RADIATION SAFETY AND REGULATION

HEARINGS

BEFORE THE

JOINT COMMITTEE ON ATOMIC ENERGY
CONGRESS OF THE UNITED STATES

EIGHTY-SEVENTH CONGRESS

FIRST SESSION

ON

RADIATION SAFETY AND REGULATION

JUNE 12, 13, 14, AND 15, 1961

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RADIATION SAFETY AND REGULATION

MONDAY, JUNE 12, 1961

CONGRESS OF THE UNITED STATES,
JOINT COMMITTEE ON ATOMIC ENERGY,
Washington, D.C.

The Joint Committee met, pursuant to notice, at 2 p.m., in room P–63, the Capitol, Hon. Chet Holifield (chairman of the Joint Committee) presiding.

Present: Representatives Holifield, Price, Morris, Aspinall, Van Zandt, Westland, and Bates.

Also present: James T. Ramey, executive director, Jack R. Newman, George F. Murphy, professional staff members, and Edward J. Bauser, technical adviser, Joint Committee on Atomic Energy.

Chairman HOLIFIELD. The committee will come to order.

The Joint Committee starts today a series of open hearings on "Radiation Safety and Regulation." It is our hope that during the course of these hearings the committee will receive an accurate picture of current developments in the fields of reactor and radiation safety generally. We look forward to the testimony of distinguished scientists and engineers concerning the technical problems in the young nuclear science.

We also look forward to hearing of achievement and progress—at the same time we shall probe into the facts surrounding the tragic loss of three lives at the SL–1 reactor in January of this year.

The committee has withheld a hearing on this accident until the Commission had an opportunity to investigate fully and make its report. The Commissioner's report was released on Sunday, June 11, and has been published by the committee as a preprint for this hearing.

In the second part of these hearings, we shall consider the recurring problem involved in the merger of regulatory and promotional responsibilities within the AEC.

This is a subject we have touched upon many times in the past. The committee will receive the testimony of prominent persons in government, the atomic energy industry, and the legal profession concerning problems in the operation of the AEC regulatory process. We shall also consider carefully recent proposals for a revision of the AEC regulatory organization.[1]

Before we hear our first witness, I would like to insert in the record at this point the press release announcing these hearings, and the schedule of witnesses.

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[1] See correspondence and H.R. 8708 (S. 2419), app. 7, p. 427.

(The material referred to follows:)

[Press release No. 317 from the offices of the Joint Committee on Atomic Energy, for immediate release Wednesday, June 7, 1961]

JOINT COMMITTEE ON ATOMIC ENERGY ANNOUNCES WITNESSES FOR HEARINGS ON RADIATION SAFETY AND REGULATION

A tentative schedule of witnesses to testify before the Joint Committee on Atomic Energy at hearings on "Radiation Safety and Regulation" was announced today by Congressman Chet Holifield, chairman of the Joint Committee.

The hearings will begin on Monday, June 12, at 2 p.m. in room P-63, the Old Supreme Court Chamber in the Capitol. They will continue through Thursday, June 15.

In the first phase of the hearings, the committee will consider current developments on the safety aspects of the handling of radioisotope materials and the building and operation of nuclear reactors. In this part of the hearings, the committee will receive testimony on the reactor accident at the National Reactor Testing Station in Idaho, the first fatal power reactor accident in the United States. This testimony will cover the results of a recently completed investigation by a special AEC board.

In the second phase of the hearings, the committee will consider problems in the operation of the AEC regulatory process, including recent proposals for revision of AEC's regulatory organization and procedures.

Prominent figures in Government, industry, labor and the legal profession will testify in the course of the hearings. Among the witnesses scheduled to appear are James M. Landis, special assistant to the President; AEC Commissioners Loren K. Olson and Robert E. Wilson; Adm. H. G. Rickover; and Dr. Theos J. Thompson, Chairman, AEC Advisory Committee on Reactor Safeguards.

A complete list of witnesses, subject to change, is attached.

WITNESSES FOR HEARINGS ON RADIATION SAFETY AND REGULATION

Monday, June 12, afternoon

Topic I-A. Introduction:
- 2 p.m.: Dr. Abel Wolman, Johns Hopkins University.

Topic I-B. Technical Aspects of Reactor Safety:
- 2:30 p.m.: Dr. Walter Zinn, Combustion Engineering, Inc.
- 3:00 p.m.: Dr Rogers McCullough, AEC Advisory Committee on Reactor Safeguards.
- 3:30 p.m.: Dr. Clifford Beck, Atomic Energy Commission.
- 4 p.m.: Mr. John Simpson, Westinghouse Electric Corp.

Tuesday, June 13, morning

Topic I-C (1): The SL-1 Accident:
- 10 a.m.: Dr. Frank Pittman, Atomic Energy Commission.
- 10:30 a.m.: Mr. Curtis Nelson, Atomic Energy Commission. (Also in attendance: Mr. John Horan, Idaho Operations Office, Atomic Energy Commission and Mr. C. Wayne Bills, Idaho Operations Office, Atomic Energy Commission.)
- 11 a.m.: Mr. W. B. Allred, Combustion Engineering, Inc. (Also in attendance: Mr. P. R. Duckworth, Combustion Engineering, Inc.; Lt. Col. H. C. Schrader, Deputy Assistant Director for Army Reactors, Atomic Energy Commission; and Capt. Robert L. Morgan, U.S. Army reactor engineer, Military Reactors Division, Idaho Operations Office, Atomic Energy Commission.)
- 11:15 a.m.: Mr. Brooks Payne, International Brotherhood of Electrical Workers.

Topic I-C (2): AEC Inspection Program Following the SL-1 Accident.
- 11:30 a.m.: Gen. A. R. Luedecke, Atomic Eneregy Commission.
- 12 noon: Dr. Gerald Tape, Brookhaven National Laboratory. (Also in attendance: Mr. Robert Powell, Brookhaven National Laboratory.)
- 12:30 p.m.: Mr. Harold Price, Atomic Energy Commission.

1 p.m.: Commissioner Robert E. Wilson, Atomic Energy Commission.

Topic I–C (3): Reactor Site Criteria:

2. p.m.: Mr. Robert Lowenstein, Atomic Energy Commission. (Also in attendance: Dr. Clifford Beck, Atomic Energy Commission.)

2:30 p.m.: Dr. Theos J. Thompson, AEC Advisory Committee on Reactor Safeguards.

3 p.m.: Mr. W. Kenneth Davis, Bechtel Corp.

3:30 p.m.: Mr. James Grahl, American Public Power Association.

4 p.m.: Mr. Oliver Townsend, New York office of Atomic Development.

Wednesday, June 14, morning and afternoon

Topic II–A: General Review of Regulatory Problems:

10 a.m.: Mr. James M. Landis, special assistant to the President.

Topic II–B: AEC Regulatory Organization and Procedures:

10:30 a.m.: Mr. Harold Price, Atomic Energy Commission.

Topic II–C: Problems in the Operation of the AEC Regulatory Process:

11 a.m.: Mr. Fox Trowbridge, Washington attorney, law firm of Marks & Trowbridge.

11:30 a.m.: Mr. Titus LeClair, General Dynamics Corp.

2 p.m.: Mr. William Kennedy, General Electric Co.

2:30 p.m.: Mr. Arvin Upton, Washington attorney, law firm of LeBoeuf & Leiby.

3 p.m.: Mr. Ben Sigal, International Union of Electrical, Radio, and Machine Workers.

3:30 p.m.: Mr. Lester Rogers, Atomic Energy Commission.

Thursday, June 15, morning

Topic II–D(1): Alternative Organizational Arrangements:

(A) AEC Regulatory Reorganization (creation of Director of Regulation).

10 a.m.: Commissioner Loren K. Olson, Atomic Energy Commission.

(B) AEC Advisory Committee on Reactor Safeguards Position on Revision of AEC Regulatory Organization and Procedures

10:30 a.m.: Dr. Leslie Silverman, AEC Advisory Committee on Reactor Safeguards.

(C) University of Michigan Atomic Energy Research Project View (separate agency)

11 a.m.: Mr. William Berman, University of Michigan Atomic Energy research project.

(D) Joint Committee Staff Proposal (Internal Atomic Safety and Licensing Board)

11:30 a.m.: Mr. William Mitchell, Washington attorney.

Thursday, June 15, afternoon

2 p.m.: Adm. H. G. Rickover, Atomic Energy Commission (Technical Aspects of Reactor Safety, continued from Monday).

Panel Discussion on Alternative Proposals for Revision of AEC Regulatory Organization:

2:30 p.m.:

Prof. Kenneth Culp Davis, University of Minnesota, School of Law.

Prof. David F. Cavers, Harvard University, School of Law.

Commissioner Loren K. Olson, Atomic Energy Commission.

Mr. Lee Hydeman, Washington attorney, law firm of Charlitt, Hydeman & Berman.

Dr. Theos J. Thompson, AEC Advisory Committee on Reactor Safeguards.

Chairman HOLIFIELD. Our first witness this afternoon, is Dr. Abel Wolman of Johns Hopkins University, a member of the Advisory Committee on Reactor Safeguards. Dr. Wolman, as always, it is a pleasure to have you with us.

STATEMENT OF ABEL WOLMAN, THE JOHNS HOPKINS UNIVERSITY, BALTIMORE, MD.

Mr. WOLMAN. Thank you, Mr. Chairman.

Mr. Chairman, I shall stick rather closely to my written text rather than to talk about it incidentally.

No industry, whether privately or publicly owned and operated, has been so elaborately scrutinized, diagnosed, evaluated and supervised as the atomic energy industry. The library of evaluation of problems, standards, economics, and collateral features of this trade now encompasses thousands of pages of valuable scientific theory and hypothesis, working experiences, expositions of required research, and listings of untoward events. The hearings of the Joint Congressional Committee, alone, now cover thousands of such pages.

The central thematic concern in virtually all the national and international documentation, aside from the purely design discussions, is how to assess, in advance, the optimum balance between caution and risk in the development of this industry.

From the beginnings of these activities in this country, the Manhattan Engineer District, the Atomic Energy Commission, and their contractors, met this challenge "with a strict take-no-chances caution at every point,"[1] parenthetically, generally with remarkably successful results.

It is still true that one of the major limiting considerations in the design and operation of nuclear reactors, particle accelerators, and other radiation sources, is concern for human safety. The essential reasons for this emphasis were precisely, albeit briefly, spelled out by the Commission in its July–December 1956 report, already referred to above. It there stated:

> In the handling of raw materials, exposure to the radioactive gas, radon, has to be controlled; in the processing of uranium concentrates, the dust of uranium compounds is a possible hazard. Problems also arise from concentrations of fissionable uranium or plutonium which could, if improperly handled, initiate a chain reaction and throw off very powerful radiations. Plutonium and various other substances of importance in the atomic energy program are poisonous if allowed to enter the body. Problems arise also from the processing of materials which have been passed through reactors; from radioactive industrial wastes; and from the testing of atomic weapons. Many of these same problems arise with development of nuclear power by private, city, State and cooperative organizations, or with industry's efforts to advance other peaceful uses of atomic energy.
>
> Public hazards could arise from excessive releases of process gases; from plant or reactor ventilation which might contain radioactive gases and airborne radioactive material; from reactor coolants where these are released to the environment; from radioactive fallout after weapons tests; from radioactive industrial wastes that are not stored; and from miscellaneous contaminated materials—tools, machinery, clothing, et cetera—from atomic energy installations.

The Joint Committee, in 1961, advisedly reopens the subject of radiation safety and regulation with the intention of taking stock as to where the industry now stands in these regards. Any thoughtful observer periodically confronts himself with the often repeated questions:

(1) Are the protection standards realistic, are they too rigid, should they be relaxed?

[1] A.E.C. Report, July–December 1956, January 1957, p. 113.

(2) Has licensing of facilities and materials been so expanded in intensity and frequently as to place an undue burden upon rapid industrial evolution? Can and should the industry police itself?

(3) Should inspection and enforcement be enhanced or reduced? Has the operational organization and art reached a level of maturity and sophistication, high enough to be trusted, to afford safety to worker and public, commensurate with the gains still to be anticipated from atomic energy operations?

These questions and others, in similar vein, remain to be assessed during the next few days for the guidance of the public, Congress, AEC, and private entrepreneurs.

The Joint Committee has asked me to present a telescopic view of the three areas delineated above. By way of benchmarks for such a "broad brush" survey, some qualitative comparisons are noted between the situations in 1961 and 10 to 15 years ago. A general caveat is an essential prerequisite to the discussions which follow.

Judgments are essentially dependent upon the recorded views of myriads of investigators. For their translation and application the present writer assumes responsibility.

THE ESTABLISHMENT OF RADIATION PROTECTION STANDARDS

The congressional hearing, already available in this area of activity, makes clear that, insofar as the machinery for the review and enunciation of criteria for protecting worker and public is concerned, no more satisfactory mechanism than the existing ones appears on the horizon. Those who look for relaxation of safety standards must continue to turn to the voluntary and official agencies long familiar with these tasks on the national and international levels. One might hazard the guess that the research and the experience gained during the past 10 years hold no great promise that so-called permissible levels of radiation are likely to be raised or relaxed in the near future.

In spite of high awareness that tolerance doses must have high factors of safety, without unnecessarily restricting the development of atomic energy and allied fields, maximum permissible doses have gone through stepwise lowering from 1931 to date. This has resulted largely because of new knowledge about the effects of low-level radiation, which dictated greater margins of safety. The persistent but difficult pursuit on ever-expanding laboratory bases of the radiation somatic and genetic affects will provide increasing support for the actual values used in protection standards. Whether such slowly accumulating research data will push these values up or down it is hard to prophesy.

Existing data unfortunately are still insufficient to provide the basis for precise estimation of the biological hazards of low-level irradiation. Most responsible authorities prefer to adhere, in the meantime, to the AEC philosophy of take-no-chances standards. It is more than probable that one must continue to work in the radiation industry under the restraint of relatively limited exposures. This is what professional groups feel is not only acceptable to, but demanded by society.

Industry may feel, under these present and prospective conditions of radiation restraint, that—

in the name of safety we could inflict greater harm by withholding the benefits of atomic energy.

It is likewise true that—

public apprehension can be more decisive than economics in the growth of the peaceful atom.

Some years may still elapse before these scales will be unduly tipped in favor of lowering industrial nuclear costs by relaxing protection standards and controls. In any event, the next few days' testimony will suggest the future trend.

Representative PRICE. Doctor, Mr. Ramey has a question to ask at this point.

Mr. RAMEY. I note at the top of page 4 of your prepared statement you say that insofar as machinery for the review and enunciation of criteria for protecting the worker and the public is concerned no more satisfactory mechanism than the existing ones appear on the horizon.

The scope of these hearings, of course, does not encompass the matter of how we establish radiation standards, although it had been suggested that the hearings be broadened to include this matter. It is my understanding that the Joint Committee will later hold hearings on bringing up to date, the data developed last year on the Federal Radiation Council and the NCRP, ICRP, so we can go into the question there as to whether or not there are possibly more satisfactory mechanisms.

Mr. WOLMAN. As you properly note, Mr. Ramey, this is a reflection of my own in looking at the present scene. The groups that now are responsible for the standards are those with which you are already familiar over the years, with the addition of the Federal Council.

Mr. RAMEY. That is the one where the question exists.

Mr. WOLMAN. Yes. Perhaps I should have noted the fact that there may be some rather serious question as to the perpetuation or the modification of the Federal Radiation Council.

I now turn to the licensing of facilities and materials.

Since the Atomic Energy Act of 1954, the Atomic Energy Commission has had the responsibility for licensing, regulating, and inspecting the activities of all public and private groups who own and operate nuclear facilities or who engage in uses of atomic energy. To accomplish these extraordinarily broad functions, the Commission has been confronted, throughout this whole period, with the dilemma of avoiding a rigid pattern of licensing and regulation which would slow down the development of civilian uses of atomic energy or which would unnecessarily interfere with management practices.

At the same time, the Commission had to assure, without equivocation, that the public health and safety were protected.

The assignment has posed two central questions closely related to each other. The first raises the obvious issue as to whether the industry should be permitted to go its natural way without regulation.

The second stems from the answer to the first question. If the trade is new, hazardous, and esoteric and hence requires governmental supervision, how may this be best evolved with maximum liberty of action by industry and with adequate protection of workers and public?

The historical assumption underlying the act of 1954 was that facilities and materials associated with nuclear fission operations were not only fraught with certain controllable dangers per se, but that the science and art creating them were not so completely understood as to permit indiscriminate application and use by the general industrial developer. Even a cursory review of the record since 1954 would give reasonable support to the conclusion that the original assumption guiding the lawmaker remains essentially unchanged.

Experience in design, construction and operation of nuclear facilities has undoubtedly moved forward on many private and public sectors.

Simultaneously, however, time has produced new concepts and untried principles and has disclosed exotic and unexpected behavior both of facilities and of materials. These events were to be anticipated.

They disclose, however, the continuing hazard intrinsic in the business and the ever-present danger of consigning controls to the trade without limitations.

Perhaps, the striking difference between this trade and more familiar ones is that both the scientific understanding of facility and material is inadequate and the total of well-trained and experienced manpower to manage them is limited. Efficiency in instrumentation has perhaps outstripped both man and understanding of new design and materials behavior.

The record of untoward events should be frankly explored during the hearings, not because loss of life has not been kept surprisingly low, but because each event has inherent in it, a lesson for new design, operations control and management programing.

Just when one reaches a plateau of optimistic belief that licensing supervision might be relaxed, an SL–1 incident occurs. Lesser events merely supplement the view that all is not known, clearly predictable or easily self-protective. Such episodes have their true value in disclosing information which would provide increased built-in safety factors in future design and operation.

The number of significant items which must be reviewed and assessed in reactor safety evaluation is unfortunately high. They cover, among other things, fuel cladding and composition, assembly, flow, corrosion, erosion, thermal characteristics, control mechanisms, chemical aspects, containment features, accident potential, and site assessment.

Dr. J. T. Thompson, chairman of the Advisory Committee on Reactor Safeguards, tried his hand, for example, in enumerating just such a checklist.

The significant number of these approached 100. They make clear some of the considerations which continue to dominate the evaluation and licensing process.

Radiation damage to reactor pressure vessels has long been a potential source of risk because of the neutron flux to which they are subjected during their lives. Virtually all of the important nuclear power reactor systems are now passing through this life process. Like all such problems, the life expectancy and the factors dominating it are highly complex. They require central review and perspective unlikely to emanate promptly from individual users and developers.

The hearings again should disclose these pressing and still unresolved areas of design and operation in order to provide some basis for an intelligent answer to the technical questions herein posed.

If the testimony makes clear that the time is not yet ripe for releasing the industry from irksome restraint, required reporting, detailed hazard exposition and time-consuming hearings, who shall pursue the review and licensing process? The question is simpler than the answer.

Certain guiding principles appear. Review functions should have some significant separation from development responsibilities. Full-time staff assessments would be preferable to part-time advice. Matured judgments are essential to provide guarantees of safety. Filings, hearings, and adjudication proceedings should impose minimum hardships upon applicants.

Like the famous Wilsonian 14 points, some of these principles are inconsistent and competitive with each other.

The studies, by the staff of the Joint Committee, by its consultants, by Berman and Hydeman of the Michigan Law School, and other informed individuals, provide an elaborate framework within which witnesses may well establish judgments on these issues.

Sharp evaluations should emerge as to how successfully staff and ACRS provide the important technical judgments on safety, how long their simultaneous assessments should be continued, what part the AEC must play in this enterprise, what real function public hearings by examiners now provide or should develop in the future, and what separation in structure experience and prospect now disclose as desirable.

Division of responsibility between development and licensing should be measured against potential loss of the accumulated and persisting expertise now so successfully at hand in the AEC. Separation of powers, by one means or another, need not be incompatible with the continued availability of these rich resources of experience.

INSPECTION AND ENFORCEMENT

The basic safety of reactors and their appurtenances, including the processing of fuels and waste disposal, depends upon the built-in stability and reliability of design and equally upon the administrative control and operation of the facilities. Both of these ingredients may be well demonstrated in application filings and be completely vitiated in subsequent transfer and operation.

The inspection and enforcement process may truly be a reflection of the reality of industrial behavior, of the level of sophistication and of alertness to public responsibility.

In many other areas of industrial enterprise regulatory agencies are increasingly confronted by overwhelming numbers of units to be monitored. The process of inspection falls down of its own weight. The official groups increasingly turn to an emphasis on self-policing by the trade, exemplified in the food and milk industries. Many major industrial processes have long been self-monitored with high success. When will this stage of release from detailed inspection prevail in the nuclear industry?

Present evidence gives no early promise of major relaxation of such enforcement, primarily because of recurrence of instability of facility and, more important, of instability of management and operation. The latter may in fact be a symptom of high irritation with the ever-mounting requirements for license and enforcement.

One would hope that the hearings will record not only the nature and frequency of violation—strictly on the basis of nonidentification of company or public agency—but confront the committee with the arguments, pro and con, for the continuing expansion of licensing-enforcement processes. The lawyer's propensity for legalistic specificity and qualification is now challenging the engineer's long supremacy in that field. It may well be that the witnesses have no other solution—at least for the next decade.

Mr. Chairman, what I have tried to do here is what I thought my assignment by the committee was, namely, to review the history somewhat and to spell out the kind of problems which I hope the next few days of testimony may discuss in detail, and perhaps may even reveal some suggestive answers.

I have intruded somewhat in that review with some personal judgments which are strictly my own and necessarily may be high in error.

Chairman HOLIFIELD. Dr. Wolman, we wish to commend you for your testimony today, and also for your past contributions to the committee's understanding of the many problems that we have had, and in particular to your testimony last year at our radiation standards hearings. I am sure there may be some questions from the members of the committee.

Mr. Price.

Representative PRICE. I have no questions.

Chairman HOLIFIELD. Mr. Van Zandt.

Representative VAN ZANDT. No questions.

Chairman HOLIFIELD. Mr. Westland.

Representative WESTLAND. Doctor, I heard in the latter part of your notes that you indicated some 10 years before you thought these reactors might be safe enough to operate in large areas, or did I hear you correctly?

Mr. WOLMAN. No; I did not refer to large areas, I said that the general reactor field might reach a level of sophistication within 10 years when relaxation, not of standards, but of licensing, appraisal and filing, might be relaxed. I would be unwilling to predict that the reactor art, even within the 10-year period, might progress sufficiently to permit placing these facilities in closely built-up areas.

Representative WESTLAND. Would you say that again?

Mr. WOLMAN. I say I would be unwilling to predict that even in 10 years the reactor art will have progressed so far that you would be willing to place such facilities of high power in heavily populated areas.

Representative WESTLAND. That is a very discouraging statement.

Mr. WOLMAN. I realize it is. I think you might and do edge more closely to populated areas. You are already doing so. You do it perhaps with the more orthodox facility which is conceivably better understood. What is happening in the science and the art, however, is that every developer within AEC and external to the AEC is trying to improve upon the nature of the facility. Each time that he does this, and all of us would agree that it is wise to do so in order to make it more economical, more efficient, more appropriate to the needs, he so modifies the facility that it raises new issues and new problems that are not completely understood.

Representative WESTLAND. Thank you; that is all, Mr. Chairman.

Chairman HOLIFIELD. On page 5 of your statement, Doctor, you remark that the public apprehension can be more decisive than economics in the growth of the peaceful atom.

Do you believe that if we did relax our protection standards and controls today, that this would help to achieve economic power?

Mr. WOLMAN. I myself doubt it. I would hope that it might, but I doubt it. The public has gotten into a very interesting position, at least on such canvasses that have been made of public reaction in certain unnamed areas where a facility is being planned and has had a great deal of publicity. People have been canvassed on the street and I have been quite impressed with their reactions.

When they were asked whether they were concerned about the placement of a facility in such and such a spot, they said, "No; we don't have any concern, because we are fully aware that the Atomic Energy Commission, the Federal Government in general, and the State is looking out to see that such facilities are very carefully reviewed before approval."

This faith in the governmental agency at each level is an abiding faith in our country, sometimes perhaps not fully warranted, but at least in the public feeling it is. I have the impression, therefore, that, if the public learned that this is not being reviewed with such care, certainly for 5 to 10 years to come there would be considerable hesitation in having the facility built in many places.

Chairman HOLIFIELD. As you point out in your statement, there has been a remarkable record of safety considering the many projects and the many uses of nuclear energy. Is it your opinion, in your contacts with the people, that people generally believe that there is a responsible scrutiny of this industry?

Mr. WOLMAN. Without question, and that it is independent of the industrial developer and is likewise independent of the public developer. It is someone, somewhere—they are not particularly clear as to exactly where. Somewhere in governmental regulatory agencies there is a body that exists and determines this and justifies the location.

Chairman HOLIFIELD. This faith, we must say, has its genesis in the fact that there have not been many accidents on the civilian level. But it also stems from a lack of personal knowledge. It is more, as you say, a national faith that the Federal Government will do its job well.

Mr. WOLMAN. The man on the street does not know much about the intricacies of our structure or who is doing what. But I have been impressed by each of these canvasses, and they have been made in several places in the eastern part of the United States.

Invariably the response has been that some agency somewhere is looking out for this and I don't have to worry about it.

Chairman HOLIFIELD. This makes it all the more important, then, that the Federal people who have this responsibility do discharge their obligation in a creditable way. Unless it is done, we will have a setback. Those we have had have fortunately been minimal. If you had a major setback, in contrast to what I have noted here, I think your industrial evolution would be set back a great many years.

When you speak on page 7 of your prepared statement, "Just when one reaches a plateau of optimistic belief that licensing supervision be relaxed, an SL–1 incident occurs," you are referring there more to the optimistic belief among the people who are actually operating and building reactors, you might say the informed people in the nuclear energy field, are you not?

Mr. WOLMAN. Yes.

Chairman HOLIFIELD. Rather than the general public?

Mr. WOLMAN. No; not the general public. You will recall, for example, when you asked me some months ago whether I thought the time had arrived for the relaxation of certain operating restraints, it was a week after this, and I said a week ago I might have had a more optimistic response to you. The significance of such an incident is that it reminds you once again that you are still not dealing with an orthodox facility that has the completeness of understanding that you would encounter in an equivalent trade.

Chairman HOLIFIELD. We are going into the SL–1 incident in more detail tomorrow morning.

Mr. WOLMAN. Yes.

Chairman HOLIFIELD. I think it is not generally known that this was a military prototype reactor, it was an experimental reactor, and it was being operated in an isolated area. Therefore, at least from the standpoint of isolation, that in itself was a precaution during this experimental phase of the operation of this reactor so that if something did go wrong it would not hurt the population.

I think it will be brought out clearly that this reactor was being operated under completely different rules and regulations than the commercial reactors which are located in proximity to populated areas.

Mr. WOLMAN. Yes.

Representative WESTLAND. If the gentleman would yield, I was wondering, Doctor, in view of the fact that automobiles kill about 30,000 to 40,000 people every year and we seem to get more every year that if we had had a safeguards committee at that time, when the automobile came out, whether we would ever have it today.

Mr. WOLMAN. I think you might have had it. This is a hopeful feeling but you might also perhaps avoid that perfectly disgraceful record.

Representative WESTLAND. That is a real good answer.

Mr. WOLMAN. As I pointed out before this committee many times—perhaps ad nauseam—that record to me is a national disgrace. Perhaps we need an ACRS for it. You might isolate the scientific and technological reasons why it is a disgrace and you might perhaps evaluate causes, both in design, construction and operation of the automobile itself. It is long overdue. This is not a plea that the automobile should be barred. It is a plea that our penalty of the automobile certainly ought to be less than 35,000 to 40,000 killed a year.

As I have said before, I would hate to see the atomic energy industry grow up on the assumption that it is not only desirable for the advancement of the art but also for the contribution to civilization that we ought to be able to kill an equivalent number each year.

Representative WESTLAND. I would agree.

Mr. WOLMAN. I feel quite strongly about that.

Chairman HOLIFIELD. Are there any further questions of Dr. Wolman?

If not, we will excuse you, sir, and thank you for your testimony.

Our next witness is Dr. Walter Zinn from Combustion Engineering Co. Please come forward, Dr. Zinn. It is always a pleasure to have you before us. You may proceed.

STATEMENT OF WALTER H. ZINN, VICE PRESIDENT, COMBUSTION ENGINEERING, INC.

Mr. ZINN. The invitation to me to present a statement at this hearing suggested that I review in general terms the technical aspects of the safety of nuclear reactors under four headings—design, construction, operation, and siting.

The request also invited brevity by scheduling 15 minutes. Each of the subjects indicated is complex and in a short time only highlights can be mentioned, omitting much important detail and also omitting examples which are very helpful in gaining full insight into the problems involved.

The hazard associated with the controlled, self-sustaining fission chain reaction was appreciated very early, well before the construction and operation of the first reactor in December 1942. It is important to realize what basically creates the hazard, and it is also important to place in proper perspective some matters which are of concern in designing a reactor but which are not of a fundamental nature.

The hazard arises fundamentally from the fact that for every watt of sustained thermal power, the fission products accumulated in the reactor have a radioactive strength of approximately 4 curies shortly after the chain reaction has been stopped.

Stopping the chain reaction quenches the radiation connection with the fission process, but the radiation from the accumulated fission products continues and decays only relatively slowly. Since a large power reactor operates at a billion watts, we see that our fundamental problem is the safe storage of approximately 1 billion curies of radioactivity.

The fact that there is such a large quantity of radioactivity in one place would be a matter of concern in any case; it becomes a hazard of serious dimensions when it is realized that potentially the chain reaction itself has the energy necessary to drive the fission products, or some fraction of them, out of the fuel elements where they are created by the fission process.

This combined effect, namely enormous radioactivity stored in a place which conceivably has the energy to drive it out of that place, is principally responsible for the situation which requires Federal Government regulation and control to protect the public welfare.

A number of additional facts are helpful in gaging the magnitude of the problem. First is the fact that the direct radiation, whether from the operating chain reaction or from the accumulated fission products, can be completely screened off by appropriate shields. There is no major problem in the shielding of the chain reaction, although devising the correct and most economical shield has required complex calculation and a good deal of experimentation. But I want to emphasize that in all except exotic applications a completely satisfactory and safe shield can be supplied.

A second point of great significance concerns the potential energy inherent in a collection of materials capable of sustaining a chain reaction. In a reactor, this energy can be released only slowly, and therefore nuclear explosions of significant magnitude are not believed possible.

High temperatures, however, due to the release of large quantities of energy in the volume of the reactor, are possible, and it is these high temperatures which may act to drive fission products out of the place where they are formed.

Our safety problem may be summarized in this question: "Can a reactor in which the probability of the release of an appreciable fraction of fission products is always very low be designed, constructed, and operated?"

It should be noted that the question is not: "Can a reactor complex be made absolutely safe?"

I do not believe absolute safety can ever be claimed. I believe what can and is being done is to reduce the probability of serious hazard to the public to a low enough value so that the risk is comparable to other risks which are found acceptable in our society.

REACTOR DESIGN

The major responsibility for safety falls upon the reactor designer. I believe that all responsible designers are fully conscious of the safety problems and that safety comes first in evaluating any aspect of design.

There are, however, competing requirements and it is the job of the designer to find acceptable, safe designs while, at the same time, meeting requirements such as cost, portability, high temperature operation, et cetera. Because a number of moderators, coolants, and fuels are available, many choices for the collection of materials to make up a chain reaction are possible. Some combinations must be rejected on safety grounds but, even so, the number remaining is considerable, adding to the complexity of the problem.

The following are some of the design features which I believe are generally accepted as design requirements. I want to hasten to say that the list is not complete, and I am sure I will omit a number of features which others would consider absolutely vital.

1. *Compatibility of materials*

The materials within the reactor must be chemically compatible. If a chemical reaction could suply additional energy to that potentially available from the nuclear chain reaction, then the possibility of the release of fission products is substantially increased. Worse still, the chemical reaction could supply the force necessary to initiate an uncontrolled nuclear reaction and consequent unacceptable high temperatures.

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The problem of compatibility of nuclear materials is not an easy one, as can be illustrated by two examples.

From the beginning of the use of water-cooled reactors, the possibility of reaction between water and hot metal has been recognized and many experiments on water-metal reactions have been performed. It is taken into account in the safety analysis of water-cooled reactors. Nevertheless, we do not today have a well-established set of data concerning the phenomenon.

The second example is the fact that in a graphite-moderated reactor energy can be stored in displaced atoms of the carbon and can be released rather quickly by temperature changes. Although this phenomenon is relatively well understood, it still requires careful consideration as reactors are evolved which operate at higher power densities and at different temperatures.

2. Power self-limitation

Designs which have autocatalytic power behavior must be excluded. The simplest example of an unsatisfactory design would be a reactor which gains reactivity due to increased temperature of the fuel.

Since most of our power reactors employ heat transfer to a coolant to remove energy from the fuel elements, it follows that in reaching operating power there must be a temperature increase of the fuel.

If this were also to cause a reactivity increase, we would have the unhappy situation where a small upward fluctuation of power would be followed by a reactivity increase which would produce further increase in power, and thus could cause melting of the fuel elements unless interrupted by the controls. Fortunately, we usually have the opposite situation. Reactors with positive fuel temperature reactivity coefficients are acceptable only if other inherent quenching, fast-acting effects are present to cancel out the undesirable one.

Another example of autocatalytic behavior might be a graphite-moderated reactor cooled by light water. It is possible in such designs to have a situation where flashing of the cooling water to steam would raise the power production in the fuel just at the moment when effective cooling is stopped. This could be expected to lead to melting of the fuel, and therefore the designer must either create a situation where flashing of coolant water to steam becomes impossible or, alternatively, alter the design so that the loss of water does not produce a power increase but rather a power decrease.

No subject in reactor design merits more attention than the inherent reactivity effects associated with temperature changes and/or changes in state for reactor materials. This is a difficult area and calls for application of a combination of mechanical, heat transfer, and physics skills not encountered in most other design work.

3. Fail-safe principle and subdivided control

With the exception of homogeneous fluid reactors, which have no control rods or similar devices at all, most reactors are placed under reactivity control by a system of control rods or elements which by neutron absorption or reflection give the operator the ability to vary the operating power by a factor of 100 million.

The control system, including all of the electronic gear associated with it, must be designed to fail safe. This is a basic premise, and I believe it is followed by all designers.

In addition, it is desirable and customary to operate each element of the control system, that is, each control rod, by a separate and independent electromechanical drive. At the same time, matters are usually so arranged that only one of these drives at a time can be actuated to add reactivity while all can operate together to subtract reactivity.

Space requirements, convenience, and economy all call for the minimum number of these control systems. Safety considerations usually dictate a larger number to insure that the reactivity under the control of a single rod falls within acceptable limits.

Here we encounter a hard choice for the designer. To secure better economic performance in power reactors, the tendency is to increase power density in the reactor and to increase the burnup life of the fuel.

The former causes a space squeeze for the control system and the latter increases the reactivity which the control system must handle. Supplementary control schemes are then invoked, such as soluable poison, spectral shift, moderator level control, and so on. Each has its special safety problems.

In some designs, fuel is discarded and added to the reactor more or less continuously so that at no time is a large excess available for burnup, thus reducing considerably the demand on the control system.

In some cases, fuel change is done while the reactor is in operation; moving fuel will have a reactivity effect so that onpower refueling from the safety viewpoint becomes part of the control system. In any case, the fail-safe principle must apply: it must not be possible for a fault in the control system to cause reactivity to be added when it should be subtracted or to ever add reactivity too quickly.

4. Interlocks and redundancy

For the proper operation of a reactor, a variety of actions can be initiated by the operator which will cause reactivity changes and therefore power changes. Such actions by the operator are not limited to the motion of control rods. The designer must take into account that errors can be made in operation, and for every possibility of an error there should be provided in the design a counteracting or canceling action.

Many process controls are interlocked to permit only acceptable manipulation of valves, pumps, gas pressures, et cetera. This is an intricate subject and general examples are not appropriate. Redundancy of sensing elements, amplifiers, and controls are all examples of the designer's attempt to be sure that human error or inattention or equipment failure cannot result in losing control.

For instance, it is customary to use an ionization chamber and electronic amplifier to produce an electrical signal originating from the neutron density in the reactor which will cause the shutoff mechanism to be activated if the power exceeds the rated value by a small percentage.

At least three such channels, completely independent, are provided. This means that some action would have to be taken three times in order to rob the reactor of the protection afforded by the overpower trip. Because of the fail-safe principle, shutting off any one of the channels or the burnout of any vacuum tube would, in any case, call for a shutdown so only a deliberately contrived scheme could circumvent the overpower trip.

5. Safety gadgets

Gadgets in wonderful variety can be provided to perform various safety functions in a reactor. This is a possible area of unlimited invention but it is also questionable that multiplication of gadgets actually improves safety. There is the danger that too great a reliance on gadgets will cause disregard of more fundamental features of safety; nevertheless, some gadgets can be usefully employed.

One example is a nuclear fuse. In its simplest form, this consists of a chamber divided into two parts by a fusable link made of fissionable material. The two parts of the chamber are so arranged that the one on the periphery of the reactor contains a neutron-absorbing gas under pressure.

The second part of the chamber is empty and lies in the center of the reactor core. Any sudden rise in power will melt the fusable link and allow the absorbing gas to rush into the core and damp out the power rise. Such devices have not been developed to a practical stage but could be useful for reactors where other inherent reactivity subtraction is not available.

6. Siting and containment

From the earliest consideration of the use of reactors, the advantage of siting them in thinly populated areas and of providing what is known as containment was recognized.

For instance, during the war, the present atomic energy sites at Oak Ridge and at Hanford were obtained for siting the first reactors. The protection which is attained by distance in the event of a catastrophic release of fission products from a reactor is a complex subject involving meteorology and atmospheric physics. It can be assumed that the farther away one is from the source of such a release the better, but just how much better is a subject which I believe will be fully discussed by others under the siting parts of the hearing.

With respect to containment, I recollect that just at the end of the war Enrico Fermi, Edward Teller, and I sent to the authorities our conclusions that a large steel container, such as a gas holder, built around a reactor, would greatly reduce the probability that the reactor fission products could reach the public.

It has been found to be a practical matter to build containment structures which have leakage rates less than 0.1 percent of the structure volume per day.

Again, it is not possible to state generally what the improvement factor is, due to a containment structure. I would estimate that for off-site persons the reduction in possible exposure to radioactivity in the event of a major accident is at least a factor of 100.

Perhaps it is appropriate to mention that the containment structure so prominently visible in our power reactors is the third barrier to the release of fission products. First there is the fuel element structure itself, second, the reactor vessel and primary coolant system, and finally, the containment sphere or cylinder. An important feature of any contained design is an evaluation of all conceivable malfunctions and accidents to establish that, as a result, the containment structure cannot be breached.

CONSTRUCTION

In the construction of a reactor complex, it is essential that the design specifications provided by the designer be followed faithfully. Thorough inspection of the completed facility is essential in order to assure that the design specifications were followed. Because inspection of some of the components is not feasible after operation, special care must be taken to see that these components are manufactured and installed in full compliance with the specifications.

For some components, only the very highest quality of construction can be acceptable because failure might lead to an accident of major proportions. The simplest example is the main coolant pipe of a pressurized water reactor operating at a pressure of 1,500 pounds per square inch. Fracture of such a pipe might very well lead to melting of some part of the core. Such a failure is not anticipated if adequate standards are used in manufacture and installation. The number of components whose failure would probably lead to serious consequences is small; hence, for such components no compromise in quality is permissible.

During construction, utmost cleanliness and defense against the introduction of obnoxious chemicals are essential. There are examples where stress corrosion caused failure due to the use of improper cleaning chemicals in the construction phase.

In this respect, a reactor system is no different than equipment in the chemical and petroleum industries. The difference is that some failures may show up after operation in parts which are highly radioactive, making repair extremely difficult. Therefore, reactor construction merits more than usual attention to such details.

OPERATION

At the time the nuclear plant is designed, a scheme for its safe operation also must be generated and, in fact, is required to be presented along with the design to the safeguard review authorities. It follows that the operator must be thoroughly familiar with the design and the reasons for the choices of operating parameters. Training of the operating staff must include understanding of these matters.

Appropriate operating manuals and checklists should be provided and the operating staff indoctrinated in their use. Full-power operation of the plant and all phases of maintenance and fuel handling, as well, should be covered in the operating procedures. The fuel discharged from the reactor contains the fission products, and during all subsequent handling of the fuel caution commensurate with the very large amount of radioactivity involved must be observed. This means that storage and shipping of irradiated fuel will come under the same careful control as the operation of the reactor itself.

Routine operation of the reactor at full power is probably the safest operating situation. Operation after shutdown for maintenance or plant changes should be treated with extra care, as in the initial startup.

In particular, if the reactor is being used for experiments in connection with new fuel cores or any experiment in connection with the reactor primary system, extra precautions are necessary since under these circumstances deviations from standard operating procedures are most likely to be encountered.

A reactor is no different from any other machine in that with use some of its parts may age and conceivably fail to stand up to operating stresses. This aging of the structure is particularly important where radiation damage effects may be expected since there is very little experience to date on radiation effects which have been going on for a long time.

A case in point is the change in ductility of steel used for pressure vessels as irradiation proceeds. However, it is not only radiation effects which must be watched carefully but such conventional phenomena as corrosion; for instance, the carbon steel which is used as the pressure container in carbon dioxide cooled reactors is subject to appreciable corrosion and in the design an allowance is made for the loss in strength due to such corrosion.

It is obviously important as years go by to quantitatively measure the corrosion and relate it to what was expected in the design. Because of the aging of structures, safeguard review of reactors will be a continuing chore through their whole life. I do not know of any reactor type which is completely free of such questions.

Reactor designers, constructors, and operators would find their work easier if standardized, acceptable design parameters were available as they are in some other technologies. At present, the variety of reactor types and operating conditions is still so large that the task of establishing standards for all of the details of design, construction, and operation is monumental.

Furthermore, it is not possible to generalize from one reactor type to another. It would be possible, for instance, for a reactor to satisfy a whole series of safety standards and still fail to measure up on an overall basis, and the converse could also be true. It will take a considerable number of years of experience to establish these standards, but it is a goal toward which the technology must strive.

Chairman HOLIFIELD. Thank you, Dr. Zinn. That is a very thoughtful and comprehensive statement and is particularly valuable to us as it comes from a person who has had so much experience with reactors.

As I recall, you deliberately caused one reactor to—I don't know whether you want to call it—explode, or at least run away just in order to really test it, with some startling results.

Of course, this was a controlled experiment.

Representative VAN ZANDT. Doctor, have you followed the accident at Arco?

Mr. ZINN. Yes, sir.

Representative VAN ZANDT. Have you had access to any of the official findings?

Mr. ZINN. There was an interim report and official finding, I have seen that. I have not yet seen the latest one.

Representative VAN ZANDT. I have followed the accident through the press and likewise read the findings which have been available to the committee. There is one conclusion that stands out in my mind and that is the failure to man the control panel. Would you agree with that conclusion?

Without attempting to place the responsibility for the accident, what I am trying to develop here is that when a reactor is in operation the control panel should be manned at all times.

Mr. ZINN. I believe there should be instrumentation at all times.

Representative VAN ZANDT. Say that again.

Mr. ZINN. I believe there should be instrumentation at all times. Sometimes when your control system is essentially inoperative for instance, when it is dismantled, then you might want something different than manning the control board? Manning the control panel does not allow you to do anything at that moment.

Chairman HOLIFIELD. Your paragraph on page 6 in regard to critical periods of reactor operation is quite a valuable reminder, I think, of the fact that there are times in the operation of the reactor, particularly when a shutdown for maintenance or plant changes occurs, that extra care should be taken.

Mr. ZINN. Experience indicates without exception that is when it happens.

Chairman HOLIFIELD. Or at the time when you start up a new reactor?

Mr. ZINN. So far in the startup of a new reactor there have been no really unknown things. But one always has to confess that is a period when care should be taken. It always is. The startup of a new reactor always gets special attention.

Representative VAN ZANDT. The basis of my question, Doctor, was your testimony on page 6 under "Operation". I just could not help but apply what you said to the Arco incident. Are you going to be here tomorrow?

Mr. ZINN. I will be here.

Chairman HOLIFIELD. Are there any further questions?

Representative BATES. Doctor, what is the nature of that water-hot metal reaction, that phenomena that you referred to? Is that chemical?

Mr. ZINN. Water is a chemical which contains hydrogen and oxygen. Many metals if heated to the right temperature can react with water and rob it of its oxygen. In many cases this is exothermic. The whole thing gets hotter when it happens. You have two dangers: One is the heat generated by the exothermic reaction, and the second is that you have now released hydrogen which if combined with some more oxygen would make an explosion. Whenever we have metal and water and some means of heating up the metal we have to worry about this phenomenon as we have from the very beginning in the reactor business.

