



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

May 11, 1998

The Honorable Shirley Ann Jackson
Chairman
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Chairman Jackson:

SUBJECT: ELEVATION OF CDF TO A FUNDAMENTAL SAFETY GOAL AND POSSIBLE REVISION OF THE COMMISSION'S SAFETY GOAL POLICY STATEMENT

During the 449th, 451st and 452nd meetings of the Advisory Committee on Reactor Safeguards, March 2-4, April 2-4, and April 30-May 2, 1998, respectively, we met with representatives of the NRC staff and the industry to discuss the elevation of core damage frequency (CDF) to a fundamental safety goal and the need for revising the Commission's Safety Goal Policy Statement. In our August 15, 1996 report to the Commission, we recommended elevating CDF to a fundamental safety goal. Our Subcommittee on Reliability and Probabilistic Risk Assessment met on February 20 and April 16, 1998, to discuss these matters. Former NRC Commissioner Forrest Remick and former ACRS Member David Okrent participated in these discussions. We also had the benefit of the documents referenced.

The Quantitative Health Objectives (QHOs) regarding individual risk and societal risk promulgated in the Safety Goal Policy Statement are fundamental goals. Due to the large uncertainties in evaluating individual and societal risk, alternative objectives are often used. The most frequently used alternatives are limits on CDF and on large, early release frequency (LERF). These are generally referred to as "subsidiary" or "surrogate" goals to indicate that they are intended to be consistent with the fundamental safety goals (to the extent that the current computational capability allows the determination of consistency¹). If one of these numerical goals were to be significantly more conservative than the QHOs, then it would no longer be subsidiary, but could itself be a new, *de facto* fundamental safety goal.

In its report dated May 13, 1987, the ACRS discussed a hierarchical structure to facilitate the implementation of the Safety Goal Policy Statement, and expressed concern over a *de facto*

¹In this regard, the Policy Statement advises that "It is the Commission's intent that the risks from all the various initiating mechanisms be taken into account to the best of the capability of current evaluation techniques." The check for consistency to which we are referring will also have to be done using the best current evaluation techniques.

change in policy: "Each subordinate level of the hierarchy should be consistent with the level above, but should be a more practical surrogate, representing a simplification or quantification of the previous level. Each surrogate should not be so conservative that it creates a de facto new policy."

The staff has stated numerical objectives for CDF and LERF in Regulatory Guide 1.174 and has employed these values in other regulatory decisionmaking. The question is whether these numerical values are consistent with the QHOs. There are plants that could have CDF values even greater than 10^{-3} per reactor-year and still be consistent with the QHOs because of their containment performance. Thus, we make the following observations:

Observation 1: Existing Level-3 PRA results can be used to estimate specific values for LERF that would be consistent with the QHOs. Such estimates show that the current LERF objective of 10^{-5} per reactor-year is consistent with the QHO on early fatalities and, therefore, could be considered a surrogate goal.

Observation 2: Results of analyses indicate that a CDF objective of 10^{-4} per reactor-year, if applied to all plants with their current level of containment performance, in many cases would be more conservative than the QHOs. This would, therefore, be a new *de facto* fundamental safety goal.

Although we agree with the criteria on CDF and LERF included in Regulatory Guide 1.174, we believe that such *de facto* changes in policy are not desirable. The issue of elevating CDF to a fundamental safety goal should be thoroughly scrutinized.

Irrespective of Observation 2, we agree with the staff position that a revision of the Policy Statement is needed to address the use of the goals on a plant-specific basis, to expand the discussion on uncertainties, and to remove the general plant performance guideline.

These and other issues regarding the current Policy Statement should be addressed if a revision is considered. Even though the Policy Statement refers to societal risk, the application guidance and practice result in essentially individual risk goals. Furthermore, environmental contamination and the total number of fatalities have been mentioned often as being appropriate societal measures of the consequences of accidents at nuclear power plants. Environmental contamination receives close attention within the nuclear regulatory framework of some other countries. The importance of environmental contamination resulting from accidents is recognized by the NRC staff in regulatory analyses and in environmental impact statements. The question is whether this and the total number of fatalities should be part of the Safety Goal Policy.

