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

ACRSR-2076

April 27, 2004

The Honorable Nils J. Diaz
Chairman
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: SECY-04-0037, "ISSUES RELATED TO PROPOSED RULEMAKING TO RISK-INFORM REQUIREMENTS RELATED TO LARGE BREAK LOSS-OF-COOLANT ACCIDENT (LOCA) BREAK SIZE AND PLANS FOR RULEMAKING ON LOCA WITH COINCIDENT LOSS-OF-OFFSITE POWER"

Dear Chairman Diaz:

During the 511th meeting of the Advisory Committee on Reactor Safeguards on April 15-17, 2004, we reviewed SECY-04-0037, "Issues Related to Proposed Rulemaking to Risk-Inform Requirements Related to Large Break Loss-of-Coolant Accident (LOCA) Break Size and Plans for Rulemaking on LOCA With Coincident Loss-of-Offsite Power." Our Subcommittee on Regulatory Policies and Practices reviewed this matter during a meeting on April 1, 2004. During these reviews, we had the benefit of discussions with the NRC staff and the Nuclear Energy Institute. We also had the benefit of the documents referenced.

CONCLUSIONS AND RECOMMENDATIONS

1. The risk-informed revision to 10 CFR 50.46 should permit a wide range of applications of the new break size as long as it can be demonstrated that the resulting changes in risk are small and adequate defense-in-depth is maintained.

2. The process and criteria in Regulatory Guide (RG) 1.174 are appropriate for evaluating the acceptability of changes proposed under a revised rule. However, explicit criteria to ensure mitigative capability for breaks beyond the new maximum break size and to limit the risk associated with late containment failure should be developed as part of the revised rule to ensure that sufficient defense-in-depth is maintained as plant changes are made.

3. We concur with the recommendation of the staff that the appropriate metric for the design basis maximum break size is the direct LOCA initiating event frequency.

4. Additional criteria and guidance are not needed for tracking cumulative risk due to the changes resulting from a risk informed 10 CFR 50.46.

5. The results of the expert elicitation for the frequency of LOCA events are yet to be finalized and peer-reviewed, but the process employed and the qualifications of the panel members appear to be well suited to the problem. The results should help provide a technical basis for the selection of the new maximum break size.

DISCUSSION

The double-ended guillotine break (DEGB) of the largest pipe in the system has always been recognized as an unlikely event. It was intended to be a surrogate accident that bounded the consequences of a wide spectrum of reactor accidents. Probabilistic risk assessments (PRAs) for existing plants show that the defense-in-depth provided by the emergency core cooling system (ECCS) capability and robust containment designs developed to deal with this accident have resulted in plants with low core damage frequency (CDF) and low risk to the public. However, experience and PRA have also shown that the focus on such large, highly unlikely breaks can have detrimental effects on safety. The demands on equipment resulting from the need to demonstrate the equipment's capability to deal with the DEGB can reduce the equipment's reliability and capability to function during the much more likely small and medium LOCAs. Improved understanding of the likelihood of various initiating events and the responses of reactor systems to those events suggests that a risk-informed approach to dealing with large break LOCAs could result in greater operational flexibility with little increase or even decreases in risk.

In a Staff Requirements Memorandum (SRM), dated March 31, 2003 (Reference 2), the Commission directed the staff to complete the technical basis supporting the redefinition of the maximum design-basis break size and to provide proposed rule changes to the Commission. In its evaluation of the SRM, the staff identified a number of policy and technical issues that it felt needed to be resolved to ensure that the new rulemaking for maximum break size redefinition does not result in any unintended consequences. The staff discusses these issues in SECY-04-0037.

Because the consequences of 10 CFR 50.46 in the regulatory system are pervasive, the staff believes the Commission needs to provide additional guidance on the scope of changes to be permitted under a new rule. The staff distinguishes between a "narrow" scope and a "broad" scope rule change. In a "narrow" scope rule change, specific areas of application would be identified, similar to the current use of leak-before-break to restrict the sizes of breaks considered in determining dynamic effects. An example would be to permit the use of the redefined maximum break size in determining the start times for emergency diesels. A "broad" scope rule would permit a wide range of applications of the new break size as long as it could be demonstrated that the resulting changes in risk are small and adequate defense-in-depth is maintained. We believe that the revised rule should support a broad scope of applications.

It may be possible to deal with some applications generically in the revised rule, but in most cases applications of the new rule will be developed by licensees and will require plant-specific demonstrations that the resulting changes in risk are acceptable. RG 1.174 provides a process for determining the acceptability of changes in risk associated with changes in the licensing basis. In SECY-04-0037, the staff's preliminary conclusion is that the numerical criteria listed in RG 1.174 for defining acceptable changes to a plant's licensing basis are not stringent enough to use for modifying the fundamental building blocks and protections provided in the current regulations. We disagree. The uncertainties may be different in different situations, but if a certain change in risk is acceptable in terms of a change to a licensing basis, we see no reason why there should be a different level of acceptable risk for a modification of a rule, even one as fundamental as 10 CFR 50.46.

The number and kind of changes that will be possible for a licensee to make under the new rule will depend strongly on the scope and technical detail of the licensee's PRA. What is important is a convincing demonstration that the resulting changes are indeed small enough to meet the RG 1.174 criteria. If a limited scope PRA is used, contributions to the ΔCDF and the total CDF and corresponding large, early release frequency (LERF) quantities from the omitted portions of the PRA and the associated uncertainties must still be conservatively estimated and demonstrated to be consistent with the RG 1.174 criteria.

