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Dr. Leslie Silverman
Chairman, Advisory Committee
on Reactor Safeguards
U. S. Atomic Energy Commission
Washington 25, D. C.

Dear Dr. Silverman:

Attached for the information of the Advisory Committee are three additional copies of the ad hoc Committee report as requested by your office.

Sincerely yours,

H. L. Price
Director
Division of Licensing and Regulation

Enclosure:

(3) cys of report

6/17

RECOMMENDATIONS ON REGULATORY PROCESSES AND SAFETY CONSIDERATIONS RELATIVE TO NUCLEAR POWER REACTORS

SUMMARY

At the request of the General Manager of the Atomic Energy Commission this Committee has considered the extent and direction of efforts which the Commission should exert at this time on definitions of criteria and standards for reactor safety and how handling of certain additional matters closely related to this topic could be revised to advantage. Our recommendations are summarized as follows:

1. We recommend that there be established rules, which may of necessity involve some degree of arbitrariness, by which sites that would be considered acceptable for locations of reactors can be selected.
2. We recommend that the AEC does not at this time attempt to standardize the technical design and construction specifications and procedures for reactors or for the various components of reactors.
3. We recommend that there be initiated a continuing effort within the AEC on the collection and organization of safety guides, or state-of-the-art practices on reactors and reactor components and on a systematic tabulation of safety performance objectives for reactors and reactor components and that these be made available as guides to the nuclear community, but not at this time as regulations.
4. We recommend that, to inform the general public and to assist applicants in the preparation of information required in support of license applications, there be prepared an explanation of the AEC licensing procedures and a guide or set of instructions, with appropriate illustrations and examples, on the preparation of hazards summary reports, which, to some extent, should follow a standard pattern.

5. We recommend that the safety research projects of the AEC, scattered among many administrative units, be brought under the surveillance and co-ordination of one appropriately located person having sufficient authority and staff to achieve appropriate scope and coherence in the program.

6. We recommend that the Nuclear Safety Journal receive full-time direction, and support from some appropriate person on the staff of the Commission, that it be increased in frequency to at least 6 issues per year and that it be expanded to include in each issue authoritative monographs or review articles on pertinent reactor safety topics prepared by experts in the field.

7. We recommend that means be found for making widely available the discussions of the Commission and its Hearing Examiners and the AEC staff analyses and evaluations of safety aspects of projects considered in the regulatory process, and that consideration be given to making more accessible the hazards summary reports.

The above recommendations are based upon the majority opinion of the Committee. Comments of those who hold diverse opinions on specific points are attached as appendices.

RECOMMENDATIONS ON REGULATORY PROCESSES AND SAFETY CONSIDERATIONS RELATIVE TO NUCLEAR POWER REACTORS

The members undersigned were appointed as a Committee in early December 1959, to consider suggestions made by the Advisory Committee on Reactor Safeguards in a letter of November 16, 1959, to Mr. McCone, and other matters closely related thereto. It was explained to this Committee that there has been an extended period of urgent and growing need for the Commission to make more articulate and definitive the safety standards which are applied to nuclear reactors in the regulatory process; that efforts exerted, to the present time, to develop definitive safety standards for reactor sites and designs have not met with success; that such suggestions as those of the Advisory Committee on Reactor Safeguards point up the need for an overall appraisal of what might be done along these lines at this time, including consideration of several other matters in addition to reactor safety criteria and standards which are closely related thereto.

It was suggested that the Committee should consider the scope of subjects which appeared to be crucial in this matter and on these to recommend to the Commission what action should be undertaken at this time.

Deliberations led the Committee to the conclusion that four questions constitute the heart of the problem which should be considered. These are indicated below. In focusing on these questions as the crucial ones, and in developing recommendations to the Commission thereon, the Committee held five full day meetings and consulted with other persons, including Dr. Silverman and Dr. McCullough of the ACRS, Mr. Coe of Yankee Atomic Power Company, Dr. Siegel of Atomics International, and Dr. Breazeale of Babcock and Wilcox, as representatives of reactor users and manufacturers; members of the Safety Research groups of the AEC, Division of Reactor Development; representatives of the AEC's Technical Information Services, and others.

