from the vendor (i.e., BWC).

The following includes some of the information discussed with BWC and Duke Power that will be requested in the letter:

1. Measurements of B&W head CRDM nozzle deformation after welding (i.e., angle of inclination) and how residual stresses in the tubes increase with the angle of inclination, yield strength, weld volume, and the thickness of weld as related to fatigue.
2. Improvements to the welding process for replacement heads to limit deformations and hence, residual stresses (Framatome has studied the ASME requirements because of the U.S. orders for replacement heads)

In addition to the technical meetings, a tour of the manufacturing facilities was provided. Several replacement RPV heads and SGs were under construction. Some of the new construction techniques were observed, and we were able to talk with some of the craftsmen about difficulties, effectiveness, etc.

The Oconee replacement once through steam generators incorporate several design enhancements compared to their original steam generators. In addition, the vendor is implementing measures to reduce the potential for damaging the tubes during steam generator fabrication. One design enhancement involves the use of hour-glassed tube support plate trifoil "holes." The hour-glass configuration is intended to reduce the pressure drop across the plate, provide a flat contact surface for the tube, facilitates tubing of the steam generator, and provides better accessibility for water lancing and chemical cleaning. To reduce the potential

for damaging the tubes, the vendor is deburring the tube support plates through various means. BWC's manufacturing sequence associated with the closure welds and final hydraulic expansion was qualified and does not compromise the tube-to-tubesheet joint.

Pending Actions/Planned Next Steps for NRC

The RES staff will develop a letter to BWC and Duke Power detailing the specific data needed to analyze the vessel head penetration nozzle cracking issue. A final decision (by Duke Power and BWC) on how to proceed will be made following receipt of the letter. The NRC staff agreed to share the results of its analyses with BWC and Duke Power.

Points for Commission Consideration/Items of Interest

No policy issues have been identified that need to be brought to management's or the Commission's attention.

Attachments

Agenda.

"On the Margins"

No additional information of probable interest to report.