Thus, we make the following recommendation:

Recommendation 1: There is a need to revise the Safety Goal Policy Statement. The revision should include: (a) a statement regarding the plant-specific use of the safety goals; (b) an expanded treatment of the role of uncertainties; (c) the removal of the general plant performance guideline; (d) a reconsideration of the set of fundamental goals and subsidiary objectives to ensure that they are consistent; and (e) a reconsideration of measures of societal risk such as environmental contamination and the total number of fatalities.

During our discussions with the staff, a question was raised regarding the level of detail that the Policy Statement should contain. Should such a document only express the overall safety policy and regulatory approach of the Agency; or should it also specify numerical values for the metrics? The current Statement does specify numerical QHOs. If it is decided to elevate CDF to the same level, should it simply state that the prevention of core damage is a fundamental safety goal and leave the specification of actual numerical guidelines in application guidance? In either case, attention will be drawn to the significance that the Commission places on core damage accidents and would be a clear statement of defense-in-depth in terms of PRA. We understand the attractiveness of providing clear, understandable criteria, yet the inclusion of too many quantitative objectives might be overly constraining and not sufficiently flexible to adapt to changes in technology.

An additional important conceptual issue is whether the objectives should be stated in terms of a single goal or a goal and an upper limit. The current Policy Statement specifies only a single goal for each objective, e.g., if the calculated risk of prompt fatality to an individual in the vicinity of a nuclear power plant is less than 0.1 percent of the sum of prompt fatality risks from other accidents, then that plant meets this objective, otherwise it does not.

An upper limit and a goal define three regions. For risk levels above the upper limit, immediate action should be taken. For risk levels between the upper limit and the goal, the possibility of reducing the estimated metric should be investigated, taking into account costs and benefits. For risk levels below the goal, no action would be required. This approach would be consistent with the "risk-informed" philosophy, which recognizes that risk metrics are only part of the decisionmaking process, but if the value of a risk metric were found to be very large, this would lead to immediate action.

The use of two values for making decisions involving risk metrics has been adopted by the nuclear regulatory agencies of The Netherlands and the United Kingdom (Versteeg, 1992; Ballard, 1993). Similarly, in a report dated October 31, 1980, the ACRS recommended decision rules that would employ a "goal level" and an "upper limit" on the various frequencies of the risk metrics. Even though the Commission did not adopt this earlier ACRS recommendation as part of its Safety Goal Policy Statement, it appears that both the staff and the industry act as if it were in effect. They respond immediately when a contributor to core damage is identified that increases the CDF to about 10^{-3} per reactor-year or greater. Some examples illustrating this behavior are the discoveries, by Individual Plant Examinations (IPEs) and Individual Plant Examination of External Events (IPEEEs), of such potential contributors initiated by internal flooding at the Surry plant and by fire at the Quad Cities plant.

The recently published report on the IPE program (NUREG-1560) states that "the CDFs for all boiling water reactors (BWRs) and most pressurized water reactors (PWRs) fall below $1E-4/ry$; however, nine licensees representing 15 PWR units reported CDFs above $1E-4/ry$ " (page 7-3). Given the limited scope of the IPE studies, it is reasonable to expect that the number of units (both PWR and BWR) with CDFs greater than 10^{-4} per reactor-year is higher than the IPE findings.

Thus, if the CDF value of 10^{-4} per reactor-year were to become a fundamental safety goal, the two-interval approach might lead to the perception by members of the public that the units having

CDFs greater than the goal are "unsafe." In a letter dated July 23, 1997, to NRC Chairman Jackson, Mr. J. F. Colvin of the Nuclear Energy Institute articulated this concern: "...using core damage frequency as a fundamental safety goal now would send a message to the public that plants that exceed the core damage frequency objective are unsafe, even though they may be well below the safety goal quantitative health objectives." The three-region formulation helps to alleviate this problem.

