ACNWR-0177

January 14, 2002

The Honorable Richard A. Meserve
Chairman
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: RISK-INFORMED ACTIVITIES IN THE OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS

Dear Chairman Meserve:

The Joint Subcommittee of the Advisory Committee on Reactor Safeguards (ACRS) and the Advisory Committee on Nuclear Waste (ACNW) met on January 19 and November 14, 2001, to discuss the status of risk-informed activities in the Office of Nuclear Material Safety and Safeguards (NMSS). This matter was subsequently discussed at the 131st meeting of the ACNW on January 8-9, 2002. Our discussions covered the proposed Standard Review Plan (SRP) Chapter 3 (NUREG-1520) for Integrated Safety Analysis (ISA), activities of the NMSS Risk Task Group, and development of a probabilistic risk assessment (PRA) for dry cask storage. This report focuses primarily on SRP Chapter 3 and the use of ISA. Although the ACNW has the responsibility for advising the Commission on this subject, input has been received from the ACRS through the Joint Subcommittee.

DISCUSSION AND RECOMMENDATIONS

ISA as a Logical Path to PRA

In our letter dated July 27, 2000, we challenged the NRC staff on the decision to develop the ISA method to risk-inform NMSS activities, rather than employ PRA methods directly. The decision appears to be based, in part, on the fact that fuel cycle and nuclear materials facilities are sufficiently different from nuclear power plants to warrant a different and "simpler" approach. We continue to question the effectiveness of ISA in leading to desired outcomes, but believe that the ISA can be a foundation from which a risk-informed methodology can evolve.

We believe that the ISA method should be a logical step toward adopting PRA as a preferred process for risk-informing NMSS activities. Ideally, NMSS should treat ISA as a transparent building block for developing a PRA. The incorporation of accident scenarios, likelihoods, and consequences in the ISA approach is an important step towards quantification of the risk. Important issues for completing the transition of ISA to a more risk-informed approach are the treatment of dependent failures, human reliability (e.g., operator error by either omission or

commission), the treatment of uncertainty, and the aggregation or assembly of the scenarios into overall facility or system measures of risk (e.g., a release of toxic material above a certain threshold, or the dose at the restricted area or site boundary).

Recommendation

- The NRC staff should move the ISA process systematically in the direction of quantitative risk assessment to enhance the overall understanding of total system risk. As experience is gained, 10 CFR Part 70 and the associated SRP Chapter 3 should be modified to be more risk-informed and, therefore, more effective and efficient.

Dependent Failures

Appendix A to SRP Chapter 3 describes an example of an ISA method for displaying accident sequences. We found very little evidence in Appendix A to indicate that the ISA methods systematically and explicitly search for and address dependent failures. An important lesson learned from nuclear power plant PRAs is that dependent failures are especially significant contributors to risk and that they can neutralize the redundancy and diversity of systems, especially accident mitigation systems. There are differences between nuclear reactors and fuel cycle facilities, but there is no technical basis for the assumption that the differences include immunity of fuel cycle facilities from dependent failures.

Appendix A alludes to the issue of dependent failures in recognizing the need to establish "independence" of items relied on for safety (IROFS). For example, fires can cause the loss of independent and redundant IROFS. Other indirect evidence in Appendix A that indicates some awareness of dependent failures is the reference to "surveillance tests for hidden failures." Nevertheless, we are concerned that dependent failure analysis does not appear to be a deliberate and explicit component of the ISA process.

Recommendation

- The NRC staff should revise Appendix A to provide guidance on the explicit treatment of dependent failures in the conduct of ISAs. The guidance should be specific to fuel cycle facility operations.

Risk Measurement

We are concerned about the emphasis in ISA on indexing and scoring of specific accident sequences, as well as the lack of emphasis on the underlying analytical process for developing consequences, likelihoods, and measures of risk. In particular, the ISA approach emphasizes compliance with the regulations at the individual accident sequence or "credible event" level, whereas for the reactor and waste field, compliance is demonstrated by aggregating all of the important accidents to generate probability density functions or frequency of exceedance curves of key risk measures. We believe that aggregating the event sequences into an integrated measure of risk is essential, since individual event sequences are not well defined and may be described in significantly varying degrees of detail.

