Comments on the NRC Office of Policy Evaluation's "Discussion Paper: Safety Goals For Nuclear Power Plants"

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In "Discussion Paper: Safety Goals for Nuclear Power Plants," July 10, 1981, the NRC Office of Policy Evaluation Staff has proposed two qualitative goals; the first calling for "no significant health risk to any individual" and the second calling for the societal risk to be "small as can reasonably be achieved...consistent with the risks of competing technologies for generating electricity" (p. 16). The Staff then asserts that these will be achieved if three quantitive goals are met, namely:

(1) The estimated mean probability of fatality from an accident at a nuclear power plant should be less than between 5 and 10 in 1,000,000 per year to individual members of the public living or working in the vicinity of the plant site throughout their lives. (This proposed safety goal implies combining prompt fatalities with delayed cancer deaths.)

(2) The statistically estimated mean fatalities per thousand electrical megawatts nuclear power plant capacity should be less than two per year of plant operation.

(3) The estimated mean probability of a nuclear power plant accident that results in a large-scale core melt should normally be less than 1 in 10,000 per year of reactor operation.

Rather than attempt to catalogue numerous problems we have with these proposed "goals", our comments here are limited to fundamental flaws identified as follows:

I. Problems With The Proposed Qualitative Goals.

a) The qualitative goals are unnessarily vague. The second goal, for example, fails to clarify whether "risks of

competing technologies" refers to the historical record, or what can be reasonably achieved in the immediate future. Is the goal to achieve a level of risk "consistent" with the best that can be achieved by the best alternatives, or the history of the worst? We maintain that the historical safety achievements of competing technologies (often taken as the more hazardous examples, e.g. coal) represent inappropriate safety goals for any one technology.

b) Societal risks of competing technologies for generating electricity cannot be made "consistent" because of the fundamental differences in the way the insults are manifested and distributed. One cannot equate the risks of nuclear weapons proliferation with health and safety risks associated with solar photovoltaic technologies, nor can one make the risk of a catastrophic accident at one of today's operating reactors "consistent" with the risk of air pollution from burning fossil fuels.

c) The qualitative goals fail to state what is permissible in terms of consequences of nuclear reactor accidents. Does the NRC, for example, believe that a catastrophic accident, or a core melt with significant off site contamination and deaths is tolerable? In this regard, our own alternative qualitative goals are given at the end of this paper.

II. Problems With The Linkage Between The Proposed Qualitative and Quantitative Goals.

a) There is no logical connection between the qualitative goals and the quantitative goals.

b) The NRC Staff provides no evidence, or discussion, to support the Staff assertion that if the quantitative goals are met the qualitative goals will be met. Surely, the combination of this assertion and the quantitative goals are not meant to be the operational definitions of the qualitative goals.

III. Problems With The Proposed Quantitative Goals

a) The NRC Staff fails to distinguish the goal from the verification procedure, or in other words, the passing grade from the testing procedure. By including the terms "estimated mean probability" and "statistically estimated mean" in the statement of each quantitative goal, the Staff has confused the desired level of safety with the procedure for determining whether this level is met. In the abstract, it might be appropriate to define a goal in terms of the desired frequency of an event, a permissiable range of frequencies, or a stated confidence level that the frequency, or range of frequencies is met, e.g. 95 percent confidence that the probability of class x accident is less than one in one million. It is inappropriate to define a goal in terms of the mean value where the uncertainty on the mean is so large as to be the principal issue in the debate. By stating the goal (actually the verification procedure) in terms of a mean, where there is substantial uncertainty in the mean without stating confidence limits, permits a showing that the goal is met regardless of the confidence limits.

In this instant case, we believe it is important to distinguish the goal from the verification procedure, because we believe, as indicated below, the staff has made bad choices in both cases.

b) The quantitive limits are unacceptable. The second goal limiting fatalities to 2 per reactor-year implies 12,000 fatalities for 200 reactor operating 30 years each. This implies that 21,000 cancers and a comparable number of serious genetic effects from accidents associated with existing plants and those in the pipeline is acceptable. This is too high. This goal, together with the other two, implies that a catastrophic nuclear accident in our lifetime is acceptable. We disagree.

Goal (3) limiting large-scale core melts to less than 1 in 10,000 per reactor year implies that with 200 plants operating 30 years each, a 60 percent chance of a large core melt is acceptable. We disagree.

IV. Problems With The Verification Procedure.

a) Since the Staff has largely ignored the fundamental question raised by the Union of Concerned Scientists in previous comments on this Safety Goal Rulemaking, it is worth repeating it here:

> Can quantitative safety goals be used in the regulatory process if quantitative risk assessment is incapable of yielding technically supportable results within an acceptable limit of uncertainty?

b) It is erronous to assume that the proposed quantitative goals could be repaired simply by stating them in terms of a mean value within specified confidence limits and continue using the probability risk assessment (PRA) methodology as a tool to verify whether the goals are met. For most applications

envisioned the confidence limits are likely to be too large. The discussion pertaining to the "square root boundary model" used in WASH-1400 by the "Risk Assessment Review Group Report to the US NRC" [The Lewis Report] is pertinent in this regard:

> In the absence of sufficient data, and in the face of such large theoretical uncertainties as are displayed in the BWR control rod problem, we feel that it is pereferable not to try to come up with a point estimate- a single number - for a failure probability, but rather to content oneself with bounds. To be useful, of course, the bounds cannot be too wide (thus a model like the "lower bound model" described above is useless).

c) Despite admonitions by the OPE Staff that the quantitative goals should not supplement the "defense in depth" approach to NRC regulation, primary users of the PRA methodology are likely to have that precise purpose in mind. Examples might include assessments of a) whether a core catcher is needed, b) whether additional independent scram systems are required, c) whether remote siting requirements can be offset by added containment requirements or other safety features.

d) The verification procedure--the PRA codes--are accessible only to the NRC Staff and the industry and not to the general public and outside experts.

e) In practical terms the PRA methodology is, in the words of the Lewis Report, "inscrutable." Even where parameters within the code can be confirmed or challenged; the public or outside expert will unlikely be able to determine the implications due to incomplete or unavailable sensitivity analysis.

V. Case Studies

To appreciate some of the inherent problems associated with

the proposed safety goals it is useful to ask how they would be utilized in the following issues:

a) Degraded core rulemaking,

b) Whether to use stainless steel rather than zircalloy cladding to minimize the risk of hydrogen explosions,

c) Whether the LWR technology should be abandoned in favor of the HTGR because of the HTGR alledged safety advantages,

d) Whether the trend toward higher power densities should be reversed,

e) Whether the limit of 3800 Mw_t should be the maximum design power level for LWR should be retained,

f) Whether emergency planning is necessary.

VI. Alternative Safety Goal.

We offer the following qualitative safety goals as a preferred alternative to those proposed by OPE:

(1) A significant likelihood of a catastrophic nuclear reactor accident during the foreseeable future (i.e lifetime of reactors existing, under construction and proposed) is intolerable.

(2) A significant likelihood of a core melt during the same period with radioactive releases resulting in either a) offsite land contamination requiring decontamination, or b) several somatic or genetic health effects is intolerable.

With regard to verification of these goals, it should not be assumed that these can be best met and/or verified by probabilistic risk assessment procedures rather than other means. Given the large uncertainties and the inherently unverifiable nature of PRA procedures when applied here the generally more reliable approach for achieving these goals and assuring their verification is to rely on the defense in depth approach to reactor regulation.