The expert elicitation and other evaluations of the likelihood of large pipe breaks demonstrate that the frequency of such failures due to normal loads and conventional modes of degradation is quite low. It is much more difficult to quantify the potential for such failures due to abnormal loads, security issues, and human errors. Thus a capability to mitigate breaks beyond the new maximum break up to the DEGB of the largest pipe needs to be maintained. In the March 31, 2003 SRM, the Commission directed the staff not to permit changes in ECCS coolant flow rates or reduce containment capabilities. However, the degree of defense-in-depth provided by these systems may change as plants make changes in response to the new rule. We believe that the staff should be directed to develop criteria and guidance to quantify the capability to mitigate DEGB beyond the new maximum break size and thus ensure that sufficient defense-in-depth is maintained. One possibility is a criterion for the conditional probability of core damage given a DEGB beyond the new maximum break size, but other approaches are possible. Calculations of the conditional probability could be performed using the realistic approaches taken in PRAs to assess core damage rather than the conservative approach taken in Appendix K to assess core damage. Some degree of core damage could be permitted to occur, but coolability would be maintained and rapid failure of the vessel precluded. It may also be necessary to develop guidance to ensure the functionality of equipment that may no longer be required under design basis conditions, but would be needed to mitigate a beyond design basis break.

RG 1.174 includes consideration of the risks associated with late containment failures, but it does not provide any explicit criteria for evaluating such risks. Such a criterion was developed in the Framework for Risk-Informed Changes to the Technical Requirements of 10 CFR 50 document (Reference 3) where it was proposed that the conditional probability of a large late release (i.e., one that does not contribute to LERF, but occurs within approximately 24 hours of the onset of core damage) be limited to 10^{-1} or less. This criterion or a suitable alternative should also be considered when considering changes associated with a revised rule.

One of the important technical issues raised by the staff in SECY-04-0037 is the choice of the appropriate metric to determine the design basis LOCA maximum break size. The staff argues that a metric based on the expected frequency of pipe breaks is more direct than one based on the impact of LOCAs on CDF and LERF. Also, the staff argues that most licensees will be following a phased approach in upgrading their PRAs and any definitions based on CDF and LERF could result in maximum break sizes that vary simply because of changes in PRA methods. We concur with the staff's conclusion that break frequency is the best metric. The rationalist approach to defense-in-depth considers the frequency of an initiating event as a basic criterion in assessing the confidence that must be provided for the response to the initiating event.

The staff proposes to identify large break LOCA sizes applicable to various categories of plants if possible. If not, the staff would specify a plant-specific implementation process necessary to determine the appropriate plant-specific break size. We believe that it is possible and desirable to make generic definitions applicable to categories of plants.

As a consequence of the redefinition of the maximum break size, licensees may propose plant changes that will result in increases in risk. The RG 1.174 process will ensure that the change in risk associated with any specific change in the licensing basis will be small, but there is certainly a possibility that a significant number of changes will be proposed because of the change to 10 CFR 50.46. The staff proposes to determine the information that needs to be tracked for individual changes authorized by the rule over the life of the plant and to develop analysis guidelines for cumulative risk estimates that can be compared to applicable risk criteria. We believe that the limitations implied by the RG 1.174 criteria, the inclusion of specific defense-in-depth criteria for mitigation of beyond design basis breaks, and an explicit criterion for late containment failure will limit changes in cumulative risk to acceptable levels. RG 1.174 provides sufficient guidance and criteria to track and control cumulative risk, and additional requirements are not necessary.

The elicitation process to determine degradation related LOCA frequencies was well structured and the expert panel has an appropriate range of expertise (Reference 4). Although the results are still under final review, we expect that they will be confirmed by the planned peer review and will provide a technical basis for the selection of a maximum break size in terms of the frequency of the initiating event.

There are important policy and technical issues to be considered in the development of a risk-informed 10 CFR 50.46. We look forward to interacting with the staff as it pursues this effort after receiving further guidance from the Commission.

Sincerely,

/RA/

Mario V. Bonaca
Chairman

References:

1. Memorandum from William D. Travers, EDO, to the Commissioners, SECY-04-0037, Subject: Issues Related to Proposed Rulemaking to Risk-Inform Requirements Related to LBLOCA Break Size and Plans for Rulemaking on LOCA With Coincident Loss-of-Offsite Power, March 3, 2004.
2. Staff Requirements Memorandum (SRM) from Annette L. Vietti-Cook, Secretary, to William D. Travers, EDO, Subject: SECY-02-057 - Update to SECY-01-0133, “Fourth Status Report on Study of Risk-Informed Changes to the Technical Requirements of 10 CFR Part 50 (Option 3) and Recommendations on Risk-Informed Changes to 10 CFR 50.46 (ECCS Acceptance Criteria),” dated March 31, 2003.
3. Draft, Revision 2, “Framework for Risk-Informed Changes to the Technical Requirements of 10 CFR 50,” August 2000.
4. Memorandum from Michael E. Mayfield, RES, to John T. Larkins, Executive Director, ACRS, Subject: Forwarding of Commission Paper on “Loss-of-Coolant Accident (LOCA) Break Frequencies for the Option III Risk-Informed Reevaluation of 10 CFR 50.46, Appendix K to 10 CFR Part 50, and General Design Criteria (GDC) 35," and its Corresponding Attachment (Pre-Decisional For Internal ACRS Use Only), March 29, 2004.

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