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Dear Mr. Garrity:

Re: PART 50 APPENDIX I SECTION II.D, VALUES TO BE USED IN COST BENEFIT ANALYSIS REGARDING POPULATION DOSE.

The enclosed technical note, "Status Report an Quantitative Safety Goals," may be useful to you in understanding the NRC's basis for the referenced cost benefit numbers, as discussed in our meeting July 19 and 20.

Sincerely,

Original signed by

Kenneth L. Heitner
Operating Reactors Branch #3
Division of Licensing

Enclosure as stated

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new nuclear plants has resulted in the identification of several QA programmatic areas that should be emphasized and upgraded to improve the effectiveness of QA programs. Areas of improvement have been identified for operational nuclear plants and for plants under design and construction. The process for implementation of these guidelines has been initiated for several selected operational plants, for several plants whose construction permits will be granted soon, and for the one license-to-manufacture application for which approval was delayed as a result of the TMI-2 accident. These guidelines are intended to be factored into the staff review process through the *Standard Review Plan*[5] and associated Regulatory Guides and staff positions.

The NRC views QA as an extremely vital management tool to ensure the proper implementation of design, construction, and operational requirements and activities to protect the health and safety of the public. Therefore an effective QA program must be established and implemented to accomplish this objective. The NRC believes that these upgrading measures will materially assist in strengthening the QA program to achieve this objective.

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Technical Note: Status Report on Quantitative Safety Goals

The use of quantitative safety goals in the nuclear regulatory process is urged by many in the nuclear industry as a means of eliminating unnecessary regulation without sacrificing health and safety. It is an attempt to answer the nuclear-age-old question "How safe is safe enough?" and to permit cost–benefit balancing of proposed safety requirements as a rational alternative to the pursuit of utopian zero-risk criteria. While the Nuclear Regulatory Commission (NRC) is just now coming to grips with the issue, it does so in an environment that has become increasingly responsive to the subject as a consequence of numerous developments since the publication of the *Reactor Safety Study*[1] (WASH-1400) in 1975.

The nuclear industry, through the Atomic Industrial Forum (AIF), has long been an advocate of development of quantitative safety goals and associated probabilistic risk assessment (PRA) techniques to rationalize and stabilize the regulatory process. Until the Three Mile Island (TMI) accident in March 1979, these industry efforts had met with little success. In fact, just prior to the accident, the NRC was rapidly backpedaling from applying PRA techniques in licensing in response to the Lewis Committee report[2] and its criticisms of WASH-1400. In this regard, one of the few silver linings of the TMI accident was to reverse this developing negative attitude and to give firm forward impetus to increased uses of PRA and to the development of quantitative safety goals. This was a result of post-TMI recommendations of various investigative bodies including the NRC's internal TMI Lessons Learned Task Force,[3] the Advisory Committee on Reactor Safeguards (ACRS), and both the Rogovin[4] and Kemeny[5] commissions. These groups all found in the TMI accident a need to examine more realistically the true sources of accident risk and to develop a rational approach to deciding where limited resources should be placed to improve safety. Congress also has belatedly recognized the need for quantitative safety goals, and both the Senate and the House have acted toward directing the NRC to develop such goals.

NRC SAFETY GOAL PROGRAM

These various actions and recommendations have prompted the NRC Commissioners to proceed with the establishment of a program to develop quantitative safety goals. Table 1 lists some important milestones in the development of the NRC safety goal plan. The NRC program was initiated in April 1980 by a Commission directive to the NRC Office of Policy Evaluation (OPE) to develop a safety goal plan. The industry, through the AIF, provided its preliminary input on the establishment of safety goals in a June 1980 letter[6] to NRC and a July 1980 presentation to the ACRS. The OPE outlined its safety goal development plan in NUREG-0735 (Ref. 7), which was issued for public comment in October 1980. Shortly thereafter, the ACRS provided formal input to the program by presenting in NUREG-0739 (Ref. 8) one possible approach to the development of quantitative safety goals.

Following receipt of comments on NUREG-0735, the NRC staff issued in March 1981 a statement on discussions of preliminary policy consideration (NUREG-0764, Ref. 9). This was followed by two NRC-sponsored safety goal workshops, the first of which was held in Palo Alto, Calif., in April 1981. These workshops sought the views of a broad spectrum of individuals representing the social sciences, the academic community, public interest groups, the legal and medical professions, regulators, and the nuclear industry.

