UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

January 7, 1983

MEMORANDUM FOR: Chairman Palladino
Commissioner Gilinsky
Commissioner Ahearne
Commissioner Roberts
Commissioner Asselstine

FROM: John E. Zerbe

SUBJECT: REVISED SAFETY GOAL POLICY STATEMENT

In the January 5, 1983 meeting on Safety Goals, the Commission requested that OPE prepare a marked up revision of the December 16, 1982 version of the safety goal policy statement. The revised policy statement is attached. I have indicated in the margin of the policy statement, the transcript page where each change to the policy statement was discussed during the meeting.

Attachment:
Policy Statement on
Safety Goals for the
Operation of Nuclear
Power Plants

cc: Leonard Bickwit
Samuel Chilk
William Dircks
Raymond Fraley

POLICY STATEMENT ON SAFETY GOALS FOR THE OPERATION OF NUCLEAR POWER PLANTS

I. INTRODUCTION

A. Purpose and Scope

In its response to the recommendations of the President's Commission on the Accident at Three Mile Island, the Nuclear Regulatory Commission (NRC) stated that it was "prepared to move forward with an explicit policy statement on safety philosophy and the role of safety-cost tradeoffs in the NRC safety decisions." This policy statement is a step in that direction.

Current regulatory practices are believed to ensure that the basic statutory requirement, adequate protection of the public, is met. Nevertheless, current practices could be improved to provide a better means for testing the adequacy of and need for current and proposed regulatory requirements. The Commission believes that such improvement could lead to a more coherent and consistent regulation of nuclear power plants, a more predictable regulatory process, a public understanding of the regulatory criteria that the NRC applies, and public confidence in the safety of operating plants. This statement of NRC safety policy expresses the Commission's preliminary views on the acceptable level of risks to public health and safety and on the safety-cost tradeoffs in regulatory decisionmaking.

This policy statement focuses on the risks to the public from the operation of nuclear power plants. These are the risks from release of radioactive materials from the reactor to the

environment from normal operations as well as from accidents. The Commission will refer to these risks as the risks of nuclear power plant operation. Except as noted in the following sentence, it is our intent that the risks from various initiating mechanisms be taken into account to the best of the capability of current evaluation techniques. The safety goal does not include risks from the nuclear fuel cycle, from sabotage, or from diversion of nuclear material.

In the evaluation of nuclear power plant operation, several types of releases are considered by the staff. The risks to the public resulting from operating nuclear power plants are addressed in current NRC practice as follows. Before a nuclear power plant is licensed to operate, NRC prepares an environmental impact assessment which includes an evaluation of the radiological impacts of routine operation of the plant and accidents on the population in the region around the plant site. The assessment is subjected to public comment and may be extensively probed in adjudicatory hearings. For all plants licensed to operate, NRC has found that there will be no measureable radiological impact on any member of the public from routine operation of the plant. (Reference: NRC staff calculations of radiological impact on humans contained in Final Environmental Statements for specific nuclear power plants, e.g., NUREG-0779, NUREG-0812, and NUREG-0854.)

The objective of the Commission's policy statement is to establish goals which limit to an acceptable level the radiological risk which might be imposed on the public as a result of the operation of nuclear power plants. While this policy statement includes the risks of normal operation, as well as accidents the Commission believes that risks from routine emissions are small and therefore

does not believe that they need to be routinely analyzed on a case-by-case basis in order to demonstrate conformance with the safety goals.

B. Development of This Statement of Safety Policy

In developing this policy statement, the Commission has solicited and benefited from the information and suggestions provided by workshop discussions. Two NRC sponsored workshops have been held, the first in Palo Alto, California, on April 1-3, 1981 and the second in Harpers Ferry, West Virginia, on July 23-24. The first workshop addressed general issues involved in developing safety goals. The second workshop focused on a discussion paper which presented proposed safety goals. Both workshops featured discussions among knowledgeable persons drawn from industry, public interest groups, universities, and elsewhere, and representing a broad range of perspectives and disciplines.