It is also important to note the differences between the ISA approach, as discussed in Appendix A, and quantitative risk assessment in relation to the issue of conservative calculations. The tradition of PRA is to present to the stakeholders an assessment of what the experts believe to be the actual risk associated with the operation of a technological system, not an upper bound of the risk except as can be interpreted by the probabilistic form of the results. Such results provide a meaningful technical basis for quantifying safety margins.

Recommendation

- SRP Chapter 3 and Appendix A should be revised to stress the importance of the total risk, that is, the aggregate risk.

Quantitative Versus Qualitative Assessment

We were informed by the staff that the absence of accident/event data posed a challenge to the use of PRA for safety assessment. Another challenge expressed was that PRA involves complex and detailed models that are difficult to justify for many NMSS applications. Among the important lessons learned in the widespread application of quantitative risk assessment is that the lack of data is not a good reason for not doing PRA. Once a system model has been developed and the data requirements are defined tightly, practice indicates there are usually sources of data available. Moreover, all data have uncertainties associated with them and require the use of uncertainty analysis to make risk calculations defensible. Embracing the concepts of uncertainty analysis (in both information and modeling) allows the analyst to address the actual risk more convincingly. In particular, the assertion that there is too much uncertainty to develop meaningful results is contrary to the risk analysis philosophy. If there is large uncertainty, that is the meaningful result of a risk assessment.

We agree with the staff that if simple bounding analysis can preclude the need to be concerned about risk and safety and the analysis can be defended, that is the best course to pursue. Often, safety practitioners prejudge PRA complexity on the basis of the analysis of complex systems such as a large nuclear power plant. Those models are not representative of PRA applications on simpler systems. Simple PRA models have been used with considerable success. It is the complexity of the application that dictates the degree of PRA complexity, not the PRA methods.

Recommendations

- The staff should encourage licensees to utilize data and data treatment methods in the ISAs to account for uncertainties and to move assessments in the direction of increased quantification. SRP Chapter 3 and Appendix A guidance should provide for explicit consideration of these methods.

- The staff should be strongly encouraged to increase the use of risk assessment techniques in implementing ISAs to facilitate the transition to a transparent and quantitative process of risk-informing NMSS activities.

Sufficiency of the ISA Summary

We had some concern that only an ISA Summary of the integrated safety analysis is necessary in the license or renewal application for fuel cycle facilities. We find it difficult to assess the ISA Summary as a basis for considering ISA to be sufficient. The ISA Summary would simplify communications with the licensee on the timely reporting of changes to the facility. However, we question how sufficient ISA Summaries will be for regulatory decisionmaking (e.g., licensing actions, oversight process, IROFS reliability and maintenance, license renewal, etc.) for fuel cycle facilities. We were unable to reach a conclusion on this point, as there is neither actual experience with processing an ISA Summary nor a "pilot plant" ISA Summary to review.

Future Considerations

We believe that much will be learned from the initial staff reviews of ISA Plans and ISA Summaries and would like to discuss this matter with the staff and stakeholders at the appropriate time. The staff has agreed to discuss insights from their review of ISA Plans in early 2002.

We were pleased to see the initiatives being pursued by the NMSS Risk Task Group to develop safety goals, risk case studies, and associated training. Likewise, we are pleased to note that most of the technical work and technical capability is being developed within the NRC for the dry cask storage PRA. We view these as necessary incremental steps in making risk-informed regulations more effective and efficient. We encourage the increased use of PRA methods of analysis to NMSS activities.

Sincerely,

/RA/

George M. Hornberger
ACNW Chairman

References:

1. U.S. Nuclear Regulatory Commission, Draft NUREG-1520, "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility," Chapter 3, "Integrated Safety Analysis (ISA) and ISA Summary," and associated Appendix A, "Example Procedure for Accident Sequence Evaluation," dated September 20, 2001.
2. Letter dated July 16, 2001, from Felix M. Killar, Jr, Nuclear Energy Institute, to Yawar H. Faraz, Office of Nuclear Material Safety and Safeguards, Subject: Comments on June 14, 2001, revision of Standard Review Plan (SRP) Chapter 3 ('*Integrated Safety Analysis (ISA) and ISA Summary*') of Draft NUREG-1520.