The AIF's views were formalized in a position paper sent to the NRC in May 1981 (Ref. 10) on the establishment and use of quantitative safety goals. In July 1981, OPE held its second workshop in Harpers Ferry, Va. The focus of this workshop was a preliminary discussion paper[11] containing several suggested quantitative safety goals that drew heavily on the AIF and ACRS proposals. Since then, OPE has been developing this paper further and has recently formally submitted a

Table 1 Milestones in NRC Safety Goal Program

Task No.	Task	Date
1	NRC directs staff to develop safety goals	April 1980
2	AIF preliminary safety goal proposal	July 1980
3	NRC safety goal plan (NUREG-0735, Ref. 7)	October 1980
4	ACRS safety goal proposal (NUREG-0739, Ref. 8)	October 1980
5	NRC preliminary policy statement (NUREG-0764, Ref. 9)	March 1981
6	First NRC workshop	April 1981
7	AIF safety goal policy statement	May 1981
8	NRC-OPE discussion paper	July 1981
9	Second NRC workshop	July 1981
10	NRC-OPE policy statement to Commissioners	November 1981
11	NRC policy statement, issued for comment	February 1982
12	NRC policy statement, end of comment period	May 1982
13	NRC safety goal policy issued	September 1982

Table 2 Comparison of Quantitative Safety Goal Proposals

Safety goal elements	AIF	NRC-OPE	ACRS, early (latent)
Individual risk, probability of fatality per year	1×10^{-5}	5×10^{-6}–1×10^{-5}	1×10^{-6} (5×10^{-6})
Population risk, fatalities per 1000 MW(e) · yr	1	2	0.2 (1)
Cost–benefit criterion	$100/man-rem	Not quantified, approximately $1000/man-rem?	$5 × 10^6/life saved ($1 × 10^6/life saved)
Large-scale fuel melt, probability per reactor-year	1×10^{-4}	1×10^{-4}	1×10^{-4}

proposed safety goal policy statement to the Commissioners for their concurrence. This document was expected to receive the approval of the Commissioners by February 1982 for issuance for a 60-d public comment. On the basis of this schedule, it may be reasonably anticipated that the NRC will have adopted a quantitative safety goal policy by the fall of 1982.

COMPARISON OF SAFETY GOAL PROPOSALS

Although the precise goals to be issued for comment by the Commission are not known at this time, some insight can be gained by a comparison of the three proposals on which NRC appears to be focusing: the AIF proposal,[6] the NRC-OPE proposal,[11] and the ACRS study.[8] There are important differences in the overall approach among the three proposals. The ACRS study, in particular, is a great deal more complex than either the AIF or the OPE documents and contains some 30 individual numerical values, including both "goal" and "upper limit" values for each item addressed. Despite these differences, there is a surprising degree of commonality. All three proposals address four risk elements: (1) individual risk, (2) population risk, (3) cost–benefit criterion (or the as-low-as-reasonably achievable principle), and (4) large-scale fuel melt probability.

Table 2 presents a comparison of the suggested values for each element in each of the proposals. For comparison purposes, the values listed for the ACRS study in Table 2 are those which most closely correlate with the corresponding values in the AIF and OPE proposals.

There is at most an order of magnitude difference among the three proposals for any one value. When one considers the uncertainties involved in the performance of risk assessments to determine whether the goals have been met, this is not a substantial range. The largest divergent values are for the individual risk goal in which the ACRS-proposed early individual risk goal (the dominant consideration for individual risk) is a factor of 10 lower than the AIF goal. With respect to population risk, the values do not diverge significantly, being within a factor of 2 on the critical parameter, latent risk.

The cost–benefit criterion is addressed explicitly in the AIF and ACRS proposals with essentially equivalent values proposed for cost–benefit criterion for latent cancer risk, which is expected to be the critical element in evaluating residual population risk. Although the OPE July 1981 proposal endorses the concept of cost–benefit balancing for reductions in residual risk, it does not propose a specific quantitative value. However, there are indications that the proposal submitted to the Commission-

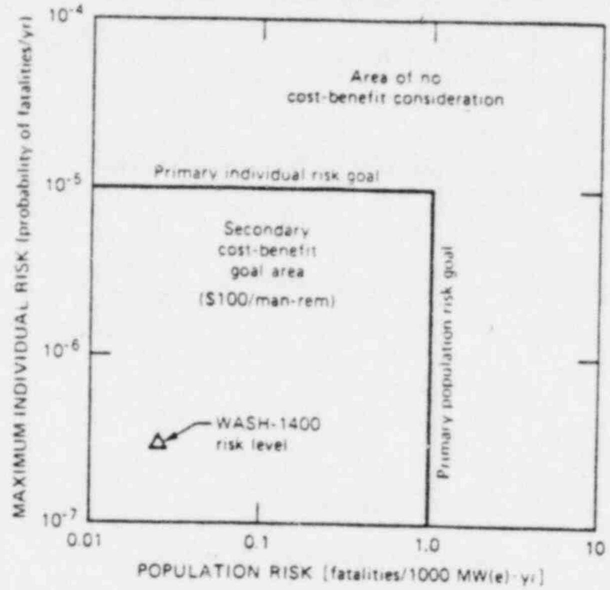

Fig. 1 Relationship of AIF Safety Goal Proposal Elements.