Representative BATES. You indicated that you have no significant data on your experience in this.

Mr. ZINN. I would say we have been doing experiments for 14 or 15 years on this phenomenon, but I can't find a book any place where I can look up the sort of information that one looks up on other chemical reactions. It is being worked on. It is a difficult subject because you are dealing with not only the thermodynamics, which is well understood, but you are dealing with what happens when you subdivide the material and you get into surface and volume effects and temperature effects, and so on. It is hard to do experiments.

Chairman HOLIFIELD. Is it possible to develop a checkoff list on these various operations on the various types of reactors?

Mr. ZINN. A checkoff list of particular points to be watched?

Chairman HOLIFIELD. Procedures for the people who are making the changes or modifications or engaged in the initial operation and so forth.

Mr. ZINN. I think this is usually done. An operating manual for a particular reactor is written and an attempt is made to list all the things that have to be done and done in a certain prescribed way.

Chairman HOLIFIELD. They vary, I suppose, from reactor to reactor.

Mr. ZINN. No two would ever be the same.

Chairman HOLIFIELD. Mr. Ramey.

Mr. RAMEY. On page 6 of your statement, you mention the problem of the aging of reactors and that the review of the reactors should be a continuing chore through the whole life of the reactor. How would this review be handled? How would you set up the standards?

Mr. ZINN. I believe that in the initial design of the reactor provision should be made for following what is happening to the critical components during operation. A specific example is the irradiation of pressure vessels. One places within a reactor coupons of the same material and removes these periodically and examines them to see what is hapepning to the steel. It seems to me that as we get more information we will be able to set levels or standards that are acceptable for irradiation of steel. We don't have these at the present time.

Representative BATES. Doctor, in reading your statement, it indicates that we are exercising an abundance of caution in this field.

Mr. ZINN. What I have set down here is a very brief statement of what I think has been going on from the day of the first reactor. I mentioned specifically that even then we were aware of what the hazard was, and many of the techniques which exist nowadays—all of them—were developed over the years as design went along. No one can think of everything. What has been attempted in the reactor design business is to inherently build into the designs things which will avoid accidents.

I personally believe that the greatest emphasis should be placed on those things which don't depend on the action of mechanical or electrical devices, but we should choose our reactor designs in such a way that we get a limitation on what the reactor can do by basic nuclear phenomena. This particular subject, the inherent self-limitation of reactors, is large and complex and is one that requires a high degree of competence to cope with. Every power reactor should have it. I think this is the basic safety of the device and not necessarily all of the other things that I have mentioned. They all contribute. They are all important. I agree with your question, namely, that we are exercising a great deal of care and caution in the design of these machines. We also ought to.

Chairman HOLIFIELD. Thank you very much, Dr. Zinn, for your very helpful testimony.

The next witness is Dr. C. Rogers McCullough, AEC Advisory Committee on Reactor Safeguards.

STATEMENT OF C. ROGERS McCULLOUGH, ADVISORY COMMITTEE ON REACTOR SAFEGUARDS, ATOMIC ENERGY COMMISSION

Mr. McCULLOUGH. Thank you, Mr. Chairman.

Chairman HOLIFIELD. Are you still on the ACRS, or have you resigned?

Mr. McCULLOUGH. No, sir; I am still a member.

Chairman HOLIFIELD. Have you indicated as to whether you are staying on that committee or not?

Mr. McCULLOUGH. My term expires in September, sir.

Chairman HOLIFIELD. September of this year?

Mr. McCULLOUGH. Yes, sir.

It is a privilege to address you on the important subject of the regulation of atomic energy for protection of the public.

I especially appreciate the privilege of giving my views at an early stage of these hearings since I will talk on the technical aspects of the problem. These I believe to be of primary importance and currently the most difficult with which to deal.

The utilization of atomic energy is a highly complex undertaking which requires and uses the knowledge and techniques of all of the sciences and technology known today. In fact, it is truly another step in the advance of our technical civilization demanding the support of all prior knowledge. It would be an impossible step without such support. It is to be expected, then, that the primary concern is that the design, construction, and operation of a nuclear reactor complex is good by technical standards and compatible with its location to assure adequate protection to the health and safety of the public. This is a matter of technical judgment.

The designers and builders of nuclear reactors and components are necessarily highly skilled, competent persons. They know far more about their particular reactor than anyone else can hope to know. There is a tendency to rely on them, and this is sensible and proper up to a limit. However, it must be realized that they are likely to be so enthusiastic about their particular design that its virtues blind them to its vices. The very complexity of the technology makes possible the lack of consideration of some pertinent information. It must also be admitted that there is pressure to keep costs down and this can influence decisions as to safety margins, the need for extra devices, or the quality of materials and components. It is, therefore, the function of government to make sure that the design, construction, and operation will protect the public.

It must be realized that there is no absolute safety. To advance the application of nuclear energy to peaceful purposes, experiments must be performed, new concepts tried, and reactors actually built and operated. This imposes a certain risk upon the public. The decision of how much risk is warranted in the public interest is a policy one rather than a technical one. It is the task of technical men to determine the amount of risk for particular projects and to make sure that it is within the limits that have been set as policy.

Since we are dealing with a very low probability of an accident and an intangible benefit, such policy decisions are difficult to make and to express. There is a great desire to express the standards or criteria in numerical terms or in precise concepts. As the technology becomes older this will be possible to an increasing extent. With definite numbers of precise concepts the decision as to the acceptability of the risk of a particular project would be easy to make and it would be easily understood. As it is, there is no escape from judgment, technical judgment, as to how well a proposal fits within the limits the policy decision has set.

It is reasonable and proper that technical judgments should be based upon whatever quantitative standards there are. Those making the judgment have an obligation to make clear to the laymen the bases of the judgment and the criteria that have been used. In the following I wish to discuss some of the technical problems which must be faced and evaluated in the design, construction, and operation of reactors in order to have adequate protection of the public.

The following outline gives the main parts of the reactor system which must be considered. It is not complete nor sufficiently definite for design or even evaluation but should suffice to give an understanding of the magnitude of the problem.

Fuel elements: Fuel materials and design; cladding; heat transfer limits, allowable temperatures and temperature drops; supports.

Core design: Integration of fuel, poison, coolant, moderator, and reflector to provide a core whose nuclear, thermal, and dynamic properties can be demonstrated to result in a design which is safe.

Primary system: Pressure vessel; piping; valves; pumps, heat exchangers; pressurizer; auxiliary systems; flow of coolant; temperature limits; heat transfer characteristics; et cetera.

Instrumentation: Primary sensing elements for neutron flux, flow, temperature, pressure, et cetera; signal amplification and transmission; signal interpretation display and recording; control commands.

Control: Neutron absorbing rods or movable fuel; rod drives, seals, buffers, and position indicators; reactivity values, power source; method of command; chemical control; et cetera.

Fuel handling and refueling: Head removal or port opening; shielding; handling devices; spent fuel transfer and storage, et cetera.

Power generating systems; Boiler; turbine; condenser; feed-water pumps; auxiliaries.

Waste disposal systems: For solid, liquid, and gaseous waste; collecting system; treatment; disposal; monitoring.

Auxiliaries: Power supply; ventilation; water supply; et cetera.

Containment: Basis for design of structure, external and internal loads; penetrations for personnel, equipment, water, steam, air, electrical power, instrument leads; leak rate, method and frequency of test; cooling by internal or external sprays; fission product absorbers or filters.

The amount of fission products contained in the reactor represents the potential hazard to the environment. This is determined by the power level, cumulative power history, and the refueling schedule.

The kind of reactor, its design, the quality of its design and construction and its manner of operation are determining factors of the probability of malfunction or accident. The physical barriers between the fission products and the environment are the fuel, fuel cladding, the primary system, and the containment. The type and severity of the malfunction and the countermeasures taken determine the probability and amount of escape of fission products from each of the barriers.

The damage to the environment is dependent upon the character and amount of fission products which escape from the last barrier and the meteorological and hydrological conditions which exist at the time. Since our main concern is damage to people, their numbers and location at the time of any release is important in assessing the damage. It is obvious that the type, design, construction and operation of a reactor must be considered in relation to its location in order to reach a judgment on the suitability of a site. Our knowledge of the rate of dispersal and dilution of materials in the atmosphere as a function of distance is quite good if the weather conditions are known. What is not at all well known is the amount and chemical composition of any escape and its form and size if it is composed of particles. The studies of atmospheric dispersion have shown that reasonable distances—one-half mile to several miles—can assure a large reduction of concentration. However, since the desire is to keep the escape of fission products to a minimum, the design features, the quality of construction, and the care in operation and maintenance are of the utmost importance in protecting the public.

There are not sufficiently great distances available for the protection of the public from large releases of fission products. At the same time, proven reactor types, well designed and constructed, carefully operated, and containing reliable engineered safeguards can be located at reduced distances and still give adequate protection to the public.

It is worthwhile to look at how well we can judge that a reactor system has been well designed and constructed. Because of the newness of this technology there are no codes for reactor systems, even in general terms. It is necessary, therefore, to examine how well the design is based on known technology and has taken care of the essential parts, and to what extent experimental proof is available for the design bases and assumptions. Because of the attention which has been given to the nuclear parts of reactor systems, although there have been a few known deficiencies in design, these parts of the system have generally worked quite well. Many problems have arisen, however, from the components which are common to other technologies such as pressure vessels, valves, pumps, flanges, gauges, et cetera.

Some of these components have codes by not all. The codes apparently are not adequate where they exist and the specifications and inspections are not adequate for those components without a code.

Many of the codes were written many years ago and contain safety factors to account for ignorance and poor materials. These need to be brought up to date to meet the needs of the nuclear industry.

There is a great unevenness in the quality of materials and components which are produced even by well-qualified reputable manufacturers. The penalty for a failure in a nuclear plant is so great, even if no one is injured, that we cannot afford poor quality or sloppy workmanship. It is my belief that American industry can meet the challenge and produce high quality materials and components without excessive cost. It should be pointed out that, so far as I know, these failures of usual components have not caused the release of any appreciable amounts of radioactive materials. However, we do not believe it is proper to overlook such unreliability.

The nuclear industry is young in years, but there has been a large amount of study, design, construction and operation. Much of this experience is published but is contained in many thousands of pages of progress reports, special reports, internal memoranda and some summary reports. Very little of it has been critically reviewed to see to what extent the information can be used for criteria for reactor design, construction, and operation. Each reactor proposal must be considered largely upon its own merits and compared with previous reactor technology only to the extent that the reviewers have been made aware of it in a somewhat haphazard way. Attemps are being made to review all the information and to summarize the criteria contained. Until this is completed, we must do the best we can—being oversafe in many cases and perhaps not safe enough in a few unrecognized areas.

It is hoped that I have made the point that there is a vast amount of technical information that must be used to get a good and safe reactor. The public has the right to know that each and every reactor does not impose upon it an unreasonable hazard. Let me compare the body of information to a pyramid. The apex is the simple statement that the reactor is "safe." Such a bare statement is unacceptable since there is no evidence that there is any substance to the supposed pyramid beneath. It is equally obvious that the whole pyramid cannot be used to convince the public. There is literally too much, and much of it is too highly technical, to be intelligible. As we go down the pyramid there is more information and more technical information. How many layers must be used to convince the public that there is a pyramid? Perhaps three, perhaps four. The real question is how does one know that there is a solid pyramid and not a jerry-built structure of props holding up the disclosed layers? How does one know that there are not dangerous holes in the structure? To my mind, some day there will be adequate criteria for all the layers, but in the meantime we must rely on the skilled technical evaluator to determine that there is adequate support for the apex. The reactor is safe for its location. The public is protected.

Chairman HOLIFIELD. Thank you, Dr. McCullough. You have been one of the very enthusiastic protectors of the public safety over the years, and I think all of the members of the committee have been aware of your intense application to this subject of safety.

We have been appreciative of it. We recognize the importance of making this industry almost super-safe because of the public reaction that would occur if we have something in the way of a major catastrophe. Many of us feel that it would almost shut this industry off for all time. So if we err at all we want to err on the side of safety, as I have said to you before.

Mr. MCCULLOUGH. Thank you, sir.

Chairman HOLIFIELD. Mr. Price.

Representative PRICE. One page 8 of your statement you state that the public has a right to know that a reactor will not impose reasonable hazards.

Do you think that the public has been given all reasonable information in this respect?

Mr. McCULLOUGH. My direct answer is yes.

A qualification of the answer is that I think perhaps we can improve on the way we phrase the information that we give them so it will be more intelligible to the layman.

Representative PRICE. How is the public to make a judgment? Is it to accept the word of some authority that it is safe, or how do they exercise any judgment of their own?

Mr. McCULLOUGH. A layman is not steeped in the intricacies of the business and must rely on the judgment of the people who know the details. At the same time the person who is the skilled evaluator must phrase his conclusions in such a way that it is intelligible to the public and the public has a feeling that he has really considered the matter and knows what he is talking about.

Representative PRICE. Do you think that this is being done now in an appropriate manner?

Mr. McCULLOUGH. I think it can be improved, sir. It is a difficult matter. It is hard to find the right words that say what you mean without alarm or raising suspicion that you are trying to cover up something. I think it can be done. I think it can be improved.

Representative PRICE. On pages 7 and 8 of your statement you call attention to the need for critical evaluation of the vast body of technical data so that criteria may be established for the design, construction, and operation of nuclear reactors.

Is the AEC doing a satisfactory job of evaluating and codifying this data?

Mr. McCULLOUGH. It is hard to say whether the work is satisfactory. There is an attempt to critically review and codify this data. There is a subcommittee of the Advisory Committee on Reactor Safeguards which is working with the staff to try to find machinery for looking this over. I personally feel that this is a very important thing in the interest of advancing the art. I would like to see it speeded up. That is a personal view, sir.

Representative PRICE. Some time ago, I recall, Dr. McCullough—I know of your fine work which the chairman has already mentioned—you had some problems in the early days of the Reactor Safeguard Committee because of lack of help and technical people to go out and make the investigations, and so forth.

What is the situation today in regard to the actual operations of the reactor safeguard committee?

Mr. McCULLOUGH. I would say that as of today the committee is getting good support from the staff of the Commission. A lot of studying has gone on. This Commission has now established a rather active research program in reactor safety. Of course, as members of the committee, we have a bias. We always want more information. We have the interest of getting facts upon which to base decisions. I think that perhaps some of the people in the industry and perhaps some of people in the Commission have not fully appreciated how difficult it is for a group like the advisory committee to judge reactors if we don't have a careful review of this mass of data which has accumulated over the years.

It is more fun to design new reactors than it is to go through and critically review data. I personally feel maybe we ought to put a little more emphasis on that. As to keeping track as to what is going on in the industry, this is always a difficult thing to do. But presently with the liaison we have with the hazards evaluation staff and with the inspection staff (called the Compliance Division), we do have a pretty good view of what is going on. We are getting excellent information.

Representative PRICE. Do you have your own personnel on the inspection and technical staff or do you borrow?

Mr. MCCULLOUGH. We borrow from other people. We have a very small staff. By "we", I mean the committee has a very small staff of its own.

Representative PRICE. Do you have a high priority when you borrow the personnel that you need?

Mr. MCCULLOUGH. The people in the field have been most cooperative. They give us quite reasonable priority, sir.

Representative PRICE. That is all, Mr. Chairman.

Chairman HOLIFIELD. Mr. Bates.

Representative BATES. Doctor, you referred to the unreliability and you referred to the unevenness in the quality of materials, and you go further and say that we cannot afford poor quality or sloppy workmanship.

Mr. MCCULLOUGH. That is what I mean.

Representative BATES. Could you give us any examples?

Mr. MCCULLOUGH. Yes, sir. I know of a particular reactor, and I think it is well not to name it, that was held up seriously because of very serious leaks of valves. When you have a multimillion-dollar facility, and you have gone through all the difficult problems of designing the nuclear part of it, I think it is a little ridiculous to be held up by a simple thing like a leaky valve. If you look into this it is my own opinion you will find that this was poor workmanship on the part of the manufacturer and lack of adequate inspection. That is one example. There are other examples where because of a design of a particular control device, we had an accident. The way the circuit was arranged, showed poor judgment on the part of the people supervising the maintenance of that particular control circuit. As a result, the reactor got out of control and melted and it was a very heavy expense. This is sloppy operation in that particular case. We have another case where welding resulted in cracks which were found subsequent to the installation of the reactor pressure vessel.

Representative BATES. Were there cracks in the containment vessel?

Mr. MCCULLOUGH. There were cracks in a nozzle, attached, not to the containment but the pressure vessel.

Chairman HOLIFIELD. There is no excuse for that not being found beforehand with the methods we have of ascertaining cracks in metal, is there?

Mr. MCCULLOUGH. If you look back into it, as we did, this came as the result of a series of blunders. The cracks were found and repaired adequately. But the whole project was held up because people had made blunders.

Representative VAN ZANDT. Was this in the containment vessel?

Mr. MCCULLOUGH. No, this was the pressure vessel. It was adequately repaired.

Chairman HOLIFIELD. This was the fault of quality control on component parts originally?

Mr. McCULLOUGH. That is right. It was a series of blunders, sir. Some of the pieces did not match in size, and so on.

Representative BATES. Are you talking about one project?

Mr. McCULLOUGH. No, each of these were different projects. The point is that people are human. They do make blunders. What I am trying to emphasize is that we cannot afford blunders in this business.

Representative PRICE. The point is that this is possible and it is your job to make adequate inspection to assure that no serious hazards result therefrom.

Mr. McCULLOUGH. No, sir; I am sorry, if I may say so. The Advisory Committee is not empowered to make inspections. We don't make inspections. We merely review what the data are. When we learn of these things we dig into them to satisfy ourselves.

Representative PRICE. Who catches these things?

Mr. McCULLOUGH. There is the Compliance Division, whose job it is to survey these things and catch them, or it could come out in the hazards evaluation staff. Both are branches of the staff of the Commission who watch these things.

Chairman HOLIFIELD. Are you talking now, really, about post mortem inspections when something has happened and you go and look at it? You find these faults, is that right?

Mr. McCULLOUGH. These were found by the staff of the Commission, actually, sir. The committee did not dig these out unbeknownst to the staff. The staff found them. I used these as illustrations of what I meant by mistakes and poor quality.

At the same time there has been some very good quality material installed. We have some examples where they have been running without failure for years. It is excellent. That is what I mean by it being uneven. These are silly things. I know of another case where a turbine was out of balance. It took weeks to get it in balance. In the meantime the whole project was held up. The nuclear part is the part that was working well.

Representative BATES. But the parts are working all right?

Mr. McCULLOUGH. The nuclear part is almost invariably working well.

Chairman HOLIFIELD. Admiral Rickover has always pointed to this point you are bringing out.

Mr. McCULLOUGH. Yes, sir, he certainly has.

Chairman HOLIFIELD. That extra care is devoted to nuclear parts, but sometimes the routine parts which are under other codes of judgment in quality are the parts that ought to be looked at more carefully.

Mr. McCULLOUGH. That is right.

Chairman HOLIFIELD. Mr. Ramey has some questions.

Mr. RAMEY. On the problem of getting to the public information on reactor safety, do you think—this is a sort of leading question—that the reports of the Advisory Committee on Reactor Safeguards are very meaningful to laymen? It seems to some of us on the staff that these reports have gradually been put into the form of AEC regulations, and that you have been consulting counsel so that you don't get into trouble. Your judgments are fine, but they are geared to the hazard analysis and it is pretty hard to understand them, it seems to me.

Mr. McCULLOUGH. I am sure this is right. I do not think that the letters the Committee writes are very informative to the layman. I guess the only excuse that I can offer is that the Committee considers itself advisory to the Commission and writes its words in terms that it hopes will be understood by the Commission. I know they are published. I think there could be some argument to its effect that maybe they should be more informative. The Committee tries to write very brief letters usually. They are not particularly informative.

Chairman HOLIFIELD. As a matter of fact, they are not made from the standpoint of popular reading.

Mr. McCULLOUGH. No, they are not.

Chairman HOLIFIELD. While they are made public, it is assumed that the persons who are interested in this subject do have some competence in the field.

Mr. McCULLOUGH. This is the assumption.

Chairman HOLIFIELD. I am not saying that they should not be so written. Probably there are too many technical terms in them. We are frequently having to admonish our witnesses to simplify things and the statements they make so that the lay reader might understand.

Mr. McCULLOUGH. There is another possibility that the committee could write more thorough and better phrased reports for the layman and if they were so instructed they very likely would do it. But there has been no such instruction.

Mr. RAMEY. I believe the Commission is now undertaking to publish its reactor hazards analysis and to publish it in such a way that the public can understand it. As you know, over the past few years, there has been quite a lot of concern over making this information available to the public, to allay fears and so on.

If the hazards analysis report is published, it would seem desirable that the Safeguard Committee letter or report, that it is geared to, should have this in mind.

Mr. McCULLOUGH. I am sure that these comments at this hearing will be taken into consideration by the committee.

Mr. RAMEY. In the Joint Committee's letter to the Reactor Safeguards Committee, we asked what problems on reactor safety the Safeguards Committee thought should be, or are, of some concern. In the response, dated April 8, there was quite a list of subjects to be given consideration, including a number that have already been discussed by previous witnesses: Aging of reactors, competence of designers, and so forth.

I believe you have that letter before you. What problems do you think are the most difficult and the ones that need the most attention now?

Mr. McCULLOUGH. Even with the possibility of repeating, I think the aging of reactors is in some respects an immediate problem because there are some reactors that have been in operation for quite a while now; some for 16 years, as a matter of fact.

I think we want to look at these reactors very carefully to be sure that there are no current emergency problems. The rest of the aging process is something that should be carried along actively and vigorously but I don't think there is any particular emergency about it.

The thing that needs to be looked at carefully and first is the radiation damage to pressure vessels. As a plant gets older, corrosion, wear, fatigue and poor maintenance will accumulate and so will affect the reliability of the system. Since it is so difficult to inspect these plants, we must be particularly aware of the possibilities and work at devising schemes of examining them. I have already spoken on the competence and unevenness of quality.

This atomic energy business, in my view, is peculiar in that the effects are orders of magnitude greater than any other industry. People frequently think they understand, but don't really understand, the importance of seemingly small things. We have had a few reactor incidents, and some of them that I am thinking of have been comparatively small accidents. But the cost of repairing the damage and getting the reactors back into operation illustrates very clearly how important it is to be very careful and use a high quality of workmanship, construction and maintenance.

The other point that I think is of considerable importance—and here again I think a study of our literature and a critical evaluation is important—is this heat transfer and burnout criteria. It is natural and proper for reactor designers and operators to get all of the power they can out of a given system. That is good economic and engineering sense. But we don't fully understand the mechanism of heat transfer.

If you will look at the plot of burnout correlations put on a log-log scale, it will look like a shotgun pattern. All this says is that we just don't understand the business well enough. There is a lot of work going on in the field. I guess the only recommendation I can make, sir, is that we better find some more people to do some more experiments and get some data so that we can make some sense out of it.

The site criteria matter will be considered at other parts of this hearing. I think I have made the point here and perhaps I disagree somewhat with my predecessor witness, Dr. Wolman, that there is a certain amount of compromise that can be made with distance by reliable, well engineered safeguards. In that aspect, more critical evaluation of our data so that we can determine how well we can rely on some of these devices would help us in our site problem. Those are the main things, I think, that are worth emphasizing. I did not include those in my testimony in the interest of saving time.

If there are any questions, I would be happy to try to answer them.

Chairman HOLIFIELD. Were you called in on the SL–1 incident?

Mr. MCCULLOUGH. I was made aware of it very promptly after it happened and as a member of the committee, I have kept myself informed about it. But that is the extent of my involvement in it.

Chairman HOLIFIELD. You did not visit the site?

Mr. MCCULLOUGH. I did not visit it.

Chairman HOLIFIELD. Thank you very much, Dr. McCullough.

Mr. MCCULLOUGH. Thank you, sir.

Chairman HOLIFIELD. Will you be available tomorrow?

Mr. MCCULLOUGH. Yes, sir.

Chairman HOLIFIELD. Our next witness is Dr. Clifford Beck of the Atomic Energy Commission.

Dr. Beck, you are assistant director of the Nuclear Facilities Safety Branch, Division of Licensing and Regulation, Atomic Energy Commission.

Mr. BECK. That is correct, sir.

71419—61——3

STATEMENT OF CLIFFORD K. BECK, ASSISTANT DIRECTOR OF THE NUCLEAR FACILITIES SAFETY BRANCH, DIVISION OF LICENSING AND REGULATION, U.S. ATOMIC ENERGY COMMISSION

Mr. BECK. Safe operation of a nuclear reactor depends primarily on three essential ingredients: Appropriate design, adequacy of materials and integrity of workmanship in construction, and reliability of operation. A weakness in any one of these can place the reactor in a hazardous condition, even though the condition of the other two may be satisfactory. I will discuss some aspects of each of these technical areas.

1. DESIGN

The two basic safety objectives in the design of a nuclear facility may be stated as follows: (1) The likelihood of accidents which would lead to excessive levels of radiation or to release of significant portions of the fission product inventory must be reduced to the lowest practical level; and (2) The hazardous consequences of such serious accidents, should one occur, must be minimized.

As corollaries to these central objectives a number of auxiliary objectives can be stated. Typical of these are the following:

(*a*) The reactor must be stable in its operation. That is, there should be no self-generated oscillatory, erratic or unpredictable variations in power level and any perturbations likely to be imposed on the system should not lead to such unstable behavior.

(*b*) Insofar as possible there should be inherent, self-limiting characteristics which would cause the reactor's power level to remain at or return promptly to a given condition when any perturbing condition tends to cause it to diverge from that condition.

(*c*) If a reactor is not fully self-stabilizing, its dynamic response to perturbations likely to occur should be sufficiently slow that control systems having reasonable characteristics should be able to restrain the power level within desired bounds.

(*d*) The temperature of fuel elements, the pressure in the reactor vessel, the heat flux on fuel surfaces, the stress on mechanical components, and other similar process variables must have a sufficient margin of safety before failure that likely perturbations will not cause the failure point to be reached.

(*e*) Routine effluents from the facility to the environment must be within permissible limits with adequate monitors to determine, and facilities for controlling, effluent levels if they are above tolerance.

(*f*) Design should be so adjusted that failures, malfunctions and misoperations that could occur would not lead to serious accidents.

(*g*) There must be adequate safeguards against release to the environment of fission products which might be accidentally released from their normal confining barriers within the reactor facility. The safeguards may include, among others, a high-integrity containment building, a washdown spray system, or a filtration system on the building exhaust.

When a reactor is being designed, questions relating to these safety objectives involve an exceedingly wide range of technical factors.

Uncertainty in predictions of reactor performance

For many of these factors, the design decisions must be made in areas where predictions cannot be made with confidence on the actual behavior and performance to be expected. Neither the amount of the accumulated information on basic parameters nor the extent of practical experience in actual operating reactors are sufficient to permit firm predictions of expected performance in a number of areas.

For example, in a large pressurized water reactor recently completed, there existed before initial operation substantial uncertainties in the heat fluxes which could be permitted in the fuel elements before burnout, the degree of nonuniformity in the power distribution and how high local temperatures might be above the average which might exist, and the perturbations to be expected if there should be local boiling at some of the hotter points within the core. These questions related to the upper limit of power level that could be scheduled without being dangerously near material damage or power instability in the reactor. After initial operation, by observation of reactor behavior and a variety of measurements within the core, the values of all the parameters assumed in advance were found to be conservative by a considerable margin, and that initial power level could be substantially increased without undue reduction in margins of safety.

Thus, the uncertainties in many such technical questions are resolved finally by observation of the actual reactor performance.

No two reactors alike; basic information is not yet generalized

Unfortunately, however, such empirical solutions to performance parameters have limited value in contributing to the solution of the same questions in other reactors. No two reactors, even of the same generic type are sufficiently alike that extrapolations on many of the parameters for one reactor can readily be made to another, and all new reactors are deliberately made differently from previous ones in efforts to achieve improvement. Differences in design details; cladding of the fuel, spacing of the elements, width of the coolant channels, flow patterns within the core, control rod patterns and other factors, can have disproportionately large effects on many of the performance parameters of a reactor.

There is, of course, some residual carry-over information of value obtained from operation and observation of every new reactor that is operated; and in time this cumulative experience and empirical comparison of performance data with theoretical calculations will provide a sound foundation for confident predictions of reactor behavior. At present, however, reactor information is not sufficiently generalized to permit complete confidence in advance calculation. It continues to be necessary, therefore, to proceed cautiously with initial operation of each new reactor, with careful measurements and matching up of de facto operating characteristics with those expected. This is particularly necessary if there has not been prior operation of an essentially exact prototype reactor or extensive critical experiments on similar core arrangements.

Subjective evaluations in many of the decisions

This inexact and unstandardized status of reactor design and lack of a firm basis for performance predictions, imposes the necessity of qualitative evaluations and subjective decisions on many of the design issues where quantitative and objective judgments are not possible. This, plus a recognition of the possible consequences of errors in judgment forces the decisions generally further toward conservative choices in design than would otherwise be necessary.

Safety research and development programs

In summary, there are important areas in basic reactor design and performance information where inadequacies still exist even for the relatively well known reactor types. This situation is more general for reactors of types less well known where there is little performance experience.

It is appropriate, therefore, that the Commission have, as it does, an extensive program of investigation into areas of technology relating directly to questions of safety in reactors. This program encompasses explorations of basic, fundamental, scientific issues as well as practical engineering studies. This program, as such, is aside from and in addition to the extensive and varied research and development projects carried forward by the Commission on particular reactor concepts, though out of such projects a great deal of information relative to safety is derived.

It is essential that there be close coordination and liaison between those responsible for the safety program, those who design reactors and those who evaluate the safety of reactors if optimum scope and emphasis is to be maintained in the safety research program and if maximum utilization is to be made of the results obtained therefrom.

It is not the intention here to present a comprehensive review of the safety research program. However, certain examples are presented which serve to identify important technical areas having particular relevance to questions of safety in reactor design and construction and to illustrate the close relevancy of safety research studies now in progress to the design and hazard evaluation processes.

A. Core performance, inherent characteristics.—Fortunately, the inherent characteristics of nuclear fission systems are such that means for controlling the rate of the process are readily available. Fortunately, also, in most nuclear reactors having potential possibilities of practical applications, the physical dimensions can be so arranged that the likely perturbations that might occur tend to be counteracted by inherent, self-limiting characteristics of the system. An example of this is the temperature coefficient of reactivity which in most cases can be made to have "negative" character by appropriate selection and arrangement of the reactor core materials. There are numerous other such parameters relating to the thermal, hydraulic, mechanical, and nuclear characteristics of the reactor which must be similarly considered.

Of particular importance, as indicated earlier in this testimony, is the phenomena of boiling at the surfaces of fuel elements, the microscopic factors influencing this, and the relationship of boiling and heat fluxes to burnout of elements. These issues are crucial to the power level at which reactors can be safely operated. Closely related to all these factors and dependent on them in a complex way is the overall stability of the reactor. The precise understanding of these factors becomes even more important as reactor power is pushed toward its limit, for there eventually comes a point in this direction where instability would set in or failure of some of the components would occur.

Attached hereto in part A of appendix B is a list of research studies on topics relating to these mentioned above which are now underway in the Commission's safety research program.

B. Fission product release characteristics; scavenging.—Of fundamental importance to the consequence of reactor accidents and methods of minimizing damages from accidents that might occur are the characteristics of the fission products accumulated in the fuel and their dispersive nature in case of accident. Knowledge of the fractions of particular isotopes that might be released and their physical and chemical characteristics is essential to predictions of their release and dispersal into the environment and to means that might be developed for their retention or collection.

Six major studies on these questions are now underway in the Commission's safety research program. They are listed in part B, appendix B.

C. Containment.—The large spherical external containment vessel, serving as a "barrier of last resort" against the release of fission products to the environment, has almost become a hallmark of nuclear powerplants. There is exploration in two directions with respect to these containment structures: (1) techniques are improving in their construction which leads to increased confidence in their integrity, and (2) new approaches are being developed to the design of such final retention barriers.

Noteworthy among the new approaches, vapor suppression for water reactor systems and confinement with controlled release are worthy of note. In the vapor suppression containment scheme for high-pressure water systems, any steam, including all radioactive materials that it might carry, which might accidentally escape from the reactor system, is directed into reservoirs of cold water where the steam is condensed, thus precluding the buildup of pressure in the building, and some of the radioactivity—hopefully much of it—would be retained in the water, thus preventing its escape to the environment.

In the confinement with controlled release scheme, which is most appropriate for facilities where high pressure buildup from accidents is not anticipated, any accidentally released effluents from the reactor system are temporarily retained, and the radioactive components are recollected insofar as possible with the noncollectable components being released to the atmosphere at a controlled rate.

Precise knowledge of the chemical and physical nature of fission products, mentioned above, is essential to both these methods of containment, in fact, to efficient design of any method.

Eight studies on these topics are now underway in the Commission's safety research program. They are listed in part C of appendix B.

D. Materials, corrosion, and radiation embrittlement.—Materials constitute the bottleneck in rapid and maximum development in almost all practical applications of nuclear processes. Reliability of components, lifetime of fuel, and stability of components under stringent temperature and irradiation conditions in reactor facilities depend on materials, and most materials now available have serious deficiencies when compared to characteristics ideally desired. Two particularly troublesome factors that have to be reckoned with in all aspects of reactor design are: (a) the possibility of corrosion which would lead to failure of components, and (b) the assorted deleterious effects of irradiation on physical properties of materials. These are discussed further in the next section.

The Commission's safety research program is directed to many aspects of these materials problems. Five principal studies on these topics are listed in part D of appendix B.

2. CONSTRUCTION

No reactor can be so fully protected by design safeguards that it will remain without hazard should failure or malfunction of its component parts occur. However well a reactor is safeguarded by design, there can always be failure in some of its key components which can lead to danger. It follows then that the less likely the failure of components in a reactor the higher its level of safety.

There are two basic ingredients—aside from design—which enter into the reliability of components: (1) The choice of materials and (2) the quality of workmanship.

Problems with materials

As noted in an earlier section, it is unfortunately true that almost none of the constructional materials readily available are full suited to ideal utilization in nuclear applications. In all choices of materials, there must be a constant awareness of the limitations of each one, the boundaries within which it can be safely operated, and the imperfections and deficiencies which can beset it.

Corrosion

Corrosion is a factor that must be considered in any area of engineering practice. In nuclear reactor applications corrosion problems are particularly acute because the environmental conditions encountered may be more conducive to corrosive attack than in the usual application and because the consequences of failure may be unusually hazardous.

As an example, there is contained in appendix A attached hereto a brief summary of the stress corrosion failure of control rods in the Dresden reactor and the defects in components in other reactors from the same cause. It was concluded that these failures probably resulted in considerable part from procedures in the manufacturing process which produced in these components in the finished state higher residual internal stresses than was necessary or desirable, and hence rendered the components more susceptible than is normally the case to stress corrosive attack.

This points up the necessity for basic knowledge of the characteristics of materials and for rigid specifications and controls in the manufacturing process as means of achieving reliability in components.

Irradiation effects

Most of the effects of radiation on materials used in nuclear reactors appear to be deleterious ones. Among others which the reactor designer must be on guard against are dimensional changes in materials, polymerization and decomposition of liquids, energy stored in lattice deformations (in graphite) which, unless released in a controlled way could cause overheating; and embrittlement. The latter problem is of particular importance in ferritic steels used in reactor pressure vessels.

In the ferritic steels (not stainless) used in the heavy, thick-walled, pressure vessels employed in most power and test reactors, there is a change in mechanical properties in the material which occurs over a particular range of temperature. A temperature, known as the nil ductility temperature (NDT) has been established as the reference point in this range at which the material would fail in a brittle manner. Above this transition temperature, the material is ductile, it yields in stress before final failure, and local fractures or cracks are not unduly extended to other parts of the material. Below this temperature the material is relatively hard and brittle. Forces which the material could withstand at higher temperatures may cause failure below the NDT; if local failures occur in the material they may be propagated over the entire piece.

It is important that a reactor pressure vessel be used for high pressure loads only at temperatures above the NDT. Normally, the NDT is at approximately room temperature. It has been known for a long time that the NDT increases when the material is exposed to high energy radiation, particularly neutrons. The NDT of a piece of material depends on a number of factors other than irradiation, but irradiation causes a shift in this point to higher temperatures. Recent studies indicate that the elevation in NDT may be lower than formerly believed at low irradiation doses, but it increases more sharply at higher doses.

Reactor vessels now in use accumulate radiation exposure doses at greatly differing rates. A vessel that fits snugly around the core with little internal thermal and other shielding will accumulate a much larger exposure dose in a year than would a large reactor vessel with much internal shielding.

For some reactors, irradiation has proceeded to such points that there must be consideration of special restrictions on loading the vessel before it has been heated to temperature higher than those which have been necessary up to the present. This problem is under active study at the present moment.

There are many complex aspects to this problem. For example, the changes in NDT depend on the exact nature of the steel, its manufacturing history, its temperature during irradiation exposure and other factors. Further, the full irradiation effect on the material is only on the exposed surface, while deeper layers, shielded from the radiation, will have greatly reduced radiation exposures. Most pressure vessels are constructed with safety factors of four, but at some of the nozzles and other penetrations, the residual stresses may be higher and the safety factors less. On the other hand, most of the nozzles are not as heavily exposed to irradiation as are other parts of the vessel. An extensive review of such factors relating to this problem by the Commission staff has been underway since early in May.

From what we now know, considering the conditions under which they are now used, there are no reactor pressure vessels presently in use in which radiation exposure has progressed to such point as to constitute a hazard of radiation embrittled failure.

Our present studies are addressed to further detailed investigations of reactor vessels on a case-by-case basis and are intended to lay the basis for operational limitations that undoubtedly will be necessary in the future for most reactor vessels as operating time is extended.

3. OPERATION

The most adequately designed automobile can be operated very unsafely; similarly, with nuclear reactors. Even though every reasonable safety device and design safeguard is provided, including protection against most of the forseeable errors and misoperations a careless operator might make, no reactor is fully immune to the hazardous consequences of erroneous judgments, faulty procedures, or careless operation.

It is not possible to insure that all human frailties in operation will be eliminated. However, there are a number of basic principles which are fundamental to safeguarding against the likelihood of misoperations.

(*a*) It is important that the lines of authority and responsibility in the operating organization be clearly defined.

(*b*) There is usually provided some system of checks and balances, internal to the operating organization, by which some competent technical group separate from the line operating staff, periodically examines reactor operations and performance, reviews proposed changes in the facility or in the operating procedures, and examines important revisions in the experimental program, to insure that hasty or ill-considered revisions are not made, and generally exercises a second management judgment on operations, independent of the operating staff.

(*c*) It is important that there be definite, written procedures by which all normal operations are performed and by which all foreseeable abnormal operations and contingencies are handled. Deviation from these procedures should not be permitted after alternate procedures are approved.

(*d*) The supervisory and operating staff should have adequate experience and training for the tasks assigned.

(*e*) There should be well defined boundaries and limits within which the facility may be operated.

In the final analysis a major share of responsibility for operational adequacy of nuclear plants must rest with the management of the facilities. The human factors are particularly important in operation, including design and construction problems, though in all these aspects, the management and plant organization must bear the primary responsibility for safety.

Site selection: this item is discussed elsewhere in these hearings.

Chairman HOLIFIELD. We will include these two appendices that you have attached to your prepared statement in the record at this point.

Mr. BECK. They are presented for your information.

(The documents referred to follow:)

APPENDIX A

EXPERIMENTS WITH 17–4 PH STAINLESS STEEL FOR CRITICAL REACTOR COMPONENTS

In November 1960, it was discovered that a main extension rod (hollow tube) in the drive mechanism of one of Dresden reactor control rod drive systems was fractured. Further investigation revealed that the same component in several other control rod drive mechanisms was cracked. Other components of the drive systems made of the same material were also cracked.

These components were made of 17–4 PH stainless steel. This material has been utilized in reactor components for a number of years where high strength and high hardness properties are required. The hardness of the material is controlled to a large extent by the final heat treatment given in the fabrication process; lower final temperatures (e.g. 900° F.) give greater hardness than higher final temperatures (e.g. 1,100° F.).

After considerable analysis and testing, GE determined that the cause of the cracking was stress corrosion. Stress corrosion is a form of chemical attack on certain types of metallic structures which may be initiated or accentuated by internal residual stresses in the structure. When such metallic structures are deformed or cold-worked, internal stresses are formed, which may subsequently be unrelieved or only partially relieved by heat treatment, particularly if heat treatment at a low temperature is used.

Review of the manufacturing process which had been followed for these components in the Dresden reactor revealed that there had been straightening and cold working of the components in various steps of the fabrication process, which would have tended to enhance the internal stressed condition, and that the final heat treatment temperature, kept low (~ 900° F.) to yield high finished hardness, was too low to relieve internal stresses. Tests of specimens cut out from the failed parts revealed that high internal stresses were present. Thus, the manufacturing processes would have been expected to yield stress conditions which would have enhanced the possibilities of stress corrosion attack.

Inquiry was made concerning the performance of 17–4 PH components in other reactors. At Argonne in the EBWR and at Vallecitos in the VBWR, where manufacturing processes had been similar in some respects to those used on the Dresden components, cracks in some components were also found, though no failures had occurred. In one reactor, where stringent controls in the fabrication process had been used with limitations on the amount of cold working permitted, no cracks were found even though the final heat treatment was approximately 900°. In other cases, the final heat treatment was higher (about 1,100° F. versus about 900° F. in Dresden), and no cracks in 17–4 PH stainless steel components were found even for components which had been in use for over 2 years.

Thus, from this preliminary investigation, there were indications that where the manufacturing process had not been stringently controlled and low temperature final heat treatments were used, one might expect the 17–4 PH components to be subject to stress corrosion, while for components manufactured under good controls and where a higher final heat treatment temperature was used, stress corrosion would be less likely.

It cannot be concluded, however, that this is the complete story, and that no stress corrosion will result where proper fabrication controls and heat treatments are employed. For example, these two additional facts must be considered:

(a) The design of a component and its load conditions in use may impose stresses in the material which may greatly enhance its susceptibility to stress corrosion, even though residual stresses resulting from its manufacture were not excessive.

(b) The chemical composition of the fluid within which components may afford a much higher tendency to stress corrosion in one reactor system than in another.

From these considerations, guidance for the manufacturing process has been developed so that the likelihood of corrosion attack is reduced. Also, the need has been pointed up for control of load stresses in operation, to reduce the likelihood of stress corrosion. Finally, it is recognized that the possibility of stress corrosion attack has not been and probably cannot be completely eliminated. In consequence, safety evaluations of reactor designs should contemplate the possibility that failure of such components could occur, and insofar as possible, care should be taken that the consequences of such failure are not unduly hazardous. Further, the possibility of stress corrosion failures which can progress statewise from small surface cracks to complete fracture of a structure has been recognized. This points to the value of periodic inspections of components, and the possibility that by suitable inspection schedules, incipient defects might be detected before complete failures occur.

APPENDIX B

ILLUSTRATIVE LISTING OF STUDIES INCLUDED IN THE COMMISSION'S SAFETY RESEARCH PROGRAM RELATING TO THE TECHNICAL ITEMS IDENTIFIED

A. STUDIES RELATING TO STABILITY AND DYNAMIC CHARACTERISTICS OF REACTORS

1. The SPERT reactor program (at Phillips Petroleum): Experimental and theoretical studies are in progress to increase our understanding of reactor transient conditions, including the study of different reactivity coefficients and their relationships to self-shutdown mechanisms. The level of excursions that can safely be accommodated by the SPERT reactor will be determined as well as the consequences of excursions where core meltdown occurs.
2. The KEWB reactor program (at Atomics International): The kinetic behavior which results from ramp and step insertion of reactivity is being studied to predict power-burst behavior and self-shutdown mechanisms under various conditions of gas formation, temperature, pressure, and initial core volume.
3. Organic reactor safety program (at Atomics International): Capsule experiments for measurement of transient void-generation and out-of-pile loop experiments are in progress on transient pressure-temperature-flow behavior.
4. Kinetics of heterogenous water reactors (at Space Technical Laboratories): Measurement of void generation in a single coolant channel is being studied. Analog simulation of basic kinetic equations relates power input to the self-shutdown mechanism of void generation.
5. Studies of dynamic bubble formation (at University of California, Berkeley): Boiling and dynamic bubble formation during high transient heat input to water systems are studied at small scale under pressure up to 2,000 p.s.i.g. and under static and dynamic flow conditions.
6. Gas-cooled reactor safety program (by Nuclear Development Associates): This is a survey study of problem areas in gas-cooled systems including transient reactor behavior and dynamic reactor characteristics.
7. TREAT reactor program (at Argonne National Laboratory): Experiments on fuel meltdown characteristics of fast reactors are being conducted as well as analyses of core behavior as a whole.

