



Project 694

WOG-03-610

November 19, 2003

Dr. Brian Sheron  
Associate Director Project Licensing and Technical Analysis  
Office of Nuclear Reactor Regulation  
US Nuclear Regulatory Commission

Subject: Westinghouse Owners Group Activities to Address CE Plant  
Pressurizer Heater Sleeve Degradation Issues

Dr. Sheron:

As you requested, a telephone discussion was held on November 3, 2003 involving you, several members of the Office of Nuclear Reactor Regulation (NRR) staff, members of the Westinghouse Owners Group (WOG), and me to discuss the current Combustion Engineering (CE) plant pressurizer heater sleeve degradation issue. The purpose of this letter is to describe the current WOG activities to support the development of an Operability Assessment for the plants in the CE fleet. The WOG plans to provide this assessment to the NRC through a follow-up communication and would support a meeting, if desired by NRR, to address the continued safe operation of the CE plants.

### Background

Since the late 1980's, the industry has been aware of the possible degradation of small-bore nozzles constructed from Alloy 600 material. The CE Owners Group (CEOG) recognized the benefit of performing a comprehensive evaluation program to better understand the safety issues associated with nozzle degradation and the environmental factors causing the degradation. Over the years, the CEOG has provided reports and briefed the NRC staff on the progress achieved in managing the degradation of Alloy 600 small-bore nozzles. Since the acquisition of ABB/CE by Westinghouse and the subsequent integration of the WOG and CEOG into a single WOG in 2003, the responsibility for follow of this issue has transitioned to the WOG.

Three CE plants that are currently shut down for refueling have performed bare metal visual inspections and/or Non-Destructive Examinations (NDE) of their pressurizer heater sleeves. These three plants have found either evidence of leakage from the presence of boric acid residue or NDE indications of potential flaws. One CE unit reported to the NRC that NDE in several heater sleeve locations had circumferentially-

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oriented indications. Additional NDE at that unit has confirmed circumferentially-oriented flaws in five heater sleeves. All of these flaws have been characterized as located above the J-groove weld on the downhill side of the sleeve/pressurizer vessel interface, extending through-wall partially around the circumference. The circumferential flaws were not located in material considered part of the pressure boundary. The other two CE plants have reported to the NRC that they each have one or more heater sleeve locations with evidence of leakage from the presence of boric acid residue. Additional NDE at these two plants has confirmed that the flaws are all axially-oriented.

### **Activities to Develop an Operability Assessment for CE Plants**

Recognizing the potential safety significance of circumferential cracks, the WOG began working on an Operability Assessment for the CE plants shortly after the inspection results from one CE plant indicated the possible existence of circumferentially-oriented flaws in their pressurizer heater sleeves. The assessment that is being developed will support the following conclusions:

- Bare metal visual inspections of the pressurizer heaters can succeed in finding degradation flaws well before they become safety-significant, and
- The CE plant design basis safety analyses bound the consequences of a loss of coolant accident (LOCA) caused by the ejection of a pressurizer heater sleeve, and the incremental contribution of such an event to the core damage frequency is negligible.

#### Part 1 – Integrity Evaluation

Credible degradation modes of pressurizer heater sleeves will be evaluated to determine:

- Leakage rate as a function of pressurizer heater sleeve flaw size
- Critical size of a pressurizer heater sleeve flaw that would grow rapidly to cause parting of the sleeve under design basis transient accident conditions
- Time for a detectable pressurizer heater sleeve leakage flaw to reach the critical size

Finite element welding residual stress analyses will be carried out using the ANSYS program. The analyses will address the two types of heater sleeves (small diameter and large diameter) and the geometries with the highest residual welding stress to address the complete range of domestic CE pressurizer heater sleeve designs. The results will be used to calculate the growth rate of a through-wall circumferential crack, using the methodology recommended by the NRC for closure head nozzles (MRP 55, Rev. A). The time for a through-wall flaw to reach the limiting size to prevent net section collapse (ejection) will then be calculated.

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## Part 2 - Impact of Potential Heater Sleeve Failure

The consequences of a heater sleeve ejection relative to small break LOCA and on the emergency procedure guidelines, based on the hole sizes created, and the potential for missile impact, jet impingement, and subcompartment pressurization on the safety of the plant will be evaluated. An examination of a typical CE plant Probabilistic Risk Assessment to determine the effect on conditional core damage frequency will also be assessed.

The Operability Assessment for plants in the CE fleet will be prepared from the evaluations performed for Part 1 and Part 2. The assessment will be completed and issued to CE licensees and to the NRC by December 31, 2003.

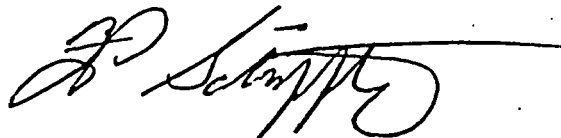
Preliminary results from the Parts 1 and 2 evaluations indicate that the time frame for progression from cracks that are detectable with the current visual inspection procedures to cracks that may result in heater sleeve ejection is at least several fuel cycles. The current programs being followed by the utilities would detect leakage flaws and replace the affected sleeves prior to reaching the estimated failure time. This provides assurance that there will be no failures due to cracking prior to their discovery and repair.

The WOG has conducted a survey of the CE fleet to determine the current methods of inspection. The results of the survey are being verified and will be included with the Operability Assessment.

The WOG looks forward to meeting with the NRC, as appropriate, to review the results of the Operability Assessment. The WOG will also be working with the NEI Materials Technical Advisory Group (MTAG) and the EPRI MRP to coordinate future actions to address this issue.

We appreciate this opportunity to discuss the CE plant pressurizer heater sleeve issues with you and your staff.

Sincerely yours,



Frederick P. "Ted" Schiffley, II  
Chairman  
Westinghouse Owners Group

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cc: Dave Mauldin (utility/MTAG)  
Alex Marion (NEI)  
Chris Crane (MEOG)  
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