The questions identified by this Committee as being crucial ones are:

I. What can and should the Commission do at this time to establish reactor safety criteria or standards governing the issuance of reactor construction permits and licenses?

II. What can and should be done to clarify, explain, and interpret the Commission's licensing procedures and the preparation of hazards summary reports?

III. What should be done to make the Commission's reactor safety research program more effective?

IV. What should the Commission do in collecting, organizing and disseminating existing information relevant to reactor safety?

Our observations and recommendations on each of these are set forth below.

I. WHAT CAN AND SHOULD THE COMMISSION DO AT THIS TIME TO ESTABLISH REACTOR SAFETY CRITERIA, STANDARDS, OR GUIDES?

The Committee recognizes at least four different catagories of reactor safety criteria:

1. Safety Performance Goals: safety objectives which should be satisfied or achieved by the reactor or by each major component of the reactor.

2. Safety Guides: suggested safety practices in reactor design, construction, and operation, which have been found acceptable.

3. Safety Standards: rules for design, construction, or operation which set minimum specifications and practices for the achievement of specific performance goals or the construction of individual components. Such standards are usually arrived at by a general consensus of experts on the basis of extended experience. The ASME boiler vessel code is an example of one such standard.

4. Safety Regulations: Regulations set up by the Government which specify minimum requirements for reactor safety. Ideally, regulations should consist of a coherent set of safety performance objectives and a corresponding set of construction standards and procedures by which the performance goals

should be achieved. Where it is not possible to define the performance objectives and standards, the regulations may include safety standards, safety guides, performance goals, any combination of these or none of these.

The law imposes on the Atomic Commission the obligation of reaching a judgment on the safety of any proposed nuclear facility before acting on a license for operation of that facility. Regulations have been issued which describe the procedure and to some extent the requirements which must be satisfied for a reactor license to be issued. The most important safety criterion is that the construction and operation of the facility shall lead to "no undue hazard to the health and safety of the public." This leaves a wide area of judgment, much of it subjective, in deciding when this criterion has been met.

The principal question faced by our Committee in this inquiry was, to what extent can the objective element in safety evaluation be increased and made quantitative and the subjective judgments minimized, so that designers and operators may know in advance the measuring sticks which will be employed in the safety evaluation of their project.

Stated differently the question was, can definitive rules be stated for the location, design, construction and operation of reactors so that safety can thereby be achieved or assured.

Our conclusions on these questions are given in the following recommendations, with a brief discussion of each:

Recommendations on I

1. As a matter of policy, the AEC should define the level of safety, which should be aimed at in the design of a nuclear facility; e.g., the level above which it would be considered that there would be "no undue hazard to the health and safety of the public." Inasmuch as the development of this definition involves substantial

policy issues, as well as technical factors, we believe the staff of the Commission, with such consultant help as they might need, should carry out this task.

We believe this can best be done by:

Establishing rules, probably involving of necessity some degree of arbitrariness, by which sites that would be considered acceptable for locations of reactors can be selected. This should include a consideration of the possibility of accidents and the consequent radiation exposures of population that might result.

2. We recommend that the AEC does not attempt at this time to standardize the technical design and construction specifications and procedures for reactors or for the various components of reactors.

This recommendation arises from these considerations:

(a) Every reactor is different, and few components even of similar reactors are exactly alike. There are usually different acceptable safe arrangements for most systems and, though some perhaps are more desirable than others, none should be ruled out arbitrarily. Standard patterns of general practice in types and general characteristics of reactors, or in the design arrangements and construction plans for reactor components have not emerged.

