UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

AUG 13 1990

MEMORANDUM FOR: William T. Russell, Associate Director
for Inspection and Technical Assessment

FROM: James E. Richardson, Director
Division of Engineering Technology

SUBJECT: SAFETY CONCERN RELATIVE TO BWR CONTAINMENT ISOLATION VALVES FOR HPCI, RCIC, AND RWCU

On July 19, 1990, a meeting was held with senior NRR management to discuss the results of a survey of MOV data supplied by the BWR Owners Group on the subject valves. An evaluation of this MOV data indicated that about a third of these valves may not be able to isolate the blowdown flow from a postulated pipe break. Based upon that meeting an action plan was prepared which includes preparation of an update of the safety assessment on the above subject provided to you on June 12, 1990. This memorandum was written to provide that assessment.

LIKELIHOOD OF PIPE BREAK

HPCI and RCIC Low Erosion/Corrosion Susceptibility

The HPCI and RCIC steam lines are fabricated from ferritic steel. Due to the erosion/corrosion susceptibility of ferritic steel in the BWR environment, NRC issued Generic Letter 89-08, "Erosion/Corrosion-Induced Pipe Wall Thinning." This generic letter recommends that all licensees establish an erosion/corrosion monitoring program to assure the structural integrity of high-energy carbon steel piping systems. To establish pipe inspection frequencies, licensees have performed various predictions of erosion/corrosion susceptibility. The HPCI and RCIC steam lines are used only intermittently during pump testing. For this reason, the predictions indicate insignificant erosion/corrosion will occur in these lines. Most licensees contacted, during a brief survey on this subject, are not planning inspections of these lines.

RWCU Augmented Inspections

The RWCU supply lines are fabricated from austenitic stainless steel. Since austenitic stainless steel in the BWR environment is susceptible to intergranular stress corrosion cracking (IGSCC), NRC issued Generic Letter 88-01, "NRC Position on IGSCC in BWR Austenitic Stainless Steel Piping." Accordingly, licensees are committed to performing augmented inspections of BWR piping fabricated from austenitic stainless steel. With these augmented inspections it is unlikely that significant flaws in the subject piping would remain undetected.

Piping Stress Levels

All of the safety related piping in the systems under discussion are either

F03
1/1
RD10-1
BWR
X RD9

ASME Class 2 or 3 and, as such, have been designed to applicable ASME Section III rules or their equivalent. Implicit in the allowable stresses is a substantial built-in margin below the material ultimate strength. Furthermore, the normal operating stresses in the systems under discussion are generally much lower than the stresses allowed by design, which further decreases the probability of failure in this piping.

Failure Mechanisms

Nuclear and fossil power plant experience has indicated that large breaks have resulted from either large water hammer events or from undetected significant pipe wall erosion. We believe that there is a low probability of either of these mechanisms occurring in the subject piping. The augmented inspections being performed for detection of erosion is discussed above. The technical findings relevant to the resolution of Unresolved Safety Issue A-1, Water Hammer, were contained in NUREG-0927, Revision 1, "An Evaluation of Water Hammer Occurrence in Nuclear Power Plants." In this NUREG the safety significance of water hammer in the RCIC and RWCU systems is classified as low. Taking into account changes that have been made in plant operating procedures, because of the results reported in this NUREG, the safety significance of water hammer in the HPCI system is now also considered to be low. Therefore, we believe that there is a low probability of a large pipe break in any of the subject lines. Furthermore, should a leak develop, it is likely to be detected by quadrant temperature and floor drain sump level monitors. These monitors alarm in the control room and cause entry into annunciator response procedures. These procedures would direct the operators to determine the cause of the alarm and would lead to closure of the MOV in the leaking pipe before a break could occur.

PLANT MITIGATIVE FEATURES

Margin on Assumed Differential Pressure

The differential pressure assumed in the design phase for the establishment of the operating capability of the MOV might be greater than would actually occur during a blowdown event. For example, many facilities have determined that the required thrust needed to close the isolation valves for the HPCI and RCIC steam supply lines is based upon the pressure setpoint for the relief valves on these lines. Because the relief valve setpoints are approximately 100 to 150 psig above the normal operating pressure, this may provide some available thrust margin for valve closure during a blowdown from a line break. We believe that a similar margin exists for the RWCU isolation valves.

Valve Redundancy

The HPCI and RCIC steam supply lines and the RWCU letdown lines are all equipped with two motor-operated isolation valves, one inside containment and one outside containment, with one powered by an AC motor and the other by a DC motor. These pairs of valves receive coincident signals to close and have the same stroke time to close. Assuming that both valves have power to close, similar stroke times and coincident isolation signals, the total differential pressure between the reactor and the break would be shared across the two valves. Due to the possibility that these valves are not set up with adequate thrust for a single valve to close against the differential pressure of a blowdown, the reduced pressure load could increase the likelihood of one or both valves closing.

Closure After Depressurization

For a large HPCI or RCIC steamline break, if the isolation valves fail to close, the reactor will depressurize below the low pressure injection systems shutoff head before the core would begin to uncover. With offsite power still available, the condensate pumps can likewise provide abundant cooling at low pressures to maintain core integrity. After depressurization the load on the isolation valves would be greatly reduced. For MOVs that failed to close completely because of a trip of the torque switch or a thermal overload device, the likelihood of closure on the second try would be high.

For the case of an RWCU system break, if the isolation valves fail to close, HPCI and RCIC would both be available to provide some make up while the reactor coolant system depressurizes. However, these systems alone would not keep up with the loss from larger RWCU breaks. Depressurization through the break or by ADS would result in core uncovery until low pressure systems refill the vessel. With the low pressure systems functioning, however, significant core damage should not occur. As discussed above, after depressurization the load on the isolation valves would be greatly reduced and the likelihood of closure of an undamaged MOV on the second try would be high.

Consequence Mitigation

The primary symptom in the emergency procedures for a break in one of the lines under consideration is water level. The mitigative systems for supplying make up are HPCI and/or RCIC, main feedwater, low pressure core injection and other low pressure systems that can be used in an accident management capacity. Provided adequate make up water is available, core cooling would continue without serious offsite consequences even if isolation of the broken line is delayed until much later in the scenario.

RISK PROBABILITY ANALYSIS

The initial view of staff risk analysis experts is that the identified MOV concerns should be resolved promptly, but that immediate action is not justified. The Division of Risk Assessment and Emergency Preparedness will be performing a sensitivity analysis using the NUREG-1150 models based on the identified deficiencies to gain insights on this problem and will determine the need for more detailed modeling. We will provide preliminary results of the sensitivity analysis by the end of October.

CONCLUSIONS

Given that some of the valves in the subject lines presently may not be capable of closing under the design basis differential pressure, we believe that the factors discussed above justify continued plant operation while licensees expeditiously pursue corrective actions. It is recognized that some corrective actions may take as long as a refueling cycle to implement. In the near term we will be working with the Division of Reactor Projects to put into place whatever mechanisms deemed necessary to have the BWR licensees correct the identified problems.

Original Signed By:
James E. Richardson

James E. Richardson, Director
Division of Engineering Technology

cc: Valve Distribution List
M. Minners
J. P. Vora

Distribution:
Central Files
EMEB RF
DET RF
PDR
TSullivan CHRON
RBarrett

*See previous concurrence

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NAME	:TSullivan:pm	:CYCheng	:RJones	:Acting BC	:LMarsh	:JRichardson
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