UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

March 18, 2009

Mr. R.W. Borchardt
Executive Director for Operations
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: CREDITING CONTAINMENT OVERPRESSURE IN MEETING THE NET POSITIVE SUCTION HEAD REQUIRED TO DEMONSTRATE THAT THE SAFETY SYSTEMS CAN MITIGATE THE ACCIDENTS AS DESIGNED

Dear Mr. Borchardt:

In the January 8, 2009, Staff Requirements Memorandum [Ref. 1], the Commission directed the staff, in part, to continue working to resolve the difference of opinion with the Advisory Committee on Reactor Safeguards on the containment overpressure (COP) credit issue. During our 559th, February 5-7, 2009, and 560th, March 5-7, 2009, meetings, we discussed the acceptability of the use of COP and the types of supporting analyses and additional information that are needed in our view to determine the acceptability of COP credit in extended power uprate (EPU) applications. This letter report is intended to facilitate the resolution of the COP credit issue.

CONCLUSIONS AND RECOMMENDATIONS

1. To preserve safety margin in all reactors, credit for COP should be limited in amount and duration. Licensees requesting such credit should continue to be required to demonstrate that it is not practical to reduce or eliminate the need for overpressure credit by hardware changes or requalification of equipment.

2. Licensees should continue to be requested to use the current guidance in Regulatory Guide 1.82 Revision 3 [Ref. 2] and the licensing-basis analyses assumptions and methods to demonstrate that the available net positive suction head (NPSH) exceeds that required for operation of the emergency core cooling system (ECCS) and containment heat removal pumps.

3. Regulatory Guide 1.82 Revision 3 [Ref. 2] should be revised to request that licensees submit additional analyses and information if the amount of accident pressure that must be credited based on the licensing-basis analyses is not a small fraction of the total containment accident pressure and limited in duration. The additional information should include thermal-hydraulic analyses, which address the conservatisms associated with the licensing-basis analyses and explicitly account for uncertainties and probabilistic

risk assessment (PRA) results consistent in scope and quality with that specified by Regulatory Guide 1.174 [Ref. 3].

4. For cases in which operator actions are required to maintain containment overpressure, licensees should show how these actions can be implemented in their procedures, that they can be performed reliably, and that any increase in risk associated with these actions is acceptably small.

5. The staff review guidance in the current Standard Review Plan (SRP) [Ref. 4] should be revised to state that, if COP credit is granted to a plant based on risk information, all subsequent licensing applications involving COP credit at that plant should also include risk information.

BACKGROUND

For most U.S. nuclear plants, NPSH for ECCS pumps in licensing basis analyses is calculated assuming that the pressure in containment is atmospheric. In reality, accidents such as loss of coolant accident (LOCA) would lead to an increase in containment pressure. The assumption of atmospheric pressure assured that in design-basis accidents the loss of COP for any reason would not affect the ability of the ECCS to maintain core cooling. This maintained the defense-in-depth philosophy of the independence of accident prevention and mitigation. The containment pressure generated by the accident is part of the safety margin against loss of NPSH. Such margin protects against unanticipated accident phenomena such as sump strainer blockage.

The inclusion of the pressure developed in the containment during an accident in the calculation of the available NPSH is referred to as COP credit. Since 1997, the ACRS expressed concerns over the crediting of COP in NPSH calculations in a series of reports [Refs. 5, 6, 9, 10, and 11]. In a report dated June 17, 1997 [Ref. 5], the ACRS stated that containment overpressure credit should not be granted. In the December 12, 1997, [Ref. 6] report, the Committee concluded that granting credit for small amounts of COP may be acceptable in some cases.

DISCUSSION

Licensees are now seeking to use the margin associated with the pressure generated in the containment during an accident to support voluntary licensing actions such as extended power uprates (EPUs). In some cases, the licensing-basis analyses supporting the EPU show that the requested COP credit is significant in amount and duration and that the pumps may cavitate for some time even with full credit for available overpressure. Although pump vendors are requested to verify that the pumps can operate under these conditions without failing and tests are done to demonstrate this capability, the pumps are being operated outside their design specifications. In order to maximize available overpressure, operators may also be directed to undertake actions, such as termination of drywell cooling, that are contrary to the actions usually expected in response to an accident.

The ACRS has consistently expressed concern with the use of this margin for voluntary licensing actions because it represents a decrease in the safety margin available to deal with a phenomenon subject to large uncertainties, namely, maintenance of adequate NPSH for ECCS pumps during accidents. The margin in this case is not against plastic deformation of some component or the failure of a few fuel rods, but potential melting of the core. It also challenges the defense-in-depth philosophy. Containment integrity is now not only the final barrier to prevent release of fission products, but is also required to prevent core damage.