B. STUDIES RELATING TO FISSION PRODUCT RELEASE

1. Fission product release program (at Oak Ridge National Laboratory): In-pile and out-of-pile experiments are conducted to investigate the effect of stoichiometry, fuel burnup and UO_2 density, fuel element geometry and cladding, temperature history, and coolant conditions upon the amount and type of fission product release.
2. Fission product release program (at Brookhaven National Laboratory): The chemical compositions, physical nature (gaseous or particulate), and particle size of biologically hazardous fission products is being examined.
3. Confinement, trapping, and filtering of fission products (ORNL).
4. Basic filtering and air cleaning studies (Harvard Air Cleaning Laboratory).
5. Scavenging of radioactive particulate materials from air (Armour Research Foundation).
6. Large scale field release studies on fission product dispersion (aircraft nuclear propulsion studies).

C. STUDIES RELATING TO REACTOR CONTAINMENT STRUCTURES

1. Reactor vessel program (at Naval Ordnance Laboratory): This study investigates the ultimate strength of reactor vessels as a first line of containment

for fission products. Basic studies of elastic and plastic material properties (a functions of strain rate under dynamic load) are in progress.

2. Vapor containment vessel studies (at Ballistic Research Laboratories): This program develops analytical tools for predicting structural response of large containment shells under internal dynamic pressure load such as might occur during reactor excursions.

3. Missiles generation program (at Stanford Research Institute): Missiles that might result from violent nuclear excursions and thereby menace the containment ability of any surrounding vessels is being determined by scale model tests. The resistance of containment materials to penetration is also being studied.

4. Shock generation studies (at Armour Research Foundation): Possible shock loads (both within the reactor primary system and within the outmost containment barrier) due to sudden release of stored energy are being studied. Methods of analyzing shells and designing protective shields have been developed, as well as the basic information on materials properties needed to apply the methods.

5. Earthquake studies (by Lockheed): This has defined the effects of earthquakes on reactor systems and presented methods for analyzing reactor structures under such loads.

6. Reactor housing studies (by Atomic International): This investigates the possible use of conventional building construction as a new and perhaps more economical means of containment. Total leakage rates from large containment buildings are being measured.

7. Pressure suppression studies (by Armour Research Foundation with Sergent and Lundy): A comparative economic survey has been made of several types of containment as applied to various sizes of water reactors. A program to design a large experimental facility that will be capable of testing several containment schemes under several degrees of simulated loss-of-coolant accidents.

8. Two-phase and critical flow studies (at the University of Minnesota): This is a basic study in phenomena underlying the loss-of-coolant accident and will ultimately provide means of predicting the loads such accidents will impose upon containment.

D. STUDIES RELATING TO REACTOR MATERIALS

1. Metal water reaction program (at Argonne National Laboratory): The possibility of exothermic reaction between reactor materials and coolant is being studied. In-pile and out-of-pile experiments are in progress on aluminum, zirconium, stainless steel, and uranium to find their reaction rates with water.

2. Metal ignition studies (at Argonne National Laboratory): This is a systemmatic study of the variables involved in the pyrophoric behavior of reactor metals. Studies concern burning and ignition properties of zirconium, aluminnum, uranium, thorium, and plutonium.

3. Studies on the use of ferritic materials in nuclear reactors are concerned with determining the susceptibility of stainless steel to stress corrosion cracking in high purity water comparable to reactor water conditions, the minimum stress required to cause cracking in stainless steel in high chloride and oxygen water, and the minimum chloride and oxygen content necessary to cause cracking at a specified stress level; the investigation of corrosion resistance of carbon and low-alloy steels in oxygenated water to determine the applicability of these materials for reactor use; the effect of environment on the creep properties of type 304 stainless steel at elevated temperatures directed towards understanding the effects of service variables such as stress and temperatures; formulating and experimentally substantiating a more precise behavior theory on fatigue damage for materials used in nuclear power pressure equipment; determination of states of stress in various types, size, and shaped nozzle outlets in cylindrical pressure vessels using full scale steel models under various load conditions; and development of welding electrodes for joining type 347 stainless base material which would reduce its susceptibility to cracking.

4. Programs on irradiation damage include: obtaining data on the mechanical properties, such as creep and tensile strength, of structural materials during in-pile irradiation in an operating reactor; fundamental studies to determine the damage mechanisms induced by irradiation in structural materials; obtaining data on the mechanical and physical properties of structural materials by post irradiation measurements.

5. Other studies include: determining the effects of oxygen, nitrogen, and hydrogen environments on the mechanical properties of niobium at elevated temperatures; the corrosion resistance of aluminum and zirconium alloy cladding matreials in high temperature water (550° F.), investigating the compatibility of various container materials with boiling potassium; the accumulation and interpretation of thermal stress fatigue on zirconium and Zircaloy-2 to determine the possibility of premature failure of these materials under conditions of cyclic stress when used as structural materials; investigation of the fundamental mechanism of hydrogen-zirconium reactions; and the development of equipment to determine the true stress-strain properties of brittle refractory materials up to temperatures of 5000° F.

Chairman HOLIFIELD. On page 3 of your statement, you state there is a lack of firm basis for predictions of reactor performance. This imposes the necessity of qualitative evaluations and subjective decisions on many design issues where quantitative and objective judgments are not possible.

I think that is a true statement. The problem we face is: Shall we proceed with the civilian power industry under these circumstances, or is it necessary to wait until they are standardized and firm performance predictions are available?

Mr. BECK. My answer to that question is that we may safely proceed. But we need to proceed as we have been in the past with a case-by-case review of characteristics, using the best judgment we can bring to bear on the problems.

Chairman HOLIFIELD. In your opinion, is safety research an area where additional work is required and an area that we may have overlooked?

Mr. BECK. There is never enough work being done to provide all the answers to the questions wanted at the moment they may be needed. But the scope of the program, and it is now being expanded and extended in various directions, is generally addressed to the important questions which are of basic importance to the safety question.

I know of no major questions or even of any significant minor ones which are not receiving attention.

Chairman HOLIFIELD. In your statement, on page 5, you call attention to the need for the close coordination between those responsible for the safety program and those who design reactors and those who evaluate the safety of the reactors. Are you familiar with the Commission's recent internal reorganization which separates the regulatory responsibility and places it under the Director of Regulation?

Mr. BECK. Yes.

Chairman HOLIFIELD. Do you think that arrangement will impede this necessary close liaison you call for?

Mr. BECK. As I understand it, this arrangement does specifically provide for liaison between the reactor evaluation staff and the reactor safety program. Further than that, as another aspect to this problem, it provides joint collaboration between the two staffs of the Commission in funneling the information from these research programs into the nuclear community. So I believe it does have within it the possibility that these two objectives mentioned here will be achieved.

Chairman HOLIFIELD. Thank you very much, Dr. Beck.

Mr. BECK. Thank you, sir.

Chairman HOLIFIELD. Dr. Simpson, are you going to be in town tomorrow?

Mr. SIMPSON. No, sir.

Chairman HOLIFIELD. How long is your statement? We are facing a rollcall in the House and that is the reason I make this interruption.

Mr. SIMPSON. I would guess about 10 minutes. I can undoubtedly speed it up. I am at your pleasure, sir, if you would rather have it for the record.

Chairman HOLIFIELD. We have to answer a rollcall.

Representative PRICE. Why don't we recess for 5 or 10 minutes?

Chairman HOLIFIELD. I think we will have to do that.

If you will bear with us, we will get back as soon as we answer the rollcall.

(Brief recess.)

Representative PRICE. The committee will be in order.

The next witness is Mr. John S. Simpson of Westinghouse Electric.

STATEMENT OF JOHN W. SIMPSON, VICE PRESIDENT, WESTINGHOUSE ELECTRIC CORP.

Mr. SIMPSON. Mr. Chairman, I welcome this opportunity to discuss nuclear reactor safety with you. My experience has been in the technical aspects of reactors and I will confine my remarks to that area.

I am John W. Simpson, general manager of the Westinghouse Atomic Power Division. I welcome this opportunity to discuss nuclear reactor safety with you.

In any discussion of nuclear reactor safety we should first look at the conceivable accidents and then analyze the protective measures we might take.

In reactor safety we are concerned with three dangers:

(1) Blast or explosion

(2) Direct radiation from the core of the reactor or the reactor system during normal and abnormal operation

(3) Release and transport of fission products or other radioactive materials and related radiation hazards.

BLAST OR EXPLOSION

The possibility of a high-energy explosion from a power reactor is sufficiently improbable as to be listed as incredible. A reactor is not a bomb—its physical arrangement is dissimilar and it does not detonate with a high-energy release.

In most reactor types, factors such as a negative temperature coefficient, doppler coefficient, the presence of a moderator, and similar physical considerations make a nuclear-bomb-type energy release an incredible occurrence.

If reactor power should rise rapidly and tend to approach the dimensions of an explosion, there would be a self-disassembly of the reactor which would reduce the reactivity and limit the energy yield. This in effect makes a reactor a self-limiting device totally unlike a nuclear weapon.

In some reactor systems chemical reactions are possible between the reactor fuel and coolant. Even if such a reaction were to occur, the energy release would be small and comparable to that associated with the total stored energy of the high pressure coolant system in a water-cooled reactor. These chemical explosions can only be conceived in certain systems.

DIRECT RADIATION

I do not believe there is any danger to the general population from the direct radiation of a power reactor, either under normal or abnormal operating conditions. There are many factors which would cause attenuation of the radiation, including distance, the internal shielding of the materials of the reactor itself, special shielding, the pressure vessel walls, the concrete biological shielding, the vapor container equipment surrounding the reactor, and finally, the air itself. Direct radiation is not a danger outside of the immediate proximity of the reactor.

RELEASE AND TRANSPORT OF FISSION PRODUCTS

Fission products release is the main potential danger to the general population and there are two obvious elements in this hazard—the creation of fission products and their release. Thus, a critical experiment, a nuclear rocket engine, a space auxiliary power reactor, or any other reactor which has not been operated at power, has no contained fission products. A cold or unused reactor, then, is a safe device from the standpoint of radiation hazard.

If fission products have been created by operating the reactor at power, we attain safety by having barriers to prevent their release. In heterogeneous power reactors we have multiple barriers.

The first barrier is the fuel element matrix and clad. The fission products are contained in the fuel element by the element structure and by the cladding. Among other things, the clad or coating might be a steel or zirconium tube. These are impervious to diffusion of fission products, and as long as no break occurs, no fission products should be released to the coolant.

The second barrier is the reactor primary system itself, consisting of the reactor vessel and the pipes and the walls of the various components. If the fission products, by some chance, should be released from the fuel element, they are contained within this reactor primary system.

The third barrier is the vapor container which surrounds the entire reactor system. This vapor container is of such strength and size that it can contain the vapor from the reactor and all entrained fission products under the most severe credible condition of rupture of the primary system.

Now, with this "multiple barrier concept," if something should go wrong, a fuel element clad leak or a rupture in one of the smaller pipes, there would still be no release to the atmosphere because of the vapor container. The chance of all barriers failing is remote and failure in any one of the barriers should not cause failure in another.

The other factor to be considered in fission product release is the quantity involved, because not every fuel element leak represents a severe hazard.

When there is a clad failure during normal service, the fission products can be detected in the water and there should be ample time for an orderly shutdown and replacement of a fuel element before a large clad rupture could take place.

Another possibility leading to clad failure is an unusual chemically or heat-produced incident. By this I mean some major change in the chemistry of the coolant which would cause rapid corrosion or a heat-produced failure due to a local hot spot in the reactor.

There is little reason for a surprise change in coolant chemistry, and as our experience grows this becomes even less likely.

In order to have a failure caused by increased heat production, there must be an increase in power or a rather significant change in the flux distribution resulting in a more adverse peak-to-average ratio, which for a given power level would cause some point in the reactor to be hotter than designed. Core design should provide an adequate margin of safety to prevent this from happening.

It should be noted that even if there is a clad failure of this type it is likely to occur in a relatively small number of fuel elements, possibly only in one. In metallic fuels, only a relatively small part of the fission products would be released and in fuels such as uranium oxide a major fraction would remain within the structure of the oxide. The gaseous fission products, however, tend to be released more readily from an oxide system.

Let's examine next a rupture of the primary system. Studies show that the worst credible failure of the primary system is a longitudinal split of moderate size in the main coolant piping. For this and less severe conditions the core can be protected from overheating by the reactor scram and adequate core cooling can be provided by an emergency coolant injection system.

In our evaluations of plant safeguards we consider what the consequence would be if we had a most adverse primary system rupture including such things as a meltdown of the core and release of fission products. Even under these conditions, we find the vapor container is sized to adequately contain the released fission products.

SAFETY MUST BE DESIGNED INTO THE REACTOR

Safety must be considered in all phases of nuclear research and development and in the design of a reactor system. It is not sufficient to simply design the most efficient reactor system and then try to eliminate characteristics which adversely affect safety. Safety must be designed into the system from the start.

There is no black magic in reactor safety. There is an adequate technological base to make reactors safe today, but the designer must truly understand the technology and apply it properly.

There has been a concerted drive to decrease the cost of atomic power but this is not necessarily inconsistent with safety objectives. I would not deny that a first-class design effort is costly, but, frequently, cost improvements increase rather than decrease safety. For example, improved manufacturing techniques which are less costly might result in a more uniform and higher quality product. Making larger quantities of components such as steam generators, pumps, and pressure vessels and the resultant increase in manufacturing experience can bring about a more uniform and higher quality product. Certainly the simplification of systems in cost reduction efforts can aid safety by reducing the number of components and decreasing the chances of equipment failure.

Many of our development programs aimed at cost reductions, in which we study such things as power distribution, flux distribution, transient conditions, and the like, add to our general knowledge and as we know, knowledge and safety are related.

OPERATION AND MAINTENANCE

Proper operation and maintenance of the nuclear plant is essential to safety.

Here, the first requirement is the recruitment of good operators, men who are intelligent and psychologically stable. They must be given a thorough theoretical and practical training followed by written and oral examinations.

While in many types of powerplants it is satisfactory to have rule of thumb operating procedures, in an atomic power plant you have to have written procedures for both normal and emergency conditions. Further, the operator should be required to write out incident reports on any problems or near accidents, and these should be analyzed by the supervisory staff to determine what changes, if any, are required. It is essential to have drills in casualty and emergency procedures and to give periodic examinations to the operating personnel to assure that they are up to date on their knowledge of the plant and any changes to the plant. This quality and training of operators and supervision is of paramount importance.

Even with an excellent operating crew, if there is not proper maintenance of the plant, difficulties may be encountered.

CLOSING REMARKS

We have seen that with radiation barriers we can have protection for the general populace from release of harmful radioactive products. But we should not assume that the physical presence of barriers is enough. We have to design safety into plants, make quality control a primary objective, and operate nuclear power stations with intelligence and meticulous care.

Mr. Chairman, I thank you.

Representative PRICE. Mr. Simpson, I would like to commend you for a fine and effective statement. I would like, also, to express the appreciation of the committee for the advice you have not only given in this instance, but in many past instances, when the committee has called upon you for advice.

We have had very frequent contact. We remember your good work with Bettis Laboratory and we are deeply appreciative of the help that you have already offered when we have gone to you for counsel and for testimony.

Mr. SIMPSON. Thank you, Mr. Price.

Representative PRICE. Would you explain this self-disassembly feature of a reactor that you mentioned on page 2?

Mr. SIMPSON. This is simply the fact that if energy is released the parts are moved away from each other in such a way that it is no longer critical and the energy release is stopped.

Representative PRICE. Is this true on all types of reactors?

There is no explosion as such, that can take place?

Mr. SIMPSON. No explosion can really take place.

Representative PRICE. But in the SL-1 case there was an explosion.

Mr. SIMPSON. And there was some limiting by things leaving the reactor, such as the coolant.

Representative PRICE. On page 8 you mentioned the importance of recruiting good operators, men who are intelligent and psychologically stable. Do you feel that the AEC requirement for the issuance of operator licenses is satisfactory and guarantees the recruiting on this basis?

Mr. SIMPSON. I think that basically they are, sir; but no rules can substitute for an awareness of the need on the part of the operating management and their scrupulous attention to carrying out the intent of the regulations.

Representative PRICE. So that almost every operator will sort of have to be on a probationary period and be observed in his work for a period of time.

Mr. SIMPSON. Experienced management people can tell these characteristics in an operator. They are very difficult to prescribe by law.

Representative PRICE. Would you withhold the issuance of a license for a probationary period for the operator?

Mr. SIMPSON. No, sir.

Representative PRICE. How would you do it, then, in order to insure the selection of stable, reliable people?

Mr. SIMPSON. This can be determined by the qualifying tests they are given, the examinations, both oral and written, and their psychological stability by their previous employment experience.

Representative PRICE. On page 9 you call attention to the importance of filing incident reports on any problem or near accident. Would it be a good idea to have these incident reports circulated to other reactor operators?

Mr. SIMPSON. The only difficulty with that would be in making them sufficiently complete that they would be really readily interpretable. So often they have to do with purely local circumstances that are very difficult to communicate adequately to other people. Certainly, major ones might well be communicated to other people.

Representative PRICE. Thank you very much, Mr. Simpson.

Mr. SIMPSON. Thank you, sir.

Representative PRICE. The Chair wishes to thank all the others who testified this afternoon and express the committee's appreciation for their assistance and cooperation.

The committee will be adjourned now until 10 a.m. tomorrow.

(Whereupon, at 4:40 p.m., Monday, June 12, 1961, the hearing in the above entitled matter was recessed, to be reconvened at 10 a.m., Tuesday, June 13, 1961.)

71419—61——4

RADIATION SAFETY AND REGULATION

TUESDAY, JUNE 13, 1961

CONGRESS OF THE UNITED STATES,
JOINT COMMITTEE ON ATOMIC ENERGY,
Washington, D.C.

The Joint Committee met, pursuant to notice, at 10 a.m., in room P-63, the Capitol, Hon. Chet Holifield (chairman of the Joint Committee) presiding.

Present: Representatives Holifield, Price, Aspinall, Van Zandt, Morris, and Bates; Senator Dworshak.

Also present: James T. Ramey, executive director; Jack R. Newman and George F. Murphy, professional staff members, and Edward J. Bauser, technical adviser, Joint Committee on Atomic Energy.

Chairman HOLIFIELD. The committee will be in order.

This morning the Joint Committee will open its inquiry into the facts surrounding the SL-1 accident at the National Reactor Testing Station in Idaho.

On January 3, 1961, an accident fatal to three persons occurred at the SL-1 reactor. This was the first fatal power reactor accident in the United States.

The committee has deliberately withheld hearings on this accident until completion of the AEC investigation and report.

The AEC report was released this past Sunday, June 11, and has been published by the Joint Committee as a preprint for these hearings.

This morning we shall receive the testimony of witnesses from the AEC and Combustion Engineering, the operating contractor for the SL-1 reactor.

The first witness this morning is Dr. Frank Pittman, of the AEC Division of Reactor Development.

Dr. Pittman, you may proceed.

STATEMENT OF DR. FRANK K. PITTMAN, DIRECTOR, DIVISION OF REACTOR DEVELOPMENT

Dr. PITTMAN. Mr. Chairman, this portion of the briefing on the SL-1 accident will include a brief description of the SL-1, the design highlights and the SL-1 organization as it was at the time of the accident.

Mr. Nelson, who will follow me, will cover the operating history and problem areas encountered during the operation of the SL-1 as revealed in the investigation of the SL-1 accident.

The SL-1 is a direct cycle, natural recirculation boiling water reactor designed for 3,000-kilowatt gross thermal capacity to produce

200 kilowatts net of electricity and 400 kilowatts net electrical equivalent energy in the form of space heat.

Work on this plant started in 1955 in response to a request of the Department of Defense for a small nuclear powerplant.

The requirement was based on the need to develop such a plant for future application at remote military installations such as DEW line, obviously quite different from plants for populated areas.

Six different reactor concepts were considered, and the boiling water system proposed by Argonne National Laboratory was selected for development and construction on the basis of compactness, simplicity, reliability, technical feasibility, long core life, and minimum plant cost.

Argonne National Laboratory undertook the design and development of the SL–1, then designated as the ALPR, or Argonne low power reactor.

Pioneer Service & Engineering Co. performed the design work on the conventional portions of the plant and Fegles Construction Co. was used as the general construction contractor.

Site work began in the fall of 1956; plant construction started in 1957, and initial criticality was achieved in August 1958.

Argonne National Laboratory performed the initial criticality and startup tests and successfully completed a 500-hour, full powerplant performance test in December 1958.

In February 1959, Combustion Engineering, Inc., took over the operation of the SL–1. Since startup, the SL–1 has been used to gain operating experience, develop plant performance characteristics, obtain core burnup data, train military personnel in plant maintenance and operation, and test components planned for use in subsequent reactors of this type.

The plant is located at the National Reactor Testing Station about three-quarters of a mile north of Route 20. The site facilities consist of the cylindrical reactor building, an adjoining, support building.

The majority of the plant equipment shown in the model is located in a cylindrical steel building 38½ feet in diameter and with an overall height of 48 feet. This building is made of steel plate, most of which has a thickness of one-quarter inch. It is not a pressure-type containment vessel.

The building is located on dummy piles to simulate the type of construction that would be used in the Arctic, in the permafrost area, where the whole structure would have to be sitting upon piles.

The reactor vessel, fuel storage well, and demineralizer are located in the lower third of the building and are shielded with gravel.

The idea of using gravel is that we would use the materials that are available at the site of construction to the greatest extent possible, with the purpose of cutting down the amount of material that would have to be shipped in.

A recirculating, air-cooled condenser is located in the upper third of the building. The middle third of the building contains the turbine generator, feed water equipment, switch gear, and shielding blocks located around the pressure vessel head. The active core is located near the bottom of the pressure vessel; above is the chimney section.

Control rods are connected to extension rods and racks and are driven by the pinions in the control drive mechanisms located on the head. The mechanisms are driven by shafts which extend through the shielding blocks to motors located on the outside. Over the head of the vessel is a metal enclosure which is filled with metal punchings and gravel to provide shielding. A top shield cap rests on the shielding blocks.

The core structure has provisions as shown in the slides for 60 fuel assemblies and 9 control rods of which 5 are cruciform rods and 4 are T-rods. The present core has 40 fuel elements located in the positions designated with the "R" and is controlled by five cruciform rods.

The control rods are made of cadmium, mechanically clad with aluminum with an effective length of 32 inches.

The 40 fuel assemblies are composed of 9 fuel plates each. The active portion of each fuel plate is 25.8 inches long and 3.5 inches wide and consists of a uranium-aluminum alloy with aluminum cladding.

The initial loading of the 40 assembly core was highly enriched and contained 14 kilograms of U^{235}.

On the 16 fuel assemblies in the center of the core, a full-length, burnable poison strip was spot welded to one side plate, and a half length strip was added to the other side plate. The remainder of the fuel elements had a single full-length boron plate on one side plate. The strips were aluminum nickel, containing elemental boron. The half length strips were 21 mils thick and the full-length strips 26 mils thick. The core contained a total of 23 grams of boron 10 as burnable poison.

At the time of the incident, the S1–1 had been in operation for over 2 years. The reactor had produced 931.5 megawatt-days of thermal energy which is approximately 40 percent of the design life of the core.

The criteria for design of a plant for the intended application are naturally quite different from those which would apply to a plant to be built in a populated area. No containment is required.

Minimum operation and maintenance crew size is important; hence, ruggedness, simplicity, and long life are highly desirable. These were factors in designing the fuel elements and control system.

Construction and operation of the reactor at the National Reactor Test Station was intended to test the design, to diagnose practical troubles, and to develop corrective measures and improvements.

Prior to the accident, for instance, it had been decided that the boron strips were an unsatisfactory method of posioning, and that the stainless steel fuel elements would be preferable to the aluminum alloy elements used in the first core.

Now I should like to discuss the SL–1 organization as it was at the time of the accident.

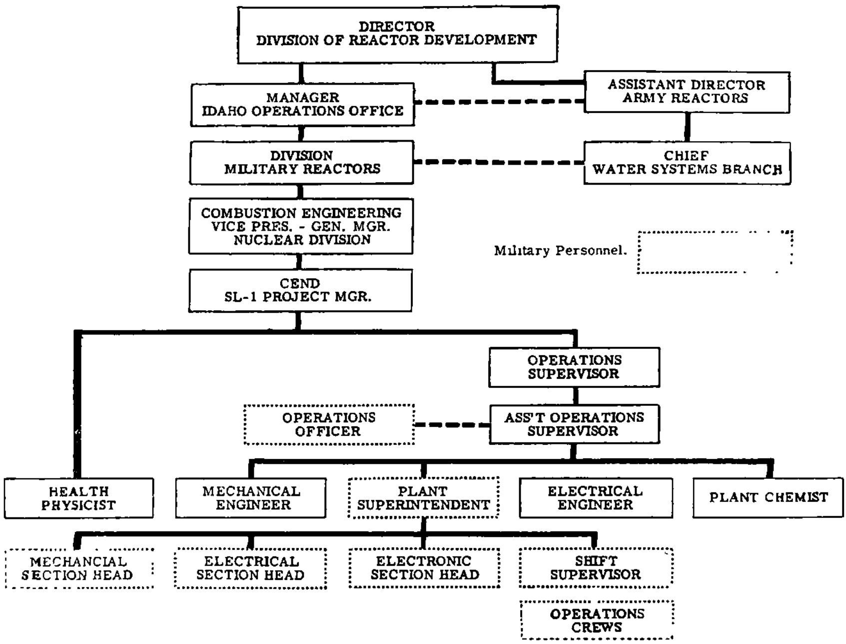
Chairman HOLIFIELD. You say prior to the accident it had been decided boron strips were unsatisfactory methods of poisoning and stainless steel fuel elements would be preferable to the aluminum alloy element.

Was anything done about that decision?

Dr. PITTMAN. Yes, sir; we were procuring a new core made of stainless steel in place of the aluminum cladding and without the boron strips on the outside.

That core was under procurement for delivery in the spring, this past spring.

I have on your right a chart that depicts the organization from the division of reactor development down to the military crews operating the SL–1.



You will note the positions held by the military personnel indicated by dotted boxes and the other positions by solid boxes.

As division director, I am responsible for managing and directing the overall program. The Office of the Assistant Director, Army Reactors, is my cognizant staff being responsible for following the program in detail, carrying on the day-to-day routine matters, providing technical program review to the field office, and keeping me informed of the status of the program.

Chairman HOLIFIELD. What was his name?

Dr. PITTMAN. That was Colonel Page, sir. Col. Gordon Page.

Specific responsibility for the SL–1 project was assigned to a project officer in the water systems projects branch of Army Reactors.

Chairman HOLIFIELD. What was his name?

Dr. PITTMAN. Captain Tardiff.

The manager, Idaho Operations Office, has the overall responsibility for carrying out the program. He, of course, receives the programmatic direction from me.

Chairman HOLIFIELD. What was his name?

Dr. PITTMAN. Mr. Allen Johnson.

Chairman HOLIFIELD. As you refer to the different positions, give us the names of the people.

Dr. PITTMAN. Yes, sir.

The manager's staff and my staff are in almost daily contact coordinating program, operations, and technical reviews.

The Division of Military Reactors is the Idaho Operations Offce unit to which the manager assigned direct responsibility for the SL–1 project.

The director of that Division was Mr. Val Hendrix.

At the time of the incident, the Director, Division of Military Reactors, Mr. Hendrix—Idaho—was also the contracting officer for the SL–1 operating contract with the Combustion Engineering. The SL–1 project officer in that Division was the Corps of Engineers officer, Capt. Robert Morgan.

Chairman HOLIFIELD. What was his name?

Dr. PITTMAN. Capt. Robert Morgan.

Chairman HOLIFIELD. What position did he have?

Dr. PITTMAN. He was the SL–1 project officer on the site reporting to the Director of the Division of Military Reactors in the Idaho Operations Office.

The operating contract was with Combustion Engineering's Nuclear Division. Combustion's project manager was physically located at the site approximately 50 percent of the time. His name was Mr. William Allred.

The line organization below the project manager consisted of the operations supervisor and his assistant, and the plant superintendent.

Mr. Duckworth, Mr. Rausch, and Master Sergeant Lewis.

The operating crews, all of which were military, reported directly to the plant superintendent, Sergeant Lewis.

Operationally, the military personnel assigned to the SL–1 reported directly and were responsible to the civilian operating contractor, Combustion Engineering.

In addition, there were engineering personnel of various disciplines reporting to the contractor's operations supervisor. The health physicists assigned to the SL–1 reported directly to Combustion's project manager.

The position described as operations officer was essentially a training position in which military officers could be trained for future military reactor powerplant supervisors. He had no operating responsibility.

It is appropriate to mention that, subsequent to the accident, Combustion Engineering was assigned the task of securing the reactor.

As reported to you on May 3, 1961, the reactor was on April 15 considered safe provided that no water was introduced into the core.

As of January 3, 1961, the scope of Combustion Engineering's contract was modified to delete SL–1 operations work and to include the SL–1 recovery operation.

Chairman HOLIFIELD. What do you mean by that?

Dr. PITTMAN. That we modified the contract to take into account the fact that there was no further operation of the plant.

The reactor was in an inoperable condition and this contract change gave them the responsibility during that interim period of getting the information that was necessary for the recovery work and conducting the work that was carried out during the earlier phases of the program. Combustion's recovery work was terminated on May 20, and on May 17, the General Electric Co. was awarded a contract for further work on disassembly of the core, and such recovery of the plant as we decide to carry out.

The first phase of the General Electric contract is to—

1. Eliminate the possibility of accidental introduction of water into the reactor;
2. To make photographic and radiation surveys in the reactor building; and
3. To study methods of core disassembly and recovery of the plant, making recommendations based on this study.

The ad hoc committee appointed earlier by the General Manager will consider these recommendations and advise the Atomic Energy Commission as to the disposition of the reactor.

Mr. Chairman, that completes my statement. I shall be glad to answer any questions you might have.

Chairman HOLIFIELD. How frequently is a power reactor such as the SL-1 opened up?

Dr. PITTMAN. Could I ask Colonel Schrader to answer that question, sir?

STATEMENT OF LT. COL. HENRY C. SCHRADER, ACTING ASSISTANT DIRECTOR, ARMY REACTORS, ATOMIC ENERGY COMMISSION

Colonel SCHRADER. I do not quite understand your question, sir.

Chairman HOLIFIELD. I am talking about when you shut it down, or remove fuel elements or go into modifications on the core assembly or any part of the internal working of the reactor. How often was that done? Was that the first time?

Colonel SCHRADER. No, the previous time was, I believe, sir, in August 1960. Then previous to that there was the careful examination that was made in August of 1959. It was during these periods that there were detailed examinations of the interior of the core.

Chairman HOLIFIELD. Those two incidents were the two previous times that the reactor was shut down and some type of inspection or modification or change in fuel——

Colonel SCHRADER. It was at that time that the shield plugs through the head were physically removed.

Chairman HOLIFIELD. Nothing had been done since August of 1960 up to 1961 as far as opening up the reactor was concerned?

Dr. PITTMAN. While we are waiting for the detailed answer, I would like to say it was between August and November that the Combustion Engineering Co. installed in those, you will recall the T-shaped position, they installed the cadmium poison to replace some of the lost boron that had fallen out.

Colonel SCHRADER. We on occasion inserted flux wires to study flux mapping of the core. This was done without physically opening the head. This was done through the apertures on the top of the head.

Chairman HOLIFIELD. I referred to a major opening up of the reactor such as removing the head.

Dr. PITTMAN. Those were the two that Colonel Schrader reported, but there were other changes in the core of the type I mentioned.[1]

The purpose of operating the reactor, of course, was to get as much data as we could from its operation. It was not being used as a test unit.

On the other hand, when we found that the boron was falling off we did make this replacement and we were running a flux pattern study and they had to have some cobalt wires put into the core.

Chairman HOLIFIELD. The insertion of the wires was through apertures?

Dr. PITTMAN. That is right.

Chairman HOLIFIELD. It did not involve a major change such as taking off the head.

Dr. PITTMAN. Yes, this was done between the last shutdown between the 23d of December and the 4th of January. I guess the wires were put in on the 3d of January before the reactor was prepared for startup.

Chairman HOLIFIELD. Now, the gentleman on your left, did you refer to him as Colonel Schrader?

Dr. PITTMAN. Colonel Schrader. He is Acting Assistant Director for Army Reactors.

Chairman HOLIFIELD. Did he take Colonel Page's place?

Dr. PITTMAN. He has been acting since Colonel Page was transferred.

Chairman HOLIFIELD. Colonel, were you familiar with this operation, or were you called in from another assignment?

Colonel SCHRADER. I was Colonel Page's deputy and have been his deputy since June 1959.

Chairman HOLIFIELD. So you are familiar with the background of this program?

Dr. PITTMAN. Yes, sir.

Chairman HOLIFIELD. I would like to direct this question to you, Colonel Schrader:

Do you consider that an operation such as taking the head off and opening up the reactor for the purpose of making a major change, is a routine operation?

Colonel SCHRADER. I considered it to be routine. Appreciate that at the time the men were following procedures that had been accepted and had been classified as routine.[2]

Chairman HOLIFIELD. I am talking about a period of time in which a head has been taken off a reactor and some major modification or change or adjustment of the internal mechanism of the core is taking place.

Do you consider that a routine operation?

Colonel SCHRADER. I beg your pardon. The removal of the head indicates a time of considerable seriousness. I would not say that the taking off of a head is routine, but once that head is removed there may be certain operations carried out which then would be routine within that time frame.

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[1] Colonel Schrader misunderstood the original question. Actually the head has been removed only once, in the spring of 1959

[2] This statement is incorrect in that it represents a misunderstanding of the question which is corrected in later testimony.

Does that answer your question, sir.

Chairman HOLIFIELD. You would——

Colonel SCHRADER. Taking off the head is not considered routine in my opinion.

Chairman HOLIFIELD. Mr. Pittman, do you feel the same way about that? Would you make the same kind of answer?

Dr. PITTMAN. Yes, I think I would, sir. A maintenance operation that involves the removal of a head and actually taking core pieces out, I would not consider as a routine operation.

Chairman HOLIFIELD. At the time this head was taken off, what type of criteria was available for the crew there, the operating crew, to follow in performing whatever function they performed?

Dr. PITTMAN. Mr. Holifield, you realize at the time of the accident the head was not off. The head was on. It had not been removed.

Chairman HOLIFIELD. It had been placed on?

Dr. PITTMAN. It had never been taken off. The last time the head was removed was in the spring of 1959.

What was done during the December-January period that immediately preceded the accident was just opening up the ports.

All the work being done at that time was through the ports. What was being done was to place the cobalt wires into the various positions in the core through the ports.

Chairman HOLIFIELD. The ports are the——

Dr. PITTMAN. Flanges with the 8-inch openings.

Chairman HOLIFIELD. Through which the rods go?

Dr. PITTMAN. Rods and other things. The rods go through five of these ports. There are other ports there. Some of these ports were open and the wires had been placed through some of these. Mr. Nelson will describe in some detail the reassembly of the control rods and the closing of the ports, but the head was not off and had not been off even for this investigation in August of 1960, I believe.

I would like correction on this if I am wrong. It was not necessary to take the head off for the investigation that found the boron loss problem.

Chairman HOLIFIELD. Then I will redirect my question.

When the ports surrounding the rods are open, do you consider that a period of routine operation, or do you consider it unusual?

Dr. PITTMAN. I consider that the problem of opening and closing the port and putting the control rod drive mechanisms in, done in a way that follows the directions that have been given, is a routine, essentially a routine operation, sir.

Chairman HOLIFIELD. Is that answer modified by the fact that there were criteria established under which they should operate during that period of time?

Dr. PITTMAN. Could I ask Colonel Schrader, or Captain Morgan, to answer that question?

Colonel SCHRADER. There was a procedure established for the work that the men were doing on the evening of the 3d of January.

Chairman HOLIFIELD. Was that a written checklist or oral?

Colonel SCHRADER. This was a written procedure. It was in the operating instructions, but it was not a detailed checklist. We differentiate between procedures and checklist. This was an operating procedure and it was in the operating manual which had been previously approved by the AEC, but there was no detailed checklist as such.

On that day, sir, the men were not following a detailed checkoff procedure because they had done this operation a number of times before. They considered it to be a normal type operation and so they were not following it such as a pilot would use when taking off in an aircraft, call off point A, and say accomplished; point B and say accomplished, etc.

Chairman HOLIFIELD. In the taking off of an aircraft, even though it is a normal operating procedure, every time an aircraft is taken off the ground the pilot and copilot go through a checkoff list, do they not?

Dr. PITTMAN. This is done at the startup of the reactor, sir; there is a checklist.

Chairman HOLIFIELD. At the startup of the reactor originally?

Dr. PITTMAN. At any time. This was a maintenance operation.

The crew that came on board was told what to do, you know, what operations to carry out, but they were not carrying it out by a checklist of turn bolt No. 4 and somebody else say bolt No. 4 turned.

They were told to reassemble the control mechanisms as an example. They had done this before. They were doing it as a routine maintenance operation and not as a startup of a reactor.

The startup of a reactor was to come on a subsequent shift. And they do have a checklist to follow in the usual way even though it is a routine startup.

Mr. RAMEY. Are your views consistent with the board report?

Dr. PITTMAN. I think it would be better for Mr. Nelson to discuss this. I was saying at the time of this particular operation that the crew that came on board was told what operations to carry out. They were not told the details of how to carry them out.

Colonel SCHRADER. That is correct. The instructions as to what they were to accomplish in this shift was left for them in writing.

Dr. PITTMAN. But not the details of how to carry them out.

Colonel SCHRADER. Because there was a procedure to do this with which they were familiar, but for which there was no detailed checklist.

Chairman HOLIFIELD. Were you aware of the problem with regard to the sticking of the control rods, Dr. Pittman?

Dr. PITTMAN. No, sir; I was not.

Chairman HOLIFIELD. Were you aware of that, Colonel Schrader.

Colonel SCHRADER. No, sir; I was not.

My record indicated that only two sticking rod conditions had ever been reported to us. Both of these dealt with rod No. 7.

Chairman HOLIFIELD. Was Colonel Page aware of the fact that the rod had been sticking?

Colonel SCHRADER. Colonel Page had no further information than I or Dr. Pittman, on this subject.

Chairman HOLIFIELD. What did you say?

Colonel SCHRADER. Colonel Page had no additional information that I did not have or that Dr. Pittman didn't have on this subject. Colonel Page was not aware of the sticking of the rod.

Chairman HOLIFIELD. Who was responsible for reporting to you from the field? Who was the ranking military officer in charge at Idaho Falls?

Dr. PITTMAN. The ranking military officer was Captain Morgan, the gentleman who was here on my left.

Chairman HOLIFIELD. Will you come forward and have a chair, Captain.

Dr. PITTMAN. Captain Morgan, however, in the AEC organization, was the project officer reporting to the director of the Division of Military Reactors of the Idaho Operations Office.

The contacts and the flow of information on a formal basis would be from the manager of operations to the Director of the Division of Reactor Development, namely, myself.

The informal day-to-day contacts are between the Army reactor's group and the Division of Military Reactors of the Idaho Operations Office, namely, Colonel Page at the time, and Mr. Hendrix at the time.

Chairman HOLIFIELD. Who did you report to? Are you located at Idaho, Captain Morgan?

STATEMENT OF CAPT. ROBERT MORGAN, SL-1 PROJECT OFFICER

Captain MORGAN. Yes, sir; I am.

Chairman HOLIFIELD. Whom did you report to?

Captain MORGAN. To Mr. Hendrix.

Chairman HOLIFIELD. Is Mr. Hendrix in the room?

Captain MORGAN. Yes, sir; he is.

Chairman HOLIFIELD. Mr. Hendrix, will you please come forward and take a chair. You are a civilian, are you not?

STATEMENT OF V. V. HENDRIX, FORMERLY DIRECTOR OF THE MILITARY REACTOR DIVISION, IDAHO OPERATIONS OFFICE, ATOMIC ENERGY COMMISSION

Mr. HENDRIX. Yes, sir.

Chairman HOLIFIELD. What is your position?

Mr. HENDRIX. I was Director of Military Reactors Division.

Chairman HOLIFIELD. Were you on the AEC payroll or the Army payroll?

Mr. HENDRIX. AEC pay roll.

Chairman HOLIFIELD. Now, Captain Morgan, did you report to Mr. Hendrix that the control rods were sticking?

Captain MORGAN. Sir?

Chairman HOLIFIELD. That you had had trouble with the control rods?

Captain MORGAN. I might state in the early history there were initially some rods sticking in the SL-1.

Chairman HOLIFIELD. What do you mean by early history?

Captain MORGAN. After startup in 1959 there had been occasions of rods sticking.

Chairman HOLIFIELD. Within a period of, say, 60 days, 90 days?

Captain MORGAN. It happened—well, it was prior to my arrival in August 1959. To eliminate the problem Combustion Engineering put in a diatomaceous earth filter because it was felt that the crud in the seal waterflow was collecting on the seals in the rod mechanism and causing the rod to hold up during rod drop.

Chairman HOLIFIELD. This was prior to your arrival?

Captain MORGAN. Yes, sir.

Chairman HOLIFIELD. Was this known to you at that time.

Mr. HENDRIX. Yes, sir.

Chairman HOLIFIELD. Was it known to Colonel Page?

Dr. PITTMAN. I believe at that time Colonel Page was not with us. It was Colonel Williams, Don Williams, who had Colonel Page's job at the time.

Chairman HOLIFIELD. Was it reported to Colonel Williams at that time from Mr. Hendrix.

Colonel SCHRADER. To my knowledge, Colonel Williams did not know anything about the sticking of the rods in the summer of 1959.

Chairman HOLIFIELD. Mr. Hendrix, did you report to Colonel Williams in the summer of 1959 that you were having this trouble?

Mr. HENDRIX. The stickiness of the rods we are talking about now in connection with the seals was a subject of some discussions. Actually, prior to the time Combustion took the reactor over, I believe——

Chairman HOLIFIELD. Who was in charge of the reactor at that time, General Electric?

Mr. HENDRIX. No; it was Argonne National Laboratory. I believe they had some difficulty in this area and I think physically enlarged some of the seals, removed them, and physically enlarged some of the seals.

Chairman HOLIFIELD. So an attempt was made then by someone to correct that?

Mr. HENDRIX. Yes, sir.

Chairman HOLIFIELD. Who was the person that had the responsibility of correction?

Mr. HENDRIX. Argonne National Laboratory, at this time.

Chairman HOLIFIELD. Did they attempt to correct it?

Dr. PITTMAN. Sir, in 1959 Combustion Engineering people were there. Corrective action must have been taken by Combustion in 1959.

Chairman HOLIFIELD. Do we have a Combustion Engineering representative here today?

Dr. PITTMAN. Yes, sir.

Chairman HOLIFIELD. Is Mr. Allred here from Combustion Engineering?

We have one remaining chair, Mr. Allred.

Mr. Allred, was this condition of sticking reported to you by the Argonne National Laboratory?

STATEMENT OF W. B. ALLRED, PROJECT MANAGER, SL-1 PROJECT, COMBUSTION ENGINEERING

Mr. ALLRED. The initial sticking referred to the time prior to Combustion taking over the SL-1 on February 5, and was known to our staff. Corrective action at that time was taken by the Argonne group, or an attempt was made to correct it.

Chairman HOLIFIELD. Did they take this under contract with you or did they do it independently?

Mr. ALLRED. That was done independently of us.

Chairman HOLIFIELD. So as far as the testimony shows there was an effort to correct this situation by all those concerned and responsible.

Now, as I understand it, this was in the summer of 1959. Now, subsequent to that——

Mr. ALLRED. May I correct that point?

The initial sticking occurred in the period of January and February and some corrective action was taken at that time by Argonne.

Chairman HOLIFIELD. In 1959?

Mr. ALLRED. The later correction which Captain Morgan referred to; namely, the addition of a filter to remove crud from the water, was done by Combustion and this was done I believe, in April.

Chairman HOLIFIELD. In April of 1959?

Mr. ALLRED. Yes, sir.

Chairman HOLIFIELD. Now, subsequent to these dates did you have additional incidents of rod stickings? Or the rod sticking, subsequent to these corrective dates you have given?

Mr. ALLRED. Yes, there was evidence of hesitation or a slight sticking on free fall; that is, with no mechanical advantage placed on the reactor drive, in a control rod drive during the period 1959 and into 1960.

This was sporadic and there was no reproducible pattern as to the sticking.

In each case the incident was examined and, we felt, understood, and some corrective action where needed was performed.

Chairman HOLIFIELD. You were the operating engineer at that time?

Mr. ALLRED. No; my title at the time was project manager for the SL–1 reactor. The operating supervisor appearing on the table over here was a man directly under my charge.

