ACRSR-1874

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D.C. 20555-0001

February 14, 2000

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

Dear Chairman Meserve:

SUBJECT: IMPEDIMENTS TO THE INCREASED USE OF RISK-INFORMED REGULATION

The ACRS has long advocated the transition to a risk-informed regulatory system. Over the last several years, we have discussed potential impediments along the path toward risk-informed regulation.

This report responds to the Commission's request in the December 17, 1999 Staff Requirements Memorandum that the ACRS provide examples of impediments to the increased use of risk-informed regulation, an evaluation of the significance of these impediments, and, as appropriate, proposed solutions to identified problems. In our review, we had the benefit of the documents referenced.

There can be a variety of views on what is meant by risk-informed regulation. One view, for example, could be that we start over and redo the whole body of regulations making them risk informed without having a reactor type or design in mind. We believe that this should be considered on a non-urgent long time frame.

Another view could be that there exists a body of regulations and a population of light water reactor plants whose designs have resulted from meeting these regulations. As a result, risk-informed regulation would mean using risk insights gained from performing probabilistic risk assessments (PRAs) on the existing plants to modify the regulations holistically or in selected areas to make the regulations coherent, ensure that all requirements are necessary, and provide a focus on the more risk-significant issues.

In responding to the Commission's request, we take the latter view of what the agency intends in its efforts to risk inform the regulations.

In this respect, we identify a number of conditions that we believe hinder the progress of risk informing the regulations and implementing the changes for operating reactors. We have placed these "impediments" in two separate categories,"cultural/institutional" and "technical."

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The cultural/institutional impediments are characterized as being related to attitudes, impressions, institutional or organizational barriers, processes, resource limits and similar such attributes. An important cultural/institutional impediment is the perception by licensees that they will need to expend substantial resources to update their PRAs to an acceptable level, provide additional staffing and resources to utilize and maintain the PRAs, and still have to comply with the current deterministic regulations. They fear that risk considerations will be add-ons to the existing regulatory system that will impose additional burdens.

There are many more cultural/institutional impediments than there are technical ones. We have chosen not to focus on the cultural/institutional impediments because it is our view that, as we risk inform the regulations in a technically defensible manner and consistently apply these regulations, most of the cultural/institutional impediments will fade away naturally with time. On the other hand, the technical impediments will not go away by themselves but will require significant effort and research for resolution.

We consider the more significant of the technical impediments to be:

1. PRA inadequacies and incompleteness in some areas.

2. The need to revisit risk-acceptance criteria.

3. Lack of guidance on how to implement defense in depth and on how to impose sufficiency limits.

4. Lack of guidance on the significance and appropriate use of importance measures.

5. Variation of PRA quality and scope and the need for Standards.

While we consider it important that efforts be undertaken to overcome these impediments, we believe that the state-of-the-art of PRA is sufficiently advanced that the agency can proceed with efforts to become more risk informed in its regulatory activities. However, it will be necessary to craft the regulations in a conservative manner to accommodate these shortcomings and in such a way that they can be easily evolved as improvements are made in the state-of-the-art of PRA. We also believe that the agency ought not to underestimate the risk analysis capabilities that will be needed to sustain a risk-informed regulatory system.

Our views on each of the technical impediments are discussed below:

1. <u>PRA Inadequacies and Incompleteness</u>

Most of the current PRAs are inadequate for assessing risk contributions from fires, seismic events, human performance, organizational factors, and safety culture factors. They are incapable of assessing the lifetime average risk contribution from shutdown conditions. The reliability database is weak for passive components and "nonsafety-related" systems and components.

2. Risk Acceptance Criteria

It is necessary to have risk acceptance criteria applicable to individual licensees in a risk-informed regulatory system. The initial efforts to risk inform the regulatory activities have utilized two metrics for risk acceptance - mean values of core damage frequency (CDF) and large, early release frequency (LERF). The values for CDF and LERF used in Regulatory Guide 1.174 are consistent with the Commission's safety goals. These safety goals were, however, originally intended to be goals (i.e., some things to strive for) for the average risk status of the population of plants as a whole. It is generally recognized that safety goals are not risk acceptance values that would, for example, be surrogates for adequate protection.

In a risk-informed regulatory system, it is necessary to have risk acceptance limits. If we are to have limits on CDF and LERF that are "consistent" with "adequate protection," we believe these would differ from those in Regulatory Guide 1.174. It is important at this stage of risk-informing the regulations that quantitative limits be incorporated into an expanded definition of adequate protection.

3. Defense-in-Depth

According to the Commission's White Paper (SECY-98-144):

> Defense-in-Depth is an element of NRC's Safety Philosophy that employs successive compensatory measures to prevent accidents or mitigate damage if a malfunction, accident, or naturally caused event occurs at a nuclear facility.

If defense-in-depth is viewed as measures taken to compensate for the PRA inadequacies and uncertainties, then there is a need for guidance to help quantify how many compensatory measures are necessary and how good these have to be.

4. Importance Measures

We have noted that risk-informed decisions are often based on categorizing structures, systems, and components according to their importance in influencing changes to CDF and LERF. As discussed in our report on importance measures, there is a need for guidance on the appropriate interpretation and use of importance measures.

5. Need for Standards/PRA Quality and Scope

Most PRAs for existing reactors were developed in response to Generic Letter 88-20 and Supplement 4 requesting the individual plant examination (IPE) and individual plant examination for external events (IPEEEs). It has been noted that there is much variation in the scope and quality of these PRAs.

NRC has requested the American Society of Mechanical Engineers and the American Nuclear Society to develop Standards to ensure that the technical quality of PRAs is sufficient to support the regulatory review and approval of licensee risk-informed applications. We believe that development of appropriate PRA Standards is important to risk-informing the regulations. However, we believe it is important that standards not stifle the continuing improvement of PRA methods.

We believe that the quality of any PRA is reflected in the quantified uncertainty distribution. It is important that the Standards include guidance on the appropriate determination of uncertainties (epistemic and aleatory) and the NRC staff needs guidance on how to consistently use these in the decisionmaking process.

As stated above, even though impediments exist, the agency has the capabilities necessary to make significant progress in developing and implementing risk-informed regulations.

Sincerely,

Dana A. Powers
Chairman

References:

1. Staff requirements Memorandum dated December 17, 1999.
2. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," July 1998.
3. U.S. Nuclear Regulatory Commission, Policy Statement, "Safety Goals for the Operations of Nuclear Power Plants," 10 CFR Part 50, August 21, 1986.
4. SECY-98-144, Subject: White Paper on Risk-Informed and Performance-Based Regulation, dated June 22, 1998.
5. Letter to William D. Travers, Executive Director for Operations from Dana A. Powers, Chairman, Advisory Committee on Reactor Safeguards, Subject: Proposed ASME Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications (Phase 1), dated March 27, 1999.
6. Report to Richard A. Meserve, Chairman, NRC from Dana A. Powers, Chairman, Advisory Committee on Reactor Safeguards, Subject: Importance Measures Derived from Probabilistic Risk Assessment dated February , 2000.
7. U.S. Nuclear Regulatory Commission, Generic Letter 88-20, dated November 23, 1988, Subject: Individual Plant Examination for Severe Accident Vulnerabilities.
8. U.S. Nuclear Regulatory Commission, Generic Letter 88-20, Supplement 4, dated June 28, 1991,Subject: Individual Plant Examination for External Events.