ACRSR-0996
092382

PDR

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

September 15, 1982

DESIGNATED ORIGINAL
Certified By per ACRS

Honorable Nunzio J. Palladino
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Dr. Palladino:

SUBJECT: ACRS REPORT ON THE DRAFT ACTION PLAN FOR IMPLEMENTING THE COMMISSION'S PROPOSED SAFETY GOALS FOR NUCLEAR POWER PLANTS

During its 268th and 269th meetings, August 12-14 and September 9-11, 1982, the Advisory Committee on Reactor Safeguards reviewed a draft of the NRC Staff's Action Plan for Implementing the Commission's Proposed Safety Goals (referred to herein as the Draft Action Plan), as provided in a memorandum dated July 6, 1982 from W. J. Dircks, NRC Executive Director for Operations. In its review the ACRS had the benefit of Subcommittee meetings on August 6 and September 8, 1982 and of discussions with representatives of the NRC Staff.

We recognize that this Draft Action Plan is based, in part, on an NRC Staff interpretation of the proposed safety goals in NUREG-0880 and that future versions of the implementation plan may be markedly different in response to guidance from the Nuclear Regulatory Commission. Our comments, therefore, will reflect the possibility of changes in the proposed NRC safety goals as well as some alternate approaches to implementation.

The following is a limited set of general comments by the Committee. We note that an extensive set of questions concerning the draft implementation plan was posed by the ACRS Subcommittee in a memorandum from R. F. Fraley, ACRS Executive Director, to W. J. Dircks, NRC Executive Director for Operations, dated August 27, 1982. The Committee did not have time to review all of the issues identified in this memorandum.

1. The Draft Action Plan notes the problems which arise in the use of PRA from the existence of large uncertainties and gaps in our knowledge but does not identify the specific processes by which PRA methodology and data would be judged and by which decisions would be made in the presence of such uncertainties. We believe that this represents a major gap in the implementation plan. Either a generally accepted approach should be established (with provisions to update it as necessary) for only partly developed and more controversial methodology and data, or a means should be established for independent review and judgment in the face of continuing large uncertainties.

   We believe that the identification of a process of implementation warrants high priority.

8208290021 XA

2. The Draft Action Plan does not indicate means for achieving a required level of quality in PRAs and in benefit/cost analyses. Nor does it specify the requirements and the means for achieving independent review of PRAs and of reliability and benefit/cost analyses performed by industry or performed by or for the NRC Staff.

3. The Draft Action Plan suggests greater application of the safety goals during the trial period than the maturity of PRA warrants. We would favor performing most of the steps outlined in the Draft Action Plan on a trial basis, using alternate criteria for decision-making in many cases, and developing and employing the review processes which would be needed were the process to be binding or at least subject to legal review.

4. We believe that mean rather than median values should be used, especially if the core melt design objective and operational level are to be 10^{-4} and 10^{-3}/reactor-year, respectively. We believe that an operational level for core melt of 10^{-3}/reactor-year is too large if it is to be estimated using median values without some additional compensating feature. We recommend that both median and mean values be used during the trial period and an overall assessment be made at the end of the period.

   We recommend that the benefit/cost criterion include onsite and offsite economic costs avoided as a benefit in any benefit/cost analyses, at least during a trial period.

   We also recommend that the operational levels reflect consideration of the possible loss of long-term access to regional societal resources such as farm land or urban areas.

5. The Draft Action Plan does not include a containment performance criterion but recommends that one be developed during the trial period. Decision-making during the trial period would largely be hinged on prediction of core melt frequency. We recommend that alternate containment performance criteria be developed and evaluated for existing nuclear power plants as part of the trial implementation program. A separate set of alternate trial containment performance criteria should be developed and evaluated during the trial period for plants yet to be designed.

   We believe that priority should be given to developing containment performance criteria for several reasons, including the following:

   a. There are major uncertainties in the calculation of statistical health effects from very small doses to large numbers of people.

   b. There are large uncertainties in calculations of accident dose. Evacuation models, for example, are fairly arbitrary and do not reflect the potential effects of earthquakes or offsite loss of power on the effectiveness of emergency actions.

c. Assumptions concerning land areas which would require interdiction and problems in large-scale decontamination require further study.

d. Uncertainties in prediction of core melt frequency would be compensated, at least in part, by a containment having a significant potential to mitigate core melt accidents.

6. The implementation plan should include a strategy to deal with sabotage such as that outlined in the ACRS letter of June 9, 1982 on safety goals, or some alternate approach.

7. Insofar as feasible, all accident initiators and risk contributors (other than sabotage) should be included in PRAs and in benefit/cost analyses. If the uncertainties are such as to make a meaningful quantification for some initiator or contributor impossible, this should be documented in sufficient detail and an allocation of risk to this contributor justified. It should be anticipated that as more is learned, the methodology and the results will change markedly with time for some contributors.

We recommend that a long-term approach to the performance of plant-specific PRAs for all plants be formulated. The schedule for and the complexity of each PRA should be developed with consideration being given to plant size, location, operating experience, and the contribution likely to result from the PRA.