Chairman HOLIFIELD. You represented Combustion?

Mr. ALLRED. Yes.

Chairman HOLIFIELD. When those events occurred did you report that to someone, and if so, to whom?

Mr. ALLRED. Yes; reports were made of these early instances. The Rod No. 7 case, which was mentioned by Colonel Schrader, was made the subject of a very extensive report with some laboratory test work performed in Windsor, which is the Combustion Engineering Development Laboratory. That report was submitted to the Operations Office.

During this period certain quarterly review meetings were held, and I believe this was discussed at one or more of those meetings.

I should also point out, if I may, sir, that at this time the design staff on the project, the contractor design staff, recognized certain problems primarily in the seal arrangement and had taken action to redesign this.

In so doing, the plan was to have an SL–1-type control rod drive, but redesigned to remove the difficult problems or poor design features.

Chairman HOLIFIELD. Colonel Schrader, were you aware of these moves?

Colonel SCHRADER. I was not aware of repeated rod sticking.

Chairman HOLIFIELD. This is earlier. This was in 1959 and 1960.

Colonel SCHRADER. I took over in June 1959 from my predecessor.

Chairman HOLIFIELD. Was this sticking earlier than June 1959?

Mr. ALLRED. Yes; there were evidences of some sticking prior to that time.

Colonel SCHRADER. My records, Mr. Holifield, showed that as of May 1, 1959, rod 7 did hang up approximately 4 inches on a rod drop check. They checked it again a short time later and it was working satisfactorily. This was on May 1, 1959.

Chairman HOLIFIELD. So you did have knowledge of the No. 7 sticking?

Colonel SCHRADER. Of this one situation, yes.

Chairman HOLIFIELD. Let us go on to the later history. Were there additional stickings after this?

Mr. ALLRED. Yes. A careful study made by the contractor since the incident on the number of instances of sticking shows that for the period of February 1959 through November 16, 1960, the cases of rods sticking represents about 2½ percent.

In other words, of the times the rods were dropped, in 2½ percent of those cases some evidence of sticking or hesitation of the rods occurred.

Mr. RAMEY. Dr. Pittman, this amount of percentage of sticking—is this comparable to other experimental or demonstration reactors? It seems like rod sticking is not entirely an unusual incident.

Dr. PITTMAN. I would say that on experimental reactors with new designs and new techniques of handling control rod drives, it is not unusual in the early phases of the program to find sticking, particularly on the drop test.

The test Mr. Allred is talking about is a test by which the rod is dropped by gravity to see if it goes all the way in.

The sticking is defined in his report as being a hesitation or the fact that it does not go clear down into the shroud.

Chairman HOLIFIELD. Were you aware of the fact these rods were sticking 2½ percent of the time?

Dr. PITTMAN. No, sir; I was not.

Chairman HOLIFIELD. Who would ordinarily have reported that to you?.

Dr. PITTMAN. This would ordinarily have come, if it has been something that was felt by the staff to be reportable, that should have been reported to me, from the Operations Office, either directly to me, in which case it would have been staffed by the Army Reactor Branch, or informally through the Army Reactor Branch to me, from Colonel Schrader to me.

Chairman HOLIFIELD. That would have been a report from Mr. Johnson?

Dr. PITTMAN. It would have been a report from Mr. Johnson if it were a formal report.

If it were just an informal report, it might have been a discussion between Mr. Hendrix and Colonel Schrader, or one of his staff men.

Chairman HOLIFIELD. Do you consider this an important occurrence, the fact that 2½ percent of the time when the rods were removed there was sticking? Is this something you think you should have received a report on?

Dr. PITTMAN. I would say on the question of the type of sticking that is talked about here, the hesitation or the delayed action, that that type of thing, provided it can be corrected, is something you might expect in an experimental reactor.

I think it is the kind of thing that generally I would like to know about, but I don't think it is the kind of thing that necessarily would call for any major action from my own office.

Chairman HOLIFIELD. Dr. Zinn, how would you evaluate the significance of rod sticking 2½ percent of the time on an experimental reactor?

Dr. ZINN. I think, Mr. Holifield, that a very important point has to be made here. These rods were tested by releasing them and allowing the force to pull them down into the core by their weight.

Now, the accepted standard for a satisfactory so-called drop test was to travel 30 inches in 2 seconds.

I believe if you drop something freely, say a weight on the floor, it travels 16 feet in 1 second. So it follows that there was expected in any such drive, and there has to be, a great deal of friction; you are not only moving the rod, you are moving the rod in scabbard and it has to touch the scabbard. Touching the scabbard cannot be prevented. You are also moving a rack and pinion and some gears, the sensing gears.

Basically, when you set up such a system you cannot expect to get uniform reproducible behavior because friction is playing the major role in the time that you measure for the drop of the rod.

I am pretty sure that the more you drop such a rod and make measurements, the greater the number of evidences of so-called sticking you will observe; namely, not meeting the prescribed 2 seconds time for dropping.

Hence, I believe that the fact that the rod hesitated and did not go in in the time prescribed was not of importance. What would have been of great importance and would have called, I think, for corrective action, was the fact that if you turned on the drivedown mechanism, which is there, and if the rod refused to go in, then you really had trouble.

But there were practically no cases of that kind of behavior. So we have to have basically in our minds the fact that the rod system for this reactior is not one in which you expect good performance on free fall—it just could not happen.

Chairman HOLIFIELD. In other words, the real control of the reactor was a system of gears attached to these rods which would not only lift them, but would also force them down?

Dr. ZINN. If we had not known there was a drive mechanism to drive the rods into the core, I assure you the reactor would not have been operated.

My main concern was, will the rods drive into the core with the drive mechanisms?

Chairman HOLIFIELD. What is the purpose of the free fall?

Dr. ZINN. It presumably has two purposes combined. It tells you whether or not the friction in the seal and in the drive gears has built up to an intolerable value. If the things won't move under their own weight, then you say that friction has gone too far.

Chairman HOLIFIELD. Some kind of bind?

Dr. ZINN. Yes, there were binds in the early history.

As I remember reading reports, efforts had been made even before Combustion had taken over the reactor to relieve clearances in the driving gears so that it would drive in more easily without binding.

The second thing you are concerned with is that if the shroud which contains the control rod through the core is misalined or has projections on it, it can do the same thing. You cannot tell the difference from the rod drop test, but it can also impede the insertion.

If it gets very bad, you cannot drive the rod in. So I believe the record will show that many tests were made of the rod drop merely to find out if the condition was normal or close to normal.

What is called sticking of the rod is really a measure of this.

I believe the record will also show, and this is, I believe, a matter of concern in the last 2 months of operation, that the performance of the rods generally in this respect was not the same as earlier.

Chairman HOLIFIELD. In other words, there was more sticking at that time?

Dr. ZINN. More drops had to be made in order to free the rods; put it that way.

The operating instructions, as I understood them, called for a stop in operation if repeated tests would not free the rod.

Chairman HOLIFIELD. On page 23 of your report, it shows that No. 3 dropped 1½ inch and stopped. Was that a matter of more significance than the factor that it was slow in dropping? That is page 23 of the committee print.

Dr. PITTMAN. Are you asking me, sir?

I would think, if I could, that Mr. Nelson who gathered the information on this and, therefore, who talked to the individuals, could give a better answer to the question as to whether this particular one had any more significance than any other.

Chairman HOLIFIELD. Is Mr. Nelson available?

Dr. WILSON. He is the next witness.

Chairman HOLIFIELD. Just stay in your seat and you may answer the question, Mr. Nelson.

STATEMENT OF CURTIS A. NELSON, CHAIRMAN, BOARD OF INVESTIGATION

Mr. NELSON. What was the question?

Chairman HOLIFIELD. The question was—and I refer to page 23 of the committee report where a review of operating log No. 13 shows that No. 3 rod dropped one-half inch and stuck.

Was that an unusual occurrence? Was it a matter of significant concern on your part, when that happened?

Mr. NELSON. Yes, we were concerned.

Chairman HOLIFIELD. Now, on the same page, on No. 1, do the two words "no drop" mean that it would not drop at all?

Mr. NELSON. On the first try; yes, sir.

Chairman HOLIFIELD. No. 7 also, no drop; is that right?

Mr. NELSON. Yes, sir.

Chairman HOLIFIELD. Now, the report says that this behavior was worse than usual. What action was taken to overcome this situation?

Mr. ALLRED. Mr. Holifield, the plant was shut down, as indicated by the records. The two rods, Nos. 1 and 7, on the initial free fall drop did stick and they were subsequently driven in by use of the control rod drive motor.

The normal course of events would have been that upon startup of the reactor the rods would be checked; they would be put through the normal criteria of rod drop test and if they did not satisfy that criteria the reactor would not be operated.

A teardown of the rod would have been performed, if necessary, to examine the sticking parts.

Chairman HOLIFIELD. Was that performed?

Mr. ALLRED. The incident occurred prior to the time of the assembly of the rod, so this could not, of course, have been accomplished.

Chairman HOLIFIELD. It has not been accomplished?

Mr. ALLRED. That is correct. The incident had occurred before the crew got to that operation.

Dr. PITTMAN. This could only be done after we reassembled the rods. This is what was being done at the time of the accident.

So this is a test that would have been made after the time of the actual assembly.

Chairman HOLIFIELD. From a layman's point, what effect does the introduction of the rods, the pushing of the rods down, have? Does that start the fission or stop it?

Mr. ALLRED. It stops it, sir. In this particular reactor, when the rods are down the fission stops.

Chairman HOLIFIELD. As it is removed, as they are lifted, the fission takes place?

Mr. ALLRED. That is right, sir.

Chairman HOLIFIELD. While these rods were in free fall situation, they were disconnected from the positive control mechanism?

Mr. ALLRED. Yes, but they were still working against the rack and pinion. These were driven up and down by a mechanism that drove a gear against a rack. They were still operating in free fall against that.

We did not depend on free fall for shutting the reactor down. The reactor was shut down by the positive action of the motor.

Chairman HOLIFIELD. While you were exercising the so-called free fall test, it must have been disconnected from the positive drive?

Mr. ALLRED. It was connected through a clutch assembly.

Captain MORGAN. It is an electromagnetic clutch which disengages it.

Chairman HOLIFIELD. Therefore, at that time, if there had been some kind of chemical explosion or rapid acceleration of any fission blow and it was in that position the rod could have been pushed out by the force of that, could it not?

Dr. PITTMAN. The rods at the time of the accident were in position, several of them, so they could have been pushed up by a force from below.

Chairman HOLIFIELD. Doctor, I noticed you were shaking your head. I wonder if my question was misunderstood by you.

Dr. ZINN. I think there is a little misunderstanding. In normal operation when a drive mechanism is in its normal condition no pressure inside the reactor can force the rod out of the reactor and out of the core.

Chairman HOLIFIELD. That is when the positive control is on.

Dr. ZINN. And that is when it is in normal condition, even if you release the clutch. Even if you release the clutch you cannot push it out of the reactor; it does not work that way.

Chairman HOLIFIELD. You mean a chemical explosion at the bottom of the reactor could not force that up when it was in a free position.

Dr. ZINN. It is extremely unlikely that it could do that because it is all contained in the same vessel and the thing that comes out is a rotating shaft, nothing that slides out so that you can get a pressure difference. This type of rod, by the way, is used in quite a few reactors.

Dr. WILSON. It is when it is partly disassembled that you can get that reaction.

Dr. ZINN. At the time the accident happened, it was in a condition that pressure or force inside could lift it out of the reactor.

Chairman HOLIFIELD. That was really the point I was trying to ascertain. Maybe I phrased my question incorrectly.

Dr. ZINN. Your question said, if you disconnect the positive drive. That is done many times in the operation of the reactor—perhaps every day. It does not follow that if it is in a position that it can be then pushed out of the reactor.

Chairman HOLIFIELD. I can understand why it would not if there was no fission, but if there was a chemical explosion or for some unknown reason which we have not been able to find out, a flareup of the fission process, my question was directed toward whether, if the rod was disconnected from the positive control, if it would have been pushed up and thereby accelerated?

Dr. WILSON. As I understand, when you release the magnetic clutch it will let the rod drop, but it still cannot go up any further than it normally would. It is only when you have the drive mechanism disconnected as it was in this case of the shutdown that that accident can happen.

Dr. PITTMAN. The important thing is the condition of the reactor at the time that the rods could come out. Under those conditions they could.

If the rods had all been connected up, then just declutching it would not have allowed them to come up. That was not the situation that existed at the time of the accident.

Chairman HOLIFIELD. I realize that the rods were disconnected from the positive control mechanism.

Dr. PITTMAN. It was more than that. They were not even connected to the drive extensions, the rod extensions, or anything like that.

Chairman HOLIFIELD. In other words, they were free?

Dr. PITTMAN. They were free, yes. They were free and down at the time.

Chairman HOLIFIELD. Mr. Nelson's letter of transmittal on this sticking of control rods, says:

> The emphasis in the testimony of difficulty with rod sticking only because of seal difficulties would seem to argue that rod sticking was unrelated to the hypothesis under discussion. It is not likely, however, that if the rods were beginning to stick in the shrouds immediately before the shutdown on December 23, 1960, the fact that sticking because of seal difficulties was an old and familiar problem might have been responsible for failure to recognize this later development, or bring it to the attention of higher supervision.

Do you have any comment on that?

Dr. PITTMAN. No, sir; I don't think I have any comment.

Chairman HOLFIELD. Do you have any comment on that, Dr. Zinn?

Dr. ZINN. I think there is a very pertinent point which is not brought out in the report.

I might say we have not had a chance to really read the report carefully. It is true you cannot, in the course of a normal measurement, tell whether the sticking is due to the drive mechanism or whether it is due to something happening in the core.

This is one of the weaknesses of, I believe, most reactor designs.

The point I want to make is that the assembly operation, which the men who were involved in the accident were doing that evening, is almost identical to a disassembly operation which was done that same morning by a different crew and they did not report any difficulties.

This is puzzling. Why is it that the disassembly crew, which had to do the same sort of thing, that is, lift the rod slightly to make the connection, did it, and recorded what they did in the logbook in the early morning of the same day, and did not report any difficulty with sticking rods.

Later in the same day the crew that was killed repeated the same operation.

We don't know what happened. But it is a little hard to understand why they should have experienced sticking at that time, by that I mean a frozen rod, one that they had to use force to remove.

You would have thought that if it was due to something that happened in the operation of the reactor, it would have been apparent on the first disassembly which took place earlier in the day; this is the puzzling thing.

Chairman HOLIFELD. Now to put this in perspective, although there has been a report made after a delay of some 5 months in which there has been an earnest attempt to determine the cause of the explosion, unusual attempts have been made to photograph the interior, by miniature cameras, and so forth, but as yet the interior of the reactor shell has been too hot for you to actually dismantle and determine further evidence that you know is there, that is, to be able to determine what actually happened; is that right?

Dr. PITTMAN. That is right, sir.

All in that intermediate level there, in that area, where you would have to go in order to get pictures down into the internals of the reactor is entirely too radioactive for people to get in there even at this time.

What we are having to do, therefore, is to try to go in with cameras remotely. We are trying to develop, of course, where the contamination level is around there. It is a very difficult job and I am afraid that most of the work of disassembly is going to have to be done remotely.

We just cannot send people into that area to get the necessary information. This is why it is a slow process and why it is going to take, I am sure, many, many months before we get the final information that we hope we can get from looking at that core.

To date, all we have seen is that we have gotten a small camera that Dr. Zinn and his people developed, using a Minox camera, putting it down in several of the holes. We have taken pictures and we see the mass of the fuel elements that have been pushed around.

I think there are some slides available that Mr. Nelson will show you later.

But we certainly don't know what the inside of the core looked like. It took us some time to find out whether there was water in there, or not. We had to do it remotely.

Chairman HOLIFIELD. So while we have the investigation board report which was printed, is it proper for me to say that this is an interim report bringing up to date that information which has been ascertained by the investigators and that there are still many months of delay, before you can actually disassemble this reactor and investigate further into the cause.

Dr. PITTMAN. Mr. Nelson will speak for the status in his report, but I believe he clearly states in his transmittal letter and the report itself that the cause of the accident has not yet been determined, and may never be determined.

We certainly will make every effort to gather all the information that is possible to gather from the core in order to determine what happened in the course of this excursion.

This will take many, many months. So far as I am concerned, we today do not know what the cause of that accident was, sir.

Representative VAN ZANDT. Doctor, in last evening's Star, the accident was dramatized by a writer. He mentioned how individuals would get inside the reactor building and stay there for, say, possibly a minute, until their Geiger counter told them to get out.

Now what section did they enter?

Dr. PITTMAN. In that central section in there. They would come up in through the door. The people would go carefully up there with their Geiger counters and would stay the 30 seconds or minute, whatever time they could stay.

In the initial phases they stayed a little longer.

Representative VAN ZANDT. Your statement a moment ago led me to believe they could not get in there.

Dr. PITTMAN. My point is this, that we do not want to give that kind of exposures to human beings and get the information so we will get it remotely.

Representative VAN ZANDT. In other words, you cannot do the job within a minute.

Dr. PITTMAN. This is right. You can send a man in but he can only stay in for a matter of seconds or maximum of a minute. You just cannot do the type of work that has to be done in that time.

Representative VAN ZANDT. Let me ask you another question:

The Army team that came out from Utah, were they especially trained for an accident of this type, or were they trained after they got on the scene?

Dr. PITTMAN. Could you answer that, Captain?

Captain MORGAN. They were not trained specifically in this type of operation. They were a radiological decontamination team which would normally decontaminate a large area of fission products. They were trained and briefed entirely and run through the so-called dry-run operations at the site.

But they had a full recognition of the type of problem that they were entering into.

Representative VAN ZANDT. Has any of this team absorbed a sufficient amount of radiation to the point where they are banned for several years?

Captain MORGAN. No, sir. The tolerance levels that they gave us from the Army were followed completely throughout this operation.

Representative VAN ZANDT. In other words, this team you transported from Utah to the site gained a lot of experience as far as a nuclear accident is concerned?

Captain MORGAN. Yes, sir; that is true.

Representative VAN ZANDT. That is all, Mr. Chairman.

Chairman HOLIFIELD. Let us go into a bit of history of the procurement of this core, Dr. Pittman. What is the history of this core?

Dr. PITTMAN. I would like to give the broad aspects of it. There was an attempt made to procure this core—if you will recall now, we are talking back in 1957—from an industrial source.

There was a procurement order put out. A core was procured, fuel elements were procured. These turned out to be unsatisfactory on inspection and under rather crash conditions and at the last moment the Argonne National Laboratory had to fabricate the entire core in its own facilities because the core was not satisfactory, it did not meet specifications when procured.

Chairman HOLIFIELD. Originally it was an attempt by the Atomic Energy Commission to contract the manufacture of these cores to industry?

Dr. PITTMAN. This is right, sir.

Chairman HOLIFIELD. The cores that were manufactured by industry were unsatisfactory?

Dr. PITTMAN. This is right, sir.

Chairman HOLIFIELD. Then you subsequently had to make the cores in your own laboratory.

Dr. PITTMAN. They were to be made at Argonne; yes, sir.

The technology of making these cores was not advanced to the point at that time where it could be done under industrial conditions.

Chairman HOLIFIELD. We are frequently criticized for not turning different parts of this program over to industry. Industry is continually complaining that we do too much in the National Laboratories.

Now, here is a very glaring example of the incapability of industry to do the job and the backup work had to be done in the National Laboratory.

Dr. PITTMAN. I think there are times when the state of the art is not ready for going into industrial procurement and we should do it under those conditions in our own laboratories.

Chairman HOLIFIELD. How extensive was the boron material which subsequently failed testing before it was attached to the core?

Dr. PITTMAN. The information Captain Tardiff gives me is that he does not believe it was tested at the Argonne National Lab, but it was tested after assembly on the fuel during zero power exponents that were run for this reactor.

Of course, that was zero power and that would not have any testing of the effect of corrosion or anything like that.

That was just to test its ability to poison the reactor and the poison pattern.

I would say this certainly would not give you any information about how well the boron strips would hold up under radiation. Whether they would bow, as we found later they did, whether they would flake off as we found later they did, but what it would do is, after you place the boron strips in the particular pattern chosen, it would give you a flux pattern or control pattern which was satisfactory.

This was found to be the case.

Chairman HOLIFIELD. Now, then, could you have performed corrosion tests on these that would have alerted you to this flaking off?

Dr. PITTMAN. I think there are two ways you can do this. One is that you could have run assemblies in a test reactor for, maybe, a year or a year and a half, to get the effect of this.

The other way is to run it in a reactor and to follow what is going on by looking at the core periodically and that was the way it was done.

Chairman HOLIFIELD. Was there anything peculiar about this type of reactor that would affect the properties of boron differently?

Dr. PITTMAN. No, sir.

Chairman HOLIFIELD. Had boron been used before for this purpose in other reactors?

Mr. PITTMAN. It has been used as a burnable poison in reactors. I would have to check whether it has been used in exactly this way as added strips. I believe it has not been used in exactly this manner previously.

Chairman HOLIFIELD. Was the core designed or the method of fabricating it, different in any respect from other reactor cores?

Dr. PITTMAN. This was made by the Argonne National Laboratory under lab conditions. Certainly from that standpoint whenever you are making a core under laboratory type conditions it certainly would be different from the conditions that you would procure if you were procuring it from a commercial operator.

I am not trying to avoid the question, sir; I just don't know how to answer the question, whether there was anything different in this one.

This was done as a one-shot job. It is certainly not the core we would procure for the second core.

As I mentioned earlier in my testimony, we had already made the orders for the procurement of a second core using stainless steel.

Colonel Schrader wants me to be sure to be correct on this, that for the second core the materials had been ordered, the fabrication had not taken place at the time of the accident.

Representative VAN ZANDT. Was the Argonne Laboratory to do this job also?

Colonel SCHRADER. We were going to give this to Combustion Engineering. This first core was an aluminum core. It was an experimental aluminum core.

As I understand it, this is the first aluminum core used in a power reactor.

Representative VAN ZANDT. The National Argonne Laboratory manufactured it?

Colonel SCHRADER. They manufactured it inhouse. One of the first tasks given to Combustion Engineering in early 1959 was to evaluate this core. In the summer of 1959 Combustion recommended that for field application use of aluminum was not sufficiently advanced and they made a very detailed study for us and in the fall of 1959 a decision was made to go to a stainless steel core as the second core for the SL–1, but would eventually be used then for future succeeding field plants.

Chairman HOLIFIELD. So in the interim period you added the boron strips, did you?

Dr. PITTMAN. No, sir. The boron strips were put on then at the start. They were in there originally; they were part of the original design.

What we added in the interim was last fall when it was found that the boron strips were not adding, giving us as much reactivity control as we wanted, they put these cadmium strips in these two positions on the side of the reactor.

That was done in November.

In regard to your question on the core, I wonder if you would allow Dr. Zinn to make a comment on whether or not this core had any particular differences. Dr. Zinn feels, I believe, that there were some. With your permission I would like to ask him to comment.

Chairman HOLIFIELD. Dr. Zinn, will you please respond to that?

Dr. ZINN. I think the differences are just two. First, the core itself was not made by the same process that is usually used to make aluminum uranium alloy cores. It was a newly developed process; one that I think is very good.

There is used as cladding material an alloy which had not been used in a power core before, called X–8001, a corrosion-resistant alloy.

Our consideration of the method of fabrication did not indicate it gave a product which was materially different from the kind of core that is used in the MTR and so on, although the fabrication method is different.

The second respect in which it differs from most other power reactor cores is that the boron, instead of being dispersed somehow within the fuel, was added to the sides of the fuel assemblies in the form of thin plates, unclad plates, actually. These were boron aluminum alloy plates. Such plates had only been used once previously, back in 1953 in a reactor I had something to do with, and were used only briefly in experiments, not in a power reactor.

I don't think there is anything inherently wrong in using boron that way, but there is one difficulty which shows up in all of the reports uniformly; namely, that way of distributing the boron makes calculation of the behavior of the core rather difficult.

It calls on the utmost skill, and perhaps more than the skill we have, to calculate the reactivity effects of the core when the burnable poison is distributed in discreet plates rather than mixed with the fuel.

This is how this core item differs from others. There is a reactor physicist here who could tell us whether this is really true or not.

Chairman HOLIFIELD. Dr. Wilson, I believe we will change the order of witnesses. Did you have a prepared statement also?

Dr. WILSON. I have a prepared statement, Mr. Chairman, yes.

Chairman HOLIFIELD. We will let you finish up the Commission presentation at this time, if you would like, Dr. Wilson.

STATEMENT OF DR. ROBERT E. WILSON, COMMISSIONER, ATOMIC ENERGY COMMISSION

Dr. WILSON. Some aspects of my report may not be clear because it was designed to follow Mr. Nelson's report. On the other hand, Mr. Nelson's full report has been released.

Chairman HOLIFIELD. We had planned to have Mr. Nelson on, but the report has been referred to and we have it before us. Your comments on Mr. Nelson's report?

Dr. WILSON. That is right.

Chairman HOLIFIELD. All right, go ahead.

Dr. WILSON. This is a statement of the Commission on the SL-1 accident and what we have learned from it. The report of the AEC Board of Investigation on the SL-1 accident and the letter of transmittal of its chairman, Mr. Nelson, making certain observations and drawing certain conclusions, has already been submitted to the committee and made available to the public (Friday, June 9). The Commission and the General Manager have kept in close touch with the progress of these investigations from their inception, and have studied the reports carefully. We have given consideration to attempting to summarize the findings, but have decided that these reports, though necessarily long and detailed, had best speak for themselves. While the precise steps by which the reactor attained supercriticality are not yet known, it is all too clear that the accident could and should have been prevented.

We are accordingly limiting ourselves to a statement of the more important things we have learned from this unfortunate incident. This will be followed by statements as to corrective actions which have been taken in this connection in order to maintain our record of safe operations, which on the whole is excellent. The SL-1 was the first fatal reactor accident in nearly 20 years of working with these hazardous types of operation.

The more important things we have learned from this accident are:

1. A design feature which should be avoided (and which exists in only one other operating reactor besides the SL-1) is to have the withdrawal of a single control rod cause the reactor to go supercritical. If this feature is deemed unavoidable in a particular design, there must be positive controls not only to prevent its happening in operation (which were provided), but to make it impossible in carrying out maintenance work. The failure to make such provisions was a design deficiency in the SL-1.

2. Where there are repeated malfunctions of a control system such as sticking of control rods, obvious structural defects in core components, or a substantial loss of "worth" in the control system, the reactor should remain shut down until effective remedial steps have been taken. The decision to continue operation of the SL-1 under such conditions was made at too low a level and without a thorough hazards review by qualified AEC personnel.

3. Even when trained men conduct so-called routine maintenance operations on reactor cores, there should be detailed written procedures to be followed, preferably under the supervision of a technically

trained individual. In the interest of simulating conditions at a remote site, the Army, the Idaho operations office, and the contractor had informally agreed that such contractor supervision would not be used on the night shifts during routine reactor or maintenance operations. The contractor had asked in late November to have this understanding confirmed in writing by the Idaho operations office, a request which had not yet been formally answered at the time of the accident. However, the testimony before the Board indicated that the contractor and the AEC operations office had agreed informally that night shift supervision by the contractor was not necessary.

4. In order to increase the safety of reactor maintenance operations there should be an operator in the control room and appropriate instruments connected whenever any work is being done on the reactor intervals. Had this been the practice at the SL-1, it might have prevented the accident and in any case would have furnished important diagnostic information as to its causes.

5. Every reactor, licensed or Commission-operated, should have periodic safety reviews by an independent group. The contractor did not make such a review, subsequent to its initial survey in February 1959. The Idaho operations office made periodic reviews of fire, radiation hazards, and industrial safety, but did not conduct special reviews of nuclear safety of the SL-1 reactor. The Inspection Division failed to bring this fact to the attention of the Reactor Development Division or the General Manager. The Reactor Development Division failed to discover this omission in their reviews of the Idaho operations office. These failures were in part the result of the complex organization referred to in the next paragraph.

6. The lines of responsibility within the AEC for health and safety, from the General Manager down to the operators of the reactors, were not as clear and definite in several respects as they should have been, nor were the levels at which certain safety and operating decisions should be made spelled out.

7. While the building housing the reactor was not designed for tight containment in view of its rather remote site, and while the accident and the contamination inside the building was unusually severe, the building nevertheless proved very effective in preventing the spread of contamination and obviating any hazard to people ouside the building. This result should be reassuring to the public generally.

The various corrective actions which have been taken to prevent similar occurrences in the future will be detailed by the General Manager and the Acting Director of Regulation in their respective spheres of responsibility. It is quite possible that further actions will be found necessary as the investigations and discussions develop additional facts.

Chairman HOLIFIELD. Dr. Wilson, your presentation is certainly one which is clear and which is indicative of the fact that somewhere along the line there has been a failure to organize the operations in such a way that a clear line of responsibility had not been established and a full reporting of the events had not occurred. Later on, when we get to the testimony of other witnesses, we will want to know, of course, what has been done. We recognize—I think the public has recognized that this was an experimental reactor; that it was purposely placed in a remote area for the purpose of experimentation on new designs, new materials, and in an attempt to simulate conditions which would obtain in a remote military area where trained operators would be in charge of operation but not necessarily be highly technical people. In other words, where machinery would be turned over to people in the military service to operate without the high qualifications of the men who operate civilian-type reactors in civilian areas.

This was part of the purpose of this experiment. It should be clear in the public record that this was an unusual situation, that it is not an example of the way reactors are operated or maintained or fuel rods changed or other modifications made in areas of civilian populations.

Dr. WILSON. And there was no complete containment such as we always provided in such areas.

Chairman HOLIFIELD. And it was a reactor without the steel containment, which we always insist is to be installed in the reactors near civilian populations.

Dr. WILSON. That is all very well said.

Chairman HOLIFIELD. At the same time, it is certainly indicated there could have been precautions taken which were not taken, and there could have been protective measures taken and protective supervision given which was not given in this instance.

Dr. WILSON. In outlining the things we have learned and the things that could have been done differently, I can't say specifically that any one of them would have prevented the accident, because we don't know exactly how the accident happened. But I am sure if we had taken all those precautions, the accident would not have happened.

Chairman HOLIFIELD. We still do not have conclusive evidence as to what actually happened and what caused it.

Dr. WILSON. That is right.

Chairman HOLIFIELD. It could have been possible that with this experimental reactor, even if those precautions had been taken, that something could have happened that would have caused it?

Dr. WILSON. I really believe if all those precautions had been taken we could have prevented the accident. I have no doubt in my mind as to that. I cannot prove that, because I don't know exactly what did happen. But I think these various precautions that I mentioned here cumulatively would have certainly prevented the accident.

Chairman HOLIFIELD. You do not fix the responsibility for the failure of taking these precautions. You do not say that the Commission, being the top body that is responsible for this, must bear its share of blame on this?

Dr. WILSON. I think so. I think the responsibility is quite general throughout the organization, including the Commission.

Chairman HOLIFIELD. I want to say this, that in the handling of this whole incident from the very time it occurred, the Commission has, in my opinion, acted frankly and honestly in trying to give to the committee and the public such facts as you had.

Dr. WILSON. That certainly has been our effort.

Chairman HOLIFIELD. I think your testimony this morning is to be commended as being a further indication that you are being frank, you are being honest with the committee and with the public, and that there is a feeling of responsibility on the part of all concerned in this deplorable incident which cost us three lives, and that this is going to be salutary in nature and cause every precaution to be taken in the future that is physically possible to take in order to insure safety not only to the operators but to the people in the surrounding areas, even in the experimental remote situations.

Dr. WILSON. That is correct.

Chairman HOLIFIELD. Are there any questions of Commissioner Wilson?

Representative VAN ZANDT. Mr. Chairman.

Chairman HOLIFIELD. Mr. Van Zandt.

Representative VAN ZANDT. I want to congratulate the Commissioner for a fine statement. As I said to my colleague, Mr. Price of Illinois, it is a confession. I think the people will appreciate it. I am a little amazed at the time factor involving the award of a bid for the manufacture of plates for the first core to the B. & W. Co. Are you acquainted with this bid?

Dr. WILSON. No, sir. That was before I was on the Commission.

Representative VAN ZANDT. Can anyone tell us the date of the award?

Colonel SCHRADER. I don't have that information.

Representative VAN ZANDT. Was it 1954?

Colonel SCHRADER. Sir, it must have been late 1957 or early in 1958.

Representative VAN ZANDT. Late 1957 or early 1958?

Colonel SCHRADER. Yes.[3]

Representative VAN ZANDT. When was it decided that the B. & W. core was not acceptable?

Colonel SCHRADER. I would rather get the specific facts for you.

Representative VAN ZANDT. How long did it take them to manufacture the plates for the core?

Colonel SCHRADER. They worked on the problem of plate manufacture for approximately 6 months.

Representative VAN ZANDT. Then the decision was made that the plates were not acceptable?

Colonel SCHRADER. Presumably, sir, this would have been made early in 1958. You see, the reactor started operating in the fall of 1958.[4]

Representative VAN ZANDT. Then on a crash basis the Argonne Laboratory had to manufacture the plates for the core; is that correct?

Colonel SCHRADER. I do not know whether the word "crash" symbolizes it, because I was not there. But 6 to 8 months they had it, on that order.

Representative VAN ZANDT. Is it not true the Argonne people had to go out and lease machinery from private business in order to manufacture the core?

Colonel SCHRADER. I am sorry, sir. I am not aware of this.

Representative VAN ZANDT. I am trying to develop the fact that this is typical of the way we do things in this country. The core, which may be the heart of this incident, was manufactured on a crash basis.

Dr. WILSON. On the other hand, it must be recognized that industry has successfully made a great many cores.

Representative VAN ZANDT. This core was manufactured by the Argonne Lab.

Dr. WILSON. That is right.

Representative VAN ZANDT. You say it is all too clear that the accident could have been and should have been prevented. Are you taking

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[3] The date was subsequently determined to be July 19, 1957.
[4] The date was subsequently determined to be Feb. 1, 1958.

any disciplinary action involving those who are responsible for the incident?

Dr. WILSON. We have taken certain disciplinary action, and we will probably take additional ones. The General Manager will report to some extent on that at a later date.

Representative VAN ZANDT. Now you say here this is the first fatal reactor accident in nearly 20 years.

Dr. WILSON. That is right.

Representative VAN ZANDT. In other words, this is the first loss of life, is that correct?

Dr. WILSON. That is right.

Representative VAN ZANDT. In connection with an accident in a reactor. We have had other accidents, minor in nature?

Dr. WILSON. Yes, mostly automobile accidents on the job, or going to and from work are by far the greatest source of death, and not nuclear accidents at all.

Representative VAN ZANDT. Have you had any personnel to absorb a dose of radiation?

Dr. WILSON. Every worker around a reactor gets a certain dose of radiation in the course of time.

Representative VAN ZANDT. But no serious dose?

Dr. WILSON. No serious dose to my knowledge.

Representative VAN ZANDT. On page 2 you mention a design deficiency in SL–1.

Dr. WILSON. That is right.

Representative VAN ZANDT. This was the basis of my question a moment ago as to the time factor concerning the first core, and the construction of the second core.

That is all, Mr. Chairman.

Chairman HOLIFIELD. Mr. Ramey.

Mr. RAMEY. Did you consider this was a routine operation at the time of the accident?

Dr. WILSON. I don't consider any juggling around of the internals of a reactor a really routine operation.

Mr. RAMEY. Have most of the reactor accidents occurred during maintenance, or shutdown, or reassembly? Was the NRX one?

Dr. WILSON. No, the NRX was not shut down.

Mr. RAMEY. Windscale?

Dr. WILSON. I believe Windscale was not during normal operation. The NRX was during startup, not steady operation.

Dr. ZINN. NRX happened when they were making experiments on a specially constructed fuel rod in the reactor. The accident was made more severe than it should have been by the fact that there had been some maintenance on the control system which had not really been completed or was not in order. But there was an experiment underway.

In the Windscale case, it wasn't an experiment and it wasn't operation. It was operation, of a maintenance character, to release stored energy from the graphite in the reactor; this was a maintenance procedure but a rather unusual one and one which occurs infrequently.

I think the statement is correct. There has not been an accident in a reactor that has been operating under power.

Chairman HOLIFIELD. Thank you, Dr. Wilson.

Mr. Nelson, will you now take the stand, please?

STATEMENT OF CURTIS A. NELSON, CHAIRMAN, BOARD OF INVESTIGATION—Resumed

Mr. NELSON. Thank you, Mr. Chairman.

The first fatalities as a result of a reactor incident occurred on January 3, 1961. I would like to review with you today the circumstances, as we know them, that brought about these fatalities. I will first review highlights of the administration of the SL–1 reactor by the people most intimately concerned, then the operating history of the equipment.

In early 1958, the Argonne National Laboratory submitted for review their Hazards Summary Report to the AEC Hazards Review Staff and the Advisory Committee on Reactor Safeguards. The design was approved by the Washington headquarters in April 1958.

A complete technical review of the reactor and its proposed operation was made in February 1959, when Combustion Engineering, Inc., became the contractor. This review was made by a nuclear safety committee composed of personnel from the Connecticut offices of Combustion Engineering. We could find no other such review or comprehensive appraisal of the safety of reactor operation which has been made since that time by Combustion Engineering, Inc.

Operating personnel were not required to follow a detailed written procedure, although one was included in the training manual and the operating manual for the disassembly-assembly of control rod mechanisms. This disassembly-assembly work was considered routine maintenance. Consequently, the work shift at the time of the accident, which was engaged in this assembly operation, did not include a Combustion Engineering supervisor or a reactor engineer.

A local reactor safety committee existed at the plant site. Its members included the Combustion Engineering's operations supervisor, their test supervisor, their health physicist, and their assistant operation supervisor. The test supervisor testified that the committee reviewed proposed test procedures and new operating procedures, but did not routinely review reactor operating experience unless specific problems were brought to it. This committee did not make any overall comprehensive safety review of reactor operations although malfunctions were reviewed and reported.

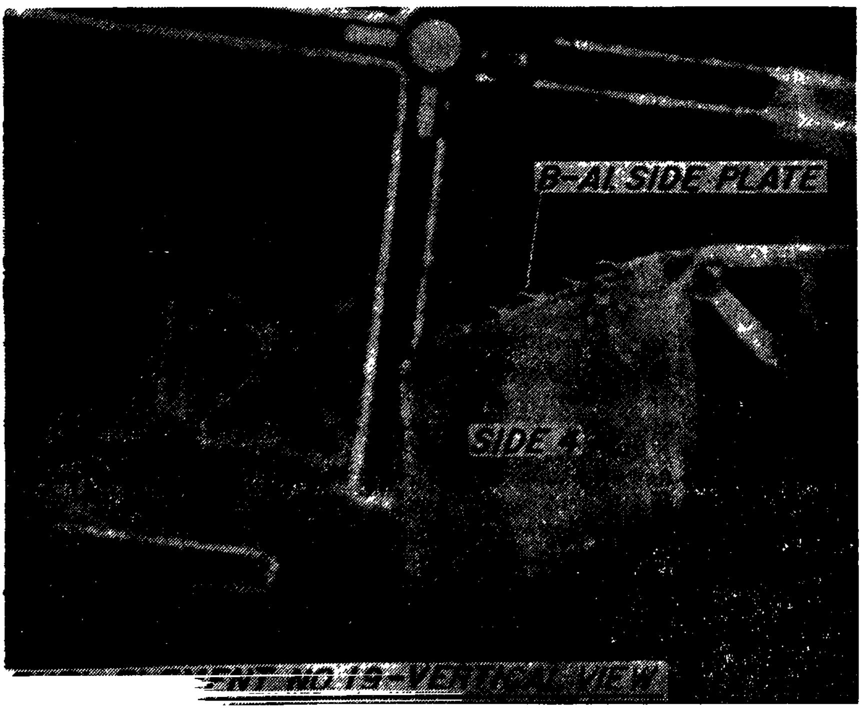
The proposed plans for operation of the SL–1, and the procedures for such operation, were subject to review and approval by the Director Military Reactors Division of the Commission's Idaho office. The contractor has routinely and consistently forwarded reports of reactor operations, including malfunction reports, to this Military Reactors Division. The sticking of control rods, which will be discussed later, was not considered a malfunction and, therefore, not specifically reported. The Director of the Division, and more often the SL–1 project engineer on his staff, made frequent visits to the facility.

Regular written reports of reactor operations were forwarded to the Army Reactors Office, Division of Reactor Development, Headquarters. Periodic appraisals, through visits to the facility, of the safety of the SL–1 plant by members of the Idaho staff, although comprehensive in most respects, did not include inspection of the nuclear safety of reactor operations. Trip reports by members of the Army Reactors Office, Headquarters, especially during early operation of the plant, did include specific comments dations concerning the operating procedures at that time. Quarterly review meetings with the contractor, which dealt with reactor operational experience as well as programmatic plans, were attended by Army Reactors Office personnel, as well as the Idaho Office personnel.

The records indicates that inquiries were made by Headquarters Inspectors in 1959, as to the extent of reactor safety reviews made by the Idaho Operations Office. The Idaho staff felt that reviews made at that time were adequate, including the SL-1 reactor. Independent, validating review, by the headquarters staff, of the Idaho reactor safety review system was not performed.

REACTOR OPERATING HISTORY

On October 24, 1958, the SL-1 achieved its full power rating of electricity and space heat of 3 MW (th). The reactor was turned over to Combustion Engineering, Inc., for operation in February 1959. The Army Reactors Office, Headquarters, at this time stated that the procedures and manuals turned over to Combustion Engineering by the Argonne National Laboratory were not satisfactory for use by Combustion Engineering for sustained operation at full power. Combustion Engineering was requested to prepare revised material which was accepted as a basis for the startup and early operation of the reactor. After obtaining actual operating experience, Combustion Engineering was to further develop and modify the operating manuals and procedures to make them suitable for operations at remote sites. Initial test operation by Combustion Engineering, for their home office nuclear safety committee, took place on March 6, as mentioned earlier, and cold critical experiments began on March 30, 1959.



I think you may be able to see the top of a fuel element (photo above) and tack welded to the side of that fuel element in a side view you will note the bowing of the boron strips between tack welds.

Initial discovery of the bowing of the boron strips, in the 3-inch sections between tack welds, was made in August 1959. During an August 1960 inspection by Combustion Engineering, it was observed that pieces of the boron strips were missing from some fuel elements, and the fuel elements in the center of the core were extremely difficult to remove, by hand. Removal caused pieces of the plates to fall off and there was flaking of the material. A considerable number of flakes were collected from the bottom of the vessel. As a result of these circumstances, it was felt that further removal of fuel elements might cause additional loss of boron, so that further inspection of the remaining fuel elements was not conducted.

By 500 MWD of operation, i.e., by May 1960, it appeared that the core was gaining reactivity faster than predicted. This gain of reactivity was ascribed to the boron loss. This loss of boron was noted during Combustion's August 1960 inspection.

The safety significance of the greater than expected rate of reactivity gain lies, of course, in the reduced capability of the control rods to render the core subcritical (i.e., a decreased shut-down margin).

Because of this reduced shut-down margin resulting from the boron loss, strips of cadmium were inserted in two of the four T-rod control shrouds on November 11, 1960. The offsetting effect of this cadmium at operating level was found to be about 1 percent reactivity.

Although numerical values for core reactivity, rod worth and shut-down margin are all subject to some uncertainty, in varying degree depending on assumptions made, such as the amount of boron loss, poison burnup and fuel burnup, etc., available information indicates the following:

1. The initial shut-down margin for the cold reactor was probably somewhat less than intended—maybe about 3.5 percent delta k actual margin versus an estimated 4–6 percent design margin. This margin was, nonentheless, considered adequate by Combustion Engineering and the AEC.

2. The design of the reactor was such that withdrawal of the central control rod alone would make the reactor critical.

3. At the time of shut-down on December 23, 1960, the shut-down margin for the cold reactor was probably 2 to 3 percent, assuming rod worth was essentially unchanged from earlier measurements and calculations. With this assumption, and a similar one regarding rod No. 9 (the central control rod), it was found that criticality could be produced by withdrawal of this rod approximately 17 inches from the reference zero position.

Testimony before the Board and operating records indicate that in more recent months of operation there was increased frequency of sticking of the control rods. On the one hand, it was postulated by several witnesses that the bowing of the boron strips attached to the fuel elements exerted sufficient lateral force to result in reduction of the clearance within the control-rod shrouds, restricting the free motion of the blades. On the other hand, several witnesses felt there was no evidence for such closing of the shrouds, but that there might be some accumulation of dirt or corrosion product on the shroud and control-rod blade surfaces. It was also indicated that the higher power operation, i.e., at 4.7 MWth, which took place only after November 1960, and the addition of the cadmium strips, required further withdrawal of the central control rods than had been previously required. Consequently, the drives were being used in a new region of the mechanical structure, where closer tolerances, or other differences, caused increased difficulties with rod motion. There was also, of course, the familiar difficulty with the friction in the control-rod seals outside the reactor.