ers this month includes a value of $1000/man-rem. The value proposed for large-scale fuel melt probability is the same in all three proposals, namely 10^{-4} per reactor-year. It therefore appears that there is at least some basic agreement between the regulators and the industry on the basic principles and structure of a safety goal framework. Furthermore, the specific values being proposed, with a few exceptions, do not diverge dramatically. Note however that there are a number of concepts in NUREG-0739 with which the industry, through AIF, has strong disagreement. These include (1) additional goals for conditional probability of containment failure given a core melt situation, (2) the use of risk-aversion factors to magnify the importance of low-probability high-consequence events, and (3) the degree of complexity and number of numerical values to be included.

APPLICATION OF QUANTITATIVE SAFETY GOALS

Although it appears that we may be converging on the approach and values to be used in the establishment of quantitative safety goals, we are far from establishing how they are to be used in either generic or plant-specific regulatory applications. The AIF has attempted to address this important area in its May 1981 policy statement[10] by proposing a process for applying the quantitative safety goals in conjunction with PRA in the regulatory process. Some of the major elements of this proposal follow.

The AIF proposal considers the individual and population risk values as primary safety goals and the cost-benefit criterion and large-scale fuel melt probability of secondary goals. Figure 1 shows the relationship of the first three of these elements. The primary goals for maximum individual risk and population risk define the boundary for determining when cost-benefit balancing may be used in regulatory decisions. That is, if the level of risk to the maximum-exposed individual or the risk to the surrounding population is greater than either of the primary risk goals, steps should be taken to reduce these risks without specific consideration of cost-benefit trade-offs. However, if it is established that the level of residual risk to the individual or population is below these primary values, any regulatory requirements aimed at further reducing this residual risk should be subject to the secondary cost–benefit goal as a decision criterion. That is, the proposed benefit in terms of population risk reduction (man-rems per year) should be compared with the annualized total cost of the change (dollars per year) and the resulting ratio compared with the $100/man-rem cost–benefit goal. Changes more costly than $100/man-rem would not be required, whereas those below this value should be implemented. The NRC would bear the burden of proof for demonstrating that proposed changes to existing regulation or backfits of existing plants meet the cost–benefit goal. Applicants or licensees would bear this burden if exemptions from regulations or conditions of license are sought.

To provide some idea of where the industry currently may be in terms of risk levels with respect to these goals, Fig. 1 indicates where the level of risk reported in WASH-1400 would fall. Actually, in terms of both maximum individual risk and population risk, the WASH-1400 risk level is about a factor of 3, 17, and 30 less than the ACRS, OPE, and AIF goals, respectively. Other plant-specific PRA studies now being completed generally indicate levels of risk comparable with or less than that reported in WASH-1400. This provides some confidence that the industry has already achieved compliance with the primary goals and that proposed new requirements should be subject to a cost–benefit test with respect to the secondary cost–benefit goal.

The question that is inevitably asked at this point is whether a complete plant-specific PRA study for all plants should be performed to determine whether the primary goals have been satisfied. The AIF contends that it is unnecessary to do this and that the primary application of safety goals should be to evaluate generically the level of safety provided by NRC's existing regulations. From past and existing studies, we are gaining insight into the critical elements contributing to risk and identifying those parameters most sensitive to plant risk variations. For example, NRC studies have indicated that population density is not a significant variable in comparative risk, even between sites with significant relative differences in population density within 50 miles of the plant. By identifying risk-sensitive parameters, it should be possible to draw generic conclusions from a representative sampling of plant-specific PRA studies. Such a sampling will be available within the near future because there are 16 plants for which risk-assessment studies have been completed or are scheduled for completion before the end of 1982. These 16 plants include several of the earliest operating plants, some plants not yet in operation, a broad range of plant sizes, plants built by all four reactor vendors, plants with all major containment types, and a variety of plant designs by most of the architect–engineers.

