

March 31, 2003

MEMORANDUM TO: William D. Travers
Executive Director for Operations

FROM: Annette L. Vietti-Cook, Secretary */RA/*

SUBJECT: STAFF REQUIREMENTS - SECY-02-0057 - 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)"

The Commission has approved in part and disapproved in part the staff's recommendations provided in this SECY paper.

Emergency Core Cooling System (ECCS) spectrum of break sizes and locations

The Commission has agreed to consider redefining the design basis large-break loss-of-coolant accident (LOCA) in view of the apparent low risk associated with such events. The staff should provide the Commission a comprehensive "LOCA failure analysis and frequency estimation" that is realistically conservative and amenable to decision-making subject to the comments and considerations noted below. Realistically conservative estimations, with appropriate margins for uncertainty, should be used. In doing so, the staff should take the following points into account.

1. The staff should use a 10-year period for the estimation of LOCA frequency distributions, with a rigorous re-estimation conducted every 10 years and a review for new types of failures every 5 years. There should be careful consideration of the implications of the 10-year frequency for the reexamination of LOCA frequency distributions. Operational changes should be reversible if the re-estimation results in unacceptable LOCA frequency increases. The staff will define what is considered "acceptable."
2. The staff should conduct a practical reconciliation of LOCA frequency distributions by the 1) expert use of service-data, 2) Probabilistic Fracture Mechanics (PFM) and 3) expert elicitation to converge the results. Both service-data and PFM estimates should be "reduced" to an appropriate set by "expert discrimination" of what data should be treated. Not all data is "born" equally nor should it be treated equally. For the purpose of LOCA estimation, a better discrimination of failure data is needed before it is used as predictive data. Service-based LOCA estimates (a statistical analysis of service experience data) are more useful than PFM, especially if the projection is limited to 10 years. PFM (a phenomena-based method using fracture and failure analysis) can make a contribution, more so if it is used to selectively converge to service data predictions.

There are some operating plants for which the preponderance of the overall risk results from accidents other than LOCAs (e.g., all BWRs). Thus, defining the LBLOCA on a plant-specific basis in terms of only the LOCA contributors to risk will create significant differences from plant to plant. That is, a plant with small LOCA contributors to overall core damage frequency (CDF) would have to consider initiating events with much lower frequencies than plants with relatively large contributions from LOCAs to overall CDF.¹ This would have the perverse result of penalizing a plant for which LOCAs already comprise a relatively small percentage of overall CDF. In order to avoid this dilemma, it might be appropriate to consider an approach in which the alternative maximum LOCA to be included within the design basis is established on a plant-specific basis using some percentage of the total CDF risk, rather than the risk associated only with LOCAs. Regardless of the specific approach, any proposed changes should be risk-informed and consistent with the principles of RG 1.174.

The staff should consider the full range of contributors to LOCAs, even if those contributors do not include actual pipe breaks. These include not only large pipe breaks, but also failures of large components, such as steam generator manways and reactor vessel head penetrations.

The staff should credit leak-before-break considerations only in conjunction with the establishment by a licensee of reliable and comprehensive means to detect primary system leaks of the relevant size.

3. The staff should use expert elicitation to converge (whenever possible) service-data and PFM results to provide the Commission a comprehensive "LOCA failure analysis and frequency estimation" predictive envelope that is realistically conservative.

The staff must establish the appropriate risk "cutoff" for defining the maximum LOCA size. The risk metric recommended by the staff should take into account the uncertainties in PRA analysis as well as the uncertainties in estimating the initiating event frequencies for rare events (e.g., 95% probability with a 95% confidence limit).

In parallel with the above technical work, the staff should prepare a proposed rule change to 10 CFR Part 50 that allows for a risk-informed alternative to the present maximum LOCA break size. The rule should be very specific, ensuring that the pertinent risk parameters are addressed and only the non-significant contributions to risk are handled through severe accident risk management. For example, the modified definition of the LOCA, for use

¹ This can be illustrated using the PRA studies in NUREG-1150. For the Surry plant, (Westinghouse three-loop PWR), the mean CDF for internal events is $4.0E-5$, and the mean CDF from all LOCAs is approximately $7.6E-6$. Using a LBLOCA size that accounts for 95% of the LOCA CDF would thus account for about 18% of overall plant CDF and would eliminate from consideration LOCAs accounting for about 1% of CDF. However, for Peach Bottom, a BWR-4 plant, the overall mean CDF for internal events is $4.5E-6$ and that from all LOCAs is $2.6E-7$. Using 95% of LOCA CDF would require consideration of events that comprise about 5% of overall plant CDF, and would eliminate from consideration LOCAs that account for only about 0.3% of overall CDF.