Having reviewed those matters which the Board considered significant, both with regard to personnel and equipment, I would now like to discuss the sequence of events beginning just before the accident.

SEQUENCE OF EVENTS

The reactor was shut down for maintenance purposes on December 23, 1960, after having been operated for slightly more than 2 years. It was planned to bring it to power about 10 days later on January 4, 1961. During this period, 44 cobalt flux measuring wires were inserted into coolant channels between plates of the fuel assemblies. This work required the removal of the control-rod drive assemblies. The disassembly and insertion of the cobalt measuring wires had been completed by the day crew on January 3, 1961. The next crew—4 p.m. to midnight of January 3, 1961—consisted of the three military personnel involved in the accident. This crew and the crew that followed had been assigned the task of reassembling the control-rod drives and preparing the reactor for startup.

The first indication of trouble at the SL-1 reactor was an alarm at the fire and security stations at about 9:01 p.m., (mountain standard time), January 3, 1961. Immediate response to the alarm was made by the fire department and security patrol. They called a health physicist who discovered increasing radiation levels as he approached the reactor building. No entry was made until the arrival of the health physicist. Two Combustion Engineering employees located two of the crewmen. One crewman who appeared to be alive was removed at about 11 p.m. He was pronounced dead almost immediately after he was removed from the building. The other two were dead when first seen by those who entered the reactor room. Of the several hundred persons who assisted in the recovery operation, 22 received radiation exposures in the range of 3 to 27 roentgens total body exposure. No clinical symptoms have been detected.

CONSEQUENCES OF THE ACCIDENT

Postmortem examination of the three deceased crewmen shows that all three died as a direct or indirect result of blast damage. There was also evidence of flesh burns probably from steam to limited areas of one or two bodies.

Only minor damage was done to the reactor building. We have no conclusive evidence of damage, if any, to the reactor pressure vessel.

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We have another slide (see above) which attempts to show the condition of the reactor after explosion. You may recall an earlier view which you saw when Dr. Pittman was speaking. It is hard to identify anything. I think, Captain, you can show them the control-rod shroud which is ordinarily a cruciform shape. I am afraid it is not clear.

Captain TARDIFF. This is a shield. You can identify in the clear photograph the fuel elements lying on top of the debris, lying on top of the core.

Mr. NELSON. Thank you, Captain.

The core has been damaged extensively. Shrouds of control rods have been greatly distorted, core components litter the top of the core, the core has been expanded, from internal pressure at several points around the reactor out to the thermal shield. It has been determined that very little, if any, water was left in the vessel.

NATURE OF THE ACCIDENT

We do not know what caused the explosion. We have good evidence that a nuclear excursion took place.

The hypothesis of an initial chemical reaction which then induced a nuclear reaction by rearrangement of core components is not supported by any evidence to date. In this regard, the Board has been advised that metallurgical examinations made after the accident probably would not establish conclusively whether a metal-water reaction initiated or resulted from a nuclear excursion.

It is possible to conceive of several different items or combinations of items which may have constituted the immediate initiating event. The accident could have occurred with no errors being committed on the part of the crew, although certain errors on the part of the operators also can be visualized as possible initiating events. From the positions of the men after the accident and the injuries they suffered, we cannot rule out the possibility that one or two of them were engaged in lifting the central control rod at the time of the accident.

I would like to say in passing, Mr. Chairman, that we have a model which if we have time and you want it done we will be glad to demonstrate the assembly and disassembly operation which was the critical operation.

Chairman HOLIFIELD. Which model is that?

Mr. NELSON. I prefer to do that when I have finished, if it is all right with you, sir.

Chairman HOLIFIELD. All right.

Mr. NELSON. On the basis of existing information on the reactivity worth of the central control rod, prior to shutdown, and the results of BORAX and SPERT experiments, it is estimated that this—immersed in water—80-pound rod would need to be withdrawn 22 to 24 inches at a rate of approximately 24 inches per second in order to produce a nuclear excursion of the magnitude estimated to have occurred. While these actions and conditions appear credible, they do not appear probable, without other influences.

Additional factors can be considered which involve the possibility that some changes occurred in the properties of the reactor during the shutdown period between December 23, 1960, and January 3, 1961—changes which would minimize the capability of the control rod system to maintain the reactor shutdown. There is no direct evidence at present that any such changes took place. If loss of cadmium or loss of boron did occur during the shutdown period in question, the shutdown margin of reactivity would have been reduced. With a reduced shutdown margin of reactivity, substantially less withdrawal of the central control rod would have produced criticality.

Other conceivable initiating events, though at the present their likelihood appears to be low, include:

(*a*) A water-metal, hydrogen explosion, or other chemical reaction, below the reactor core, which would drive the central rod or several of the rods up out of the core, or that would lift the seal plugs and therefore the attached rods by a general pressure increase.

(*b*) Addition of water to a core which had become dry and otherwise changed.

It should be emphasized that the foregoing discussion is limited to possibilities and is not intended to imply a degree of probability.

In closing, with your permission, I would like to read into the record the conclusions of the Board of Investigation, although somewhat repetitive of what has been said.

(A) An explosion occurred in the SL–1 reactor at approximately 9 p.m., on January 3, 1961, resulting in the death of three persons, in damage to the reactor and to the reactor room, and in high radiation levels (approximately 500–1,000 r/hr.) within the reactor room. On June 1, the levels had decreased to the order of 25–100 r/hr. and were decaying with a half life of approximately 40 days.

(B) Two members of the crew were killed instantly by the explosion. The third died within about 2 hours as a result of an injury to the head.

(C) The explosion involved a nuclear excursion. The thermal nvt about the reactor was estimated to have been approximately 10^{10} n/cm^2 and may have resulted from more than a single burst of radiation.

(D) Chemical and radioactivity measurements on a single fragment of reactor fuel ejected by the explosion, if representative of the total fuel, suggest that the reaction may have resulted in 1.5×10^{18} fissions. This would have produced 50 megawatt-seconds of energy. Other estimates, based on decay of gaseous activity and on analogy with SPERT and BORAX experimental results, give a range from 100 to 500 megawatt-seconds for the total energy release.

(E) At the time of the explosion, the reactor crew appears to have been engaged in the reassembly of control rod mechanisms and housings on top of the reactor. The pressure generated within the reactor, which probably reached several hundred pounds per square inch, was vented through a number of partially closed nozzles in the head of the reactor, blowing out shield plugs, portions of control rods, and some fuel.

(F) The explosive blast was generally upward from the ports in the top of the reactor. Structural damage to the building, principally due to objects projected from the nozzles was slight. Damage to the reactor core is extensive, although there does not appear to have been gross melting of the aluminum core.

(G) Some gaseous fission products, including radioactive iodine, escaped to the atmosphere outside the building and were carried downwind in a narrow plume. Particulate fission material was largely confined to the reactor building, with slight radioactivity in the immediate vicinity of the building.

(H) At this time, it is not possible to identify completely or with certainty the causes of the accident. The most likely immediate cause of the explosion appears to have been a nuclear excursion resulting from unusually rapid and extensive motion of the central control rod. As yet, there is no evidence to support any of several other conceivable initiating mechanisms.

(I) It is known that a variety of conditions had developed in the reactor, some having their origin in the design of the reactor and others in the cumulative effects of reactor operation, which may have contributed to the cause and extent of the accident. Among these conditions were the loss from the core of the burnable boron and the condition of the control rods that caused sticking.

Dr. WILSON. I wonder if it might not be worthwhile to hear some description of the operations of assembly of the control rods.

You did not cover that in your report.

Mr. NELSON. We have a model here. If you would like us to demonstrate this.

Chairman HOLIFIELD. Yes; I think we will want to look at that, Mr. Nelson. If you want to step up to the board now.

Mr. NELSON. Yes, sir. I will have Captain Tardiff go through this. He is accustomed to doing it.

First, he will go through the disassembly which was performed, you will recall, that early morning.

Captain TARDIFF. We have a full-size scale model of the SL–1 control rod drive mechanism except for the upper and lower extremities.

The model in the configuration whereby the pinion drive shaft has been disconnected, the shield unit, are not shown. In the disassembly the first maneuver is to unbolt from the head the mechanism, remove the bell housing. This is removed over the pinion housing and the spring housing. Next the operator takes the lifting tool, screws it on the rack. The black portion is the rack, which is connected to a control rod extension, in turn connected to the control rod blade. Any movement of the black portion of the model is in turn movement of the control rod blade in the core. He pulls the rack 3 to 4 inches. There is no reason for him to pull it any farther. He attaches a C-clamp, removes the lifting bar, then removes a nut and stop washer. The spring is not in tension now. Then he places the lifting bar on the rack, removes the lifting clamp, then lowers the control rod into the core.

This is in what we call the bottomed portion. The next maneuver is to take off the pinion housing and the spring housing. Both are removed at the same time over the rack. At this point the shield plug is just resting on the head; the only force holding the plug in place is gravity and frictional forces along the nozzle and the head.

Next they remove the shield plug by hand over the rack. Next the mechanism has been disassembled. At this point we have access to the reactor core through a 6-inch nozzle.

Now, in the assembly it is essentially just the reverse of the disassembly.

Mr. NELSON. This is the operation, Mr. Chairman, that was performed by the three boys involved in the accident, the reassembly which he will now perform.

Captain TARDIFF. After the flux wires were put in, now we are going to assemble the control rod drive assembly. We lower the shield plug into the nozzle. Again, it is just resting in place.

Next we lower the pinion housing and spring housing over the rack and bolt to the shield plug. Again, we are not connected to the head.

Next we take the lifting tool. There is no reason again to raise the rod any further than we did in disassembly, about 3 or 4 inches. We place the C-clamp in place, replace the stop washer and the nut. In this movement he has to lift the rod just slightly to release the C-clamp.

Mr. RAMEY. What if it gets stuck when he wants to place it there? Would it be natural to exert a lot of pressure to pull it?

Captain TARDIFF. I don't believe so. He would just have to move it a fraction of an inch to release the C-clamp. There is no reason to pull it.

Dr. WILSON. But when they lift it up the 3 or 4 inches, if it were stuck down, there would be a possibility of giving it a jerk.

Captain TARDIFF. That is correct.

Chairman HOLIFIELD. Is there some kind of tool that the man would hold there, some kind of lifting bar?

Captain TARDIFF. The lifting bar has a handle on it. However, there is another lifting bar that has no handle and you can grip it like a pole.

Chairman HOLIFIELD. Would it be within the strength of one man to be able to make a sharp jerk on that and pull it up higher than it should go?

Captain TARDIFF. Yes; I believe the operations contractor has performed some experiments and it is possible for one man to jerk the rod a sufficient distance to cause the excursion.

Chairman HOLIFIELD. In a number of seconds?

Captain TARDIFF. Yes, sir.

Chairman HOLIFIELD. It would not take two men to do that?

Captain TARDIFF. One man can do it. This is normally a two-man operation, but one man can do it.

Dr. WILSON. It would be pretty difficult to do that feat. I think two men seems more probable.

Dr. ZINN. Two men failed when one man succeeded. They could not coordinate their motion quickly enough.

Chairman HOLIFIELD. Would it be possible to have a mechanical bar across the top of that lift rod there as a safety measure to prevent that from going higher than it should?

Captain TARDIFF. Yes, sir.

Chairman HOLIFIELD. Apparently there was no such safety bar.

Captain TARDIFF. There was no such stop on this mechanism.

Dr. WILSON. That is what I referred to in my testimony.

Chairman HOLIFIELD. You have the mechanical control of it through your gears and your regular control. Is there a limit to which it can be lifted?

Captain TARDIFF. Yes, sir. When the entire mechanism is assembled and connected to the pinion shaft and the seals and the drive motors have been connected, it is interlocked whereby its travel is restricted. In this position its travel is not restricted.

Chairman HOLIFIELD. I assume such a bar across the drive rods that are being lifted would interfere to some extent with the operator's doing the job. At the same time operations are performed in many cases in industry in restricted areas and with limitations of space and access, and it seems to me that it would be entirely possible for that kind of precaution to have been taken.

Captain TARDIFF. The rack is then lowered and the spring is under compression. Of the five mechanisms that were disassembled, we know that the bell housings were not connected.

Chairman HOLIFIELD. That what?

Captain TARDIFF. This bell housing, which is a pressure seal, bolts the entire mechanism to the head. The bell housings were not assembled, which means that the plug was free to move with any buildup of pressure.

Chairman HOLIFIELD. It means that precaution was not present?

Captain TARDIFF. Yes, sir. Those are lined up along the side of the shield blocks subsequent to the accident. They were not assembled.

Chairman HOLIFIELD. Are you through?

Captain TARDIFF. Yes, sir.

Chairman HOLIFIELD. Thank you.

Representative VAN ZANDT. How long does it take to disassemble a reactor?

Captain MORGAN. The complete disassembly and moving back of the shield blocks would take several hours. This operation here with one control rod would take 15 to 20 minutes.

Representative VAN ZANDT. When was this reactor disassembled?

Captain MORGAN. It was disassembled on the morning of the 3d of January. The first crew came on, on the midnight shift, on the 3d of January, and they completed the disassembly around 5, 6, 7 o'clock at that time. I don't know the exact time.

Representative VAN ZANDT. In the morning?

Captain MORGAN. In the morning. So it was within 14 to 16 hours that this operation had taken place prior to the incident.

Chairman HOLIFIELD. I believe this would be a good time for us to adjourn until 2 p.m. this afternoon, at which time we will continue the hearings on the SL-1 accident and corrective measures which have been taken by the AEC following the accident.

We will start with Mr. Nelson at 2 o'clock.

(Whereupon, at 12:20 p.m., the committee recessed to reconvene at 2 p.m. of the same day.)

AFTERNOON SESSION

Chairman HOLIFIELD. The committee will be in order.

This afternoon the committee will continue hearings on the facts surrounding the SL-1 accident.

In addition, we will receive testimony on corrective measures taken by the Atomic Energy Commission following the accident in both contractor and licensee reactor operations.

If time permits we shall also take up the Commission's proposed reactor site criteria.

Mr. Nelson, you were in the chair, I believe, when we adjourned. Do you have any further statement you wish to make?

Mr. NELSON. No, sir; no further statement.

Chairman HOLIFIELD. Now we have printed the preliminary report. Does the board's final report include any significant data in addition to that contained in the preliminary report?

Mr. NELSON. You have the report that was sent over recently, sir, and along with a memo? You have both of these reports?

Mr. RAMEY. There was a memo of submittal, yes. Then we had an earlier report several months ago.

Mr. NELSON. Yes.

Mr. RAMEY. I think the question was, Did you develop any data of any significance in between your initial report and this report?

Mr. NELSON. I would not think anything of outstanding significance; no, sir.

Chairman HOLIFIELD. Do you consider the operation of a power reactor conducted when the reactor vessel is opened up and fuel elements and control rods are exposed to be routine operation?

Mr. NELSON. No, sir; particularly not if any change is made to the core reactivity.

Chairman HOLIFIELD. Did you question the men on the preceding day's shift in regard to their experience during their time of work?

Mr. NELSON. Yes, sir; we talked to each of them.

Chairman HOLIFIELD. Had they noticed any reactor defects during their shift?

Mr. NELSON. No, sir; I think not.

Chairman HOLIFIELD. They made no written report on any unusual phenomenon?

Mr. NELSON. If you will pardon me a second, I would like to check whether there were any entries in the log that were of any significance. No, sir; there was nothing of any significance.

Chairman HOLIFIELD. Nothing of any significance?

Mr. NELSON. No, sir.

Chairman HOLIFIELD. Could this accident that occurred be attributed in any way to a lack of training on the part of the three men working on the reactor?

Mr. NELSON. We thought not, sir.

Chairman HOLIFIELD. Was the recovery plan after the accident then executed in accordance with a preset emergency plan?

Mr. NELSON. No, sir; I would not say it was.

Chairman HOLIFIELD. There was a preset emergency plan, was there not?

Mr. NELSON. There is an emergency plan and up to a point I think it was followed. It was not perhaps tailored for just this type of occasion.

STATEMENT OF CLIFFORD K. BECK, ATOMIC ENERGY COMMISSION

Mr. BECK. I think the comment is that the initial activities of the rescue operations seemed to be carried out as well as they possibly could have been.

The nature of the accident was unique and the experience had not been of this kind at any other place so there was a necessary time of regrouping of facilities in the succeeding days before a plan had been evolved that fitted this particular case.

Chairman HOLIFIELD. Would you say, then, that the emergency planning was adequate, but that it could have been improved upon.

As a matter of hindsight, it could have been a better emergency plan.

Mr. BECK. I think we learn by our experiences and certainly we have found here that there are some things that can be done in the light of this experience which would make our operations more efficient, I believe, in future cases.

Chairman HOLIFIELD. Have steps been taken, recommendations been made, along that line, so far as you know?

Mr. BECK. I think the General Manager perhaps will discuss that in his testimony.

Chairman HOLIFIELD. In your letter forwarding the report of the investigative board, you pinpointed responsibility up to the level of the General Manager. Was it the board's conclusion that the Commission had no responsibility for the effective performance of the staff?

Mr. NELSON. No, sir; we think they share in the responsibility to a degree.

Chairman HOLIFIELD. After your investigation experience, would you say that Combustion Engineering was adequately performing its responsibilities under the terms of the contract with AEC?

Mr. NELSON. Not completely, sir.

Chairman HOLIFIELD. In what way would you say they were not living up to their contract?

Mr. NELSON. It was the board's feeling that it would have been a prudent act to shut down the reactor when it was known that it had somewhat deteriorated in the core and control rods and to have made a very close examination of it.

Chairman HOLIFIELD. That would have been an act of judgment rather than an act of fulfillment of the contract, would it not?

Mr. NELSON. That is true.

Chairman HOLIFIELD. Was there in existence an oral agreement between AEC and Combustion Engineering on supervision during operation of the reactor?

Mr. NELSON. I would like to consult with my associates, sir.

Dr. Beck is a little more familiar with this particular item.

Dr. BECK. There was an understanding that at any time routine operations were being performed they would be carried out by the military crew and if they were standard routine operations, which had been repeated numerous times, supervision of the Combustion Engineering representative would not be required.

If any nonroutine activities were in progress, whatever shift might be involved would have Combustion Engineering supervision.

Chairman HOLIFIELD. It is your understanding that was an oral agreement and was never reduced to writing; is that right?

Mr. NELSON. Yes, sir; it was an oral agreement.

Mr. RAMEY. This period was construed as a period of routine operation when this accident occurred and there was no supervision?

Mr. NELSON. Yes, sir; that is true.

Chairman HOLIFIELD. Will you elaborate on the changes which could have occurred on the reactor between December 23, 1960, and January 3, 1961, which could have caused the accident? There has been reference to the fact that something may have occurred within the reactor during the period of 10 or 11 days. On page 8 of your statement, you say:

> It is possible to conceive of several different items or combinations of items which may have constituted the immediate initiating event. The accident could have occurred with no errors being committed on the part of the crew, although certain errors on the part of the operators can also be visualized as possible initiating events.

Mr. NELSON. I would like to have Dr. Morris respond to that.

STATEMENT OF PETER A. MORRIS, ATOMIC ENERGY COMMISSION

Mr. MORRIS. I think this statement in part reflects our ignorance on what actually did take place and we were trying to grope if possible with mechanisms whereby loss of poison from the core could increase the reactivity or redistribution of fuel might have increased reactivity or even admitting the possibility of sabotage, the placement of some kind of explosive within the core.

I don't think we had any specific mechanism in mind, but I think the board does take the position that although the manipulation of the central rod by operators appears to be the most credible thing, it is not a plausible mechanism in terms of what we have learned about the training of the men and the difficulty of moving this rod rapidly and far.

So we are trying to include any other mechanism not yet conceived of in making the statement that we did.

Chairman HOLIFIELD. Was there any investigation made or contacts or interviews held between yourselves as a board and the families of these boys, immediate families that lived there in Idaho Falls?

Mr. NELSON. Yes, sir; indirectly they were interviewed.

Chairman HOLIFIELD. Was there any indication from those interviews that would be pertinent to the consideration of the psychological attitude of these members of the military that might lead you to believe that these individuals were temperamentally unsuited for their position?

Mr. NELSON. We had this specifically in mind, sir. We interviewed with this in the back of our head and we found nothing whatsoever.

We also reviewed medical records and military records. We could find nothing whatsoever.

Chairman HOLIFIELD. Your reference to thinking that there might be some possible sabotage, then, was not predicated upon the personalities or attitudes of any of the workers that were involved?

Mr. MORRIS. No, sir.

Chairman HOLIFIELD. Looking further at that point, was the reactor at all times under guard and supervision so that outside saboteurs would have difficulty getting to the reactor?

Mr. NELSON. I would like to consult for just a moment, sir.

Yes, sir; there is an exclusion fence and a guard post. It was always under surveillance.

Chairman HOLIFIELD. It was under surveillance at all times.

Mr. NELSON. Yes, sir.

Chairman HOLIFIELD. Do you think it is probable that this accident could have occurred without operator error?

Mr. NELSON. It is conceivable; yes, sir.

Chairman HOLIFIELD. Under what circumstances?

Mr. NELSON. As covered in the statement this morning rather generally, it is possible that the reactor core may have deteriorated to a point where the control rod need not have been taken out as far as they thought to reach criticality.

Chairman HOLIFIELD. In other words, the safety factor could have been lowered to the point where a movement of the rod, which would be normal under ordinary circumstances, would be dangerous?

Mr. NELSON. It would seem that this is a possibility, sir.

Chairman HOLIFIELD. Could that have occurred as a result of the scaling off of the boron or the dropping off of some of the strips that were attached to the fuel rod.

Mr. NELSON. This is one way it could happen; yes, sir.

Chairman HOLIFIELD. Did your photograph show that some of those strips had fallen off the fuel rod?

Mr. NELSON. Yes, a small amount.

Chairman HOLIFIELD. A small amount?

Mr. NELSON. Yes.

Chairman HOLIFIELD. Of course, your photographs are inconclusive and incomplete, are they not?

Mr. NELSON. That is true.

Mr. RAMEY. Would it be possible for the insertion of those flux wires to have dislodged any more boron?

Mr. NELSON. May I refer that to Dr. Morris.

Mr. MORRIS. We asked this question of several of the witnesses who appeared before the board. To the best of our knowledge the insertion of these wires was in regions between fuel plates and not next to the boron strips, so the consensus of opinion was that this operation did not dislodge any more boron.

Chairman HOLIFIELD. Are there any questions?

Representative VAN ZANDT. Mr. Nelson, did you look at the qualifications of these three men who lost their lives?

Mr. NELSON. Yes, sir; we did.

Representative VAN ZANDT. They were military?

Mr. NELSON. Yes, sir.

Representative VAN ZANDT. All in the U.S. Army?

Mr. NELSON. No, sir.

Representative VAN ZANDT. Two Army, one Navy?

Mr. NELSON. One Air Force, one Army, one Navy.

Representative VAN ZANDT. What were their qualifications?

Mr. NELSON. May I consult with my associates to get this precise.

One correction, sir. There was not an Air Force man among them. There were two Army and one Navy.

Dr. Beck will review for you the qualifications and training given the board.

Mr. BECK. These men were assigned on official duties: one as shift supervisor for which he had fully qualified through the training program and the examination program conducted jointly by the Army and Combustion Engineering.

The other was a qualified operator who had been processed through the same training procedures and qualifications examinations.

The third man was a trainee who had completed the formal training programs and had been assigned somewhat as an apprentice, with the expectation that within a very short time after this incident he would have come up for his examination as a fully qualified operator.

But at the time he was a trainee in the later stages of his training program.

Representative VAN ZANDT. Were they qualified for doing the work they were doing at the time of the accident?

Mr. BECK. All the evidence we have indicates that they were completely qualified for this, the two were completely qualified and the third was qualified for the work under supervision which he was performing.

Representative VAN ZANDT. In your opinion, could this accident have happened in the morning when they were disassembling the reactor?

Mr. NELSON. I presume it could have happened then, sir; yes, sir.

Representative VAN ZANDT. What about the fact that the control room was unmanned? Would it have prevented the accident had it been planned?

Mr. NELSON. Probably not. I suppose it is possible that it could have.

Representative VAN ZANDT. In other words, the nuclear excursion that resulted in the explosion would not have shown up on the panel of the control board?

Mr. NELSON. I would like one of my technical people to answer that.

Dr. Beck?

Mr. BECK. I think it is difficult to answer the question because we don't know how the accident occurred. It is conceivable that the accident may have occurred in an exceedingly short interval of time which could not have been forewarned in any way by any instruments.

On the other hand, it is conceivable there could have been a slower buildup, climaxed by a more abrupt excursion in which case it is conceivable that instrumentation might have given some forewarning.

But in the absence of information about what actually occurred we can't answer; we can't say one way or another.

Representative VAN ZANDT. That is all, Mr. Chairman.

Representative PRICE. Mr. Chairman, may I ask a question on the same point that Mr. Van Zandt has developed?

How long had these three military personnel been engaged in their particular assignment?

Mr. NELSON. The board had testimony to the effect that one of them had gone through the same procedure at least four times and I think another had gone through it perhaps also four times.

In other words, two of them were experienced.

Representative PRICE. Is this considered an adequate experience to be left alone without supervision in such work?

Mr. NELSON. It was considered so, yes.

Representative PRICE. That is all.

Chairman HOLIFIELD. Mr. Aspinall?

Representative ASPINALL. No questions.

Chairman HOLIFIELD. Mr. Morris.

Representative MORRIS. No questions.

Chairman HOLIFIELD. Thank you very much, gentlemen, for your report.

Mr. NELSON. Yes, sir.

Chairman HOLIFIELD. The next witness will be Mr. W. B. Allred of the Combustion Engineering Co.

Mr. Allred, will you take the witness stand and you may proceed with your statement, sir.

STATEMENT OF W. B. ALLRED, PROJECT MANAGER, SL-1 PROJECT, COMBUSTION ENGINEERING, INC.

Mr. ALLRED. Mr. Chairman, by letter dated June 5, 1961, from the Idaho Operations Office of the Atomic Energy Commission, we were requested to prepare and submit information to this hearing on four areas of the SL-1 operation. These, in the order in which they will be covered, are as follows:

1. Supervision as it existed, including the degree of supervision.
2. Qualifications of Combustion Engineering, Inc., and military personnel at the site.
3. The military personnel training program.
4. Combustion Engineering's safety and operating procedures.

Upon selection by the Atomic Energy Commission, Combustion Engineering, Inc., became the operator of the SL-1 facility in February 1959. According to the contract with respect to the SL-1 the objectives were—

A. To gain, through SL-1 plant operations:

i. data and experience at design and off-design conditions in support of the Army boiling water reactor program.

ii. knowledge of the costs of operating the SL-1 on both a commercial and a Government accounting basis.

iii. Familarity with the problem areas encountered through sustained operation.

B. To train and assist others in training crews to operate the SL-1 and other reactor installations.

The following statements are submitted by the contractor on each of the points listed above:

1. Supervision as it existed, including the degree of supervision: To realize the objectives of the contract, the contractor supplied a supervising staff of professional people and the Army Nuclear Power Field Office supplied an operating staff of military personnel.

This arrangement was requested by the Commission and concurred in by the contractor. An organization chart is attached.

The SL–1 organization, in effect at the time of the accident on January 3, 1961, consisted of four organizational functions under the project manager. These were operations, health physics, test and evaluation, and administration.

The operations section consisted of five contractor staff members as follows: An operations supervisor, assistant operations supervisor, electronics engineer, operating engineer, and chemist.

The military operations staff consisted of 17 men, including a plant superintendent reporting to the contractor operations supervisors for technical direction and operating instructions.

The staff in the remaining sections were all contractor personnel as follows:

A health physicist reported to the project manager in a staff position. His duties included preparation of health physics and safety manual, SL–1 disaster plan, monitoring radiation levels in the plant, preparation of reports, and providing health physics instruction to the military.

The test and evaluation section consisted of four professional men, including a supervisor. Their function was to coordinate the test program, prepare test procedures, evaluate test data, and prepare test reports.

The administrative section under a supervisor was assigned all site administrative functions, i.e., personnel, budget, purchasing, security, et cetera.

In the normal conduct of business with respect to the operation of the SL–1, the Commission communicated with the contractor through the project manager. With respect to the operation of the reactor, the contractor's operations supervisor gave instructions to the plant superintendent. The plant superintendent, in turn, organized the military cadre into shifts consisting of a chief operator and an operator.

These assignments were reviewed by the contractor's operations supervisor or assistant operations supervisor.

During the performance of the test programs approved by the Commission, contractor personnel supervised and/or operated the reactor.

The above method of operation was in effect for just under 2 years. A training and test program had been carried out successfully and the reactor had operated 83 percent of scheduled time.

It had been demonstrated that operation and maintenance with a minimum military crew was feasible. This point was considered essential since SL–1 was a prototype for remote site use.

The contractor's operating budget for the SL–1 operation did not permit staffing of the plant with contractor personnel on an around-the-clock basis. Operation of the plant with only military crews present on an around-the-clock basis was in conformity with the intention of the supervising Commission operations office.

2. Qualifications of Combustion Engineering, Inc., and military personnel at the site——

Chairman HOLIFIELD. Before we go to that, was this an agreed-upon plan between Combustion Engineering and the Commission, or was there a qualification to the matter contained in the last sentence:

Operation of the plant with only military crews present on an around-the-clock basis was in conformity with the intention of the supervising Commission operations office.

My question is: This is in conformity with the intention, but is it also in conformity with the agreement of Combustion?

Mr. ALLRED. Combustion had agreed with this principle of operation at SL–1, yes.

Representative PRICE. In that connection, Combustion had agreed. There has been some testimony to the effect that this was a well-considered plan because the reactor would principally be used in remote places and there would be times when it would not be possible to have an abundance of operators.

So they wanted to get the men experienced to handle the project themselves, but the way your statement reads, I think you are giving more consideration to the budget feature of the thing, the idea of working the night shift without supervision was more of a budget consideration rather than a training consideration.

Did Combustion fully agree that it was a safe procedure to work the night shift without supervision?

Mr. ALLRED. We did feel, at the time, that this procedure of permitting military crews to operate the plant for routine or normal operation of the plant was satisfactory. We had in our program an expanded test effort and at this time we did propose that some Combustion supervision might be required on around-the-clock basis so that the test program would be operated in that manner.

Representative PRICE. Are you saying because of budget consideration you found it not possible to have round-the-clock supervision?

Mr. ALLRED. I would prefer not to make my comments solely on the basis of the budget. At one point during the budget hearing the question did come up, Combustion had proposed adding staff members to the operating organization because of the expanded test program which we visualized would be coming up.

The Commission did not approve that expansion in our staff requirements.

Representative PRICE. For budget reasons?

Mr. ALLRED. Yes.

Representative PRICE. That is all.

Chairman HOLIFIELD. Was the expanded program put into effect?

Mr. ALLRED. It was not.

Chairman HOLIFIELD. Proceed with your statement, sir.

Mr. ALLRED. The key personnel experience résumés are summarized below to indicate the qualifications of the men for these positions. Detailed résumés of contractor personnel and the qualified chief operators at SL–1 are attached to this statement.

The contractor project manager was a graduate engineer with advanced study in reactor technology. He had 18 years of industrial experience of which 14 years were in the reactor development program, and 10 years in positions of responsible charge.

Chairman HOLIFIELD. What is this man's name?

Mr. ALLRED. W. B. Allred.

Chairman HOLIFIELD. I just want to be sure whom we are talking about.

Mr. ALLRED. The contractor test supervisor was a graduate engineer with advanced study in reactor engineering. His experience included 12 years in industry, of which 4 years were in the reactor development program.

Chairman HOLIFIELD. What was his name?

Mr. ALLRED. Sidney Cohen.

The contractor operations supervisor was a graduate engineer with advanced study in reactor engineering. He had 13 years' industrial experience, of which 5 were in reactor operations on the MTR, ETR, and SL-1. His name was Paul Duckworth.

The contractor assistant operations supervisor was a graduate engineer with 8 years' experience, 4 of which were in operation and maintenance of conventional marine powerplants and 2 years on reactor operation. His name was William P. Rausch.

The contractor health physicist was a university graduate with 5 years in the health physics field. His name was E. J. Vallario.

The military plant superintendent was a high school graduate with 15 years of military service. His present rank is master sergeant in the Air Force.

Following careful selection for special duty in the Army nuclear power program, he has accumulated a total of 5 years' operating experience at the Argonne CP-5 and experimental boiling water reactors and the SL-1 nuclear powerplant.

His name was Richard Lewis.

3. Military personnel training program: The training program for military personnel—Army, Navy, or Air Force—assigned at the SL-1 plant was conducted by the Army nuclear power field office, Fort Belvoir, Va.

A military field training staff was established at the SL-1 site to conduct final phases of the operator training, including familiarity with the SL-1 plant and on-the-job operator training.

The training program, as understood by the contractor, included an 8-month course of instruction at Fort Belvoir, Va., of which 4 months were in the trainee's specialty, that is, electronics or mechanics, and 4 months were in reactor technology.

Upon completion of the Belvoir training, personnel were sent to the SL-1 field training program for an additional 12-week program of instruction. The 12-week course was broken into six topics which are—

Administrative time, 24 hours;
Familiarity training, 80 hours;
Operator training, 288 hours;
Specialty training, 64 hours;
Training in other specialties, 8 hours;
Qualifications training, 16 hours.

Following the 12-week training period, trainees were given a written examination by military instructors. If the student passed, he appeared before a military training review board for oral questioning.

If accepted by the board, the trainee was further questioned by the contractor staff and required to demonstrate his proficiency to operate the SL–1 plant.

Upon completion of this final review he was qualified as a reactor operator by memorandum from the contractor operations supervisor.

Approximately 40 percent of the candidates submitted to the contractor for qualification were returned for further training. In all cases the man, his supervisor, and the field training group were informed of the points on which the man was considered to be deficient.

Following a specified time period, during which the man was retrained and re-recommended by the military, he was reexamined by the contractor. All men were finally passed and qualified, one man was examined three times. In all, some 122 military and maritime personnel were trained. Of these, approximately 30 completed the operator training course and were qualified as SL–1 operators.

Of the operators possessing the necessary time qualifications, only 15 were selected for chief operator training, and all 15 qualified. The chief operator qualification examinations were as follows:

A. At least 6 months' operation on SL–1 plant as a qualified operator.

B. A written examination given by military instructors.

C. An oral examination given by the military operating and training staffs.

D. An oral examination given by a contractor board consisting of the health physicist, operations supervisor, assistant operations supervisor, and reactor engineer.

The military training group selected its instructors from chief operators who had an aptitude for conducting training. The men were approved by the SL–1 cadre chief, based on his evaluation of their general knowledge of the plant as well as other factors. The contractor did not participate in this selection.

The single exception to the above arrangement for training by the military was the health physics training in which the contractor provided both the classroom and the operational training.

In addition, the contractor had reviewed the military's training program for content. It was the opinion of the contractor supervisory personnel that the program was adequate for the training of personnel for the operation of the SL–1.

4. Combustion Engineering's safety and operating procedures:

The contractor was requested by the Commission to prepare a "complete operating manual" prior to full scale operation of the plant. The Commission furnished an outline for the chapters on individual systems, and each completed segment of the manual was forwarded to them for approval.

The reactor was operated on a limited basis during this period to obtain data and information for the writing of the manual. During that time each such operation required specific approval from the Director, Division of Military Reactors, of the Idaho Operations Office.

The manual prepared by the contractor was approved by the Idaho Operations Office in March 1959. This manual of operating procedures was subject to continuous revision based on operating experience.

Such revisions were made periodically and in September 1960, volume II, Operating Procedures, of a new, completely revised SL–1 Operating Manual was submitted in draft form to the Commission for review and comment.

Volume I, covering reactor and system descriptions, was to follow in early 1961. To conduct plant maintenance, procedures were prepared and issued as part of the operating manual.

A manual, SL–L (ALPR) Health Physics and Safety Procedures, was approved and published by the contractor in February 1959. This manual was subsequently revised in December 1960, and submitted for approval.

The basic guidelines for these manuals was the Code of Federal Regulation, title 10, chapter 1, part 20, "Standards for Protection Against Radiation," and the "National Bureau of Standards Handbook 69."

The SL–1 Safety Committee served as an advisory committee to the project manager. Its function was to review procedures, malfunctions aad plant changes and to make recommendations to the project manager. These meetings were called by the committee chairman, as required. The committee functioned as a working group with members conducting investigations in their own specialties. All work was not necessarily done in formal committee meetings. Specific instructions to the military operating crews on safety were transmitted through normal channels, i.e., the SL–1 operations supervisor.

The contractor's nuclear division safety committee at Windsor, Conn., was brought into specific SL–1 problems at the request of the SL–1 project manager, or of the nuclear division management.

The following is a list of the questions referred to the contractor's nuclear division safety committee. The conclusions of the safety committee were recorded in memorandum form:

A. Nuclear safety review of SL–1 facility, March 5 and 6, 1959, which was at the beginning of our operational period.

B. Review of SL–1 operating manual, April 24, 1959.

C. Review of SL–1 operations, August 19, 1959.

D. Review of SL–1 Malfunction Report No. 7—low water level—December 4, 1949.

E. Review of SL–1 plant expansion hazards evaluation report, No. IDO–19016, June 20, 1960.

F. Review of SL–1 operations, including the loss of boron-aluminum strips, November 17, 1960.

The contractor's nuclear division safety committee did not include any staff members from the SL–1 operations.

(Attachments to the formal statement of Mr. Allred follow:)

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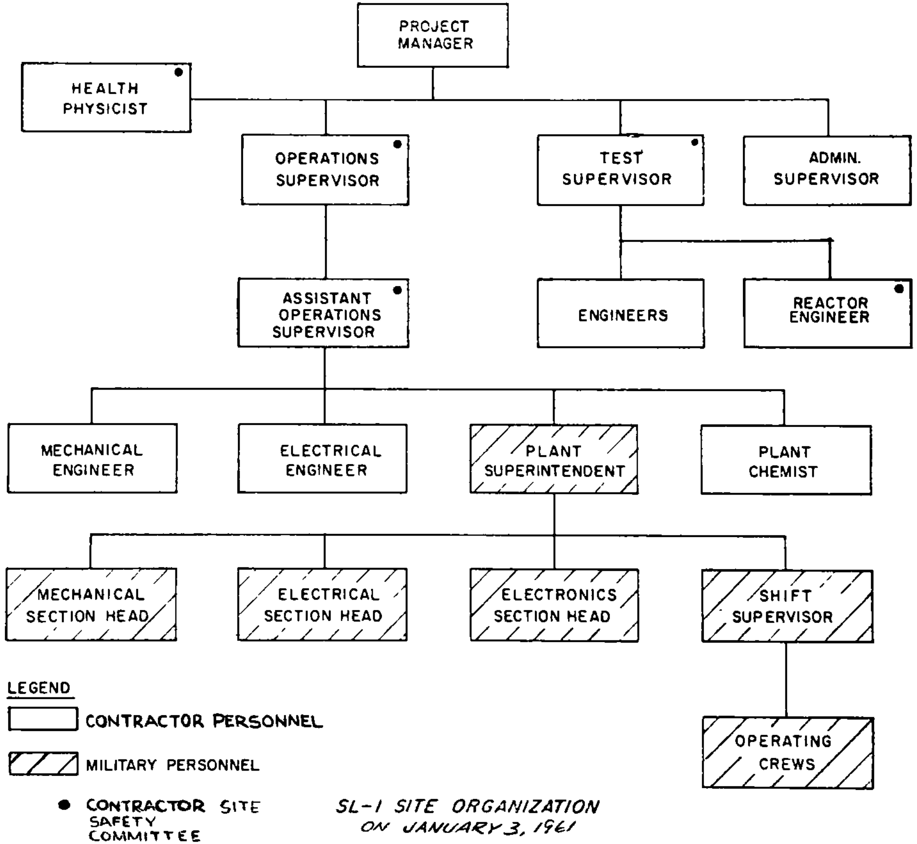

SL-1 SITE ORGANIZATION ON JANUARY 3, 1961

Experience resumes for the following contractor personnel are attached:

ALLRED, William B.
COHEN, Sidney
DAMOUR, Paul R.
DUCKWORTH, Paul R.
ETZ, Jr. William H.
LUKE, Charles W.
RAUSCH, William P.
RUSSELL, Malcolm L.
SAGER, Deo L.
VALLARIO, Edward J.
YOUNG, Roger G.

WILLIAM B. ALLRED	B.S., Chemical Engineering, 1942, North Carolina State University Graduate Study in Chemical Engineering and Metallurgy, 1943-44 Special Training in Reactor Engineering at Oak Ridge National Laboratory, 1946-47

1954-Date COMBUSTION ENGINEERING, INC., Nuclear Division

Title: Project Manager

Since December 1958, Mr. Allred has been Project Manager, Army Boiling Water Reactor Project, responsible for operations, test and evaluation of the SL-1 Facility and associated research and development programs directed toward design of improved package boiling water reactor plants of the PL series. Previously, he was Manager of Engineering Laboratory, responsible for reactor experimental work in the areas of mechanical and electrical development, including heat transfer, fluid mechanics, stress analysis, mechanisms development, corrosion studies, reactor component and systems evaluations, reactor control systems evaluation, instrument development and test, and analog computer programming and operation.

1949-1954 OAK RIDGE NATIONAL LABORATORY, Atomic Energy Commission

Title: Reactor Engineer

On joining the AEC, Mr. Allred was made responsible for Program Planning and Analysis on the HRP, MTR, chemical processing projects, and reactor metallurgy development. In 1951, he was promoted to Chief, Reactors Branch, USAEC, Oak Ridge, with responsibility for program management on all reactor projects at Oak Ridge, including MTR, HRP, and ANP projects.

1944-1949 OAK RIDGE NATIONAL LABORATORY, Union Carbide Nuclear Company

Title: Group Leader

Mr. Allred joined the ORNL as a development engineer and was subsequently appointed group leader. His group was concerned with gas flow, heat transfer and experimental stress analysis on gaseous diffusion plant problems and the MTR project.

1942-1944 ALUMINUM COMPANY OF AMERICA

Title: Chemical Engineer

During this period, Mr. Allred worked as a chemical engineer and subsequently as a group leader for the Operations Analysis Group which served as a process control center in the aluminum reduction plant.

SIDNEY COHEN

B.S., Chemical Engineering, 1948, Princeton University

Graduate Studies, 1952-1957, University of Houston

Special Training, Nuclear Physics and Engineering, Phillips Petroleum Company, 1957-1960

May 1960-Present

COMBUSTION ENGINEERING, INC., Nuclear Division

Title: Supervisor SL-1 Test and Evaluation

Supervised test planning, scheduling. Preparation of test procedure at SL-1, analysis of test data, and preparation of test reports. Project engineer for the field installation of PL condenser loop, preparation of test procedures, and initial performance testing.

1957-1960

PHILLIPS PETROLEUM COMPANY

Project engineering work involving design, installation and operating supervision of the following types of experiments at MTR and ETR:

High Pressure Recirculating Water Loops
Recirculating Liquid Metal Loops
Gas Cooled Loops

General experience in radiation instrumentation, reactor controls, shielding, radiation damage, nuclear calculation, critical facilities. Detailed heat transfer calculation for Nuclear Test Design Work for EOCR and associated experimental facilities. Hazards analysis for two large experimental facilities in the ETR.

1952-1957

MONSANTO CHEMICAL COMPANY

Research Engineer. Design, installation, operation and evaluation of Pilot Plants; study of chemical processes for manufacture of acrylon monomer, polyethylene and other materials; trouble shooting for plant operating facilities; laboratory development of processes with subsequent design and operation of large Pilot Plant and small product facilities.

1949-1952

CROWN CENTRAL PETROLEUM COMPANY

Testing of Petroleum Products, Operation of Water Treatment Plant, Servicing of High Pressure Boilers and Plant Cooling Towers, Operation of Boiler Plant Equipment.

<u>PAUL R. DAMOUR</u>

B.S., Liberal Arts, 1960
American International College

October 1958-Present

COMBUSTION ENGINEERING, INC., Nuclear Division

Title: Assistant Staff Chemist

Mr. Damour was initially employed as a Technician in the Windsor Health Laboratory, where he performed routine and special chemical analyses of health physics samples. In May of 1960, following receipt of his bachelor's degree, he was assigned to the ABWR Project in Idaho as an Assistant Staff Chemist, where he was responsible for performing chemical and radiochemical analyses of the reactor coolant and special reactor samples. He was also responsible for reviewing and reporting on analytical work performed for the ABWR Project by the Phillips Petroleum Company.