(b) Every reactor is a complex combination of strengths and weaknesses with respect to safety. An unfavorable characteristic e.g. a positive temperature coefficient of reactivity, can be offset by other features so that such reactors can (and do) operate safely. From the safety standpoint, the designer should not yet be required a priori to include any particular set of characteristics in his reactor. In this transitional developmental stage of reactors, the safety evaluator cannot be in position of saying to the reactor designer "do it this way," but rather he should answer the question: "Is the safety of this reactor adequate?"

(c) To establish definitive regulations on reactor design and construction at this early stage would unduly and unnecessarily hamper the evolving technology of reactor design. (Liquid shutdown poisons, coolant circulation control, vapor suppression containment, nuclear superheat, and nucleate boiling, among other features, have first appeared in power reactor proposals within the last year or two).

(d) Issuance of standardized design and construction specifications would discourage incorporation of alternative arrangements which further experience might reveal to offer greater safety than that achieved by the best now known. Furthermore, issuance of standardized specifications would tend to discourage research and exploration into better and safer designs and construction techniques.

3. We recommend that there should be initiated a continuing effort within the AEC, on (a) a systematic tabulation of safety performance objectives, (b) the performance experience of reactors, and (c) on collection and organization of safety guides, suggestions of state-of-the-art practices, etc., which have been found suitable for reactors and their various components and systems of reactor facilities.

Some of these performance objectives are contained or implied in the present regulations (e.g. "the location, design construction and operation of reactor shall be such that no undue hazard . . . . will result" and "the waste disposal systems must be so constructed and operated that the radioactivity level of effluent therefrom does not exceed the values stated in AEC Regulations.") We would not attach excessive value to such an accumulation of safety performance objectives, per se, though we do believe the value well worth the effort required. A tabulation of safety performance objectives would have very

great worth if there could be associated with each one a corresponding standard specification requirement or a procedure by which that objective should be achieved. This Committee has concluded, however, as discussed above, that it is not now possible, in the present stage of reactor development and experience to define such standards requirements or procedures. Nevertheless, some substantial usefulness would attach to a systematic tabulation of safety performance goals associated with the various components and systems of reactors, particularly when these are associated with corresponding practices that would be kept current as general patterns of practice emerge.

The state-of-the-art practices or guides, expansions of collections that have already been started within the Division of Licensing and Regulation on control systems, instrumentation systems, waste disposal systems, etc., supplemented by the work of committees of the American Standards Association and that of other professional groups as it may become available, should be published for information and guidance. These should not be crystallized into standards and regulations until extended experience has revealed that some value will thereby be achieved without danger of forcing the infant technology too soon into a stereotyped format.

This Committee believes that it would be possible to extract, organize and articulate from accessible information on current practices in nuclear technology, a reasonably complete set of performance objectives for reactor components and systems and to collect a description of state-of-art practices in various areas, to an extent that would be useful. We believe that a reasonable continuing effort would suffice to keep the material in these two areas in reasonable relationship with the development of the technology.

The majority of this Committee is not convinced that extensive efforts by teams of experts in collection and organization of information in various areas of reactor technology would lead to establishment of safety standards in the design and construction of reactor components and systems. For reactor fuel elements and reactor control mechanisms, for example, it should be possible with relatively little effort to articulate general performance goals; it is inherently impossible at the present time - regardless of how many experts might work on the problem - to specify unique design and construction methods which should be followed in reaching the desired performance goals.

II. WHAT CAN AND SHOULD BE DONE TO CLARIFY, EXPLAIN AND INTERPRET THE COMMISSION'S LICENSING PROCEDURES AND THE PREPARATION OF HAZARDS SUMMARY REPORTS?

Treatment of hazards summary reports appear to follow a wide variation in pattern. There are different assumptions in calculations, differences in calculational procedures, and greatly different scope of subject matter coverage, even for similar reactors. Furthermore, there often seems to be almost ritualistic coverage of certain topics (e.g., certain types of meteorological data) having no obvious implications in the analysis of hazards.

