



UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D. C. 20555

GT3500014

May 25, 2000

MEMORANDUM TO: G. Wallis, Chairman, Thermal-Hydraulic Phenomena (T/HP)
Subcommittee

G. Apostolakis, Chairman, Reliability and Probabilistic Risk
Assessment (RPRA) Subcommittee

FROM: P. Boehnert, Senior Staff Engineer 

SUBJECT: NRC MEETING WITH WESTINGHOUSE OWNERS GROUP -
RISK-INFORMING 10 CFR 50.46 FOR LARGE-BREAK LOCA
DESIGN-BASIS ACCIDENT, MAY 18, 2000, ROCKVILLE,
MARYLAND

I attended the subject meeting, held to discuss the proposal from the Westinghouse Owners Group (WOG) to risk-inform the ECCS Rule (10 CFR 50.46), pursuant to the staff's plans to risk-inform technical requirements of Part 50 (Option 3). This was the second meeting held with the WOG to discuss this matter, the first being held in March.

Key points noted during the meeting discussions included:

- Office of Nuclear Regulatory Research (RES) staff discussed the current status of their approach for risk-informing Part 50, i.e. Option 3. Since the Committee has been exposed to this information, via SECY-00-0086, it will not be repeated here.
- Mr. E. Haskin (ERI Consulting, Consultant to NRC) discussed two sets of options for risk-informing the ECCS Rule: (1) options based on current requirements, and (2) options based on defense-in-depth (DID) strategies. For Option (1), eight items were listed as potential revisions to the Rule:
 - Relax Appendix K conservatisms (e.g., use ANS-79 decay heat, replace Baker-Just oxidation model, etc)
 - Make realistic (best-estimate) models less burdensome
 - Treat break size and location probabilistically (propagate this uncertainty with others)

- Change acceptance criteria (e.g., permit more core degradation¹ but require containment integrity and long-term cooling)
- Relax simultaneous failure assumptions (double-ended break, loss of offsite power, etc.)
- Eliminate very large breaks as design-basis initiators for ECC
- Eliminate all large breaks as design-basis initiators for ECC
- Eliminate LB LOCA as design-basis accident (ECC, containment, etc.)

For Option (2) (risk-informed options based on DID), a risk-based framework was proposed (Figure 1) keyed to a set of quantitative guidelines (Figure 2). The basic "requirement" was that the frequency of large pipe break should be demonstrably less than 10⁻⁶/year. One point noted by Mr. Haskin was the issue of what DBA one is to assume for the containment and ECC systems, given the elimination of the LB LOCA DBA. He also recommended that the WOG provide a written report that lists the benefits associated with risk-informing 50.46, the associated cost savings, and potential impact on generic safety issues.

- Mr. N. Lauben, RES, discussed a project underway to address a user need request from NRR (Figure 3). Specifically, NRR requested that RES perform an evaluation of possible revisions to the required features of Appendix K with the goal of supporting expedited rulemaking to grant regulatory relief (similar to the recent approach to delete the 102% requirement on assumed power in Appendix K). RES is focusing on two significant conservatisms: use of the ANS-79 decay heat standard and the Cathcart-Pawel metal water reaction model (versus the ANS-71 and Baker-Just requirements, respectively). RES is also evaluating the reduction in margin and retained conservatism associated with the use of these less conservative models. Work on this matter is scheduled to be complete by the end of August, 2000.
- Representatives of the WOG discussed their approach to LB LOCA redefinition. The WOG believes that rulemaking is the best option to pursue for this matter. Their focus will be on two items: extension of existing leak-before-break (LBB) applications (apply to dynamic effects, extend LBB to pipes as small as six-inches

¹ The point of permitting more core damage was highlighted in the current issue of "Inside NRC", and was also picked up by a wire service, absent any of the remaining detail or that this was just one of several options under consideration.

in diameter), and, use of PRA analysis to support rulemaking. Estimates of the economic benefits for redefinition of the ECCS Rule were considerable (e.g. relax diesel-generator start times - \$1.1M/year, power uprate - \$1.7 - 2.8M/year), while the costs were minimal (\$0.7 - \$1.0M/plant). This LB LOCA redefinition proposal is to be presented to the WOG Executive Committee for a decision on funding approval in June.

During discussion, the WOG indicated that if the staff crafts a LB LOCA redefinition rule within the next 1-2 years this would correspond with its schedule planning, rendering moot the need to peruse a petition for rulemaking on its part. The WOG also indicated that providing the information suggested by Mr. Haskin was prudent.

Prior to concluding the meeting, the lead staff representative (Ms. M. Drouin) stated that the staff plans to meet with the ACRS (subcommittee and full Committee) in the September - November timeframe to discuss the risk-informing of the ECCS Rule, in the context of the staff's requirement to provide the Commission with recommendations on proposed changes to risk-inform Part 50 by the end of the year. [Note: M. Markley is aware of these staff's plans and we will be scheduling a combined RPRA/T/HP Subcommittee meeting, consistent with the staff's schedule.]