PAUL R. DUCKWORTH

B.S., Naval Science, 1945
University of California

B.S., Chemical Engineering, 1947
University of Kansas

April 1960-Present

COMBUSTION ENGINEERING, INC., Nuclear Division

Title: Supervisor - SL-1 Operations

Responsible for the reactor operation under the direction of the Project Manager. Supervised operations, maintenance, performance of tests, and military training activity.

Oct. 1955-April 1960

PHILLIPS PETROLEUM COMPANY, Atomic Energy Division, Idaho

(Aug. 1958-April 1960)

Title: ETR Operations Supervisor

Supervised twelve to thirty day-shift employees in the operation of plant and experimental equipment for the Engineering Test Reactor. Prepared operating manuals, trained new technical personnel and supervised reactor shutdowns.

Prior to leaving this position was engaged in writing and editing a portion of the MTR-ETR Operations Training Manual.

(May 1957-Aug. 1958)

Title: Operations Shift Supervisor - ETR

Responsible for component and systems testing prior to ETR startup.

(Aug. 1956-May 1957)

Title: Engineer - Startup Staff

Reviewed construction drawings, followed construction and recommended necessary construction changes. Prepared detailed procedures for testing reactor systems and components.

(Oct. 1955-Aug. 1956)

Titles: Reactor Technician - Reactor Engineer - Foreman
Materials Testing Reactor Operations

Operated reactor console and loop experiments. Supervised technicians and Union personnel operating reactor and plant auxiliary equipment. Supervised reactor engineers during reactor operation and shutdown.

WILLIAM H. ETZ, JR.

B.S., Mechanical Engineering, 1960
University of Arizona

June 1960-Present

COMBUSTION ENGINEERING, INC., Nuclear Division

Title: Assistant Staff Engineer - ABWR Project, Idaho

Joined Division following graduation from University of Arizona. Assigned as operations engineer in training. Qualified as a reactor operator in October 1960.

CHARLES W. LUKE

B.S., Physics, 1948
University of Idaho

M.S., Physics, 1951
University of Washington

May 1960-Present

COMBUSTION ENGINEERING, INC., Nuclear Division

Title: SL-1 Reactor Engineer - ABWR Project, Idaho

Planned and conducted tests at SL-1 including flux mapping, control rod reactivity checks, investigation of boiling noise vs. power level, investigation of boron loss on shutdown reactivity margin. Prepared test procedures and reports.

1957-1960

GENERAL ELECTRIC COMPANY, ANP Project

Assigned as Shield Test Engineer in the Shield Test Operation Unit of the ANP-NRTS Project. Responsible for swimming pool reactor operation and conducting test on shielding materials. Duties have included preparation of Hazards Report, reactor operating procedures, check-out and critical experiments on reactor, installation and check-out of reactor core and instrumentation. The work includes planning and preparation of test procedures, conducting of test, evaluation of test data and report preparation. Assignment also includes training of personnel.

1951-1957

UNITED STATES ARMY CHEMICAL CORPS

Technical Supervisor in charge of Inorganic Chemistry Laboratory, Physical Testing Laboratory and Special Project Laboratory of the Army Chemical Field Laboratory in Germany. Directed the activities of 11 scientists and 15 technicians.

RADIOLOGICAL DIVISION, CHEMICAL WARFARE SERVICE

In 1953, Mr. Luke was reassigned to the Radiological Division as Assistant Branch Chief, Nuclear Branch, AFSWP. He served as Project Officer in charge of radiation measurements and nuclear weapons testing. His duties included planning, testing, budget, procurement, assignment of personnel, evaluation and reporting. Was subsequently promoted to Branch Chief, Nucleonics Branch with administrative and technical responsibilities for all branch activities including Radiochemistry Section, Radiophysics Section, Electronics Section and Analytical Section. In this responsibility directed activities of approximately thirty scientific personnel. Duties included program planning, direction of technical program, budgeting, and personnel functions.

<u>WILLIAM P. RAUSCH</u>

B.S., Marine Engineering, 1953
Maine Maritime Academy

Feb. 1959-Present

COMBUSTION ENGINEERING, INC., Nuclear Division

Title: Assistant SL-1 Operations Supervisor ABWR Project, Idaho

Supervised SL-1 Operations, and maintenance and training of military personnel. Assisted in preparation of operations manuals and reports.

Sept. 1957-Feb. 1959

COMBUSTION ENGINEERING, INC., Naval Reactors Division

Title: Engineer I Operations and Training

Mr. Rausch joined the Company as an Operations Engineer in training. Upon completion of the training program he co-ordinated the preparation of S1C plant manuals and test program documents required for acceptance testing of the reactor control, instrumentation and piping systems.

Sept. 1954 Sept. 1957

UNITED STATES NAVY

Title: Chief Engineer and Engineering Instructor

Mr. Rausch joined the Navy as Chief Engineer aboard the U. S. S. Menelaus, where he was responsible for the maintenance and operational supervision of the power plant and associated equipment. He subsequently served in the same capacity aboard the U. S. S. Searcher. From October 1956 until his discharge in September of 1957 he served as Engineering Instructor at the Officer Candidate School in Newport, Rhode Island.

June 1953-July 1954

ORE NAVIGATION CORPORATION

Title: Third Assistant Engineer

Operation and Maintenance of Marine propulsion plant and associated systems aboard Steamships Venore and Santore.

MALCOLM L. RUSSELL

B.S., Mechanical Engineering, 1958
University of Vermont

Member: American Society of Mechanical Engineers

Dec. 1960- Present

COMBUSTION ENGINEERING, INC., Nuclear Division

Title: Assistant Staff Engineer - ABWR Project, Idaho

Assigned as test engineer to prepare test procedures, plan and procure test equipment, conduct plant systems test and prepare test reports.

June 1958- Dec. 1960

COMBUSTION ENGINEERING, INC., Naval Reactors Division

Title: Test Engineer

Responsible for operation and test of electronic controls for S1C reactor plant steam system. Inspected components and construction details and witnessed acceptance tests. Engaged in assembly and operation of complex test instrumentation during initial reactor system testing. Collected data from performance and evaluation tests and coordinated its conversion and distribution. Continued in above activity during subsequent operations of reactor.

DEO L. SAGER

High School Graduate, 1943

Additional training in Radio Television service and repair, 1946-50 University of California Extension

Completed Industrial Engineering Course 1946-50 International Correspondence School

Oct. 1960-Present	COMBUSTION ENGINEERING, INC., Nuclear Division Title: Assistant Staff Engineer ABWR Project, Idaho Assigned to operations section with responsibility for plant instrumentation, operation, test and maintenance. Was in training to qualify as reactor operation.
April 1957-Oct. 1960	PHILLIPS PETROLEUM COMPANY, Atomic Energy Division, Idaho Title: Electronics Specialist Performed design, layout and development of radiation detection instruments, friskers, cams and counters. Serviced electronic test equipment such as operational and linear amplifiers, data system units and counting and pulse equipment. Instructed technicians in electronics service and maintenance. Taught night classes in Industrial Electronics at Idaho State College.
March 1953-April 1957	J. M. PERRY INSTITUTE, Yakima, Washington Title: Instructor Taught comprehensive two-year course in Industrial Electronics to technicians in training.
March 1951-March 1953	JOHN DEER MANUFACTURING COMPANY, Yakima, Washington Title: Leadman Responsible for servicing and maintaining electrical and electronic plant services and equipment used in operating boilers, heat treating furnaces, switch gear and automatic production machinery.

EDWARD J. VALLARIO

B.A., Psychology and Biology, 1955, Brooklyn College
Physics and Electronics, 1956-1958
University of Hartford
Reactor Safety Training, 1958, Oak Ridge National Laboratory

Membership: National Health Physics Society

1959-1961 COMBUSTION ENGINEERING, INC., Nuclear Division

Title: Supervisor, Health Physics and Safety, SL-1 Project, Idaho

Mr. Vallario has been in charge of the Health Physics and Safety at the SL-1 Reactor Project at Idaho for two years. While in Idaho, he has written a Health Physics and Safety Manual and Emergency Disaster and Evacuation Plan. He has written and taught training courses for Army personnel who are being trained at the SL-1 Reactor Project.

1957-1959 COMBUSTION ENGINEERING, INC., Nuclear Division

Title: Senior Health Physicist

Mr. Vallario served as Senior Health Physicist in charge of the Advanced Critical Facility and the Flexible Critical Facility. Here he became well acquainted with high fields of radiation and gross contamination. During foil experiments, he monitored radiation levels of 10-50 r/hr. Also, fields of 50 rad/hr. of beta radiation were experienced. He was responsible for the general safety of operating personnel.

1956-1957 COMBUSTION ENGINEERING, INC., Nuclear Division

Title: Health Physicist

Mr. Vallario worked as a Health Physicist in the Fuel Fabrication Department. In this capacity, he was responsible for radiation surveys, air and surface contamination surveys, decontamination facilities, personnel monitoring and safety.

ROGER G. YOUNG

B.S., Mechanical Engineering, 1956, Stevens Institute of Technology

Westinghouse Reactor Engineering School, 1957

June 1956- Present

COMBUSTION ENGINEERING, INC., Nuclear Division

Title: Associate Staff Engineer

Mr. Young joined Combustion Engineering upon graduation from college. He was initially assigned to the Reactor Power Plant Section and participated in the design and development of mechanical systems for the S1C reactor. In 1957, for a six months' period, he attended the Bettis Reactor Engineering School to extend his knowledge of reactor physics and control, shielding, nuclear materials, reactor mechanical design and power plant design.

In June of 1959 Mr. Young was assigned to the ABWR Project in Idaho as reactor and plant test engineer for the SL-1 Reactor.

Experience resumes for the following enlisted military personnel are attached:

BISHOP, Robert M.
CONLON, Paul J.
KAPPEL, Herbert L.
LEGG, Richard
LEWIS, Richard C.
MEYER, Robert D.
MILLAR, Gilbert B.
STOLLA, Gordon J.
WOODFIN, Charles E.

BISHOP, Robert M., SFC RA 53001441 - Chief, Mechanical Maintenance

Length of Service - 11 years
Education High school graduate, USAFI, GED
Specialty - Mechanical

Previous Experience:

Merchant Seaman Engine room; machinist; deck engineer; junior engineer, 6500 HP; 3rd assistant engineer, any ship, any ocean

Stationary engineer for Benito, Texas, 40,000 KW steam turbo-generator license.

Service Experience:

Schools - U. S. Army Diesel Engine Repair Course and Engineer Equipment Repairs.
Instructor, Diesel Engines, Engineer School, Ft. Belvoir, Va.

Reactor Experience:	Reactor	Date Qualified	Length of Experience
Operator	CP-5	31 March 1956	9 mos.
Operator	Borax I	4 March 1957	1 yr.
Operator	SL-1	19 November 1958	8 mos.
Chief Operator	SL-1	23 June 1959	1-1/2 yrs.

CONLON, Paul J., SFC, RA 33943040 Chief, Training Section

Length of Service - 15 years
Education High school graduate
Two years at Lafayette College, Chemical Engineering
Specialty Instrument Technician

Previous Experience:

York-Shipley Inc., Oil and Gas Burning Equipment Installation Technician's Course

Senior Construction Inspector, Department of Highways, Pennsylvania, 1948.

Technician, Oil Heat Engineering Co., Wilkes-Barre, Pa. 1949-1950. Repair and Installation Supervisor of oil and gas burners and associated equipment, controls and instrumentation. Installation, adjustment, and repair of thermal, pressure, level, flow controls, etc.; mainly Minneapolis-Honeywell equipment. Worked with units to $4\frac{1}{2}$ MBTU capacity.

Service Experience:

Schools Commo School, Ft. Leonard Wood, Mo.
UHF (Microwave) School, The Signal School, Ft. Monmouth, N.J.
Special Course, Nuclear Engineering, University of Virginia.
Leeds & Northrup Instrument Co. Instrumentation Course.
228th Microwave Radio Relay Co., Ft. Gordon, Georgia, supervise installation and operation of Microwave Radio Stations.

Reactor Experience:	Reactor	Date Qualified	Length of Experience
Operator	CP-5	30 November 1956	4 mos.
Operator	EBWR	31 May 1957	9 mos.
Operator	SL-1	19 November 1958	11 mos.
Chief Operator	SL-1	7 October 1959	15 mos.

KAPPEL, Herbert L., SFC, RA 16322019

Length of Service - 17 years
Education - High school graduate
One year college, GED
Specialty Mechanical

Previous Experience:

Mechanic since 1941
Apprenticeship - Machine Shop

Service Experience:

U. S. Navy School, Iowa State College, Diesel Engineering, General Motors; Diesel Engineering.
Motor Machinist Mate in Navy $5\frac{1}{2}$ years.
U. S. Army School, Motor Vehicle Maintenance Supervisor's Course, USARCARIB, Panama, Canal Zone.
NPPOC, Fort Belvoir, Virginia

Reactor Experience:	Reactor	Date Qualified	Length of Experience
Operator	SL-1	25 February 1959	1 yr.
Chief Operator	SL-1	March 1960	9 mos.

LEGG, Richard - Chief, Electrical Maintenance

Length of Service - 8 years
Education - High school graduate
Specialty - Electrical

Service Experience:

Schools - Construction engineering school - 13 weeks
U. S. Army Signal School - 25 weeks
NPPOC, Ft. Belvoir, Virginia - 8 months

Reactor Experience:	Reactor	Date Qualified	Length of Experience
Operator	SL-1	February 1960	6 mos.
Chief Operator	SL-1	October 1960	3 mos.

LEWIS, Richard C., MSgt, AF 18175437 - Plant Superintendent

Length of Service - 13 years
Education - High school graduate
Specialty Instrumentation

Service Experience:

Schools - Radio Operator (Mechanical) (Airborne).
D-17 Atomic Weapons Electronics.
Instructor, Technician, Weapons Firing System.
Field Utilities Course (Diesel Generators and Refrigeration)

Reactor Experience:	Reactor	Date Qualified	Length of Experience
Operator	CP-5	30 November 1956	5 mos.
Operator	EBWR	30 April 1957	1 yr.
Operator	SL-1	19 November 1958	3 mos.
Chief Operator	SL-1	30 January 1959	2 yrs.

MEYER, Robert D., SP-6, RA 19543873

Length of Service - Approximately 7 years
Education - High school graduate
Specialty - Instrumentation

Service Experience:

Schools: Radar School, Ft. Monmouth, N. J.
NPPOC, Ft. Belvoir, Va.
U. S. Army Signal Corps Electronics Proving Grounds,
Yuma, Arizona.

Reactor Experience:	Reactor	Date Qualified	Length of Experience
Operator	SL-1	February 1960	6 mos.
Chief Operator	SL-1	August 1960	5 mos.

MILLAR, Gilbert B., SFC, RA 19242604 - Chief, Electronics Section

Length of Service - 15 years
Education - High school graduate
Two years of college
Specialty - Instrumentation

Service Experience:

Schools - Nuclear Weapons, nuclear assembler, radiac instrument repair, electronic maintenance, final weapon check-out, instruction and inspection.
AFSWP, NT-24 Nuclear Technician
ABE-60 Electrical Assembly
Radiac repair
NPPOC, Fort Belvoir, Virginia.
Signal School, radar repair.

Reactor Experience:	Reactor	Date Qualified	Length of Experience
Operator	SL-1	25 February 1959	1 yr.
Chief Operator	SL-1	March 1960	9 mos.

STOLLA, Gordon J., SFC, RA 20652406

Length of Service - 18 years
Education - High school graduate, GED
Specialty - Mechanical

Service Experience:

Schools - NPPOC, Fort Belvoir, Virginia

Machinist - Army Mine Planter Service

Engineman

Reactor Experience:	Reactor	Date Qualified	Length of Experience
Operator	SL-1	February 1960	6 mos.
Chief Operator	SL-1	October 1960	5 mos.

WOODFIN, Charles E., TSG, AF 14268855

Length of Service - 13 years
Education - High school graduate
Specialty - Mechanical

Service Experience:

Schools - Vehicle Maintenance School
Instructor in Automotive Maintenance School
Vehicle Maintenance Technician
Diesel Electric Power Plant School
Diesel Powerman
Basic Electronics (night school)
Supervised maintenance and give instruction on nuclear weapons systems.
NPPOC, Ft. Belvoir, Virginia

Reactor Experience:	Reactor	Date Qualified	Length of Experience
Operator	SL-1	February 1960	6 mos.
Chief Operator	SL-1	August 1960	5 mos.

Mr. ALLRED. I should like to extend my remarks briefly to comment on two questions. The first, it is clear that on the same day of the accident the control rod drive units were disassembled without any harmful effect. This is rather conclusive exidence that no changes in the core had taken place since shutdown of the plant on December 23 which prevented normal disassembly or assembly operation to be carried out safely.

The second point I have referred to safeguard reviews. I wish to point out that the loss of boron was reviewed by the contractor's safety committee and concurrence was given to continued operation provided that careful record was kept of control rod position.

Control rod position is a most sensitive and direct indicator of reactivity. Any sudden or large loss of boron would have shown immediately a change in control rod position.

The record of control rod position shows that no indication of a sudden or large loss of boron during the last month of operation occurred.

Chairman HOLIFIELD. Did you give us the qualifications of all the men who were working there as reactor operators and assistants?

Mr. ALLRED. The qualifications of all chief operators and all professional personnel of the contractor's staff have been attached to the brief.

Chairman HOLIFIELD. The SL–1 board report states on page 8:

> Reactor operating procedures, completely satisfactory to the AEC, have never been completed by Combustion Engineering, Inc., although they have been in the process of preparation and revision since Mid-1959.

Now, this seems to be in conflict with your statement on page 4 that the operations procedure were approved by the Idaho Operations Office in March 1959. Do you have any comment on that?

Mr. ALLRED. Our statement indicates that approval for operation of the SL–1 was given on the basis of the manual submitted to the Idaho office.

In his instructions to us, the supervising representative of the Idaho office did ask that we on a continuing basis modify, clarify, bring up to date operating procedures as operational experience was gained.

This procedure was in process during the entire operating period of the plant. As my testimony indicates, we had prepared a draft of volume II and submitted this to the Commission in September of 1960.

Chairman HOLIFIELD. Do you believe that your operating procedure was at any time satisfactorily approved by the AEC?

Mr. ALLRED. We do believe that they were approved by the AEC, yes.

Chairman HOLIFIELD. Did you know about the 40 instances of control rod sticking.

Mr. ALLRED. I did know that there had been a number of cases of control rod hesitation during this free fall test and I do know also that investigations were made in many of these cases where we felt it prudent to do so.

During the last month, from November 16 through December 23, we have reported that the number of instances of sticking had increased.

I was not completely aware of significant increase.

Chairman HOLIFIELD. Whose responsibility was it to report to you?

Mr. ALLRED. The operations supervisor.

Chairman HOLIFIELD. What again was his name?

Mr. ALLRED. Mr. Duckworth.

Chairman HOLIFIELD. Mr. Duckworth?

Mr. ALLRED. Yes.

Chairman HOLIFIELD. He was your employee, Combustion Engineering Co.'s employee, was he not?

Mr. ALLRED. Yes.

Chairman HOLIFIELD. Your testimony is that he did not report to you the number of instances that the control rod was sticking?

Mr. ALLRED. During this latter period I was not at the SL-1 for about half the time; that is, from the period November 16 to December 23, and during this period the number of instances of apparent sticking had increased.

I was not aware that this sharp increase had occurred.

Chairman HOLIFIELD. Had you been aware of it, would you have shut down the reactor?

Mr. ALLRED. I think that is a difficult question to answer. I think in retrospect the answer probably would have been that we would have shut the plant down for more detailed examination.

I should point out that the normal procedure for the operating staff in cases where sticking occurred was to perform a drop test. If the plant were in operation it would have been a hot drop test, and then if the rod did fall freely and satisfied the time criteria operation could be continued.

Chairman HOLIFIELD. Were records kept of the different times in which the rods stuck and the numbers of the rods also kept?

Mr. ALLRED. Records were kept in the form of operating logs.

Chairman HOLIFIELD. That was a daily log?

Mr. ALLRED. Yes.

Chairman HOLIFIELD. You did find that those logs did reflect this sticking of rods.

Mr. ALLRED. The logs did record the instances, yes.

Chairman HOLIFIELD. You testified that Mr. Duckworth was a graduate engineer of advanced study in reactor engineering; he had 13 years of industrial experience of which five were in reactor operations at MTR, ETR, and SL-1.

Do you feel he should have exercised his judgment and shut down the reactor for further study?

Mr. ALLRED. In retrospect, the answer would certainly be "Yes" to that question.

Chairman HOLIFIELD. Are there any further questions, Mr. Price?

Mr. Van Zandt?

Mr. Aspinall?

Mr. Morris?

Thank you, sir. You are excused.

Our next witness is Mr. Brooks Payne of the International Brotherhood of Electrical Workers.

Mr. Payne, will you please come forward? You may proceed with your statement.

Mr. PAYNE. Thank you.

STATEMENT OF BROOKS PAYNE, REPRESENTATIVE ON ATOMIC AFFAIRS, INTERNATIONAL BROTHERHOOD OF ELECTRICAL WORKERS

Mr. PAYNE. My name is Brooks Payne. I work as a representative for the International Brotherhood of Electrical Workers, and report directly to International President Gordon M. Freeman.

I am assigned at present at President Meany's request to follow up and complete the McGowan report due to Mr. McGowan's appointment by President Kennedy to the Department of the Interior.

I would like to, at this point, offer the statement of Mr. Andrew J. Biemiller, director of the department of legislation of the American Federation of Labor and Congress of Industrial Organizations to this Joint Committee for the record.

Chairman HOLIFIELD. Without objection, it will be received.

Mr. PAYNE. Thank you, Mr. Chairman.

(The document referred to follows:)

STATEMENT BY ANDREW J. BIEMILLER, DIRECTOR, DEPARTMENT OF LEGISLATION, AMERICAN FEDERATION OF LABOR AND CONGRESS OF INDUSTRIAL ORGANIZATIONS

Mr. Chairman, my name is Andrew J. Biemiller. I am director of the department of legislation, American Federation of Labor and Congress of Industrial Organizations. I am also chairman of the AFL–CIO Staff Subcommittee on Atomic Energy and Natural Resources.

I wish to set forth the position of the AFL–CIO on several matters pertaining to improving the regulatory process of the Atomic Energy Commission.

We regard the instant hearings before the Joint Committee as performing a timely function—that of reevaluation of the effectiveness of the administrative organization of the Atomic Energy Commission in the regulation of its reactor development program.

I wish to remind the Joint Committee that the instant proceedings will not present a full record of the Commission's regulatory program. An additional hearing should be held for the purpose of reviewing the Commission's health and safety regulatory program in fields not covered in this hearing. We urge that the Joint Committee plan for such a hearing.

The AFL-CIO agrees with the Joint Committee in calling these hearings for the purpose of "reconsideration of the AEC's regulatory organization and procedures" in light of problems emerging since the 1957 study by the staff of the Joint Committee and the regulatory amendments enacted in that year.

As the staff study has mentioned, the next 10 years should, if the Commission revitalizes its peaceful nuclear program, bring about greatly expanded uses of atomic energy and a corresponding increase in the regulatory workload of the Commission.

In 1960 Chairman Holified told the former Chairman of the AEC that the solution of regulatory problems "has to be made in such a way that the Commission itself is not continually placed under the criticism of confusing its safety regulations with its promotional objectives, both of which are valid and both of which are necessary."

Also in 1960, former Joint Committee Chairman Anderson raised the same question when he said to Commissioner Graham: "* * * I wonder if there is not going to come a point in the work of the Commission at which the regulatory and licensing functions might be split off from those functions which deal with the development of isotopes and the planning of atomic powerplants in Antarctica or some place of that nature."

At the risk of being repetitious, I wish to call attention to the many times we have indicated the unresolved problems attendant upon the Commission's responsibility for both promotional and health and safety aspects of its peaceful nuclear development program.

We cite the unfortunate result: The regulatory program, to protect the health and safety of workers and the general public, has become the least emphasized of the Commission's activities. For fiscal 1961, Congress appropriated

$2.66 billion for the AEC's total operating and construction activities. Of this amount, only $2.5 million was earmarked for the total regulatory program—less than one-tenth of 1 percent of the total appropriation.

Constantly expanding responsibilities complicate the work of the AEC in insuring safe use of fissionable materials it owns, in safe operation of its own huge and farflung facilities, in its mounting waste-disposal problems, and in its responsibilities of review over safety standards of military, the civilian space agency, maritime, and State and local developments.

It is difficult to reconcile these increasing regulatory problems with the relative weight of the Commission's efforts to surmount them.

The AEC's regulatory program touches upon the activities of other Federal agencies which either use or have some regulatory or other authority over radioactive materials. These include the U.S. Public Health Service and Food and Drug Administration within the Department of Health, Education, and Welfare; the Interstate Commerce Commission, the Coast Guard, the Civil Aeronautics Board, the Maritime Administration and the Departments of the Interior, Post Office, Labor, Commerce, and Defense.

As a result of enactment of Public Law 86–373, the AEC is required to coordinate its activities with respect to safety standards and regulations with the Federal Radiation Council established in 1959. In addition, it must administer that part of Public Law 86–373 dealing with handing over to the States regulatory authority over AEC-owned source, byproduct, and special nuclear material.

A tangled web of policy, administrative structure, and interagency relationships has grown out of enactment of the Atomic Energy Act of 1954.

In our opinion, the policy legacies that have been handed down from the past remain as a dead hand upon truly significant peaceful atomic development in the United States.

They consist of a tradition of secrecy, compartmentalization, and esoteric attitudes by those in the Commission entrusted with responsibility for operation of its programs.

A further legacy is the philosophy which has permeated the Commission since the 1954 act—a philosophy far from dynamic and content to allow the pace of peaceful nuclear development in its infancy to be set by the private business community. This is particularly true regarding programs to develop atomic power.

It is the hope of organized labor to see a change in these basic attitudes which, if continued, will inevitably hamper the best laid plans to reorganize the regulatory functions of the Commission.

If there had been the spirit and the will to regulate effectively within the Commission, results would have been far better even under the former administrative setup than the AEC's actual record of performance shows.

Out of the Joint Committee's review of the total regulatory process, we hope will come not only better administration but a new hope for the entire peaceful program—that it will be based on positive policies geared to national goals.

There should be within the AEC the same kind of esprit de corps for the public interest and the advancement of safe nuclear technology for the people as is found within the Tennessee Valley Authority in its program to develop water, land, and energy for the citizens of the region it serves.

Several proposals are before the Joint Committee to effect administrative organization of the Commission's regulatory framework to achieve a more efficient and better balanced program.

In presenting brief comments on these proposals, I should like to begin with one which at the writing of this testimony has not been made public. We have reason to believe, however, that it will be advanced seriously by the reactor industry and the private utilities.

As we understand it, the proposal will call for rescinding the 1957 amendments to the 1954 act. These amendments provide mandatory public hearings for application for a permit to construct a major power or test reactor, and review of such applications from the safety standpoint by the statutory Advisory Committee on Reactor Safeguards.

Labor wishes to register the most forceful objection to any such proposal if it is made. This is a frontal attack on sound regulation, for it would result in negotiated permits between the applicant and the Commission. Objective review of the safety aspects of the proposed reactor design and public hearings with a public record and intervention by interested parties, together with other necessary protections to the public interest, would no longer be the guiding policies.

The *Enrico Fermi* case now before the U.S. Supreme Court would never have been an issue had there been no public hearings and the permit had been granted by the AEC as an outcome of quiet, unpublicized negotiations with Power Reactor Development Corp.

We submit that any unnecessary burden to the applicant which now exists in AEC licensing procedures for nuclear reactors can be eliminated without the need for amputation endorsed, we understand, by the atomic industry and the private electric utilities.

The AFL–CIO advocates, in principle, reorganization of the AEC regulatory administrative structure set forth by the staff of the Joint Committee.

Without separating the corollary functions of safety and development, there should be established within the AEC a regulatory entity to which individual cases would be referred for final licensing authority within the framework of AEC policy. This regulatory entity's responsibilities should include the total field of licensing. It should set the conditions under which the AEC would issue such licenses.

Its rulemaking function would be expected to develop from the particular to the general with the growing body of cases handled.

We would also expect that the regulatory entity should be given the authority to review proposed safety standards and regulations of both the AEC and its contractors for licensed users of AEC fissionable materials. The regulatory entity should also be enabled to propose standards and regulations if deemed necessary in the interests of safety.

With such a new technically skilled regulatory body, equipped with necessary staff assistance, the part-time Advisory Committee on Reactor Safeguards would be relieved of a topheavy workload, handling only cases involving novel or controversial questions of safety requiring a hearing.

The importance of mandatory hearings on major facility applications, with hearings conducted in an atmosphere of informality and direct testimony written and prepared in advance, can scarcely be overstated.

In this fashion a meaningful record can be obtained, decision making accelerated and the public kept informed. Situations where the decision is unfavorable to the applicant could in many instances be resolved in conformity with the goals of both safety and development by informal discussions of alternatives.

Licenses in many cases could be issued without hearings, unless hearings were in the public interest.

Changes in design or operation of reactors, working safety or other changes should be referred by AEC to the regulatory entity, which then would determine if a hearing were necessary.

In all such matters the applicant or intervenor should be provided with the right of judicial review. Yet we would hope that judicial review by an applicant or intervenor would be less likely. This would stem from a more meaningful decision-making process dealing with safety issues by the regulatory entity, a much more satisfactory method than putting the determination into the hands of appellate courts.

The Commission announced in March of this year that it took one step in the direction of separating safety and regulatory functions from those of operation and promotion.

The new position of Director of Regulation embraces health and safety responsibilities. They were formerly handled through AEC's General Manager, who had under him an Assistant General Manager who was delegated the job of overseeing certain AEC health and safety programs.

Involved in this reshuffle is the lumping together, under the new Director of Regulation, the administration of coordination with the Federal Radiation Council, Public Law 86–373 and the licensing program. Compliance, inspection, and operational safety, however, are in separate divisions.

The Director of Regulation, under this or any similar internal reshuffling, could not meet the need for a better qualified full-time review of staff decisions by an expert entity. It would not necessarily lessen the load of ACRS. It would not reduce the burden on applicants. It certainly would not reduce the Commission's workload, which also could entail settling jurisdictional or other conflicts among the licensing, regulation and compliance and health and safety divisions, unless they would be referred to the General Manager by the Director of Regulation.

We are puzzled as to where this leaves the Assistant General Manager, who still has the title, if not the job, of overseeing safety regulation. As a matter of fact, we are more than a little confused as to who is in overall charge of safety regulations in AEC.

We have rejected the possible establishment of an independent regulatory agency separate from the AEC, because insufficient research has been undertaken on the real need for creating another quasi-judicial agency.

In theory, even the regulatory entity within AEC could become so rigid that the aims of its supporters for an equitable balance between promotion and regulation could be swung to the opposite extreme and become a road block to peaceful atomic development.

The Commission could take a stronger stand for a balanced and aggressive peaceful nuclear program, with full protection of health and safety, if it was operating under policies which would gear the goals of such programs to national objectives, both immediate and long range.

Public confidence in the safe conduct of the program stems from elimination of administrative waste and inefficient time consuming procedures, from the employment of skilled personnel in the regulatory field, from the fullest possible availability of information, and from keeping safety considerations and human values at an equal pace with technological advance.

We hope the Joint Committee can assist in advancing sound regulatory reorganization so that the AEC will retain public confidence, and so that our Nation can realize the full potential of peaceful uses of the atom.

Mr. PAYNE. I would also like to present the full text of the McGowan report for the record, and I have prepared a summary of the report regarding some facts that are of concern to labor.

Chairman HOLIFIELD. Without objection, those documents will be received for the record.

(Mr. Payne's summary and the McGowan report follow:)

SUMMARY

Based upon the data appended hereto, the following facts appear to be significant. It can not be too highly emphasized, however, that actual access to the reactor or a complete photographic examination of the reactor may entirely change the conclusions drawn herein. This estimate of the situation is based entirely upon the facts as known to date. Likewise, postulation and conjectures are formulated on the basis of these data and theoretical calculations:

(1) There is room to question the design of the reactor. This is based upon the fact that assembly of the reactor (the insertion of the plugs, hooking up control rods, drives, and bell housings) had to be done in such a manner that a pressure surge, such as occurred, could create missiles of all these parts.

(2) The wisdom of a design which will permit a reactor to go critical as a result of the movement of a single control rod is also questionable. In this particular case, the center control rod (No. 9) alone was sufficient to bring the reactor, not only to critical or prompt-critical, but could conceivably have resulted in a nuclear excursion of this type.

(3) It is possible that the expulsion of the steel punchings and other dry shielding from immediately above the reactor cover could have been caused by a control rod or fuel elements sharply striking the bottom of the cover. These, in themselves, when struck by water or steam, could have also become missiles.

Although distance substituted for containment in Idaho and, likewise, this reactor was much smaller than any power reactor, it is clear that power reactors, henceforth, should approach population centers only to the extent that absolute containment of missiles and fission products can be guaranteed in the event of an accident of this or any other nature.

a. There is a question remaining as to the health physics procedures of the SL-I.

b. A question also remains as to both the training of the personnel, their immediate supervision, and the supervision by the contractor.

c. The correctness of many procedures, apparently thus is subject to individual interpretations and may not be firm enough.

THE REACTOR

I. DESIGN DATA

The reactor, which is involved in the incident, was formerly known as the Argonne Low-Power Reactor. Since this was the prototype of a packaged power plant whose function will be to power radar equipment and furnish heat at remote arctic installations, it became known as the Stationary Low-Power Reactor Number One, or SL-1. The architect engineer was the Pioneer Service and Engineering Company of Chicago. The engineering contractor at the National Reactor Testing Station in Ohio was Fegles Construction Company of Minneapolis. The conceptual design for the reactor was done by Argonne National Laboratories located near Chicago. It was designed to be transported easily by aircraft since: (1) no single component exceeds ten tons in weight or has larger dimensions than 20' x 7' x 9'; (2) it is mounted on concrete pillars eliminating need for excavation; (3) it is designed to operate continuously for three years using a single fuel loading; (4) it does not require a large supply of water; (5) continuous supervision during operation may not be necessary.

The reactor was a 1955 design of Argonne National Laboratories. Site construction began in 1956. The reactor was completed in 1957 with a full power test in 1958. In February 1959 a contract with Combustion Engineering Company, Inc., New York, was signed under terms of which C. E. would become a contractor of the AEC to operate the reactor, do the research and development necessary. At the same time, military personnel would be trained on the operation of this particular reactor.

II. DETAILS

The reactor (see Illus. #2) pressure vessel is fabricated from Firebox quality steel (SA212 GrB) designed for a temperature of 500 degrees F. at 400 psig with a test pressure of 600 psig. The vessel is 14-1/2 feet in height (inside) by 4.34 feet diameter (inside) with a wall thickness of 3/4". In addition, a Type 304 stainless steel cladding .188" thick is applied to the inside, giving a total wall thickness of .938". The reactor cover plate is eight inches thick and has nine 6" nozzles for control-rod drives and two smaller nozzles for water indicators. Proceeding radially outward, outside the reactor vessel is three inches of magnesia insulation in a steel jacket, then an air space, then the support cylinder, (which is attached to the bottom of the reactor building and from which the reactor is suspended), then a thermal shield with cooling coils. An additional thermal shield is inside the reactor and covers the active core area. The main biological shield consists of gravel, steel shot, boric oxide and sand. Ring-shaped concrete shield segments on the operating floor are capped by a removable masonite-and-steel laminated shield.

Normal water level of the SL-1 is four feet four inches above the active core. Under cold conditions, however, the water level would drop about two feet and hence would cover the active core by slightly more than two feet. During shutdown, the reactor vessel is entirely filled with water, but in order to perform the work on the reactor at the time of the accident, about 250 gallons of water were pumped out, thus dropping the water about two feet below the top of the reactor vessel, which would then give a total of slightly more than seven feet of water above the active core at the time of the incident. The reactor is designed to produce steam at the rate of 9,020 lbs/hr at 420 degrees F. The coolant is light water and circulated at the rate of approximately 18 gpm.

Facts which have not been revealed in press releases, possibly because of their technical nature, are as follows:

Purpose of the reactor basically is to serve as a prototype (as distinguished from a purely experimental type of a reactor) designed for remote use (see reactor description). Although a part of the function of the reactor was to test components, it was also intended and served to train military personnel of the type who would be expected to operate the reactor if it were installed for military purposes in very remote location.

Consequently, the reactor has been assembled, disassembled, and scrammed many times in its two years of operation. In October 1960, the reactor had been shut down as a result of CE's determination that additional neutron-absorbing materials were needed to offset the destruction of the Boron ^{10} burnable poison and the addition of flux measuring wires. At this time, approximately 2% more cadmium was added in the T-slots at the perimeter of the core. This was intended to offset the estimated reactivity gained by the reactor by the loss of about 18% of the Boron ^{10} poison (See Illus. #3-3B). Incidentally, it was learned that corrosion of boron, the welds attaching the boron to the fuel elements were preferentially attacked. Primarily, control of the reactor was by means of the five movable cruciform control rods. Of the five, the center rod (designated No. 9) was the most effective and the most used since it was the most strategically located rod. This rod alone had a rod worth of about 4.8%. Since the reactivity of the reactor was estimated to be about 2%, this left about 2% shutdown margin. This 2% margin is normally considered adequate. In order for the reactor to go critical after cadmium was added, and providing the other four movable control rods remained in place, it was necessary to withdraw the center control rod (No. 9) exactly 19". To obtain prompt criticality, an additional 3" withdrawal was necessary, or about 22-23". (See Illus. 3C)

At the time of the accident, this center rod was disconnected. While disconnected, the bottom of this rod was 3-7/8" below its zero position. Zero position, of course, is that point in the control rod's travel when it is exactly in the position to exert its utmost neutron absorbing qualities. In order to connect this control rod to its drive, it was necessary to lift the rod by means of a special tool approximately 6" to a point where the gripper on the rod drive would engage the bottom or knob on the top of the control rod extension. Thus, if this operation were correctly performed, the rod would be left only 2-1/8" above the zero position, leaving the rod about 17" below the position at which the reactor would go critical and over 20" below the prompt critical point. The estimated weight of this rod, taking buoyancy into account, is approximately 80 pounds (90 lbs. dry).

The work scheduled for the evening shift the night of the accident was to continue the job of connecting up the reactor control rods preparatory to restartup of the reactor after having been shut down for ten days. The purpose for the shutdown was to enable the staff to insert the power distribution measurement wires. These wires were intended to determine the neutron flux within the reactor. The reactor was shut down then, and on December 23, it was progressively disassembled. From December 27 to December 30 calibration work was done and on January 3 the insertion of these wires was completed and the job of assembling the reactor begun. During the shutdown, the heavy concrete shield blocks on the reactor operating floor were moved to give access to the reactor and the reactor was filled with water to the top of the vessel.

The last notes in the operator's log book were that the water was pumped down about two feet (leaving about 7 feet of water above the top of the core and an air space of 2 feet between water and reactor cover), and that the control rod drive mechanisms were being replaced.

The accident occurred at 9 01 p.m. presumably during the time when the men were installing the rod drive mechanisms. This substantiated by the positions of the bodies, tools and parts.

It is thought that one man, whose body was found against the ceiling, was engaging the rod drive mechanisms while the other two men were carrying rod drive housings from their place of storage and installing them on the nozzles of the reactor head. Based upon the supplementary shreds of evidence now available, rod drives Nos. 9 and 7 were in place and presumably engaged (See Illus. No. 3F). Housing No. 5 was in place. Nozzle No. 4 had a dummy block on the head, the cap was in place on No. 6 and No. 2. The cap was apparently blown off No. 8 and the condition of the head makes the condition of No. 3 and No. 9 uncertain.

At the time of the explosion, the best estimate is that the thimbles or plugs were in place in all nozzles. It is not known exactly how many of the components were secured in place by bolts or studs. Without having been bolted, it was estimated that a force of 10 psi would be sufficient to lift these plugs from their seats (See Illus. No. 3E). The best estimates of pressure within the reactor vessel at the time of the excursion are about 500 psi, taking into account in this estimate the amount of force which would have been required to raise the body of the first victim to the ceiling of the room to blow off and bend the rod drive housings and studs, as evidenced in the photographs, as well as to rupture the thin metal cover over the top of the reactor and expel the dry shielding material contained therein.

III. REACTOR REVIEW

A. Design Evaluation

Adequacy of the design of this reactor was reviewed by the Hazard Evaluation Branch of the AEC as well as the Advisory Committee on Reactor Safeguards. This was on the basis of the Hazard Report which was printed in 1957. While hindsight is 100% accurate as compared to foresight, it seems that some of these efficiencies in design, as noted above, might have been considered. However, this reactor accident/is presumed to be less than "Maximum Credible Accident" based upon the following:

(1) Maximum credible accident to this reactor envisioned the complete release to the atmosphere of all toxic and radioactive materials in the core including the fission products.

(2) The total estimated content of the core is about one million curies of fission products. Only a low percentage of these fission products were expelled although the total and their distribution are not yet entirely known.

B. Inspections

This reactor, like the others, is subject to periodic safety inspections and reports by both the Commission and contractor. The Commission has received reports on all cases of malfunction including rod sticking, burnable poison burnout, etc. Only after some lengthy and detailed scrutiny, after the complete knowledge of the cause is ascertained, will the adequacy of the inspection be known.

The organizing plan of the operation on the SL-1 is extremely complicated and it is difficult to determine where military and civilian operation divide. However, it is definitely established that the reactor was under civilian control even though training military personnel.

C. Procedures

Some of the designated difficulty might have been overcome by proper procedures for assembly of the reactor. Specifically, the reactor controls could have been reduced to the degree of hazard by bolting each part down as it was installed. Normal procedures, it is understood, did not call for this, which left a great many missiles flying about in the containment tank. Other procedures similarly, might have been carefully examined.