Recommendations

1. Publication should be made of an information memorandum or pamphlet, in layman's language, in which explanation of the Commission's licensing regulations and procedures, and the reasons or objectives behind these would be given.
2. A guide or set of instructions should be prepared for assistance to reactor designers on the preparation of hazards reports. In this there should be included examples of acceptable treatment of various major subjects usually covered in hazards reports. More importantly, there should also be identified all significant safety questions and issues which should be dealt with in a hazard report.

Thus, there would be identified those important factors, and the context within which they should be treated, on which evaluations and considerations of safety are based.

3. Certain calculations should be regularly required in all hazards reports, and these by a standard pattern or by a demonstrable improvement to such pattern, in order that these reports would provide greater usefulness for comparative purposes and contribute to more uniform and consistent evaluations.

III. WHAT SHOULD BE DONE TO MAKE THE COMMISSION'S REACTOR SAFETY RESEARCH PROGRAM MORE EFFECTIVE?

The Committee's investigation and review of the scope and coverage of the Commission's safety research program have not been sufficiently extensive to permit comprehensive analysis and evaluation. Nevertheless, some observations and recommendations appear justified.

Observations

1. There is substantial evidence that the Commission's safety research program is fragmented among several groups and divisions in the headquarters organization, and that there is inadequate coordination between these groups. There does not exist a sufficient channel of information exchange between the different groups in the field who carry out the programs, and there does not seem to be an appropriate feedback channel between those performing the research and those controlling the program, or between either of these groups and those who are the principal "users" of the information generated.

2. Topics of importance to reactor criteria and safety evaluation do not now appear to be receiving attention in proportion to their importance. Illustrative of such topics are:

(a) Radiation effects on structural materials

(b) Operations analysis

(c) Actual core meltdown and cleanup of fission products

(d) Kinetic properties of new types of reactors

(e) Performance tests of safety systems

(f) Atmospheric dilution at long distances

Recommendations

1. The diverse programs of reactor safety research scattered throughout the Commission's administrative organization should be brought under the surveillance and co-ordination of one person in the AEC. It would be the responsibility of this person to be aware of all research programs in progress, to analyze and evaluate the coverage of the programs relevant to safety problems to remedy the deficiencies in coordination noted above, and to recommend new safety programs as necessary. Sufficient staff and authority should be available to the co-ordinator for these purposes.

IV. WHAT SHOULD THE COMMISSION DO IN COLLECTING, ORGANIZING AND DISSEMINATING EXISTING INFORMATION RELEVANT TO SAFETY?

Discussion

On this point the ACRS has suggested that there be collected a large full time but temporary team of experts, who would be instructed to bring together and digest all existing reactor safety information as quickly as possible. A group of 25 persons working for 12 months was suggested as an example. Following the disbanding of the team other arrangements would presumably be made to keep the collection and interpretation of information current and easily accessible.

The ACRS noted that the increasing number of reactors and the growing difficulty of handling cases in a reasonable time makes it important to do this work now.

This Committee has given much thought to this matter and has reviewed and discussed it at length. The benefit to the nuclear community of a comprehensive

information collection project would consist primarily of convenience. Until factual statistically significant experience data are available and yield discernibly preferable patterns of practice, the most complete tabulation of design data and collection of specialized experimental results would not significantly accelerate criteria development.

This committee therefore cannot support a recommendation for an urgent program of major proportions in collection and organization of such data and information.

On the other hand, we are convinced that some improvement can be made in the overall practices now being used in the nuclear field in order to make conveniently accessible to the nuclear community the information from safety research programs and experience with reactor operations.

We believe the changes recommended below will not only give the assistance of convenience to the nuclear community but will keep the collection and organization of data and information in the nuclear field in pace with accumulation of experience and emergence of preferred practices so the orderly development of criteria will proceed as rapidly as possible.

We believe the AEC has already in progress commendable efforts to provide dissemination of information, through sponsorship of books and monographs, issuance of public Technical Information Documents, and, just recently, publication of the quarterly technical journals including the Nuclear Safety Journal.