Dr. Forrest J. Remick did not participate in Committee deliberations regarding this matter.

Additional comments by ACRS Members Myer Bender and Jeremiah J. Ray and ACRS Member Robert C. Axtmann are presented below.

Sincerely,

P. Shewmon

P. Shewmon
Chairman

<u>Additional Comments by Members Myer Bender and Jeremiah J. Ray</u>

There is no way in which the currently proposed safety goal policy will serve any useful public safety purpose as long as its main assessment basis is PRA. It is very likely to distort the significance of important public safety matters, and it has already diverted the attention of knowledgeable personnel on the NRC Staff from important physical plant problems to studies of issues being analyzed on the basis of a vacuum of statistical data. The issues concerning "pressurized thermal shock" (PTS) and protection of nuclear plants against public safety threats from fires are illustrative of the problem.

In the case of PTS, the NRC vigorously urged nuclear licensees to develop a probabilistic basis for determining whether PTS required changes in the physical plant or new operational constraints. When one of the groups attempted to develop a probabilistic method, it became evident that the entire issue hinged on the ability to determine whether and where pressure vessel flaws are present, how they grow and in what physical form. Lack of data resulted in the NRC Staff urging that related uncertainties be combined in an ultra-conservative manner. The logic of the proposed combinations is so complex that no single person in the NRC Staff or its supporting consultants is yet able to explain it. Probabilistic methodology in this case adds nothing to public understanding and even less to public safety protection.

In the case of fire protection, the regulatory position is totally based on arbitrary detailed requirements for fire protection without a defined basis for judging the potential for fire damage to public safety provisions. In this case, too, the statistical base for PRA purposes is totally absent and most of the requirements are derived from fire protection requirements intended mainly for conventional buildings. The principal basis for judging fire damage potential is predicated on experimentally testing the resistance of various types of fire barriers and equipment arrangements under fire conditions that derive from uncontrolled fires initiated and spread by unknown means.

The above-mentioned matters are not special cases. They were selected for discussion only because they represent two of the more recent controversial matters to which the safety goal policy might be applied. In the policy statement issued by the Nuclear Regulatory Commission, PRA was indicated to be the methodology to be used to determine conformance with the goals policy. These illustrations show the difficulty in relating PRA to important safety issues.

The PRA methodology stems from the Reactor Safety Study, WASH-1400. The well-established "inscrutability" of the WASH-1400 results was primarily a consequence of the thin and generally unvalidated data base used to establish event probability. These data from WASH-1400 are still being used in PRAs with very little discretion concerning their validity. Hardly any new data are available.

Among the most serious deficiencies in the WASH-1400 study was its use of the MARCH Code to show the transport of radionuclides, an evaluation basis that has since been shown to be seriously in error. The MARCH Code was not consistent with known physical facts, and it literally described the dispersal of radionuclides in a manner contrary to physical laws. Even now, after some effort to refine the code and to develop improved analytical methods, we do not know how to describe the transport of radionuclides resulting from a core melt because we do not know what core melt is being described, when and how it happens and the time increment between its initiation and the final conditions under which transport phenomena are being evaluated. Furthermore, the NRC Staff concedes that it does not have the capability to apply PRA methodology to containment because it doesn't know how to relate containment integrity matters probabilistically. The use of PRA for regulatory purposes is defensible if event sequences and related probabilities are well understood and the consequences to public welfare can be clearly defined. The PRA methodology now in use does not meet these conditions.

The following should be noted about probabilistic matters important to current PRA work:

1. Valve reliability data have no experience base other than a few demonstrations of performance under specific test circumstances for the important emergency service conditions. Pilot actuated and spring-loaded pressure relief valves, stem driven globe and gate valves, pivoted butterfly and rotary closure valves are subject to in-service tests, but most such valves have never seen the actual service conditions for which they were selected. Valve reliability estimates, therefore, have no basis that is developed from operating performance statistics.

2. Pressure and temperature sensor-initiated functions have not been observed often in the applications required for public safety purposes. The data being used is derived from what is thought to be analogous circumstances, but the combinations of system behavior, sensor response, signal transmission and equipment actuation have only been seen for a few events. The experience base is not broad enough to validate the reliability data being used.

3. Piping behavior depends upon state of stress, material quality, correct design application, correct engineering analysis and correct installation. The statistical reliability data currently in use is derived from an experience base dominated by a number of instances of design error and incorrect application. The generalized use of these data to assess everything from primary coolant piping to conventional underground cooling water transmission lines assures that the data will be incorrect for every application.

4. Other structural systems represent such a variety of applications that the design practices cannot be correlated with previous structural practice for reliability assessment purposes. Bolting, for example, may be crucial to seismic hold-down, fluid system closures and structural restraints, equipment attachments, and instrumentation mountings but the reliability of bolting cannot be related to any statistical base. Other types of structural elements are even less adaptable to reliability analysis. There are, for example, no statistics that could be applied to concrete containment structural reliability. Hence, the actual reliability will ultimately depend upon the knowledge and integrity of individuals responsible for determining adequacy of the original design and the care with which the construction is executed.