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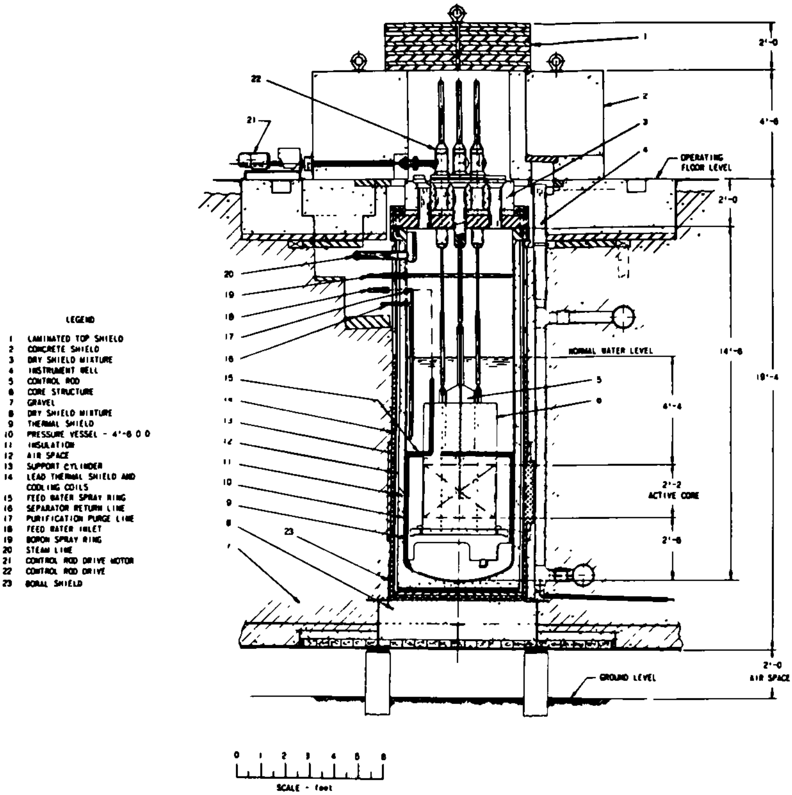
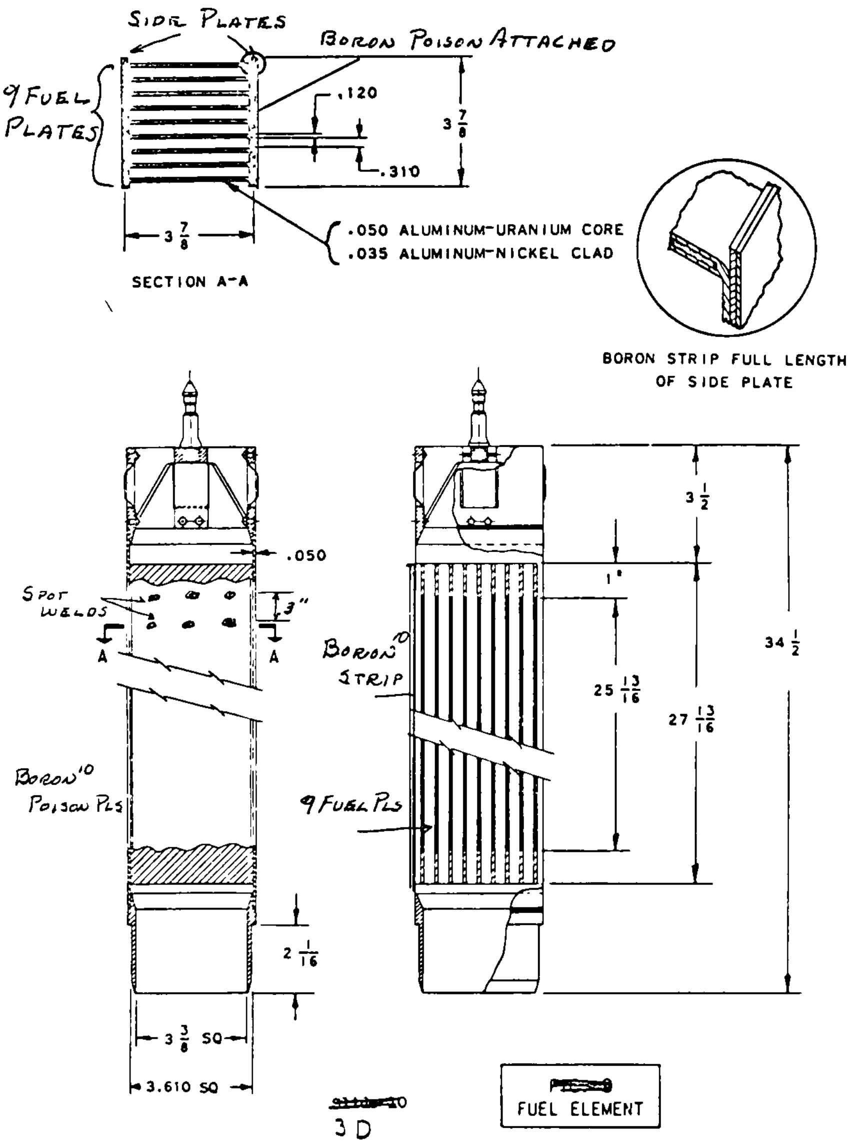
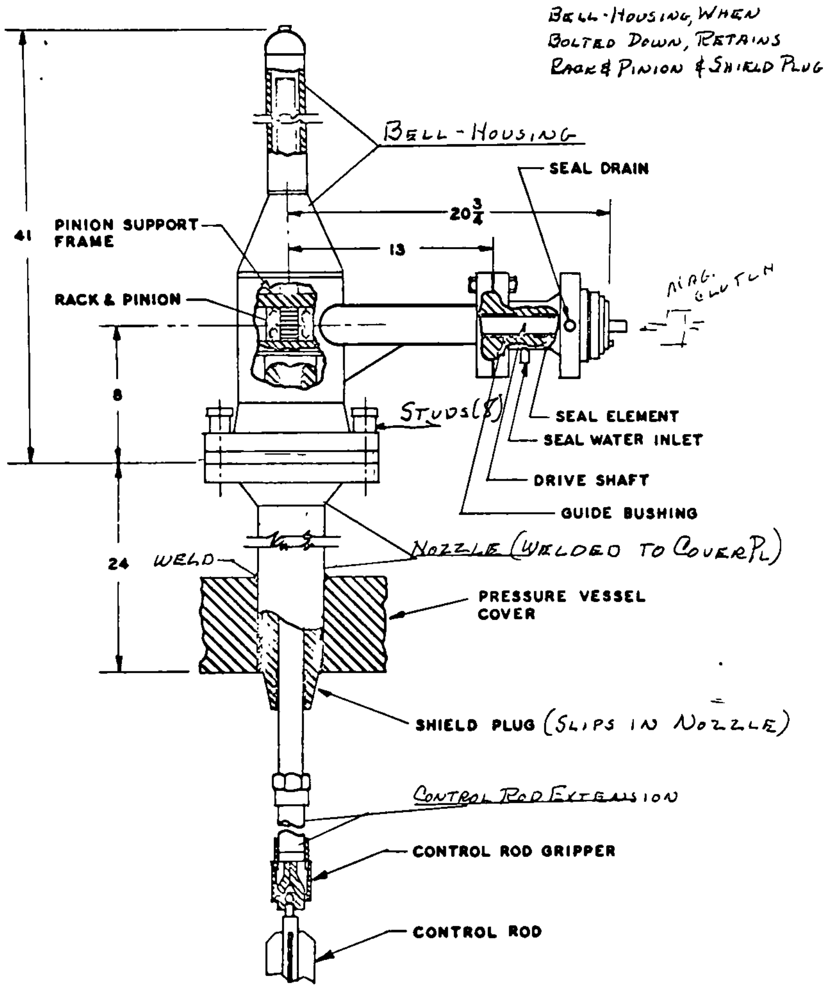


FIG 13
REACTOR INSTALLATION
VERTICAL SECTION

[redacted]

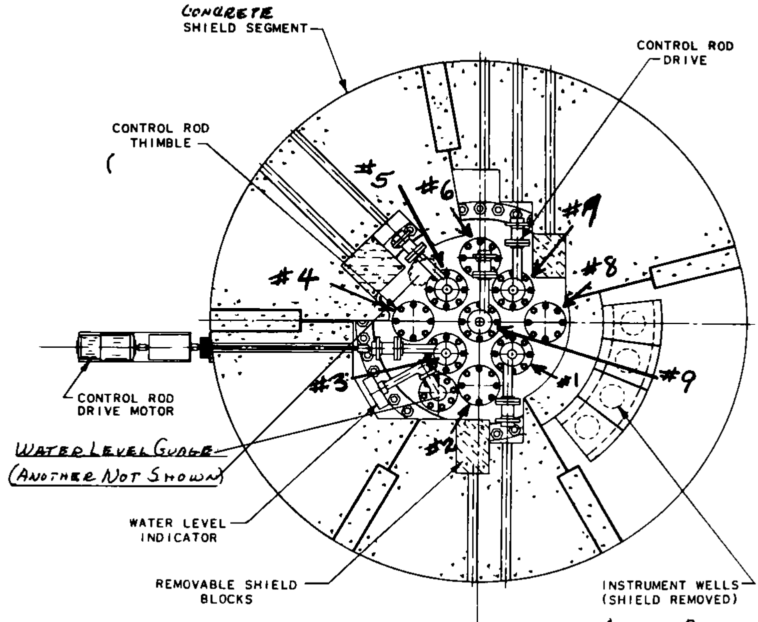

SIDE PLATES
BORON POISON ATTACHED
9 FUEL PLATES
.120
.310
3 7/8
3 7/8
.050 ALUMINUM-URANIUM CORE
.035 ALUMINUM-NICKEL CLAD
SECTION A-A
BORON STRIP FULL LENGTH OF SIDE PLATE
.050
SPOT WELDS
3"
A
A
BORON 10 STRIP
BORON 10 POISON PLS
9 FUEL PLS
3 1/2
1"
25 13/16
27 13/16
34 1/2
2 1/16
3 3/8 SQ
3.610 SQ
3 D
FUEL ELEMENT



~~Slide 23~~

3E

CONTROL ROD DRIVE



0 1 2 3 4 5 6

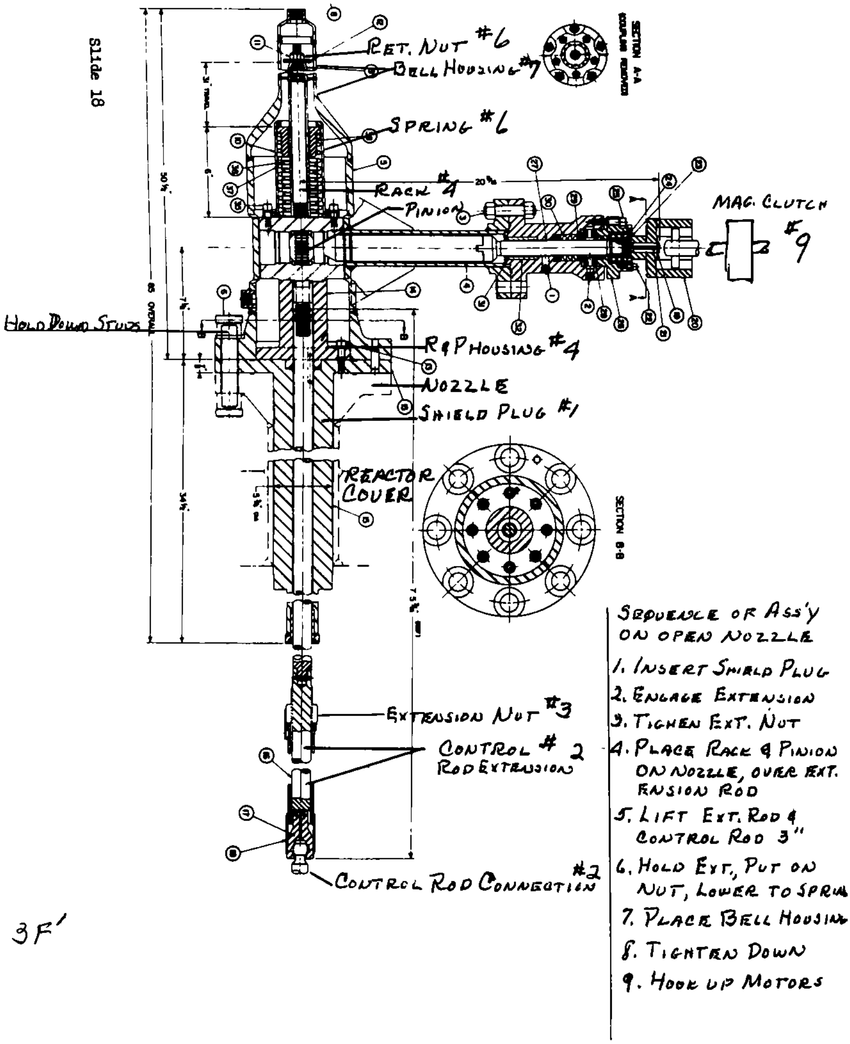
SCALE feet

FIG. 14
CONTROL ROD DRIVES AND TOP SHIELDING

[redacted]

3F

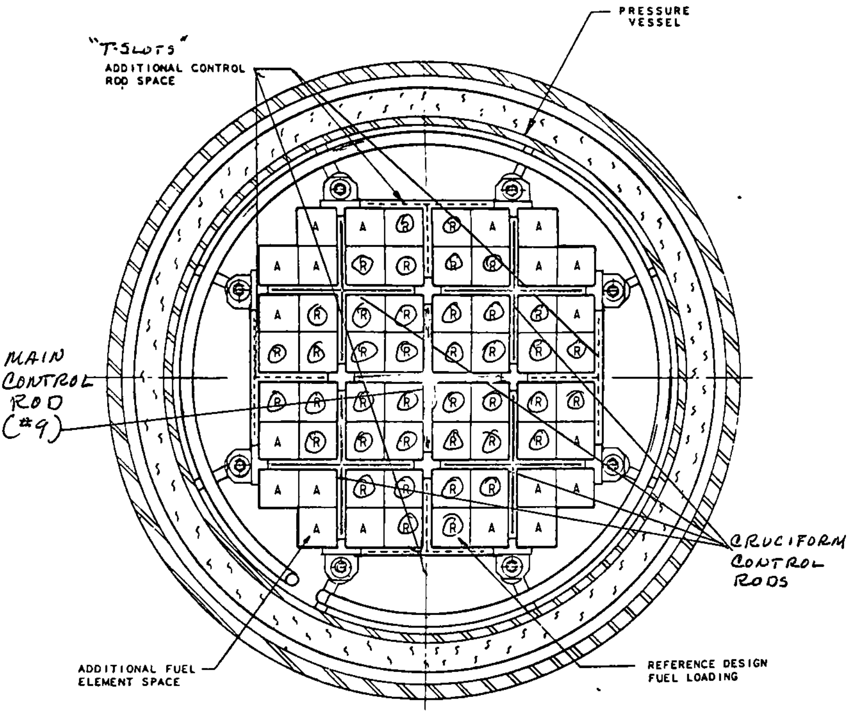
AFTER ACCIDENT
#1 RACK & PIN ON, 6"-12" HIGH
2 CAP BOLTED ON
3 ? - PERHAPS IN CEILING
4 DUMMY PLUG EJECTED
5 COMPLETE, IN PLACE
6 ? CAP'S LOCATION UNCERTAIN
7 RACK & PIN ON 6"-12" HIGH
8 CAP OFF - HOLE OPEN
9 NO DATA - HOLE MAY BE OPEN


Slide 18
RET. NUT #6
BELL HOUSING #7
SECTION A-A
SPRING #6
RACK #4
PINION
MAG. CLUTCH #9
HOLD DOWN STUDS
R & P HOUSING #4
NOZZLE
SHIELD PLUG #1
REACTOR COVER
SECTION B-B
EXTENSION NUT #3
CONTROL ROD EXTENSION #2
CONTROL ROD CONNECTION #2
SEQUENCE OF ASS'Y ON OPEN NOZZLE
1. INSERT SHIELD PLUG
2. ENGAGE EXTENSION
3. TIGHEN EXT. NUT
4. PLACE RACK & PINION ON NOZZLE, OVER EXT. ENSION ROD
5. LIFT EXT. ROD & CONTROL ROD 3"
6. HOLD EXT., PUT ON NUT, LOWER TO SPRING
7. PLACE BELL HOUSING
8. TIGHTEN DOWN
9. HOOK UP MOTORS

3F'

CORE

At the time of the accident, the core did not contain the maximum amount of nuclear fuel for which it was designed. The maximum number of fuel elements in the reactor could have been 59. At the time of the accident, there were only 40 elements. These 40 fuel elements each contained nine fuel plates of 91% enriched Uranium or a total of 14 kg. of U235. Estimated U235 contents at the time of the accident was 12.94 kg.,allowing for burn-up. The fuel plates are aluminum-clad for a total thickness of 120 mils. Each fuel element is rectangular, and is 34-1/2" long by 3-7/8" square containing 9 fuel plates each. The remainder of the core structure is fabricated of aluminum-nickel alloy containing, besides the fuel elements, 5 cross-shaped and 4 T-shaped control-rod channels or shrouds. Only the 5 cross (or cruciform) shaped control rods were movable. To reduce control-rod neutron absorbing requirements, a burnable poison, Boron ^{10} was uniformly dispersed throughout the core. (Roughly, the purpose in including a burnable poison is to have the poison decay at about the same rate the uranium 235 is burned so that the control-rod-worth and reactivity of the reactor would remain relatively constant). This Boron is spot-welded to the side plates of the fuel elements to achieve dispersal.

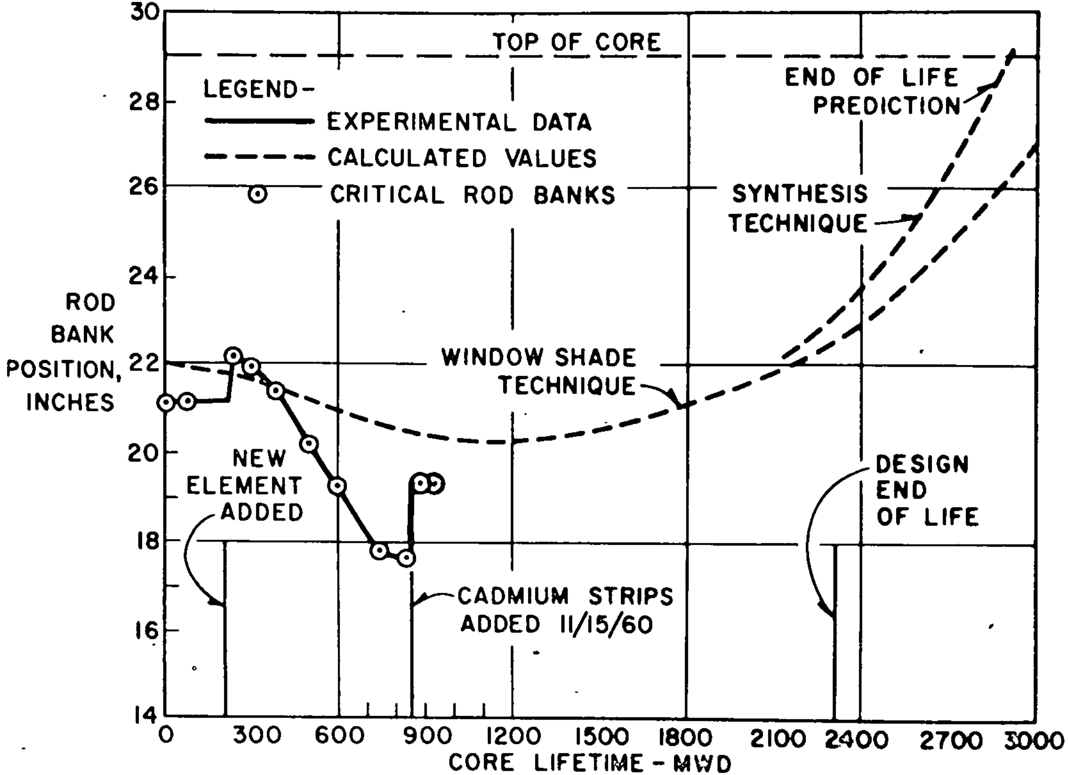


O = "LIVE" FUEL ELEMENTS

FIG. 8
CORE LOADING PATTERN

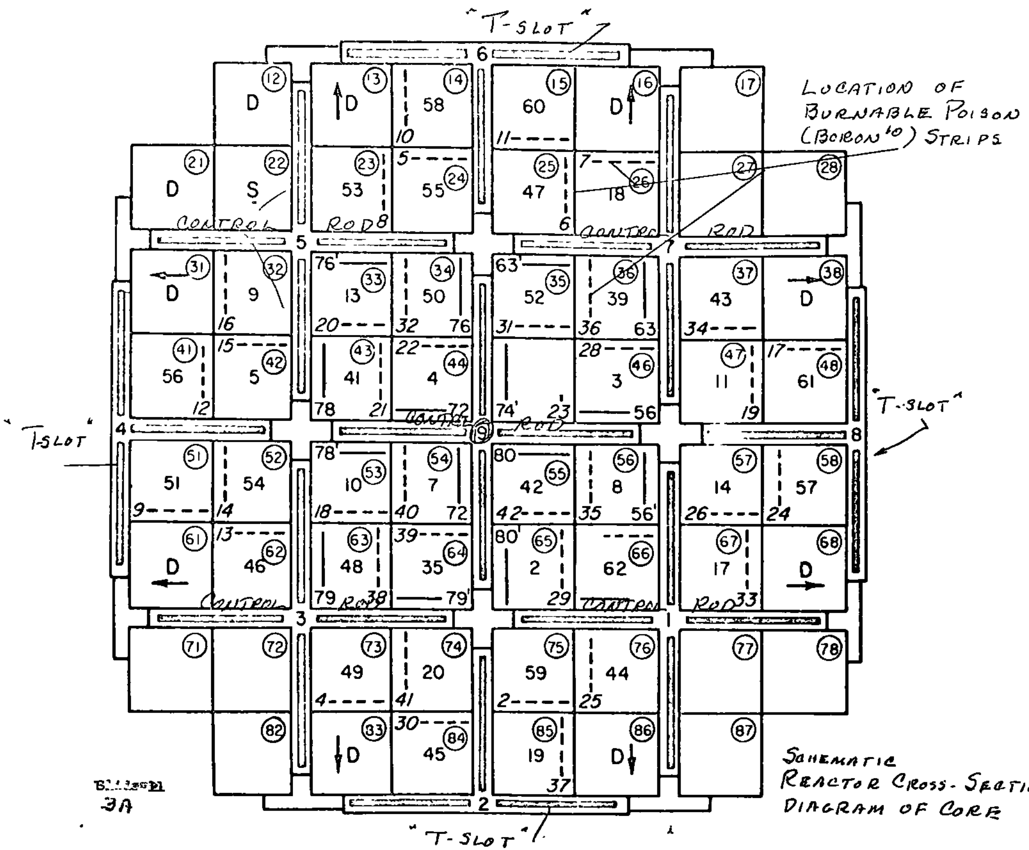
Slide 8
#3

3 Prime



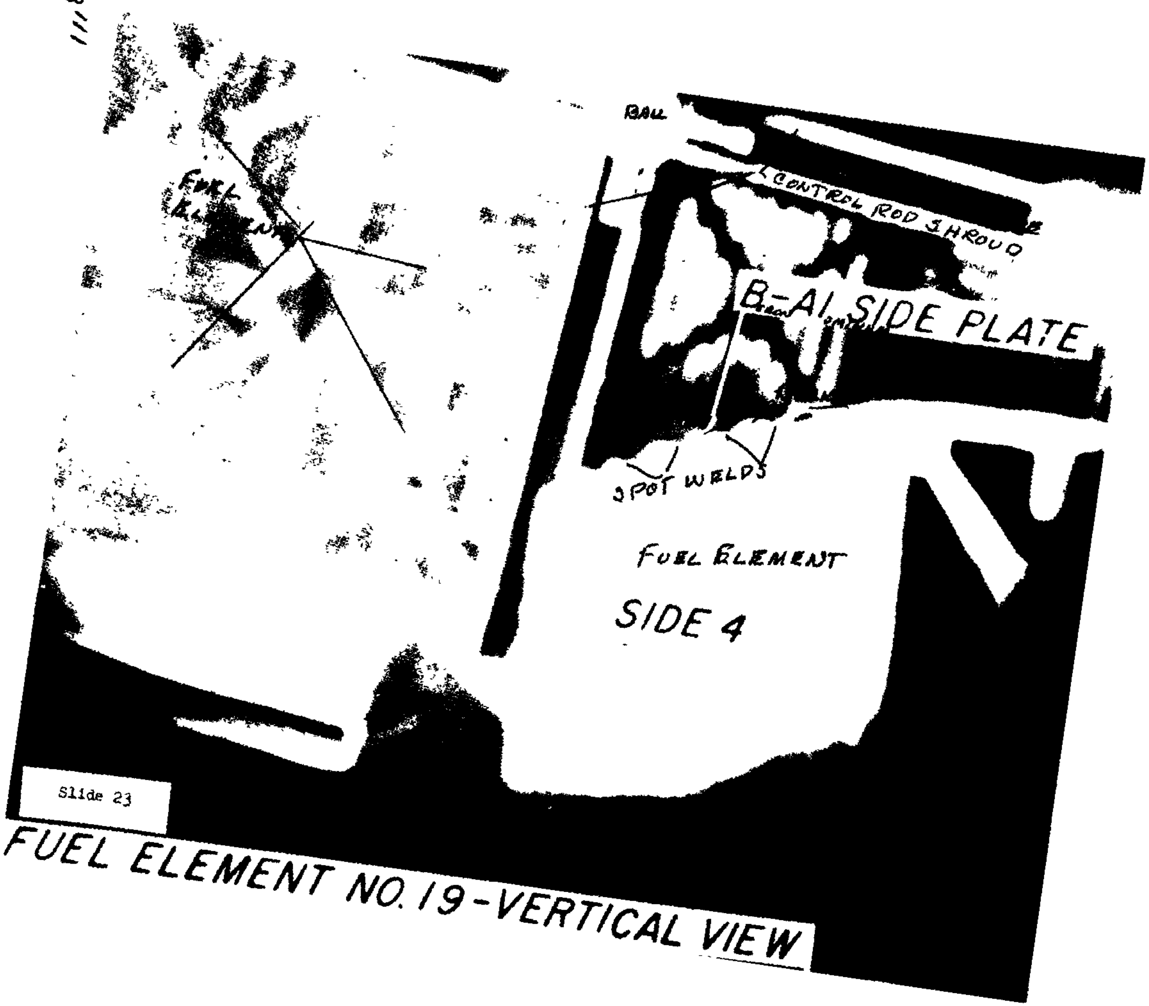
Slide 26

CRITICAL ROD BANK POSITION
WITH EQUILIBRIUM XENON CONCENTRATION AT 2.56 MW



SCHEMATIC REACTOR CROSS-SECTION DIAGRAM OF CORE

3111



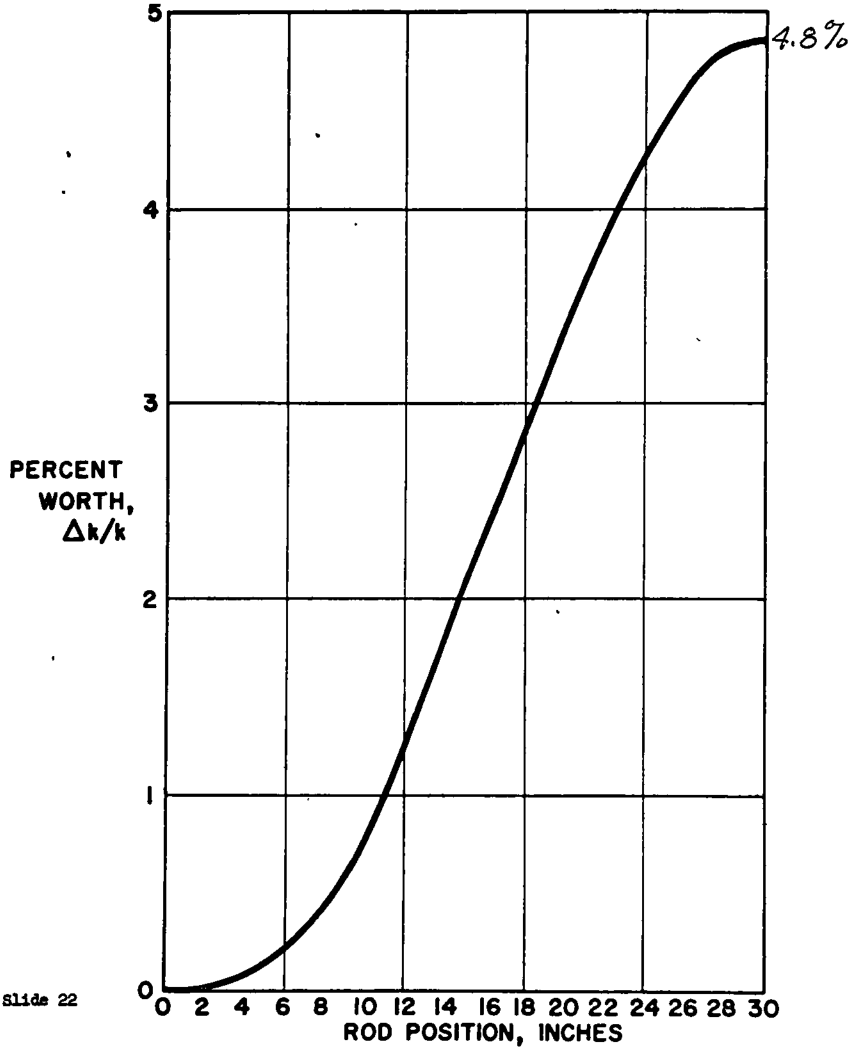
FUEL ELEMENT NO. 19 - VERTICAL VIEW

SHOWING DISINTEGRATION OF A BORON[10] POISON PLATE FROM REACTOR AS COMPARED TO A NEW PLATE

UNIRRADIATED BORON PLATE

Slide 24

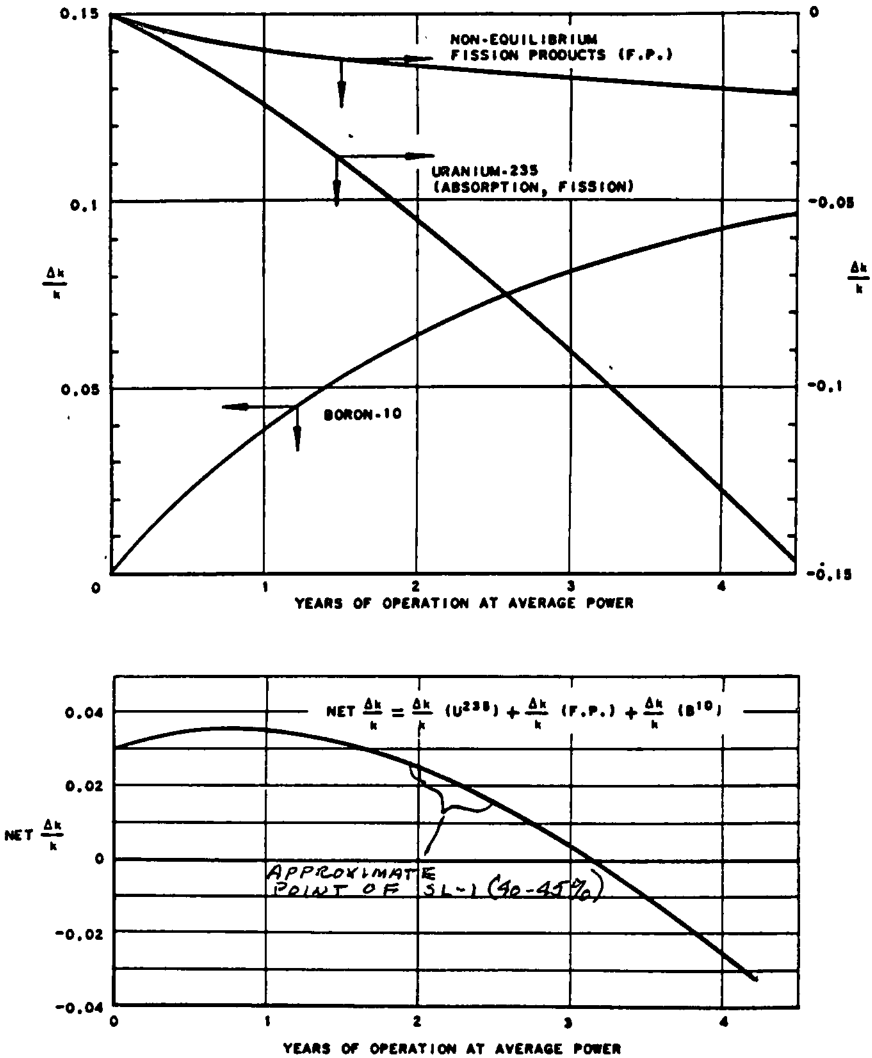
OUTER SURFACE OF PLATES NO. 42 & 35



Slide 22

INTEGRAL ROD WORTH CURVE FOR ROD NO. NINE
Figure 4

3″



~~Slide~~ 12
#3B

FIG. 28
REACTIVITY VARIATION DURING CORE LIFETIME

CONTROL RODS

The SL-1's cruciform control rods were made of cadmium with aluminum-nickel alloy cladding and follower sections. The rods are connected to drive mechanisms by stainless steel ball joints and fittings and extension rods. The rods are moved vertically by a rack-and-pinion mechanism mounted above the reactor. A conventional 1/8 hp electric gear motor with a magnetic-disc brake is positively engaged to the pinion drive shaft by an electro-magnetic clutch. A single-direction cam clutch was intended to drive the rod down in the event of a scram if the magnetic clutch failed.

The "T-Slots" intended for later addition of control rods if all 59 fuel elements were inserted, were not used as such at the time of the accident, since only 40 fuel elements were in place, although cadmium strips had been added in two of the four slots.

Total rod worth of the 5 cruciform rods was originally 17% AK/K, of which the center rod (#9) was estimated to contain 4.8% AK/K at the time of the explosion.

To go (delayed) critical, it was <u>measured</u> just prior to the accident that #9 rod would need movement of 16". By addition of cadmium in the "T-Slots", it was calculated movement would be increased to 19" to achieve criticality.

Prompt criticality would necessitate an additional 3 to 4 inches, for a total of 22-23". The type of explosion which occurred would require more than 2 feet of upward (or downward movement) in a period of time measured in fractions of a second.


WATER

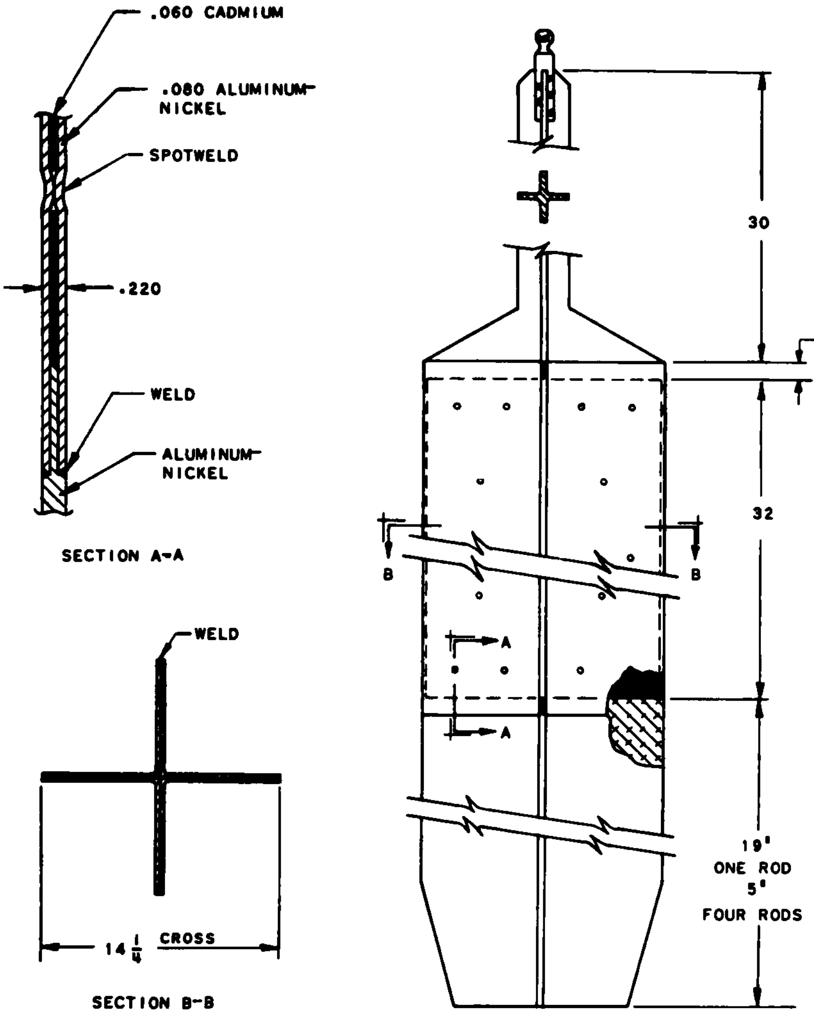


FIG. 10
CROSS TYPE CONTROL ROD

3C

PROCEDURES

The scram system on this reactor is also subject to some question. Normal procedures for scram involved the disengagement of the motor by a magnetic clutch thereby permitting the control rods to fall back into the reactor on gravity alone. This operation normally can be accomplished in one to two seconds. Since, however, there are forty cases in the last two months of control rods sticking, it is safe to assume that at the time of the accident, at least one control rod might have been sticking. In cases of this type, to overcome the sticking, it was necessary to regroup the electromagnetic clutch and run the control rod back into the reactor by reversing the electric motor. The maximum rate at which this motor operated was three feet per minute. A poison system, which admittedly was not designed to prevent explosive surges such as this, could only be utilized while the reactor was operating since liquid boron had to be ejected into the water at the water inlet and carried into the fuel elements by the natural circulation of the water. Since the reactor was "down", and the pump was not working, this poison device could not have been used.

Mentioned elsewhere, but still to be considered as procedural elements, are the questions of mechanical sequences, supervision and health physics.

REACTOR SITE

The reactor is located in the National Reactor Testing Station about three quarter miles north of Hiway 20, a commissioned highway known as Fillmore or SL-1 Roadway. The site itself is a fenced-off area, approximately square, and about 350 feet long per side. The major buildings on the site contain the reactor containment tank, extrapolation building, pump house, a water tank, a technical support building, and decontamination building. Directly connected to the reactor building is the Support Facilities Building. Connected in turn to the Support Facilities Building is the Administration Building (See Illus. No. 1, 1A, 1B, 1D). The operating floor of the reactor is located directly on top of the biological shield and concrete poured thereon. Approximately the upper-central one fourth of the reactor tank is devoted to the purpose of providing a working plate from around the top of the reactor, as well as for housing mechanical accessories. These accessories would include such items as: the motor control board dump heat exchanger for 400 kw exterior heat rod, a complex of pipes, tanks, pumps, and turbines, as well as an overhead crane intended to service various equipment located therein.

Outside the fence of the reactor site there was almost no radioactivity except that which was barely detectable in the area covered by the plume or cloud and the most radiation on the site proper was due to "shine" from the reactor vessel itself, not contamination.

REACTOR CONTAINMENT

This reactor was considered non-contained despite the fact that the building housing it was steel and the only apparent leaks to the outside were through the access doors, the freight loading doors and the filter outlets. The utilization of the airtight container would have prevented any contamination whatever to the outside.

The Containment Tank, which contains the reactor vessel, is made of 1/4" steel plate and is 38.7 feet in diameter by 48" high. The lower third of the building contains the biological shield on top of which is poured concrete to form the operating floor of the reactor. The upper 1/4 of the building contains fans and filters (See illus. No. 1A)

This reactor Containment Tank, while carefully constructed, was not intended to be pressure tight. This is a significant departure from formal containment devices. These departures were utilized because of the remote location of both this reactor and any which would follow, as well as the above-ground character of the reactor vessel.

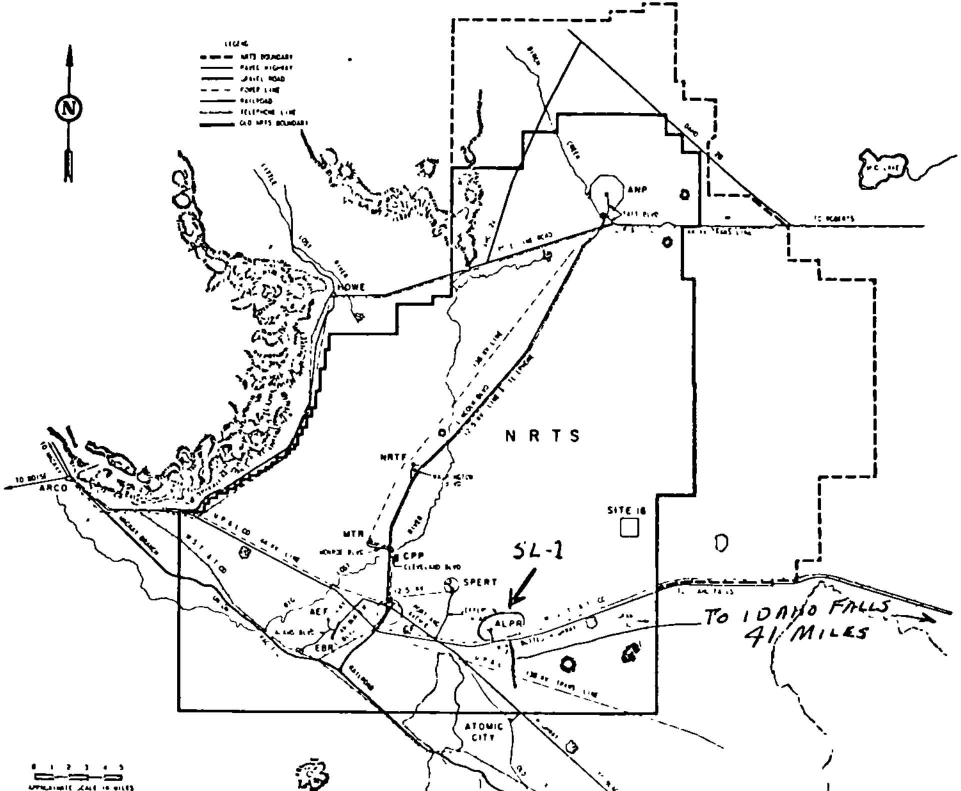
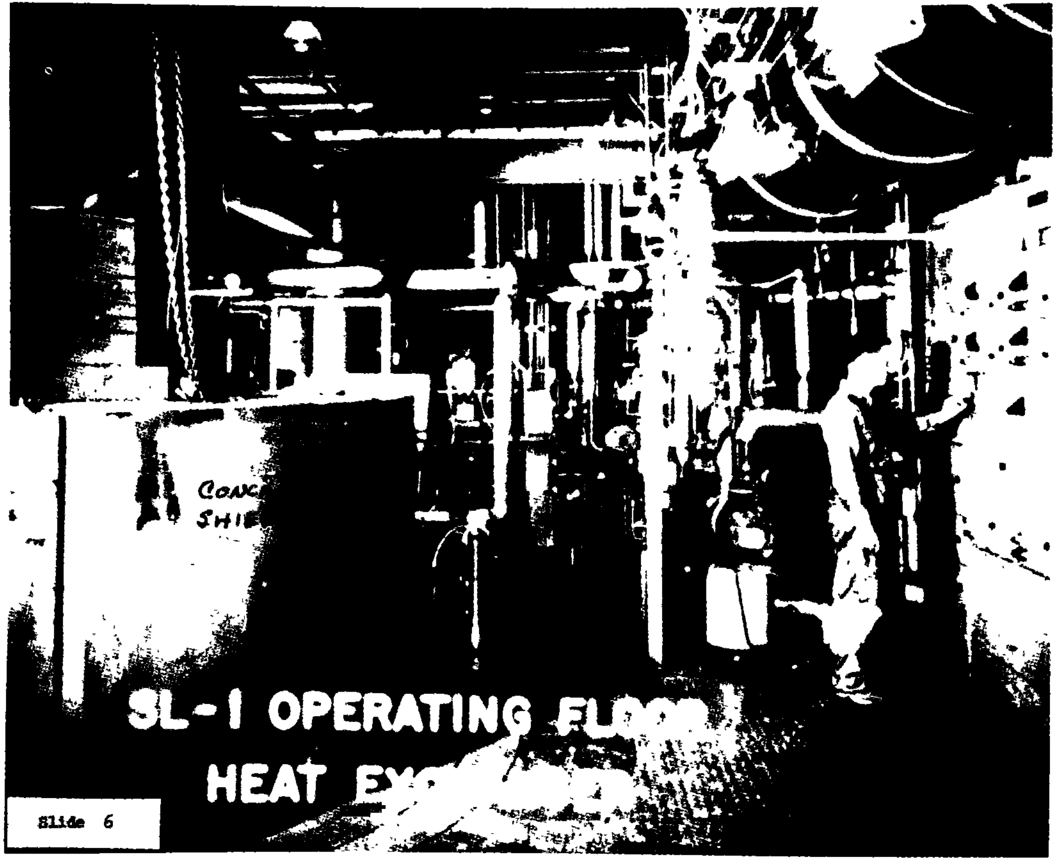
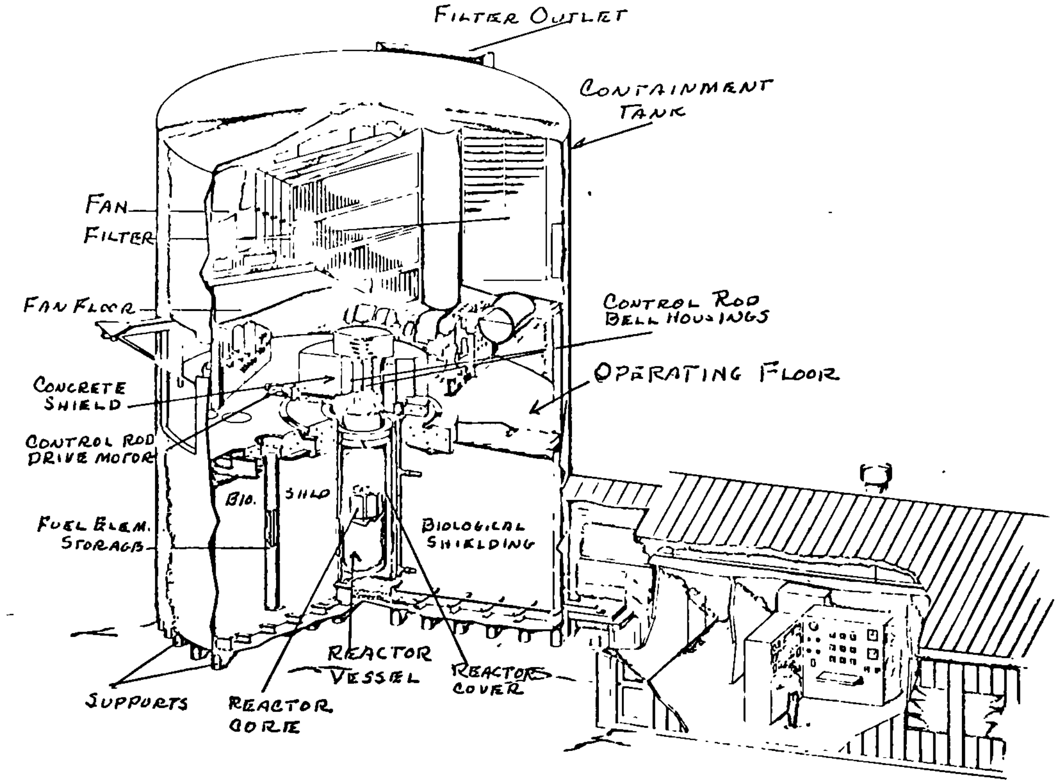


FIG 1
NATIONAL REACTOR TESTING STATION SITE PLAN


ADM. BLDG
SL-1


SL-1 OPERATING
HEAT
Slide 6



REACTOR BUILDING

Slide 3

THE DESCRIPTION OF THE ACCIDENT

CHEMICAL EXPLOSION THEORY

The explosion of the SL-1 reactor was originally interpreted as a chemical explosion. The basis for advancing this hypothesis was that disassociation of water from fission product gamma rays in the fuel elements could have produced significant quantities of explosive hydrogen gas, which could have collected in the two foot space between the water level and the reactor top cover. The theory went that this could have been ignited by either a spark from the tools or from a cigarette from one of the operators although a "No Smoking" requirement was enforced. This theory is virtually discarded and at this time, it seems evident that the explosion was entirely nuclear, both in nature and in origin.