Attachments: As Stated

cc: R. Savio

cc w/o attach (via E-mail):

J. Larkins
H. Larson
S. Duraiswamy
ACRS Technical Staff & Fellows

Attachment C

Very Preliminary Illustration of a Possible Composite Way to Risk-Inform LBLOCA Requirements

Frequency of large RCS pipe break	$f_{LB} < 10^{-6}/\text{yr}$	$10^{-6}/\text{yr} \leq f_{LB} < 10^{-5}/\text{yr}$	$10^{-5}/\text{yr} \leq f_{LB}$
LOP & Single Failures	No Regulatory Requirement	No Regulatory Requirement	Consider system/train failures with probability ^{a,b} $P_F \geq (10^{-6}/\text{yr})/f_{LB}$
Short-term Cooling	No Regulatory Requirement	Criteria to assure coolable in-vessel debris ^c	Current ECC Acceptance Criteria 1-4
Long-term Cooling	No Regulatory Requirement	Current ECC Acceptance Criterion 5 ^c	Current ECC Acceptance Criterion 5
Containment Integrity	No Regulatory Requirement	Demonstrate ^a $CP-ECF_{LB} < 0.1$ $CP-LLR_{LB} < 0.1$	Containment Integrity Required as per Current Regulations
Plant Risk Measures	Demonstrate ^{a,d} $CDF < 10^{-4}/\text{yr}$ $CP-ECF < 0.1$ $CP-LLR < 0.1$	Demonstrate ^{a,d} $CDF < 10^{-4}/\text{yr}$ $CP-ECF < 0.1$ $CP-LLR < 0.1$	Demonstrate ^{a,d} $CDF < 10^{-4}/\text{yr}$ $CP-ECF < 0.1$ $CP-LLR < 0.1$

NOTES:

- ^a All quantitative comparisons are to mean values from full-scope PRAs
- ^b Example: Suppose $f_{LB} = 2 \times 10^{-5}$ and the probability of loss of offsite power given a large RCS break is 0.02. LOP need not be postulated as part of a design-basis LBLOCA because $P_f = 0.02$ is less than $(10^{-6}/\text{yr})/(2 \times 10^{-5}/\text{yr}) = 0.05$.
- ^c The impact of suspended debris on long-term cooling must be considered.
- ^d Mean CDF and CCFP should satisfy these quantitative objectives considering all LBLOCA-related changes.


FIGURE 1

- Adjust downward for IGSCC mitigation (BWRs)
- Multiply by conservative estimate of probability of rupture given a through-wall crack based on
 - Technical review of information on fracture mechanics
 - Data on high-energy pipe failures and cracks
 - Assessments of pipe-break frequencies by others
 - $P_{R,TW} = \max(2.5/\text{diam}(\text{mm}), 0.01)$

Prob to pipe size

20

LBLOCA Quantitative Guidelines

- Quantitative guidelines are stated for mean values from full-scope PRAs (internal & external events, all modes of operation)
- For the plant
 - Core damage frequency, CDF < 10^{-4} /year
 - Conditional containment failure probability, CP-ECF < 0.1
 - Conditional probability of large late release, CP-LLR < 0.1
- For any specific initiator type, e.g., LBLOCA
 - $\text{CDF}_{\text{LBLOCA}} < 10^{-5}$ /year
 - $\text{LERF}_{\text{LBLOCA}} < 10^{-6}$ /year
 - $\text{LLRF}_{\text{LBLOCA}} < 10^{-6}$ /year
- To eliminate RCS pipe breaks larger than a certain size as design-basis initiators their collective mean frequency should be demonstrably less than 10^{-6} /year

FIGURE 2

Discussion Items



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December 15, 1999

MEMORANDUM TO: Ashok C. Thadani, Director
Office of Nuclear Regulatory Research

FROM: Samuel J. Collins, Director *Roy P. Zimmerman*
Office of Nuclear Reactor Regulation

SUBJECT: RISK-INFORMING THE REVISION OF SEVERAL REQUIRED
FEATURES OF 10 CFR 50.46, APPENDIX K MODELS

In a memorandum you sent to me on May 13, 1999, you proposed that Appendix K to 10 CFR Part 50 be modified to allow use of the current American Nuclear Society (ANS) decay heat standard in place of the 1971 ANS decay heat standard. We are in agreement with your May 13, 1999, proposal. We also believe that the current required oxidation model could be revised to allow the use of a new model based on appropriate data and with a suitable uncertainty.

In addition to the work you are already planning to undertake, we also request that the Office of Nuclear Regulatory Research (RES) perform an analysis of the proposed changes on a short-term schedule. Specifically, we would like RES to determine for 10 CFR 50.46 analyses using Appendix K, whether there would be any significant risk changes associated with using more-realistic decay heat models. In order to support rulemaking, we also request that RES provide an estimate of the reduction in margin and the retained conservatism in Appendix K (10 CFR Part 50) evaluation models as a result of the proposed changes. We would like RES to complete work on the decay heat model and provide a regulatory analysis before August 31, 2000, in order to support an expedited rulemaking schedule. With regard to the metal-water reaction, NRR recognizes RES plans to perform oxidation tests on high burnup fuel and that the results will not be available in the immediate future. Nevertheless, we request RES to provide the results of sensitivity studies and the regulatory analysis to assess the different metal-water reaction models available in the open literature by 8/30/2000. As our staffs have agreed, although this project could be considered a part of the Option 3 process to risk inform 10 CFR part 50, the potentially substantial reduction of unnecessary burden to be derived from these changes warrants proceeding on an expedited basis. In addition, if RES identifies other potential changes that can be assessed in the same time frame, please discuss these with us for possible inclusion in the study.

The proposal has been coordinated with your staff.

CONTACT: Joseph Staudenmeier, SRXB/DSSA
415-2869

FIGURE 3