These efforts alone are not entirely sufficient for the needs, though they are steps in the right direction. We believe that with some redirection and expansion of these efforts the need can be met insofar as AEC's responsibilities would demand. It must be recognized that industry, and the nuclear community generally, must itself assume part of the obligation for communication channels in this field and that AEC alone does not bear the full responsibility.

It is from these considerations that we make our recommendations.

Recommendations

1. The Nuclear Safety Journal should be increased in the frequency of its publication, to at least six issues per year, and should be changed in contents. To the present "current events" type of coverage, which should be re-studied and improved, there should be added a "Review of Modern Physics" type of coverage of selected major topics relevant to nuclear safety. Each issue should contain comprehensive, current status monographs on important safety topics, prepared by top authorities in the respective fields.

The Journal staff should be expanded, and full AEC support should be given the editors in their solicitation of the comprehensive review articles from the experts.

At least one technical person in AEC headquarters should devote full time to the direction and support of the Journal.

2. Means should be considered for making the Hazards Summary Reports on reactor projects more widely available to the nuclear community. Placing these reports in the AEC's Public Document Room does not make them available except at considerable inconvenience.

3. The AEC staff analyses and evaluations of hazards aspects of projects considered in the regulatory process and intermediate and final decisions of the Hearing Examiner and the Commission would be of great benefit to the nuclear community. These documents, although available to the public as public documents, are not widely distributed for easy access by the nuclear community. They constitute the best indication now existing of what is important, what is acceptable, and what is not acceptable in the safety of reactors.

4. Consideration should be given to suggesting to such professional and technical groups as the American Nuclear Society, American Standards Association and others

that they give wider opportunity for public discussion of nuclear safety topics among members of the nuclear community.

Committee Members

M. C. Leverett
W. E. Nyer
B. Spinrad
J. H. Sterner
T. J. Thompson
H. Worthington
C. Dalzell
R. Lowenstein
M. M. Mann
F. Western
C. K. Beck, Chairman

APPENDIX "A"

COMMENTS BY B. I. SPINRAD ON ITEM T OF THE AD HOC COMMITTEE REPORT

I agree with the conclusions reached by the Committee as far as they go. However, I believe that much more ought to be recommended. In particular, I believe that only lip service remains to the concept of objective judgment based on objective facts.

I believe that a key concept which must form the basis of objective evaluation is the following, which I would include as a recommendation:

"A safety criterion for the protection of the general public must be based on quantitative information as to the consequences of irradiation to individuals and populations, and the degree of improbability of irradiations occurring. Therefore, a correlation must be made between probabilities of accidents of varying degrees, and biological damage rates which would ensue from these accidents. A final goal would be to determine: (a) the degree of tolerable radiation effect to the population which is commensurate with the benefits of reactor operation; and (b) the real probability of accidents."

Discussion: As to item (a) in the last sentence, a policy judgment, based in part on biological information, must be made; this judgment may be ultimately a matter of direct Presidential decision.

As to item (b) in the last sentence, the point is that operating experience in the nuclear industry and in other industries using similar equipment already permits quantitative estimates of a multitude of equipment and personnel failure rates; and that, while error limits are now large, they illustrate both the flimsy basis of current safety reasoning, and provide a quantitative basis for improvement. I recognize the importance of expert subjective judgment as exercised by evaluation bodies both now and in the near future; but this cannot continue indefinitely, and I believe these bodies have the best background to begin converting qualitative to quantitative judgment.

APPENDIX "B"

COMMENTS BY T. J. THOMPSON ON AD HOC COMMITTEE REPORT

The principal reservation that I have with the Committee report concerns its reluctance to take decisive action at this time regarding the problem of securing adequate and objective safeguard criteria.