Therefore, we offer the following recommendation:

Recommendation 2: If revised, the Policy Statement should be written in terms of high-level principles and expectations and should include numerical guidelines on fundamental goals. We continue to believe that CDF should be elevated to a fundamental safety goal. Using three regions for some of the objectives should be evaluated, as opposed to the two that the current Policy Statement identifies.

We believe that a revision of the Policy Statement as discussed above would be a major undertaking. The staff stated that revising the Safety Goal Policy Statement would necessitate the reallocation of limited staff resources and would have an adverse impact on risk-informed regulatory activities. We view the completion and implementation of the Standard Review Plan and Regulatory Guides associated with risk-informed regulation as having great and immediate importance. We are, thus, led to the following recommendation:

Recommendation 3: The staff's request to defer modifying the Policy Statement for one year to permit evaluation of related issues and impacts should be approved.

We plan to continue our discussions with the staff regarding these matters.

Sincerely,



R. L. Seale
Chairman

References:

1. Memorandum dated October 16, 1997, from John C. Hoyle, Secretary, to L. Joseph Callan, Executive Director for Operations, NRC, Subject: Staff Requirements - SECY-97-208, "Elevation of the Core Damage Frequency Objective to a Fundamental Commission Safety Goal."
2. Memorandum from L. Joseph Callan, Executive Director for Operations, NRC, for the Commissioners, Subject: "Modifications to the Safety Goal Policy Statement," received March 26, 1998 (Predecisional Draft).
3. Report dated May 13, 1987, from William Kerr, Chairman, ACRS, to Lando W. Zech, Jr., Chairman, NRC. Subject: "ACRS Comments on an Implementation Plan for the Safety Goal Policy."

4. Report dated August 15, 1996, from T. S. Kress, Chairman, ACRS, to Shirley Ann Jackson, Chairman, NRC, Subject: "Risk-Informed, Performance-Based Regulation and Related Matters."
5. SECY-98-015, Memorandum dated January 30, 1998, from L. Joseph Callan, Executive Director for Operations, NRC, for the Commissioners, Subject: "Final General Regulatory Guide and Standard Review Plan for Risk-Informed Regulation of Power Reactors." (Predecisional Draft).
6. M. F. Versteeg, "Showing Compliance with Probabilistic Safety Criteria and Objectives," *Reliability Engineering and System Safety*, 35 (1992) 39-48.
7. G. Ballard, "Guest editorial: Societal Risk-Progress since Farmer," *Reliability Engineering and System Safety*, 39 (1993) 123-127.
8. Report dated October 31, 1980, from Milton S. Plesset, Chairman, ACRS, to John F. Ahearne, Chairman, NRC, Subject: "An Approach to Quantitative Safety Goals for Nuclear Power Plants."
9. U. S. Nuclear Regulatory Commission, NUREG-1560, "Individual Plant Examination Program: Perspectives on Reactor Safety and Plant Performance," Vols. 1-3, December 1997.
10. Letter dated July 23, 1997, from J. F. Colvin, President and CEO, Nuclear Energy Institute, to Shirley Ann Jackson, Chairman, NRC, regarding elevation of the core damage frequency subsidiary objective to a fundamental safety goal.
11. Memorandum dated July 2, 1997, from Shirley Ann Jackson, Chairman, NRC, to L. Joseph Callan, Executive Director for Operations, NRC, Subject: "The Statement of Core Damage Frequency of 1E-4 as a Fundamental Commission Goal."
12. Memorandum dated October 8, 1997, from NRC Commissioner Diaz, to John T. Larkins, ACRS, Subject: "Safety Goal."
13. U. S. Nuclear Regulatory Commission, Policy Statement, "Safety Goals for the Operations of Nuclear Power Plants," 10 CFR Part 50, August 21, 1986.

