ACRSR-1929

February 13, 2001

Dr. William D. Travers
Executive Director for Operations
U.S. Nuclear Regulatory Commission
Washington D.C., 20555 - 0001

Dear Dr. Travers:

SUBJECT: REVIEW OF THE SIEMENS POWER CORPORATION S-RELAP5 CODE TO APPENDIX K SMALL-BREAK LOSS-OF-COOLANT ACCIDENT ANALYSES

During the 479th meeting of the Advisory Committee on Reactor Safeguards, February 1-3, 2001, we met with representatives of the Siemens Power Corporation (SPC) and the NRC staff to discuss the approval of the SPC S-RELAP5 thermal-hydraulic code for small-break loss-of-coolant accident (SBLOCA) analyses pursuant to the requirements of Appendix K to 10 CFR Part 50. Our Subcommittee on Thermal-Hydraulic Phenomena discussed this matter during meetings held on March 15 and August 8-9, 2000, and on January 16-17, 2001. We also had the benefit of the documents referenced.

Conclusion and Recommendation

1. We agree with the staff's decision to approve the use of S-RELAP5 to satisfy Appendix K requirements for analyses of the SBLOCA.

2. Documentation must be improved if it is to be suitable to support a “realistic” (best-estimate) version of the code. This applies to all features of the code, particularly the basic formulations, the solution procedure, assessment versus data, and the evaluation of uncertainties.

Discussion

The S-RELAP5 code has evolved from the earlier RELAP5/MOD2 and /MOD3 code versions, which have been used extensively and have been approved for SBLOCA analyses. SPC has made several significant improvements to the code, including better correlations, a more robust solution procedure, and a two-dimensional modeling option.

We agree with the staff's judgment that the code assessment performed by SPC is adequate for Appendix K SBLOCA analyses. In its original submission, SPC made comparisons with five tests. Two of these, the system tests Semiscale S-UT-8 and BETHSY 9.1b, posed substantial challenges that the code met successfully. In response to requests for additional information, SPC submitted further code calculations and data comparisons that increased confidence in the suitability of the code for the uses described in the Safety Evaluation Report (SER). These are the major reasons why we agree with the staff's decision to approve the code for Appendix K SBLOCA analyses.

Observations

Although we find that the staff has sufficient grounds to approve the present application of the code to Appendix K SBLOCA analyses, we have several observations that the staff should consider as it prepares to review the "realistic" (best-estimate) version of S-RELAP5.

1. SPC submitted documentation that had shortcomings of the type described in our report dated January 11, 2001. Although our Subcommittee had identified these shortcomings, there is little discussion of them in the staff's SER. During the August 8-9, 2000 Thermal-Hydraulic Phenomena Subcommittee meeting, SPC presented a different formulation of the mathematical models than that included in the written material submitted before the meeting. It is unclear to us what the final documentation will contain.

   Good documentation is sound quality control practice. It provides insurance against costly delays, uncertainties, confusion, and mistakes. It simplifies and enhances staff and ACRS reviews and aids users. It also builds confidence in the soundness of regulatory judgments in the broader technical community.

   In the future, the staff should insist on complete documentation before issuing a final SER.

2. The Appendix K provisions for code assessment for SBLOCA as listed in NUREG-0737 specifically identify only two comparisons with system tests: Semiscale Test S-07-10B and LOFT test L3-1. The SBLOCA covers a range of break sizes, leading to different rates of flow and a variety of conditions throughout the system. A more complete set of comparisons would increase confidence that the code has not been tuned to a single sequence of events and that some conditions where it might not perform appropriately remain undiscovered.

   The staff needs to consider how broad-based the assessment of realistic codes should be, not only to ensure adequacy but also to measure uncertainty. Clear criteria are also needed on what constitutes an adequate database for assessing this uncertainty and on how this should be done quantitatively.

3. In describing the Upper Plenum Test Facility (UPTF) test of loop seal performance, SPC stated [Page 5-46 of SPC Topical Report EMF-2328(P)] that in one case "the level predicted by S-RELAP5 was about 3.5 times greater than the measured level," while in another case “the predicted pressure drop across the loop seal was 10.9 kPa versus about 2.9 kPa from the data.” SPC argued that these rather large deviations are conservative for the purpose of evaluating the success criterion of peak clad temperature during a SBLOCA. However, there are other applications of thermal-hydraulic codes for which deviations of this magnitude might prove to be unacceptable. For example, the performance of passive plant designs is likely to be more sensitive to the balance between hydrostatic driving forces and pressure drops throughout the system and may require greater accuracy in code predictions of these phenomena.

4. SPC provided the staff with a working version of their code and input decks to enable test conditions to be simulated. However, the staff informed us that it had not run the code as an independent check, nor used this capability to investigate some key features. We understand that the staff’s rationale in this particular case is that it is familiar with previous relevant applications of RELAP5. The use of the codes by the staff should be an important part of its review process. We look forward to staff reports on its independent evaluation of code runs when S-RELAP5 is submitted as a realistic code.

5. Because we cannot check many features of a complex code, some of our assessment must be based on establishing confidence in the applicant's technical judgment. In the present case, we have been helped in our evaluation by the cooperation of SPC in responding to our technical questions and supplying additional information. Another important factor in establishing confidence is the provision of accurate, complete, and unequivocal documentation. We look forward to reviewing the revised documentation supporting the realistic version of the code.

Sincerely,

/RA/

George E. Apostolakis
Chairman

References:

1. Siemens Power Corporation Report, EMF-2100(P), Revision 2, “S-RELAP5 Models and Correlations Code Manual,” January 2000 (Proprietary).
2. Siemens Power Corporation Report, EMF-2328(P), Revision 0, “PWR Small Break LOCA Evaluation Model, S-REALP5 Based,” January 2000 (Proprietary).
3. Siemens Power Corporation Report, EMF-2310(P), Revision 0, “SRP Chapter 15 Non-LOCA Methodology for Pressurized Water Reactors,” November 1999 (Proprietary).

4. Siemens Power Corporation Report, EMF-2101(P), Revision 1, "S-RELAP5 Programmers Guide," December 1999 (Proprietary).
5. Siemens Power Corporation Report, EMF-CC-097(P), Revision 4, "S-RELAP5 Input Data Requirements," December 1999 (Proprietary).
6. U. S. Nuclear Regulatory Commission, Draft Safety Evaluation Report by the Office of Nuclear Reactor Regulation for EMF-2328(P), "PWR Small-Break LOCA Evaluation Model, S-RELAP5 Based," undated (Predecisional).
7. U. S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, "S-RELAP5 Request for Additional Information (RAI)," undated (Proprietary).
8. Report dated January 11, 2001, from D. A. Powers, Chairman, ACRS, to Richard A. Meserve, Chairman, NRC, Subject: Issues Associated with Industry-Developed Thermal-Hydraulic Codes.
9. U. S. Nuclear Regulatory Commission, NUREG-0737, "Clarification of TMI Action Plan Requirements," November 1980.