I personally believe that with a prompt and diligent effort it is possible to make substantial progress in creating and annunciating criteria for reactor safeguards within one to two years. There exists a substantial body of opinion with this same viewpoint. To carry out this task, a much more extensive effort is needed than is envisioned in the full Committee report. One possible three-step procedure to accomplish this accelerated program is outlined below:

1. The AEC should establish maximum emergency exposure doses to individuals and the population beyond the reactor site boundaries from credible accidents to the facility. The basis of individual exposures might be that of no clinically detectable tissue damage and the basis of total population exposure might be that it be only a very small fraction of the total population annual dose due to the average normal "non-radioactive" environment.
2. The AEC should move at once to start the preparation of a series of monographs or summaries, each of which would represent a thorough coverage of a section of the field including: a well-organized collection of the best existing information (giving conflicting information where it exists and is important); a presentation of any theory, definitions, laws, calculational methods, rules, and organized knowledge needed; and a complete bibliography in the field. This program, as well as others mentioned herein, should be under the supervision of a single administrative head in the AEC consulting with the other AEC

divisions and the ACRS. It is believed that sufficient manpower exists to pursue this program rapidly. The required personnel should be given the time necessary and paid sufficiently well to complete the job at least to the rough draft stage by July 1, 1961. They should consult freely and often with existing safety groups in such organizations such as ASA, ANS, ACRS, etc. Below are a series of desirable monographs together with possible authors. These men may not be available and have not been consulted, but they are certainly capable of doing the work and they are not the only ones who can carry it out.

Site and Environment

Frank Gifford, C. R. McCullough, H. Gomberg, W. Cottrell

Meteorology (Review of new work and revisions)

J. I. Holland, J. R. Austin, F. Gifford

Containment

R. Brittan, Al Kolflat, Stuart McLean

Nuclear Core Design

W. K. Ergen, Dixon Callihan, B. Spinrad

Reactor Kinetics

J. A. DeShong, W. K. Ergen, W. Nyer, S. Forbes

Fuel Elements

A. R. Kaufman, B. R. Hayward, B. W. Dunnington, Spencer Bush

Metallurgy and Material Radiation Effects

J. P. Howe, D. H. Gurinsky, J. Cunningham, B. Lustman

Instrumentation and Control

E. J. Wade, E. P. Epler, J. Harrer

Chemical Reactions

(ANL), J. Draley, H. F. McDuffie, Harold Secoy

Reactor Operating Organization and Procedures

M. Mann, M. Biles, P. Morris, R. Dikeman

Mechanical Systems

J. J. Dickson

These monographs should be revised and reviewed at least once every three years thereafter to insure that their content is still applicable.

3. With the completion of the rough drafts outlined in (2) these summaries can serve as the basis and starting point for an intensive one-to-three month effort to forge a set of acceptable criteria in the areas of the sub-topics listed. This effort should be carried out at some selected site by a special group, including the summary authors, the ACRS, Dr. Beck and selected members of the HEB, and other advisors and consultants as needed.

   The intent of this final effort would be, first, by group effort, to formulate and enunciate reactor criteria wherever this proves feasible. Second, the summaries or monographs should be discussed and evaluated and edited so that these documents themselves would carry considerable weight in serving the function of guides to reactor safety practice and procedures. In this sense, they would in themselves provide reactor safety performance goals, safety guides, or safety standards. They would constitute safeguard criteria.

Discussion

General

The current program of the AEC in reactor safety is a good one. However, in view of the ever-increasing number of reactor types and the increasing rate of reactor construction, there is good reason to believe that the effort should be increased sharply for the next few months in order to lay the ground work for the formulation of a better-defined reactor safety program, including definitive reactor safety criteria.

Point 1

Emergency dose limits may be defined as doses which will, in general, not affect seriously the overall well being of individuals or the general public. However, it should be pointed out that reactor design, construction, and operation should still be sufficiently safe so that these limits will never be approached in actual practice. In the same way, the number of reactor accidents should be overestimated to insure that conservative figures are used.

