May 10, 2002

MEMORANDUM TO: S. F. Newberry, Director
Division of Risk Analysis and Applications
Office of Nuclear Regulatory Research
/RA by Roy J. Caniano Acting For/

FROM: John A. Grobe, Director
Division of Reactor Safety

SUBJECT: POTENTIALLY GENERIC SAFETY ISSUE - BWR ECCS SUCTION CONCERNS

As discussed with L. B. Marsh, NRR, Roy Caniano, and John Jacobson of my staff on May 10, 2002, this is to inform you of a potentially generic safety issue identified by a Region III inspector. The issue pertains to the possible failure of low pressure emergency core cooling systems (ECCS) due to unanticipated, large quantities of entrained gas in the suction piping from boiling water reactor suppression pools. The issue is applicable to Mark I or Mark II containments during large or medium break loss of coolant accidents and could potentially cause pump failure or degraded performance due to gas binding, vapor locking, or cavitation.

Prior AEOD evaluation of this issue addressed the recirculation phase of this issue; however, did not address the large air bubbles generated during initial blow-down because the gas was expected to rise quickly out of the pool water. (Reference AEOD memorandum dated March 31, 1982, (AEOD/E218), "Engineering Evaluation - Potential for Air Binding or Degraded Performance of BWR RHR System Pumps During the Recirculation Phase of a LOCA.") However, due to the violent nature of the blow-down during the above accidents, there is a question regarding the gas that may become entrained in the suction flow to the ECCS pumps as a result of turbulence or mixing effects. The question is whether sufficient gas will get entrained in the suction flow to the ECCS to cause failure or degraded performance of the pumps.

There are several specific aspects that pertain to the above general concern for air entrainment in the suction flow to the ECCS pumps:

a. One of the bounding design basis accidents is a loss of off site power combined with a loss of coolant accident (LOOP/ LOCA). While this may be bounding from an ECCS performance perspective, it may not be bounding from a gas entrainment perspective. Because the pumps will start sooner during a LOCA without a LOOP, bubbles generated during the initial blow-down may not have risen to the surface and more may become entrained in the ECCS suction piping. Since a LOCA without a LOOP was not considered, this aspect should be considered for further evaluation.

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b. The AEOD evaluation, for potential air binding or performance degradation of RHR pumps, only used the volume of water in the RHR suction piping to determine the amount of dissolved gas. However, the amount of gas that is potentially available to affect pump performance is the total volume of water in the suction piping and the suppression pool. The potential for pump air binding or performance degradation may need to consider the total volume of available water in determining the volume of gas.

c. The swell/exclusion zone in the torus after a LOCA is considered to be limited to less than one diameter of the down-comer pipe. There does not appear to be a technical basis for this limitation, and it may not be conservative. The intrusion of non-condensable gas into the torus may be greater and the effect will potentially be worse due to the larger suction strainers installed in response to NRC Bulletin 96-03, "Potential Plugging of Emergency Core Cooling Suction Strainers by Debris in Boiling Water Reactors." Adequate bases to limit the exclusion zone to less than one diameter of the down-comer pipe should be established, especially with respect to the recently installed larger suction strainers.

The above issues were identified during the course of several inspections by researching available information from licensee and the NRC. No known equipment or component failures led to the identification of this issue. We believe the issue does not pose an immediate safety concern, however, could benefit from further review as a potential generic issue.

cc: G. O'Dwyer, DRS

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