Once the results of these studies are in hand, it should be possible to generically determine whether the level of risk to the individual or population, which is reflected in designs covered by current regulations, is within the primary goals. However, as a means of providing confirmation of such a generic judgment, the AIF has endorsed the performance of limited PRA studies on all plants. It should be emphasized, however, that completion of these studies is not considered to be a necessary condition for licensing of new plants or continuing operation of existing units. These studies would not be part of a Final Safety Analysis Report.

These confirmatory plant-specific studies would be of similar scope to the Interim Reliability Evaluation Program (IREP) studies currently being performed by NRC on selected plants. The objective of the IREP studies is to estimate the overall probability of accidents resulting in core damage without including consequence analysis or overall estimates of public risk. Here the fourth safety goal—the secondary goal for large-scale fuel melt—can play an important function. Existing PRA studies indicate that satisfying a value of 10^{-4} per reactor-year for core melt frequency would provide assurance that the individual and population risks are well below the primary goals proposed. Therefore, if the plant-specific IREP studies indicate compliance with the large-scale fuel melt goal, this should obviate the need for performance of a full-scale plant-specific PRA study. In this way, the large-scale fuel melt goal can serve as a confirmatory or screening criterion on a plant-specific basis. However failure to comply with the secondary goal does not indicate that a condition of unacceptable risk exists. In this event, if the estimated core melt frequency was in excess of 10^{-4} per reactor-year, a complete plant PRA could be performed to determine directly whether the primary goals have been met.

WASH-1400 and several other plant-specific PRA studies (including the German risk study[12] and the Zion[13] and Limerick[14] PRA reports) indicate probabilities of large-scale fuel melt below 10^{-4} per reactor-year. In addition, these studies estimate levels of individual and population risk that are well within the primary goals. However the recently completed study on Big Rock Point[15] indicates a large-scale fuel melt probability in excess of the secondary goal, both for the plant as it exists and with certain modifications that have been proposed to provide greater core melt accident prevention. It is interesting to note that the Big Rock Point study also indicates levels of individual and population risk well below the primary goals and, in fact, well below WASH-1400 risk levels. This is an excellent example of the application of the secondary large-scale fuel melt goal in which, although this secondary goal is not necessarily satisfied, the primary goals have been met directly. Thus the cost–benefit goal should be applied to determine the need for additional backfitting.

SUMMARY

It appears that substantial progress has been made in the effort to establish quantitative safety goals. The NRC deserves a great deal of credit for its vigorous pursuit of this objective. The ACRS has been an important catalyst in ensuring continued effort in this area, and it is encouraging to note the high priority assigned to the development of quantitative safety goals by NRC Chairman Nunzio J. Palladino. We may, therefore, look forward with some optimism to adoption of a safety goal policy before the middle of 1982.

Much remains to be done, however, in actually applying these goals as regulatory decision tools. In particular, we still need agreement on the methodology to be used in performing the PRA studies that will be used in the regulatory process. The NRC has sponsored a joint effort with the American Nuclear Society and the Institute of Electrical and Electronic Engineers to describe acceptable methodology in a PRA procedures guidebook due to be issued in mid-1982.

Even more important, a clear policy needs to be developed on the generic and plant-specific uses of PRA and safety goals to control rule changes, backfits, and exemptions from regulations. In this regard, I am encouraged by the process outlined in the NRC's proposed *Plan for Early Resolution of Safety Issues*[16] and, in particular, its proposed application of cost–benefit criteria to prioritizing unresolved issues. Clearly, quantitative safety goals and PRA cannot be used as the sole decision-making tools, and the role of qualitative engineering judgment must be defined in this process. Although there has been an understandable tendency toward skepticism regarding licensing reform, I believe if there is any way to rationalize this process we are on the right track.

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SEVENTEENTH DOE NUCLEAR AIR CLEANING CONFERENCE

Denver, Colo., Aug. 2-5, 1982

The Seventeenth DOE Nuclear Air Cleaning Conference, arranged by the Harvard Air Cleaning Laboratory and sponsored by the U. S. Department of Energy, will be held at the Denver Hilton Hotel from 11 a.m., Monday, Aug. 2, to noon on Thursday, Aug. 5, 1982. The conference will feature invited and contributed papers on (1) new and important developments in nuclear air cleaning research and (2) field experiences and air cleaning applications of special interest to nuclear plant operating personnel. Contributed papers on all aspects of nuclear air and gas cleaning technology are solicited for inclusion on the program and later publication in the proceedings of the conference. For more information, contact Melvin W. First, Sc.D., Conference Chairman, Seventeenth DOE N.A.C.C., Harvard School of Public Health, Department of Environmental Health Sciences, 665 Huntington Avenue, Boston, Mass. 02115.