The argument has been advanced that emergency dose limits cannot be established until the probabilities of reactor accidents are supplied. It is clearly impossible to predict the probabilities of any major reactor accident -- let alone all of them. Any estimates would be pure guess work. The estimates might be off in either direction by a number of orders of magnitude. For example, even such information as frequency of pipe ruptures is lacking for the most part.

The definition in (1) above concerning doses to the individual can be set completely without regard to any probability of accident. It is a purely medical definition and, while subject to some minor arguments, will be orders of magnitude more reliable than accident probabilities.

The problem of an emergency acceptable dose rate to the general public is more difficult, but not impossible. In this case, it is a problem of the long term genetic effects. These effects are much in controversy now. However, I believe that very few will quarrel with a philosophy which sets a population dose which is only a small fraction of the levels which already exist in the "non-radioactive" environment. As far as accident probabilities are concerned, a small arbitrary probability can be assumed initially and adjusted if long term experience warrants it. Such a dose might be, for instance, one major accident per 100 years for every ten large power reactors.

Point 2

Because of the nature of reactor hazards, it is more important that the safeguards program and information pertaining thereto keep pace with the ever-increasing number and types of reactors and new developments. In order to reach a set of generally valid conclusions to any problem, it is always necessary to collect, compile, and codify all pertinent existing information on the subject in question. In research, this is known as the "literature search" and summary of the current status in the field. It leads naturally to well-founded conclusions and to a clear perception of the remaining unresolved problems. Lacking such a status report, definitive conclusions are essentially impossible and any decisions made are likely to be unsound, since they must be based on personal opinions and judgments.

It appears to be feasible to ask individual authors to prepare monographs in their special fields much in the same way that the monograph "Meteorology and Atomic Energy" was prepared. Through this simultaneous preparation of a series of such monographs, it would be possible to obtain an up-to-date review of the literature, the current status in each sub-field, a summary of the definitive facts and relationships, and a knowledge of what was left to be done. Since each would be written by a single author or a limited group of authors, they would receive recognition (and, hopefully, extra compensation) for their work. In addition, they would not have to uproot their lives completely for an extended period of time. It is clear that some monographs would state controversial points of view. Use of the monographs would point out the areas of controversy and stimulate resolution of the arguments. Reference to these monographs and their calculational techniques would simplify at once the preparation of Reactor Safeguard Reports, just as "Meteorology and Atomic Energy" has been of assistance already in this regard. A member of the reactor community could, of course, take a different

view on any point than that stated by the author. If his view proved to be better than the author's, it could be adopted and would lead to review and improvement of these monographs. In a real sense, the monographs would form the first concrete step towards safety criteria. Dr. Weinberg, in a letter to C. R. McCullough, has indicated that Oak Ridge probably has some manpower available. Since Dr. Weinberg had already suggested this possibility, the list drawn up above leaned heavily on ORNL personnel. Other lists of widely known authorities from other locations could as well be drawn up.

This effort may be viewed as the first step necessary towards a definitive set of reactor safeguards criteria. Without these summaries, it seems difficult to set up logical criteria. In one form or another, such an effort must be carried out before completely valid criteria can be created. One cannot draw conclusions until the necessary information is collected and digested.

Point 3

It appears almost certain that by the conclusion of steps (1) and (2) above, enough background knowledge will be available to establish reasonable safety "standards" in the sense defined above. In fact, the monographs discussed in step (2) are themselves criteria of a sort. It is almost certain that, even now, utilizing past experience and current knowledge together with limits on the "once in a lifetime dosage to the individual and the population," that performance goals and safety guides are possible, given a short full-time concentrated effort on the part of a small group. It is likely that MIT or other establishments would be willing to serve as a center for a possible summer project with the goal of establishing a set of workable criteria once step (1) is near completion with the monographs at least in final draft-form.

APPENDIX "C"

COMMENTS BY R. LOWENSTEIN ON AD HOC COMMITTEE REPORT

My disagreement with the Committee report is concerned principally with those matters discussed under items number 2 and 3 of Topic I (pages 4 to 7 of the majority report). I believe that regulations can and should be prepared now establishing the criteria on the basis of which proposed reactor design and operating procedures should be evaluated.