In most operating plants, all of the pressure generated during an accident is part of the safety margin against loss of NPSH in the ECCS pumps. To preserve this safety margin in all plants, COP credit should be limited in amount and duration. The amount of accident-generated pressure credited should only be a small fraction of that expected to be available.

We also have concerns regarding requests for COP credit requiring operator actions to establish or maintain elevated containment pressure for adequate pump NPSH, irrespective of the amount or duration of these conditions. Of particular concern are actions that stop or reduce operation of systems whose normal design function is to remove heat from the reactor core or containment.

The current guidance in Regulatory Guide 1.82, Revision 3 focuses on the conservative calculation of containment pressure for licensing-basis accidents and imposes no limits on the amount and duration of credit as long as these calculations show that the available NPSH is greater than that required for operation of the pumps. Since 2005, the guidance for the staff's review of requests for additional COP credit associated with EPU has included a risk review based on Appendix D of SRP Section 19.2. There is some question as to the scope and quality of risk information that the staff can request under this guidance. The PRA information for EPUs in which substantial amounts of COP credit are requested based on licensing-basis analyses should be of scope and quality consistent with Regulatory Guide 1.174.

The staff contends that the significant conservatism included in the LOCA analyses provides adequate margin. Also, for special events, which are analyzed with less conservative thermal-hydraulic assumptions, a reasonable level of safety is maintained because of the other conservatisms in the analyses. Although it is true that the licensing-basis analyses currently submitted by licensees to justify COP credit are based on conservative input assumptions, it is difficult to assess the degree of conservatism and hence the impact on margin against loss of NPSH associated with these analyses.

We agree with the staff that a conservative calculation of containment pressure for licensing-basis accidents that shows that the available NPSH is greater than that required for operation of the pumps is a necessary condition for COP credit. We also agree that, if COP credit is requested, the licensee should be requested to submit an explanation of why hardware changes or requalification cannot be practicably implemented that would eliminate or reduce the need for COP credit. In our view, if hardware changes are impractical but the licensing-basis analyses show that the amount and duration of credit are "small" and operator actions to maintain containment overpressure are not introduced, no further analyses need be required.

If hardware changes are not practical and the requested amount and the duration of COP credit are not "small" or operator actions are introduced, Regulatory Guide 1.82 should be revised to request that the licensee provide additional analyses and/or tests to help understand the impact

on safety margins and defense in depth of granting COP credit. Such analyses could include more realistic evaluations of LOCA scenarios with treatment of uncertainties; alternate, more realistic fire analyses for Appendix R scenarios; identification of the particular single failures that lead to the need for COP credit; estimates of conditional changes in core damage frequency (CDF) if required COP credit were not available (an importance measure for COP credit); and pump tests to show the capability of ECCS pumps to function with cavitation. The staff should review this information along with the results of licensing-basis analyses.

The number and detail of the additional analyses would depend on the amount and duration of the requested COP credit and the nature of any operator actions credited in maintaining the required containment pressure. These analyses should provide more realistic estimates of the amount and duration of credit actually needed, the likelihood of scenarios that would require substantial COP credit, and the reliability of, and potential problems associated with operator actions.

Irrespective of the amount and duration of requested COP credit, if operator actions to increase or maintain elevated containment pressure are required, an integrated assessment should be performed to examine the specific accident scenarios that require operator intervention. The assessment should quantify the frequency of each scenario and evaluate the reliability of the required actions for expected plant conditions. The assessment should also identify and evaluate situations in which unexpected consequences from these actions could result in increase in risk. Explanations should be provided of how these actions are addressed in operating procedures, whether they are consistent with an applicant's current design and licensing bases, and what evidence is available that they can be performed reliably.

The PRA information associated with the review is important not only to ensure that the risk is small, but also to help assess the impact of the credit on defense in depth. Current PRAs can estimate the likelihood of pre-existing containment leakage. They typically do not evaluate the likelihood of relatively small amounts of leakage or other evolving conditions that might reduce the available NPSH. However, PRAs could be used to investigate the likelihood of scenarios in which large amounts of COP credit are needed for significant amounts of time and thus could be used to help judge the impact of the credit on defense in depth.

Unlike the position of Regulatory Guide 1.1, [Ref. 12] or the previous staff position based solely on licensing-basis analyses, the judgment whether to grant COP credit for a particular application would depend on an integrated decisionmaking process that considers the more realistic, available estimates of the amount and duration of COP credit required; the likelihood of scenarios that would require COP credit; and the operator actions required to maintain COP for adequate pump NPSH.

The current staff guidance in Appendix D to SRP Section 19.2 includes a risk review for COP credit only for EPU applications. This current staff guidance should be revised to state that, if

COP credit is granted based on risk information, all subsequent licensing applications involving COP credit should also include risk information.

We look forward to working with the staff on these important matters.

Sincerely,

/RA/

Mario V. Bonaca
Chairman

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