The Commission also received and considered a Discussion Paper on Safety Goals for Nuclear Power Plants submitted in November 1981 and a revised safety goal report submitted in July 1982, by its Office of Policy Evaluation.

In arriving at a final decision on a statement of its nuclear power plant safety policy and goals, the Commission has taken into consideration the comments and suggestions received from the public in response to the Proposed Policy Statement on "Safety Goals for Nuclear Power Plants."

II. QUALITATIVE SAFETY GOALS

The Commission has decided to adopt qualitative safety goals supported by design objectives for use during a 2-year ~~trial~~ EVALUATION period. The Commission's first qualitative safety goal is that the risk from operation of a nuclear power plant should not be a significant contributor to a person's risk of death or injury. The intent is to require a level of safety such that individuals living or working near nuclear power plants should be able to go about their daily lives without special concern by virtue of their proximity to such plants. Thus, the Commission's first safety goal is: TR 3

> Individual members of the public should be provided a level of protection from the consequences of nuclear power plant operation such that individuals bear no significant additional risk to life and health.

Even though protection of individual members of the public inherently provides substantial societal protection, the Commission also decided that a limit be placed on the societal risks posed by nuclear power plant operation. The Commission believes that the risks of nuclear power plant operation should be comparable to or less than the risks from other viable means of generating the same quantity of electrical energy. Thus, the Commission's second safety goal is:

> Societal risks to life and health from the operation of nuclear power plants should be comparable to or less than the risks of generating electricity by viable competing technologies and should not be a significant addition to other societal risks.

The comparative part of this goal is to be interpreted as requiring that the risks from the operation of nuclear power plants are comparable to or less than the risks of the operation of competing electricity generating plants, PARTICULARLY COAL. TR21

III. QUANTITATIVE DESIGN OBJECTIVES

A. General Considerations

As used here, a design objective is an aiming point for public risk reduction which nuclear plant designers and operators should meet where feasible. Since the design objectives are aiming points and not firm requirements, there may be instances where a given nuclear plant may not achieve all of the objectives. A key element in formulating a safety policy which establishes design objectives is to understand both the strengths and limitations of the techniques by which one judges whether these objectives have been met.

A major step forward in the development and refinement of accident risk quantification was taken in the Reactor Safety Study completed in 1975. The objective of the Study was "to try to reach some meaningful conclusions about the risk of nuclear accidents." The Study did not directly address the question of what level of risk from nuclear accidents was acceptable.

Since the completion of the Reactor Safety Study, further progress in developing probabilistic risk assessment and in accumulating relevant data has led to recognition that it is feasible to begin to use quantitative reactor safety design objectives for limited purposes. However, because of the sizable uncertainties still present in the methods and the gaps in the data base -- essential

elements needed to gauge whether the objectives have been achieved -- the design objectives should be viewed as aiming points or numerical benchmarks which are subject to revision ~~as further improvements are made in probabilistic risk assessment~~. In particular, because of the present limitations in the state of the art of quantitatively estimating risks, the design objectives are not substitutes for existing regulations. TR36

B. Quantitative Design Objectives

We want to make clear at the beginning of this section that no death attributable to nuclear power plant operation will ever be "acceptable" in the sense that the Commission would regard it as a routine or permissible event. We are discussing acceptable risks, not acceptable deaths. In any fatal accident, a course of conduct posing an acceptable risk at one moment results in an unacceptable death moments later. This is true whether one speaks of driving, swimming, flying or generating electricity from coal. Each of these activities poses a calculable risk to society and to individuals. Some of those who accept the risk (or are part of a society that accepts risk) do not survive it. We intend that no such accident(s) will occur, but the possibility cannot be entirely eliminated. Furthermore, ~~this risk is~~ INDIVIDUAL AND SOCIETAL RISKS ARE less than the risk that society ~~will accept~~ IS NOW EXPOSED TO from each of the other activities mentioned above. TR37

1. Individual and Societal Mortality Risks

The Commission has decided to adopt the following two design objectives:

- The risk to an average individual in the vicinity of a nuclear power plant of prompt fatalities that might result from reactor accidents should not exceed one-tenth of one percent (0.1%) of the sum of prompt fatality risks resulting from other accidents to which members of the U.S. population are generally exposed.