In any discussion concerning the desirability of establishing criteria by regulation concerning facilities as complex and novel as nuclear reactors, there is a problem of definition as to what is a regulatory "criterion" or "standard". By association with the word "regulation," "criterion" and "standard" have developed a connotation of almost absolute rigidity. It should be apparent, however, that criteria and standards can be made as general or as specific as the circumstances warrant. Moreover, provision can be made for justifiable departures from standards and criteria. I am impressed and agree with the need, advanced in the Committee report, to avoid "standardization" of reactor design.

The Commission, as noted in the Committee report, has established the basic criterion for issuance of reactor construction permits and licenses in 10 CFR, Part 50, as "reasonable assurance that . . . the health and safety of the public will not be endangered" (§50.40). There are other similar criteria elsewhere in Part 50 and other Commission regulations applicable to activities licensed under Part 50. These criteria have been in effect without substantial change since early 1957.

Since adoption of the Atomic Energy Act of 1954, construction permits or licenses have been issued for more than 85 reactors; and many additional reactors in the United States have been designed and constructed. Substantially all of these reactors have been evaluated and approved. Each of the approvals has

represented judgments as to the safety of each of the many complex systems and procedures involved in each reactor. Unless these many judgments are to be considered as having been made without reasonable foundation -- which I do not believe to be the case -- they must necessarily have been based upon still unarticulated "standards" or "criteria" for approval. I believe it is both possible and important promptly to begin the process of articulating these criteria in deliberate fashion through the rule-making process.

The criteria which might be established now would undoubtedly be more general and less detailed than those which could be established five or ten years from now. The fact that greater specificity will be possible sometime in the future, however, is no argument for not doing the best we can now, and improving the criteria as time goes on. At any time in the future it will be accurate to say that we could write better criteria if only we wait a little longer.

Some, perhaps most, of the criteria which might be established at the present time are perhaps so obvious to technical experts, and so taken for granted by them, that they would doubt the worthwhileness of the exercise until it is possible to establish more detailed requirements. "Is it worth the effort," it might be asked "to establish as a regulation such an elementary criterion as 'the worth of all control rods or materials must exceed the amount of available excess reactivity?'" I believe it is, and that it is important to do so promptly, for the following reasons:

1. Regulatory criteria are needed to facilitate the efficient and effective review of reactor hazards by the responsible government reviewing agencies. As the art becomes more complex, the review and

evaluation process becomes more complex. Thus regulatory criteria are becoming more essential to apprise the heads of such agencies of the nature of judgments being rendered by those who perform the detailed review and evaluation work; and to protect against oversight by the reviewing agencies.

2. Safety of reactors is not a matter which is of concern exclusively to scientists. Safety judgments ultimately must be made in industry by management officials; in government agencies by various government officials; in the courts; in the legislature; by many private organizations having indirect or special interests, such as insurance companies; and by the general public. The publication of regulatory criteria is essential to enable them to understand the elements involved in reactor hazards evaluation, the standards being applied, and the degree of risk they are being asked to accept.

3. Most important, regulatory agencies operating under authority delegated by the Congress, have special obligations to the public and the public's representatives, and to those regulated by such agencies, to make known the criteria on which agency action is based. Only by so doing, can we achieve the objectives outlined in "1" and "2"; and achieve the objectives of fairness to applicants and of opportunity for public participation in the development of criteria and the evaluation of license applications.

I agree with Dr. Thompson's recommendations that a series of monographs be prepared on significant topics relating to reactor safety and that experts be engaged promptly to prepare such monographs. I am not qualified to express

an opinion as to which topics should be covered or as to the particular individuals who should be selected. I agree with him that the monographs will be useful as convenient reference tools and should, if properly oriented, be a significant aid in the preparation of regulatory criteria. I do not think, however, that it is necessary to postpone starting the preparation of regulatory criteria until after the monographs are completed.