throughout Part 50 and wherever applicable, could read:

Loss of coolant accidents (LOCA). Loss of coolant accidents mean those postulated accidents that result from the loss of reactor coolant at a rate in excess of the capability of the reactor coolant makeup system from breaks in the reactor coolant pressure boundary up to and including a break equivalent in size to the double-ended rupture of the largest pipe of the reactor coolant system *or up to an alternate maximum break size determined by including at least XX% [e.g., 95%, 96%...] of the LOCA failure contributors to core damage frequency.*

While pertinent changes in the design basis and associated analysis would be expected to occur naturally, the Commission agrees with the staff that changes in hardware and operation “would require that it be demonstrated that the ECCS functional reliability is commensurate with the frequency of accidents in which ECCS success would prevent core damage or a large early release”. The Commission does not support changes to functional requirements unless they are fully risk-informed and protective of public health and safety. For example, the Commission would not support actual changes to ECCS coolant flow rates or containment capabilities to mitigate accidents, but would support changes that provide for risk-informed sequencing of equipment with demonstrated functionality and reliability requirements that arise from the alternate criteria. The staff should maintain similar margins in future plant design certifications, even if we ultimately adopt a revised LBLOCA definition.

The redefinition of the LBLOCA would also require strict configuration controls and a high quality PRA, including low power and shutdown operations. In establishing guidance for these configuration controls, the staff should, to the maximum extent practical, make use of the existing regulatory infrastructure provided through the Reactor Oversight Process, the Maintenance Rule and Regulatory Guide 1.174. Once the appropriate standards are in place, the PRA should be a level 2 internal- and external-initiating event all mode PRA, which has been subjected to a peer review process and submitted to and endorsed by the NRC.

The technical basis supporting the LB-LOCA break size redefinition, supported by a 10-year estimation of LOCA frequencies, should be completed by March 31, 2004. The proposed rule changes should be provided to the Commission.

(EDO)

(SECY Suspense: 3/31/04)

ECCS acceptance criteria

The Commission has approved the staff’s recommendation to proceed with modifications to 10 CFR 50.46 to provide for a more performance-based approach to meeting ECCS acceptance criteria. This includes the development of acceptance criteria for cladding performance such that licensees would be able to use materials other than Zircaloy or ZIRLO without an exemption. However, this approach should not relieve licensees of the need to provide an adequate technical basis to demonstrate that other cladding materials can meet the performance-based criteria.

ECCS reliability

The Commission has approved the staff’s recommendation to proceed with rulemaking, as an

option, to risk-inform the ECCS functional reliability requirements in General Design Criterion 35, and thus relax the current requirements for consideration of a large-break loss of coolant accident (LBLOCA) coincident with a loss of offsite power (LOOP). The staff should move forward with the development of the necessary regulatory changes and continue their dialogue with industry and other external stakeholders in this area. In developing the technical bases supporting these changes, the staff should ensure that relevant issues and uncertainties that can impact plant risk are adequately considered (e.g., delayed LOOP and “double sequencing” of safety functions).

The staff should pursue a broader change to the single failure criterion and inform the Commission of its findings.
(EDO) (SECY Suspense: 7/31/04)

The staff must include the need for a high quality PRA in the proposed rule.

ECCS evaluation model

The Commission has disapproved the staff's proposal to provide a voluntary alternative to Appendix K which would replace the 1971 ANS decay heat standard with the 1994 ANS standard. However, 10 CFR 50.46 should be modified to require that future applicants for design certification or for future construction should use best-estimate codes for LOCA analyses. Moreover, licensees who seek the benefit of the changes that redefine the design basis LBLOCA requirements should be required to use best-estimate codes. The staff should include such a modification in the proposed 10 CFR 50.46 rulemaking.

Other matters

The Commission has approved “unbundling” the proposals and proceeding with the development of separate rulemakings and also approved the staff’s recommendation that separate rulemaking plans are not necessary for each of these actions. The staff should seek early public and stakeholder comments on all of these proposals and keep the Commission informed of progress. The staff should ensure that these changes are viewed in totality for identification of any potential cross-cutting impacts.

cc: Chairman Meserve
Commissioner Dicus
Commissioner Diaz
Commissioner McGaffigan
Commissioner Merrifield
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