- The risk to the population in the area near a nuclear power plant of cancer fatalities that might result from reactor operation should not exceed one-tenth of one percent (0.1%) of the sum of cancer fatality risks resulting from all other causes.

The Commission adopts this 0.1% ratio of the risks of nuclear power plant operation to the risks of mortality from non-nuclear plant origin to reflect the first qualitative goal, which would provide that individuals bear no significant additional risk. The 0.1 percent ratio to other risks is low enough to support an expectation that people living or working near nuclear power plants would have no special concern due to the plant's proximity. TR77

The average individual in the vicinity of the plant is defined as the average individual biologically (in terms of age and other risk factors) and locationally who resides within a mile from the plant site boundary. This means that the average individual is found by accumulating the estimated individual risks and dividing by the number of individuals residing in the vicinity of the plant.

However, this does NOT NECESSARILY MEAN THAT AN ADDITIONAL RISK THAT exceeds 0.1% would by ITSELF CONSTITUTE A SIGNIFICANT ADDITIONAL RISK.

In applying the design objective for individual risk of prompt fatality, the Commission proposes to define the vicinity as the area within 1 mile of the nuclear power plant site boundary since calculations of the consequences of major reactor accidents suggest that individuals within a mile of the plant site boundary would generally be subject to the greatest risk of prompt death attributable to radiological causes. If there are no individuals residing within a mile of the plant boundary, then the vicinity should be taken as a one-mile wide annulus measured outward from the location of the first individual.

In applying the design objective for cancer fatalities, as a population guideline, the Commission proposes that the population generally considered subject to significant risk be taken as the population within 50 miles of the plant site. A substantial fraction of exposures of the population to radiation would be concentrated within this distance. This guideline would ensure that the estimated increase in the risk of delayed cancer fatalities from all potential radiation releases at a typical site would be no more than a small fraction of the year-to-year normal variation in the expected cancer deaths from non-nuclear causes. Moreover, the prompt fatality limit protecting individuals generally provides even greater protection to the population as a whole. That is, if the design objective for prompt fatality is met for individuals in the immediate vicinity of the plant site, the estimated risk of delayed cancer fatality to persons within 50 miles of the plant would generally be much lower than the limit set by the design objective for cancer fatality. Thus, compliance with the design objective applied to individuals

close to the plant would generally mean that the aggregated estimated societal risk for a 50-mile radius area would be a number of times lower than it would be if compliance with just the design objective applied to the population as a whole were involved.

2. Benefit-Cost Guideline

AS ONE CONSIDERATION

The Commission has adopted a benefit-cost guideline for use in decisions on safety improvements. It has decided that a guideline of $1,000 per person-rem averted be adopted for trial use. The value is to be in 1983 dollars. This value should be modified to reflect general inflation in the future. TR47

- The benefit of an incremental reduction of societal mortality risks should be compared with the associated costs on the basis of $1,000 per person-rem averted. TR51

This guideline is intended to encourage the efficient allocation of resources in safety-related activities by providing that the expected reduction in public risk that would be achieved should be commensurate with the costs of the proposed safety improvements. The benefit as measured by an incremental reduction of societal mortality risks in terms of person-rem averted should be compared with the reasonably quantifiable costs of achieving that benefit, (e.g., design and construction of plant modifications, incremental cost of replacement power during mandated or extended outages, changes in operating procedures and manpower requirements). ~~During the trial period,~~ application of the benefit-cost guideline should be focused principally on situations where one of the quantified safety goals is not met. No further benefit-cost analysis should TR46

be made when it is judged that all of the design objectives have been met. This guideline does not replace the Commission's backfitting regulation (10 CFR 50.109).

The NRC staff has some experience in the use of benefit-cost analysis and criteria in evaluating improvements to reduce the risks from normal operations. In the past the Commission discussed a benefit-cost value of $1,000/person-rem reduction in the evaluation of improvements proposed to reduce releases of radioactive material during normal reactor operations including expected operational occurrences. However, the use of a benefit-cost guideline in evaluating the means for reducing population risks from power reactor accidents would be new.