5. So-called "core melt probability" is being assigned without a definition of its meaning.

6. Severe accident mitigation is being discussed as though one knew which accidents needed mitigation. There is no established mitigation method for any event beyond one having consequences equivalent to those of the TMI-2 accident. Proposals have been suggested but nothing has ever been completely designed, and until a design exists, its workability in probabilistic terms cannot be evaluated, its monetary cost is unknown, and its contribution to reducing public risk cannot be determined.

7. Earthquake probability is being established by trying to relate numerous small earth tremors to a very small number of large seismic events by using logarithmic plots of frequency versus scale within defined tectonic boundaries. Such correlations hide the fact that the few large events are so widely separated from most of the smaller events with respect to observed frequency that the data is really disconnected. At best, the data only permit speculative evaluation of the relationship between large and small seismic events within a tectonic province. The statistical significance of the data has not been examined by those accustomed to evaluating statistical data of such character. Whether the correlations should be used as a basis for regulatory requirements is an important issue if PRA methodology is to be used in regulatory practice.

   To eventually accept any correlation of the data, it is necessary to have a statistically significant amount of data covering the entire range. To be comfortable with its application, the data in the higher seismic intensity ranges should be the dominant information that determines the shape and position of the curve which represents the data. Fortunately, there are few large seismic events so the data is meager. Unfortunately, that makes the data correlation almost meaningless.

8. Flood probability considerations are dominated by the effects of dam failures postulated to be caused by seismically induced structural loadings. Correlation with rainfall experience or flood plain capacity has hardly been examined.

The foregoing is sufficient to show why PRA studies as currently performed will remain inscrutable and will, at least for the next decade, be little more than a display of logical thought based on essentially arbitrary reliability assumptions. <u>They may permit event probabilities to be assigned very conservative boundary values, but if the mathematical interpretations are rigorous, the values will be only a measure of the data base content and not a measure of public safety adequacy</u>.

Without question, the most serious distortion of fact being introduced by the use of PRA is the claim that it can estimate the probability of a core melt. As noted previously, the NRC has not even attempted to define what it means by a "core melt." Is it a TMI-2 like event or a condition which potentially can burst or melt through containment? Does it occur over a period of hours, days, weeks or months? Does it occur in a manner that obviates all actions to mitigate its progression and is it then mitigatable when it has penetrated containment barriers by interdictive actions? In truth, the PRAs cannot predict core melt probability. At best, they can display the experience from previous circumstances involving badly trained operators without suitable diagnostic tools for accident analysis and speculate on the end result of modified practice. How can such techniques be construed as useful methodology suited to showing that the health and safety of the public is adequately protected?

While probabilistic analysis has value for some safety purposes, the "safety goal policy" is misguided in its intent to use probabilistic risk assessment as a basis for determining whether safety goals can or are being met. The claims for PRA concerning its ability to assess public safety risk are little more than a sham that will hide the fact that the basis for safety will always depend upon the judgment of a few individuals. In many cases, the judgments to be made will not have sufficient basis to show by measurement that the proposed safety goals can be attained. The policy must recognize that limitation. The message it should convey to the public and the regulated industry is that the NRC is exercising the control intended by its legislative mandate. As presently presented, the safety goals policy does not convey that message. The regulatory system should be examined further to determine whether there are more understandable ways of showing that the provisions for protecting the health and safety of the public are adequate.

Additional Comments by ACRS Member Robert C. Axtmann

The magnitude of human and financial resources that will be required to implement the proposed program on quantitative safety goals is extraordinary in view of the body politic's reluctance to deal with portions of the fuel cycle other than the reactors. A recent survey of nuclear plant construction experience in the U.S. and Canada[1] indicates about 1.5 occupational fatalities, 60 major injuries and 12,000 days for lost time injuries per reactor construction project. The premature death rate of uranium miners remains a world-wide scandal. The TMI-2 accident, according to a recent analysis, may result in one latent cancer fatality. In humanitarian terms, the Commission's safety goal program may be a gross misallocation of resources.

References:
1. Memo, W. J. Dircks, NRC Executive Director for Operations, to Commissioners, Subject: Action Plan for Implementing the Commission's Proposed Safety Goals, dated July 6, 1982
2. Memo, F. J. Remick, Director, Office of Policy Evaluation, to Commissioners, Subject: Safety Goals for the Operation of Nuclear Power Plants, dated July 12, 1982

[1] Memo, K. Kirby To R. Axtmann, dated April 26, 1982, "Occupational Mortality Risks and Nuclear Plant Construction"

3. U. S. Nuclear Regulatory Commission, NUREG-0880, Subject: Safety Goals for Nuclear Power Plants: A Discussion Paper, dated February 1982
4. SECY-82-1A, Policy Issue (Affirmation) from W. J. Dircks, Executive Director for Operations, Subject: Proposed Commission Policy Statement on Severe Accidents and Related Views on Nuclear Reactor Regulation, dated July 16, 1982
5. Letter, C. Walske, Atomic Industrial Forum, to N. J. Palladino, Chairman, U.S. Nuclear Regulatory Commission, Subject: NRC Safety Goals and Plan for Implementation, dated September 10, 1982