August 15, 2005

MEMORANDUM TO: William H. Bateman, Chief
Materials and Chemical Engineering Branch
Division of Engineering

FROM: Meena K. Khanna, Materials Engineer ***/(RA by M. Khanna)/***
Materials and Chemical Engineering Branch
Division of Engineering

SUBJECT: SUMMARY OF JULY 26, 2005, MEETING BETWEEN THE CHECWORKS USERS GROUP AND THE NUCLEAR REGULATORY COMMISSION STAFF TO DISCUSS THE CURRENT STATUS OF THE BOILING WATER REACTOR BOTTOM HEAD DRAIN LINE FLOW ACCELERATED CORROSION INSPECTIONS

On July 26, 2005, representatives of the CHECWORKS Users Group (CHUG) met with the Office of Nuclear Reactor Regulation (NRR) staff to discuss its generic evaluation of the susceptibility of flow accelerated corrosion (FAC) on the bottom head drain lines of boiling water reactors (BWRs), and its recommendations on how the bottom head drain lines in BWRs should be evaluated and inspected. The primary area of discussion was the 1st elbow downstream of the reactor vessel drain line connection which is immediately underneath the vessel and inside the pedestal. This piping is not readily inspectable due to the accessibility challenges from interferences from the control rod drive housings and other penetrations underneath the reactor vessel.

A representative of the CHUG began the meeting by stating the objectives of the meeting which included: an overview, a discussion of FAC susceptibility of the bottom head drain line, industry activities, industry survey, parametric analyses, categorization of plants, and conclusions and future actions.

The CHUG indicated that the reactor vessel bottom head drain line can be susceptible to FAC depending on operating conditions. It was also indicated that parametric studies had been performed for the BWR fleet to evaluate the conditions that would lead to the greatest susceptibility. The studies suggested that water chemistry is the most important variable affecting the rate of FAC wear. In addition, the overview included a discussion of inspections that have been performed at some stations. Finally, it was stated that FAC susceptibility of lower head drain piping is not an emergent issue for the fleet. The discussion is summarized below.

The representative of the CHUG stated that the bottom head drain piping is susceptible to FAC per the criteria of NSAC 202L-R2, based on operating conditions and the carbon steel piping. In addition, it was stated that most BWRs have included the piping in their susceptible-not-modeled program, and a few plants have modeled the line in CHECWORKS.

The CHUG sponsored an evaluation that included an industry survey, parametric sensitivity analyses, CHECWORKS analyses of the most susceptible plants and a review of inspection options. The CHUG representative provided the results of the industry survey. Results from the survey identified that: the general configuration of drain lines is quite similar, the flow rates vary from 0 to 240 gpm, operating temperatures vary from 430EF to 562EF, dissolved oxygen varies widely depending on water chemistry, and that 12 units have done some inspections.

The CHUG representative discussed how the effect of the different water chemistries is to alter the amount of dissolved oxygen and hydrogen peroxide in the lower plenum, FAC is directly related to oxidant, i.e., oxidant is equal to oxygen + 0.47 peroxide. The typical values of oxidant in the lower plenum were provided for the different water chemistries; e.g., normal water chemistry (250 ppb), noble metals chemical addition (125 ppb), and moderate hydrogen water chemistry (HWC) (0 to 52 ppb depending on level of H_2 injection).

Then, another CHUG representative discussed the parametric studies that were performed for the BWR fleet. He indicated that a parametric analysis of the piping underneath the vessel was performed to identify the variables that most affect the rate of degradation. He also stated that the CHECWORKS Steam/Feedwater Application was used for the analysis, which is used to assess FAC in piping components as well as to manage inspection data. The CHUG representative then discussed the results from the parametric analyses. The parametric analyses found that oxidant is the most important variable, flow rate is also an important variable, and the temperature variations between units are relatively unimportant.

The CHUG representative then mentioned that case studies were performed to cover common plant conditions. He also indicated that these results showed that only plants on HWC with high levels of hydrogen would have the potential for significant wear rates. Based on the case studies, plant-specific analyses were conducted of plants that had low oxidant for several years and moderate to high flow rates for several years.

The CHUG representative then indicated that based on the parametric analyses and case studies, the 35 US BWRs were placed in one of the three following categories: Category A-never on moderate hydrogen water chemistry (18 units), Category B-limited time on moderate hydrogen water chemistry or a lower level of H_2 injection resulting in high oxidant (7 units), and Category C-longer time on moderate hydrogen water chemistry (10 units).

Then, the CHUG representative discussed the available inspection data. He stated that a total of 12 units have inspection data, seven units have inspection data but never operated on moderate hydrogen water chemistry, and five Category B and C units have inspection data. The representative then provided a ranking of the units, whereby Plant A is the highest ranked and Plant K is the 11^{th} ranked unit. Details regarding each plant, i.e., category, operation on moderate hydrogen water chemistry, and inspection results were provided for each of the ranked plants. The NRC staff expressed concerns that the inspections had been performed at a distance downstream of where the drain line exits the vessel, and may not be completely representative. A representative of the BWRVIP responded by indicating that the BWRVIP is providing funding for tooling that is being developed through the CHUG to directly inspect the segment of the line exiting the bottom vessel. The representative also indicated that the BWRVIP would keep the NRC informed about their progress in developing the tooling.

A question was asked by the staff regarding whether a list of the ranking of plants was provided to the BWR Vessel Internals Project (BWRVIP) Executives. The CHUG indicated that currently, that had not been done; however, they indicated that they were going to take an action item to provide the BWRVIP with a letter from the CHUG that would provide the ranking of the plants.

The CHUG representative also stated that more inspection data from highly ranked plants would become available by the completion of the Spring 2006 outages. He also indicated that after the January 2006 CHUG Meeting, the BWRVIP would brief the staff regarding the results of the meeting and any additional inspection data. Finally, in closing, NRR management thanked the CHUG representatives for their update on the boiling water reactor bottom head drain line flow accelerated corrosion inspections.

Attachment: Meeting Attendees

CONTACT: Meena Khanna, EMCB/DE
301-415-2150

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MEETING ATTENDEES

MEETING WITH THE BOILING WATER REACTOR VESSEL AND INTERNALS PROJECT

JUNE 14, 2005

CHUG
Delisa Smith
Harold Crockett
Jeff Horowitz
David Crawley
Doug Munson

BWRVIP
Robin Dyle

NRC
Bill Bateman
Louise Lund
Kryzstof Parczewski
Carolyn Lauron
Meena Khanna
John Lamb
David Hills

ATTACHMENT