3. Plant Performance Design Objective

An important objective of efforts to reduce the public risk associated with nuclear power plant operation is to minimize the chance of serious reactor core damage since a major release of radioactivity may result from accidents involving severe core damage. Therefore, to assure emphasis on accident prevention the Commission has decided to adopt a limitation on the probability of a large-scale core melt as an objective for NRC staff use in the course of reviewing and evaluating probabilistic risk assessments of nuclear power plants. The design objective for large-scale core melt is subordinate to the principle design objectives limiting individual and societal risks. This design objective may need to be revised as new knowledge and understanding of core performance under degraded cooling conditions are acquired. Thus, the Commission has selected the following design objective: TR 77

. The likelihood of a nuclear reactor accident that results in a large-scale core melt should normally be less than one in 10,000 per year of reactor operation.

The Commission also recognizes the importance of mitigating the consequences of a core melt accident and continues to emphasize features such as containment, siting in less populated areas, and emergency planning as integral parts of the defense-in-depth concept. TR18

IV. IMPLEMENTATION

judge the effectiveness of the goals and design objectives.

The qualitative safety goals supported by the quantitative design objectives are being adopted for use during a 2-year ~~trial~~ evaluation period. The Commission believes that ~~such trial use~~ an evaluation period is necessary in order to ~~evaluate their effectiveness~~. At the end of the ~~trial~~ evaluation period the Commission will consider what changes in the regulations and regulatory practices appear necessary in light of experience during the 2 years. Proposed changes in the regulations will be addressed in rulemaking proceedings. TR3 TR3 TR3

To provide adequate protection of the public health and safety, current NRC regulations require conservatism in design, construction, testing, operation and maintenance of nuclear power plants. A defense-in-depth approach is mandated in order to prevent accidents from happening and to mitigate their consequences. It is not clear how the Commission's essentially deterministic regulations would be supplemented if the qualitative safety goals and quantitative design objectives--which are based on considerations of probable risk--were incorporated into the regulatory framework. TR18

Siting in less populated areas is emphasized. Emergency response capabilities are mandated to protect the surrounding population.

The basic impediment to adoption of regulations requiring risks to the public to be below certain quantitative limits, as exemplified by the quantitative design objective for large-scale core melt, is that the techniques for developing quantitative risk estimates are complex and, in the cases of interest here, have substantial associated uncertainties. This raises a serious question whether, for a specific nuclear power plant, the achievement of a regulatory-imposed quantitative risk goal can be verified with a sufficient degree of confidence. For this reason, the Commission has decided that, during the ~~trial~~ EVALUATION period, implementation of the Policy Statement should be limited to uses such as examining proposed and existing regulatory requirements, establishing research priorities, resolving generic issues, and defining the relative importance of issues as they arise. The ~~trial~~ EVALUATION period should be used to develop information and understanding as to how to further define and use cost-benefit guidelines. TR3 TR3

The qualitative safety goals and quantitative design objectives contained in the Commission's Policy Statement will not be used in the licensing process or be interpreted as requiring the performance of probabilistic risk assessments by applicants or licensees during the ~~trial use~~ EVALUATION period. The goals and objectives are also not to be litigated in the Commission's hearings. The staff should continue to use conformance to regulatory requirements as the exclusive licensing basis for plants. TR3

The detailed Staff Implementation Plan addresses ways to use the Safety Goals during this ~~trial~~ EVALUATION period so as to gain the experience necessary for later application in the regulatory process. The ~~Implementation~~ EVALUATION Plan outlines a process for obtaining this experience in developing new regulatory requirements as well as examining existing requirements to determine whether the regulatory basis needs to be revised. TF

It is expected that during the evaluation ~~trial~~ period familiarization may be gained with the techniques of risk estimation and sufficient data may be collected and analyzed so that the Commission can decide whether to expand the use of the Policy Statement or to propose rulemaking that would incorporate quantitative risk limits as design objectives in the regulations. The qualitative safety goals and quantitative design objectives may be changed as a result of the experience gained during the two-year evaluation ~~trial~~ period.

TR3

TR3