OPERATOR ERROR

The most plausible explanation at this time seems to be as follows; During the operating history of the SL-1 there had been reports of control rods sticking. While all rods would, indeed, have this history, No. 9 or the center rod has had the least number of reports and at the time of the start up all rods, including No. 9 were operating freely. However, twelve fuel elements were in very close contact with the shroud which enclosed No. 9 rod and were presumably the hottest fuel elements in the reactor in terms of fission products. This made residual gamma heating a possibility as a result thereof.

Many deductions are based on this, and as a result, therefore are not without some basis of fact. The sequences leading to the explosion might well be as follows:

(1) In order to hook up No. 9 control rod, it was necessary to move it upward from its down position approximately 3" (total 6" movement since it was below the zero position)

(2) From these "hot" fuel elements, gamma heating produced a steam bubble in the space under the control rod.

(3) Since there was only 1/8" or less clearance between the shroud and the control rod, the steam forming below it tended to propel the rod out of the shroud in a projectile like fashion.

(4) In lieu of gamma ray heating and steam formation, it is conceivable, although remote, that during the shutdown period, additional poison had, inadvertently, been lost and the 3" movement of the rod was enough to set the reactor critical. From that point on, the expulsion of the control rod and the remainder of the facts will apply. Regardless of the origin of the steam, with the expulsion of the center control rod, the reactor went exponentially critical on a reactor period of milli--seconds.

(5) It is necessary that No. 9 control rod be ejected in fractions of a second in order for the reactor to go explosively critical. Had this control rod been expelled slowly, the self-regulating characteristic (negative temperature coefficient) of the reactor would have tended to shut the reactor down. With the rapid ejection of the control rod, then, it became a non-controlled nuclear chain reaction.

NUCLEAR EXPLOSION THEORY

That a nuclear excursion was responsible for the accident has now been quite generally accepted. A Hurst dosimeter indicated a neutron flux of 1 2×10^{8} neutrons. Jewelry, reactor parts and clothing generally confirmed the reading by the Hurst dosimeter. It is thus estimated that the reaction may have resulted in 1.5×10^{18} fissions or the equivalent of 50 megawatt seconds of energy. The rapid development of this heat energy resulted in a pressure estimated at about 500 psi within the reactor vessel It is evident that the direction of the blast was upward, thus the pressure violently expelled the shield plugs, portions of control rods, and some of the fuel and at least water from the reactor.

The undetermined amount of water was expelled from the reactor proper as a result of the probable rapid formation of steam in the active core. (See Illustration 5) Evidencing this are the visible water marks outside the doors in the reactor tank leading onto the reactor operating floor as well as the scalded condition of the body of the man who had been working on the top of the reactor. This water, some of which may have drained into the gravel (biological shield) below the reactor floor, apparently ran out of the outside doors, thereby, contaminating the ground areas immediately below those doors. Also indicative of the expulsion of the water was the fact that a steam cloud was visible above the reactor tank and was seen by some early observers on the scene. The fact that this water was expelled and that the steam was formed, is quite important in this investigation.

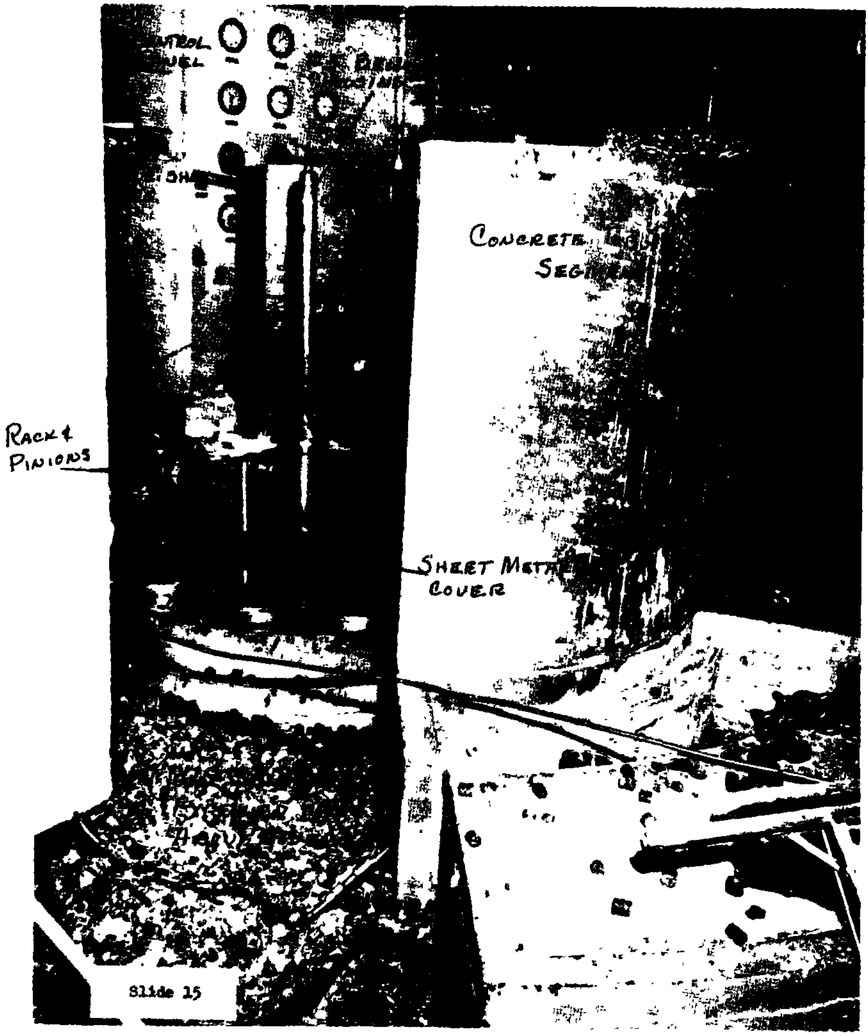
The 500# pressure estimated to have occurred at the moment of the excursion is above the designed pressure of the reactor vessel but below its test pressure. For this and other reasons, the investigators do not expect to find the reactor vessel ruptured. The facts also point out that the direction of the blast was confined to the upward direction, thereby concentrating the destruction and effects to the personnel in the immediate vicinity of the top of the reactor.

This is further supported by the fact that a light bulb ten feet away from the reactor was still burning after the accident while another bulb directly over the reactor was shattered. There is a significant dent in one of the overhead beams which corresponds to a dent in the flange of one of the control rod housings. Careful calculations indicate that the postulated 500# pressure would have been sufficient to throw the housing against the beam and deform both to the degree noted. The plugs for positions No. 2 and No. 7 are in the ceiling above the reactor, one of which penetrated the floor to the room above and possibly the other as well. A Hurst criticality dosimeter located outside the reactor tank and on the wall thereof was triggered. This gave positive evidence of a nuclear explosion and indicated a neutron flux in the cold foil contained in the dosimeter of about 1.2×10^8 neutrons. (See illustrations 5A, 5B)

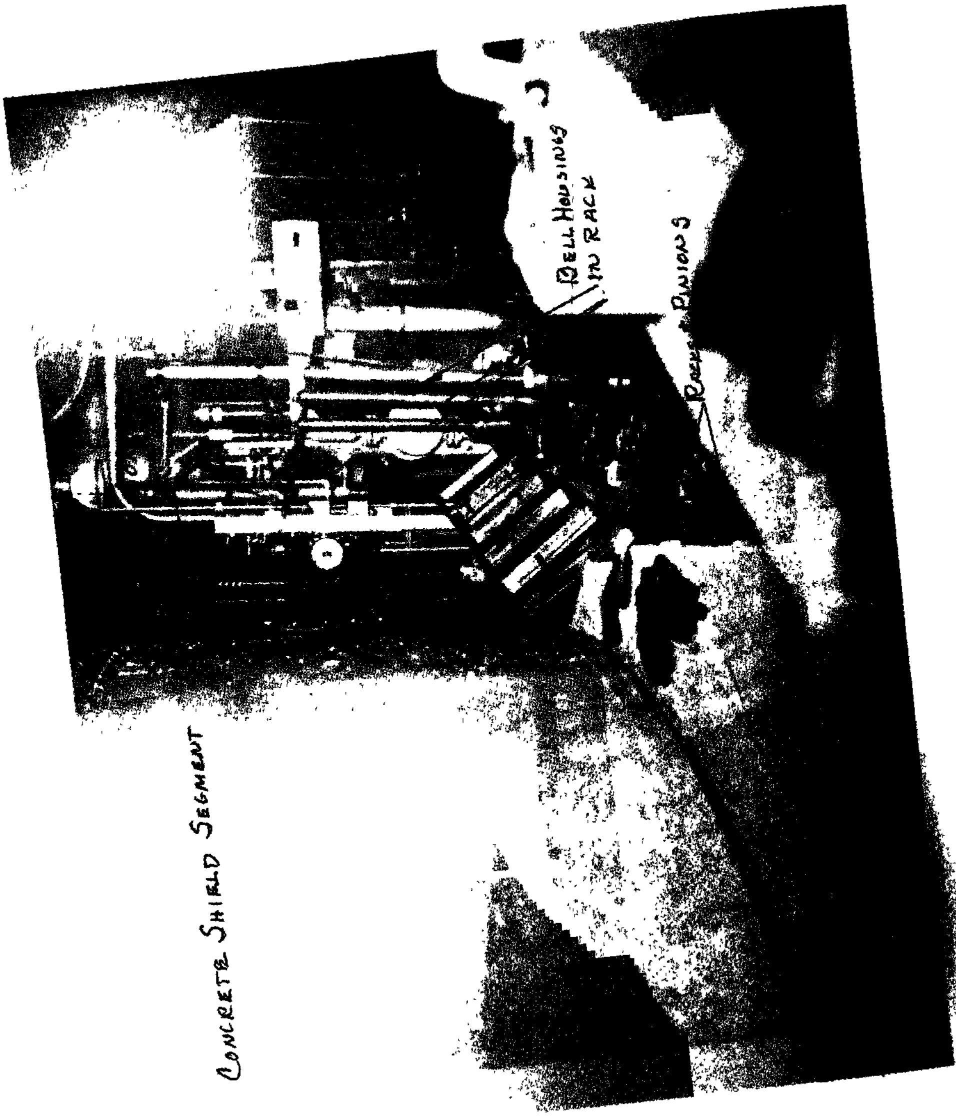
There is, as yet, no unamimous agreement as to the cause of the accident. The explanations, which are considered most likely at this time, are as follows:

(1) A chemical explosion, as stated earlier, could have resulted from an accumulation of hydrogen gas which could have accumulated in the two foot air space between the water and the reactor. Ignition of this gas by sparks could have resulted in enough pressure to blow the shield plugs and control rods out of the reactor thereby precipitating the nuclear excursion of the reactor. This is not now considered a likely answer.

(2) It is possible that the reactor, although shut down with the control rods in place was, for some unknown reason, capable of spontaneous exploding. This is the least likely of the nuclear theories since the reactor has been shut down many times for periods equal in length to this most recent shutdown. Also, there would have been some signs of an increasing neutron flux within the reactor which would have been detected.



5A


BELL HOUSINGS
IN RACK
RACK
PINIONS
CONCRETE SHIELD SEGMENT

5B

5C

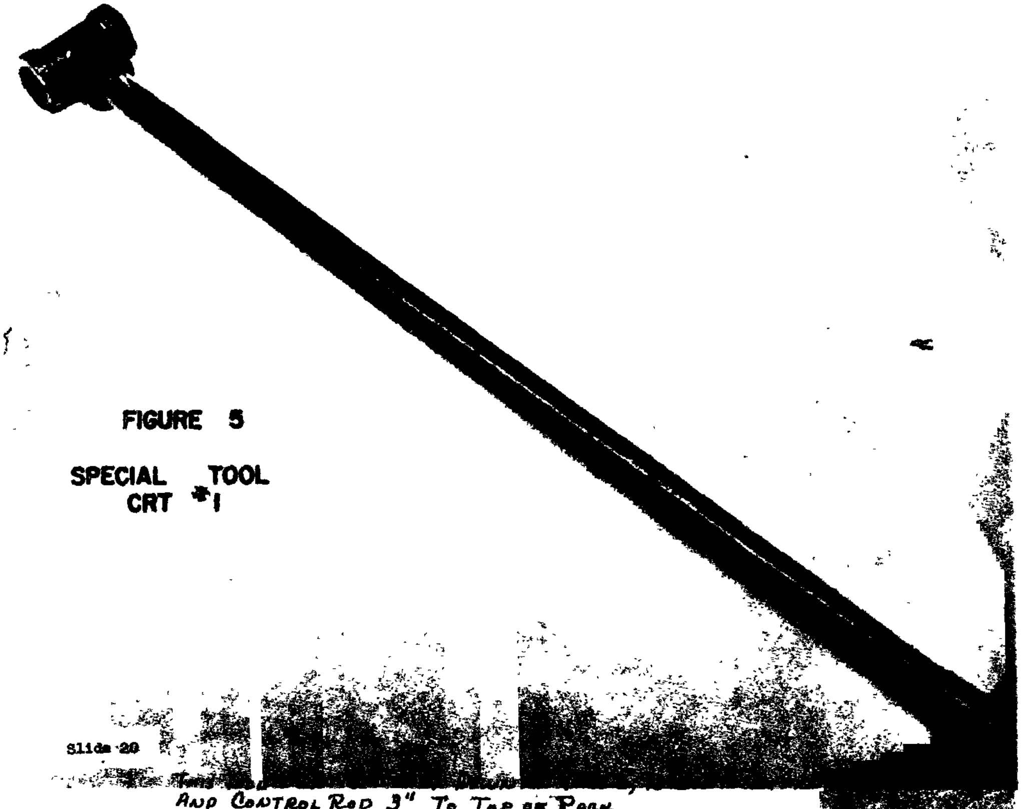
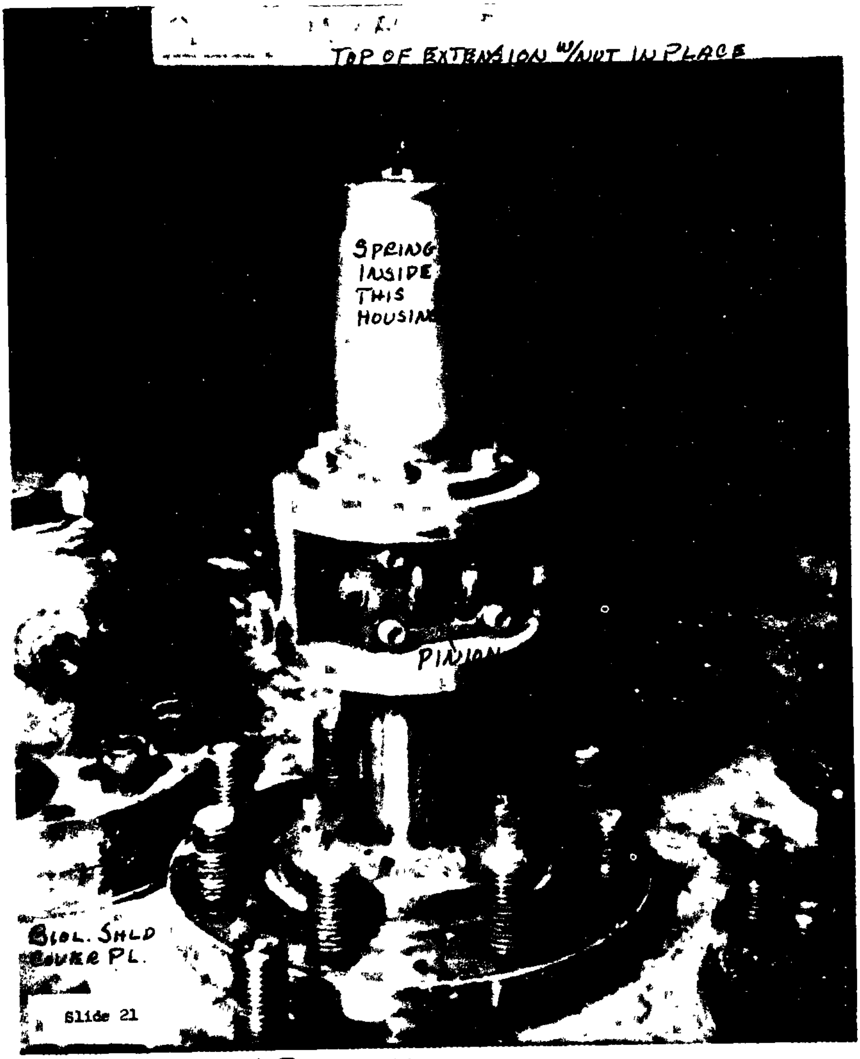


FIGURE 5

SPECIAL TOOL
CRT #1

Slide 28

AND CONTROL ROD 3" TO TOP OF RACK



RACK & PINION HOUSING

JE

PERSONNEL

The ordinary complement of the SL-1 totals 52 persons for the four shifts. These four shifts, one more than the normal three shifts, since week ends must also be included, are equally staffed. The total of 52 is combined military personnel and CE staff. It is not possible to differentiate numerically between the two staffs since the number of military personnel on any site at any given time is classified information on the orders of the Department of Defense. We must, therefore, combine the figures with no distinctions being made between civilian and military. It is therefore understood that the total of 52 includes all personnel, both civilian and military. The day shift from 8:00 a.m. to 4:00 p.m. is the most heavily staffed numerically. Employed on the day shift, again combined, are 26 persons. The 4:00 p.m. to 12:00 p.m. shift, or second shift as is now well-known, was comprised of three men, all military. They are:

SP-5 John A. Byrnes, 22, U. S. Army, from Utica, New York a certified reactor operator since February 26, 1960.

SP-4 Richard L. McKinley, 27, U. S. Army

Construction Electrician First Class Richard C. Legg, 26, U. S. Navy, Certified September 1960.

Thus, two men had received certificates from CE as to their proficiency in operating this reactor. The third man had completed his course but had not received the formal certificate since he had not received his final examinations. It is in order to say that there were no supervisors, as such, unless it is to be considered that Byrnes with a certificate nearly a year old was not designated as a supervisor, (but Legg with a Senior Rating was so designated). Beyond this there was no civilian or more highly trained supervision.

(1) It is the feeling of most people who have talked to military reactor operators of the same level and especially as to the three victims, that these men have been and are quite sophisticated in the mechanical requirements of reactor operation. This is to say, of course, that in so far as reactor operation is concerned, these men are quite well trained in the purely mechanical aspects of reactor operation. It is quite certain, based upon their academic backgrounds including their military training, that these men are not nearly so sophisticated in the realm of reactor theories. Despite the twelve month academic training which must cover more on the spectrum of reactor operations by the subject of elementary health physics as well, that all these subjects could not have been covered in detail.

(2) The adequacy of supervisor and supervisory training is likewise a subject of some concern. Since the accident, it has been said that Richard Legg, Construction Electrician First Class, was the supervisor. This information was not voluntary and it seems possible that his higher grade, as well as his certification, caused the presumption that he was the supervisor. It is also noteworthy that the contractor had no supervisor of his own on the reactor or on the entire site at the time of the accident. This is explained by the military as normal since these reactors were intended to be operated at remote sites by this type of personnel.

(3) Although the presence of a health physicist would probably not have prevented or even mitigated the explosion, it is difficult to conceive of justifiable reasons for permitting any personnel to work about the top of an open reactor without some method other than the automatic instruments furnished for estimating radiation doses to these personnel.

That there was no health physicist on duty on the site at that time, was explained, in the view of the Army, by stating that all three men in the course of their training as reactor operators, had been indoctrinated in the use of protective measures and devices. Furthermore, it was stated that while this particular shift consisted of three men, the normal complement would have been two men. A supervisor, whose principle function would have been to observe the installation of the control rod motors to the rack-and-pinion of the control rods would have come to work on the 12:00 to 8:00 a.m. shift the night of the incident.

REACTOR OPERATORS TRAINING

Since the reactor operators are certificated by a civilian contractor (Combustion Engineering Corp.) to operate military reactors, the certificates granted to military personnel on this site must be confined to a certification of their ability to operate only this specific type of reactor. Following is the normal training process for military personnel which will lead to a certificate as Reactor Operator.

(1) Personnel must have a "good" background in Electronics, Mechanical or Instrument Mechanics. This implies graduation in one of the above fields from the service operated schools.

(2) An evaluation of the IQ follows; with specific emphasis on the ability to learn complex technical facts.

(3) Eight months training at Ft. Belvoir in (a) four months of which are spent in academic courses on reactor theory and operation, etc.; (b) remaining four months training in their speciality as applied to reactors.

(4) Personnel are then transferred to the reactor itself either at Idaho Falls or at Ft. Belvoir for another four month period of which approximately three weeks is class work, then shop work, and then training on the reactor itself.

(5) Personnel then go on "on shift" or actual reactor operation for two months under close supervision. Following this, the minimum requirement is that the operator be compelled to take the reactor on three "hot" scrams and one "cold" scram. The "cold" scram involves a complete startup of the reactor.

At this point, the formal training is finished. There remain three examinations; (1) One written examination covering all the academic and practical methods discussed, (2) Oral examination by the military board and (3) Oral examination by the contractor (C.E.). Following these examinations and contingent upon receiving good grades, the certificate of the reactor operator is granted.

As mentioned elsewhere, two of the victims had received certificates. One had not received a certificate pending completion of examination. A chief operator's certificate is achieved by the expenditure of an additional six months of classroom and on-the-job training followed by an examination, and was not, to my knowledge, possessed by any of the three victims.

THE INCIDENT

The incident at the SL-1 occurred at 9:01 MST, January 3, 1961. Automatic signals were broadcast over the NRTS networks simultaneously. The personnel radiation monitor at the Gas Cooled Reactor Experiment gate house, almost one mile away, was triggered. This alarm, which could have resulted from either excessive temperature or excessive pressure in the region above the reactor floor, brought the AEC Fire Department and AEC Security Forces, who arrived approximately 9:10 p.m. from the central facilities area about eight miles from the SL-1 site. Firemen equipped with radiation survey meters and Scott Air-Paks examined the administration building and support facilities building (See Illustration No.1A) in search of the operators or evidence of fire The firemen were unable to re-enter the reactor building because of unusually high radiation levels. No fire or personnel were seen in any of the other buildings. At 9:17 p.m. the Phillips health physicist from the Materials Testing Reactor area arrived. He and a fireman, equipped as above, were again unable to enter the reactor tank since they had encountered radiation fields up to 10 r/hr. By this time it was determined that the three SL-1 operators must still be in the reactor building. At 9:35 p.m. two more Phillips health physicists arrived, this time in protective clothing. One of them, with two firemen, went up the stairs of the reactor building until they encountered a radiation field of 200 r/hr. They then withdrew.

With AEC approval (to exceed safe dose limits) the other Phillips H-P men and an AEC fireman went to the top of the stairs. Radiation levels in excess of 500 r/hr forced their withdrawal. They were able to see evidence of damage but no bodies. Because of the high levels of radiation, the fact that there was damage and the fact that the personnel were presumed to be in the reactor building, at 10·25 p.m. the Idaho Falls Operation Office designation of a Class I disaster was broadcast over the NRTS networks.

About this time, at about 10:35 p.m., two CE supervisors (plant operations and health physics departments) entered the reactor for about two minutes to search for the men. They saw two men; one moving. After finding the men, they left and returned with two more CE men and an AEC health physicist.

Two of the group picked up the man who was alive and put him on a stretcher at the head of the stairs. The other three of the group observed that the second man was apparently dead. The group got the stretcher down the stairs and out the west door within three minutes of entry, and put the stretcher in a panel truck. The man was taken in the panel truck to meet the ambulance, transferred, and taken to the junction of Highway 20 and Fillmore Blvd. where the AEC doctor was met. When the doctor examined the casualty at 11:14 p.m. he pronounced him dead and the ambulance returned with the body to the SL-1 site pending a decision on the temporary disposition of the body.

At about 10:48 p.m. another group, made up of two military and two Phillips personnel, entered onto the reactor floor to locate the third man. They located him and determined that he was dead and did not attempt to remove him.

The recovery group went to the GCRE for preliminary de-contamination. Gamma exposures of the five-man group ranged from 23 to 27 roentgens. As the groups were returning from the GCRE, they stopped long enough to permit one military man, and one AEC health physicist to go through the support facilities building and close doors to lessen the chance of a fire starting and spreading in the disaster area; the two men did not enter the reactor building on this trip. When the two men returned to the rest of the group, it proceeded on to the decontamination trailer set up at Fillmore Blvd. and Route 20. From here the group split up with part going to the Central Facilities dispensary and the rest going to the Chemical Processing Plant for further decontamination.

Having concluded that the remaining two operators were dead, the AEC-IDO health physicist suspended rescue efforts and ordered all personnel back to the roadblock established on Fillmore Blvd. at Highway 20.

After the ambulance had been returned to SL-1 to await a decision on disposition of the body, personnel involved in the transfer of the body from the panel truck to the ambulance went to the Central Facilities dispensary for decontamination. Between mid-night and 3:00 a.m. on January 4 approximately 30 people who had been engaged in the emergency at the SL-1 area were admitted to the dispensary for secondary decontamination. These personnel included firemen, security patrolmen, and military personnel. Preliminary badge readings and urine sample analyses for these 30 people were received around 3:30 a.m. and indicated that all personnel could be released. To assist in the above-mentioned decontamination processes, four Phillips Petroleum Company health physicists came to the dispensary from the MTR and the Engineering Test Reactor.

At approximately 6:00 a.m. on the morning of January 4 a team of five men removed the body from the ambulance located in the SL-1 area. The body was disrobed in order to remove as much contamination as possible at the site. The body was replaced in the ambulance, covered with lead aprons for shielding purposes, and transported to the Chemical Processing Plant where surface decontamination was attempted. Individuals involved in the disrobing and transfer process received a maximum exposure of 770 millirems gamma. Prior to decontamination the reading from the first body was approximately 100 r/hr at the feet, and from 200 to 300 r/hr over the remainder of the body. First efforts to decontaminate the body resulted in no significant decrease in the readings.

Between 7:00 a.m. and 11:00 p.m. on January 4, the day following the incident, several entries into the reactor buildings were made. As a result of the entries, the second body was recovered, leaving one fatality to be recovered.

Detailed events involved with removal of the second body are presented in a subsequent paragraph. A Hurst criticality dosimeter was recovered from just outside the door leading onto the reactor operating floor. Personnel history files were recovered from the Administrative Support Building. In addition, the reactor operating log book and all but one of the plant instrument charts were recovered from the Control Room Area. The only chart not recovered was the Constant Air Monitor.

During this same period investigation teams were organized by the AEC, Argonne National Laboratory and Combustion Engineering, Inc. Efforts continued on planning removal of the last victim and assessing the damage incurred. In addition to the normal continuous radiation monitoring stations which were operating at the time of the accident, radiological monitoring teams started intensive surveys of the adjacent areas and NRTS environs to evaluate any possible radiological hazard. These surveys are continuing. No radiological hazard to the public has been indicated.

At approximately 4:00 p.m. January 4, 1961, preparations began to recover the second body from the reactor operating floor. The body was located in an area where radiation levels were estimated to be approximately 750 r/hr.

A recovery team consisting of six military personnel and two AEC health physicists proceeded from the decontamination check point on Fillmore Blvd. near U.S. Highway 20, after having been extensively briefed, rehearsed, and attired in protective clothing, to the entrance of the SL-1 compound at about 7:30 p.m. Of this group, two military men and two health physicists entered the support facilities building trhough the side entrance into the maintenance workshop area. A blanket was placed on the floor of the control room.

Because of the high radiation levels to be encountered, the maximum permissible working time on the reactor operating floor was limited to one minute.

One health physicist was assigned to hold a stop watch and time the actual entrance to the reactor operating floor, signaling the two-man recovery team when their time was up. The other health physicist remained in the support facilities building to check the body for radiation after its removal from the reactor building.

Having been briefed as to the location of the body to be recovered, the two-man team entered the reactor operating floor and proceeded directly to the body. One man picked up the victim's legs while the other grasped the body aroung the shoulders and they moved rapidly out of the high radiation area and down the stairway. Their one minute limit in the reactor area did not expire until they were part way down the stairway. The two men continued down the stairs and placed the body on the blanket in the control room.

The second two-man team entered the support facilities building and went to the control room where they picked up the body by the four corners of the blanket and carried it out of the SL-1 compound. The work clothing was removed from the body, which was then placed in an ambulance standing by for the purpose at 8:08 p.m. The ambulance proceeded with the body to the Chemical Processing Plant where facilities had been prepared to receive it. The third two-man military team proceeded into the support facilities and onto the reactor operating floor for the purpose of attempting to gain some more information about the status of the remaining body and the reactor.

The short periods of time that these recovery teams were in the high radiation areas on the reactor operating floor resulted in gamma exposures of from 1 rem (roentgen equivalent man) to about 13 rems.

On Thursday evening, January 5, an official photographer entered the radioactive reactor compartment to photograph the scene of the explosion.

Radiation fields greater than 500 r/hr were reported by the accompanying health physicists. The photographer, wearing protective clothing and breathing apparatus, was allowed 30 seconds to complete his assignment. By entering the reactor compartment only long enough to trigger his camera and withdrawing to a less radioactive area to change film and make adjustments, the photographer was able to obtain the interior photograph needed. This photograph assisted AEC investigating teams in making plans to recover the third body and in evaluating damage to the reactor operating area. Maximum radiation exposure of these two men was less than two roentgens gamma of radiation.

The third body had been observed to be lodged in the ceiling above the reactor. Because of the high radiation fields (about 500 r/hr) personnel could not climb onto a beam to free the body which itself was highly contaminated with radioactive material.

The plan for removal of this third body was to position a large net (5'x20') under it and attempt to lower the bod' nto the net. The net itself was fastened to the end of a crane boom. The large doors on the reactor building that are used for moving equipment in and out of the building were opened to permit the crane to position the net just below the body. A closed circuit TV camera had been placed in the reactor building to help position the net.

When the net was in position, teams of two men each were to move in quickly and try to lower the body onto the net. Because of the radiation fields, each team had less than a minute to make its attempt at freeing the body.

Due to a malfunction of the TV equipment, it was necessary to use the first team of men to check that the net was properly positioned; they accomplished their mission in less than their allotted time.

Four additional teams were used to accomplish the mission of freeing the body and lowering it into the net.

A sixth crew, outside of the building, was used to move the crane which held the net. The third body was removed from the building at 2:37 a.m. on January 9, 1961. The estimated doses received by the men entering the reactor building to free the body ranged from 2.5 to 7.5 rem.

Recovery operations were completed at 4:42 a.m., January 9, 1961.

Official photographers have made a permanent record of activities at the SL-1 area. Aerial photographs were taken late Friday, January 6, to record the condition of the reactor building exterior, which appears undamaged.

At 1:45 a.m., Sunday, January 8, 1961, a photographer, accompanied by a health physicist, photographed the reactor compartment. The photograph was requested by the technical advisory committee assisting the Idaho Operations Office to aid in planning the recovery of the third victim. A photograph of the control room was also taken. Readings of the high range gamma dosimeters worn by the men showed a maximum exposure of less than three roentgens.

Entry to the reactor building continued to be a hazardous undertaking. To protect individuals from contamination, a detailed procedure is observed prior to any entry. A detailed plan of action for each operation is established in order to obtain maximum benefit from the limited observation time of one to two minutes. AEC and Combustion Engineering health physicists personnel control the disaster field operations to ensure maximum safety for all participants. They determine who may enter, the radiation exposures to be tolerated, and the equipment to be utilized.

The person assigned an entry mission and a health physicist are each dressed in two pairs of coveralls, shoe covers, and gloves. Around the wrists and ankles, tape is used to insure no skin remains exposed. Caps and respiratory protection equipment plus miscellaneous radiation detection equipment complete the outfitting of participants. Following exit from the contaminated area, clothing is removed and participants are decontaminated, if necessary, by scrubbing with soap and water.

Since radiation effects are cumulative, each entry by an individual brings him closer to prescribed maximum permissible limits. Exposures to personnel are kept as low as possible by strict time limitations and careful planning. To prevent multiple high exposures to individuals the missions are assigned to different personnel, thereby requiring a larger number of persons.

RADIATION LEVELS AND PERSONNEL EXPOSURES

As is to be expected in an incident of this nature, partly where the only knowledgeable observers are dead, there is a whole spectrum of stories relative to personnel exposures experienced, particularly during the efforts to recover the victims.

Estimates of personnel exposure, for instance, have rapidly gone as high as 200 to300 rem. I must say that I have been able to establish to my own satisfaction that there are no doses of this magnitude.

Attrached hereto and made a part of this report, you will find the actual breakdown given me by the AEC. This report was shown me in its original form which included the numbers, the names, the dates, and the operation. Since it was considered that this was a violation of privacy, I asked that the list be given me in the form which you now see it. I wish to assure you,however, that the complete report with names, dates, etc. is available; although for the foregoing reason, it has not been not publicly printed.

You will note that the highest explosion noted is 27 r. This, I say again, is the only really <u>factual</u> report I have been able to obtain and I have diligently attempted to determine if there are any deviations from these exposures reported. The radiation field readings are presently as attached (See Illustration No.44A). This is to say that the major radiation field now exists within the reactor tank. Directly above the reactor, readings of 500 to 1,000 r/hr are detected. Elsewhere in the tank toward the walls on the operating floor, readings of 100 r are reported and these levels have stayed relatively constant following the accident. There definitely existed a radiation plume which drifted down wind from the site following the accident. This plume is estimated to be very narrow (hundreds of yards) and very long (10-15 miles). This plume was followed closely by aeriological survey and ground-metering instruments. The meteorlogical status at the time of the accident was that an inversion existed which prevented a cloud from rising more than a few hundred feet above the ground. Atomic City is approximately half way to Blackfoot, Idaho (roughly 5-½ miles), where a low volume instrument (MSA 2133 Type) which metered at the rate of 1 cu.ft. per minute, detected in the first 12 hours, 3x10 to the minus 10u/cc of iodine 131. In the next four days, it was a reading of 3.4x10 to the minus 11u/cc of iodine 131. As a result, the first sampling of milk obtained in the area covered by the plume showed Iodine 131 at the "barely undetectable" limit. If this contamination is representative, this would result in a 40 mr dose to the thyroid of a child under the age of one (this would be a 2 gm thyroid which is the standard for measurement). Also on this basis, the accident in England at Windscale, resulted in thyroid doses in excess of 500 times the above dose. Also detected at Atomic City were samples of Xenon, Krypton, Strontium 91, and Yttrium 91. Noting the discovery of these trace elements aided in the early determination that a nuclear excursion had occurred. No other milk samples showed traces of contamination. Because of this it is possible that the laboratory itself, in the early chaotic hours was contaminated and this reading, therefore, is questionable. No areas were found in which the radiation level exceeded two times the normal background amount which is the lower limit of instrumentation detection.

Thirty-nine samples of milk taken after the first sample, were statistically zero.

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UNITED STATES
ATOMIC ENERGY COMMISSION
P.O. Box 2108
IDAHO FALLS, IDAHO

January 31, 1961

Mr. C.F. MacGowan
566 New Brotherhood Building
Kansas City 1, Kansas

Dear Mr. MacGowan:

On your visit January 26th and 27th, you requested information regarding exposure of personnel in connection with the SL-1 incident. Following is the information you requested of 27 personnel receiving 3 R or more broken down by AEC, Contractor and Military personnel:

BODY REMOVAL

Affiliation	Exposure
AEC	27 R
"	16 R
"	15 R
"	11 R
"	3.0R
Contractor	27 R
"	27 R
"	25 R
"	23 R
"	11 R
"	11 R
"	7.4R
"	3.1R
Military	21 R
"	13 R
"	9.0R
"	5.9R
"	4.1R
"	4.0R
"	3.6R
"	3.2R

C.F. MacGowan - 2 -

PHOTOGRAPHY OPERATIONS:

Military	3.2 R
Contractor	3.0 R

DECONTAMINATION OF BODIES

AEC	3.1 R
Contractor	3.3 R
Military	3.7 R

RECOVERY OF NUCLEAR ACCIDENT DOSIMETER

AEC	4.6 R

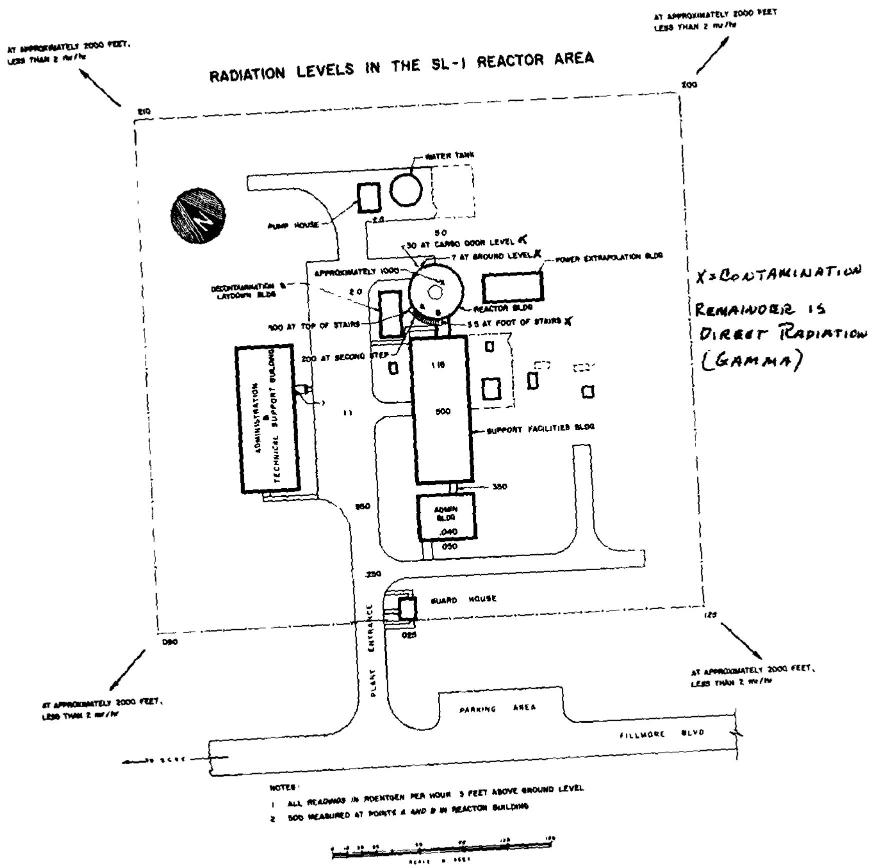
You also requested the distribution of the SL-1 incident gamma radiation exposures by levels of exposures. Through January 26 there were 150 persons receiving 300 Mr (the weekly administrative exposure guide) or more as follows:

300 MR to 900 MR	900 MR to 3000 MR	3000 MR to 12000 MR	1200 MR to 25000 MR	2500 MR to 27000 MR
64	59	18	6	3

Very truly yours,

(signed) Allan C. Johnson, Manager
Idaho Operations Office

AIR MAIL


RADIATION LEVELS IN THE SL-1 REACTOR AREA
AT APPROXIMATELY 2000 FEET, LESS THAN 2 mr/hr
AT APPROXIMATELY 2000 FEET LESS THAN 2 mr/hr
210
200
WATER TANK
PUMP HOUSE
2.0
50
30 AT CARGO DOOR LEVEL X
7 AT GROUND LEVEL X
POWER EXTRAPOLATION BLDG
APPROXIMATELY 1000
DECONTAMINATION & LAYDOWN BLDG
2.0
REACTOR BLDG
A
B
500 AT TOP OF STAIRS
5.5 AT FOOT OF STAIRS X
200 AT SECOND STEP
ADMINISTRATION & TECHNICAL SUPPORT BUILDING
11
110
500
SUPPORT FACILITIES BLDG
350
950
ADMIN BLDG
.040
.050
.250
GUARD HOUSE
PLANT ENTRANCE
.025
.090
.125
AT APPROXIMATELY 2000 FEET, LESS THAN 2 mr/hr
AT APPROXIMATELY 2000 FEET, LESS THAN 2 mr/hr
PARKING AREA
FILLMORE BLVD
X = CONTAMINATION
REMAINDER IS DIRECT RADIATION (GAMMA)
NOTES:
1 ALL READINGS IN ROENTGEN PER HOUR 3 FEET ABOVE GROUND LEVEL
2 500 MEASURED AT POINTS A AND B IN REACTOR BUILDING

Mr. PAYNE. Based upon these data of the report the following factors appear to be significant. However, it cannot be too highly emphasized that actual access to the reactor or a complete photographic examination may change the conclusions drawn herein. This estimate of the situation is based on factors as known to date:

I. REACTOR DESIGN EVALUATION

A. There is room to question the design of the reactor. This is based upon the fact that the assembly of the reactor, that is, the insertion of plugs, hooking up control rods, drives, and bell housings, had to be done in such a manner that a pressure surge, such as occurred, could create missiles of all these parts.

B. The wisdom of a design which will permit a reactor to go critical as the result of the movement of a single control rod, is also questionable. In this particular case, the center control rod, known as No. 9, alone was sufficient to bring the reactor not only to critical, or prompt critical, but could conceivably have resulted in a nuclear excursion of this type.

C. It is possible that the expulsion of the steel punchings and other dry shielding from immediately above the reactor cover could have been caused by a control rod or fuel elements sharply striking the bottom of the cover. These, in themselves, when struck by water or stream, could have also become missiles.

D. The scram system on this reactor is also subject to some question. Normal procedures for scram involved the disengagement of the motor by a magnetic clutch, thereby permitting the control rods to fall back into the reactor on gravity alone.

This operation normally can be accomplished in 1 to 2 seconds. Since there were 40 cases in the last 2 months of operation of control rod sticking, it is safe to assume that at the time of the accident, at least one control rod might have been sticking.

In cases of this type, to overcome the sticking, it was necessary to regroup the electromagnetic clutch and run the control rod back into the reactor by reversing the electric motor.

The maximum rate on which this motor operated was 3 feet per minute. A poison system, which admittedly was not designed to prevent explosive surges such as this, could only be utilized while the reactor was operating, since liquid boron had to be ejected into the water at the water inlet, and carried into the fuel elements by the natural circulation of the water.

Since the reactor was down, and the pump was not working, this poison device could not have been used.

II. REVIEW OF THE HAZARDS EVALUATION BRANCH

Adequacy of the design of this reactor was reviewed by the Hazards Evaluation Branch of the Atomic Energy Commission, as well as the Advisory Committee on Reactor Safeguards. This was on the basis of the hazards report which was printed in late 1957 and early 1958.

It seems that some of the deficiencies in design as noted might have been considered. However, this reactor accident is presumed to be less than "maximum credible accident" based on the following:

A. Maximum credible accident to this reactor envisioned the complete release to the atmosphere of all toxic and radioactive materials in the core, including fission products.

B. Total estimated content of the core is about 1 million curies of fission products. Only a low percentage of fission products were expelled.

III. INSPECTION

This reactor, like others, is subject to periodic safety inspection, and reports by both the Commission and the contractor. The Commission has received reports on all cases of malfunction, including rod sticking, burnable poison burnout, et cetera.

Only after some lengthy detailed scrutiny, after the complete knowledge of the causes, will the adequacy of the inspection be known.

IV. PROCEDURES

Some designated difficulty might have been overcome by proper procedures for assembly of the reactor. Specifically the reactor operators could have reduced the degree of hazard by bolting down each part as it was installed. Normal procedures, it is understood, did not call for this, which left a great many missiles flying about in the containment tank. Other procedures similarly might have been carefully examined.

Chairman HOLIFIELD. Will you please explain that to me, the expression particularly "left a great many missiles flying about in the containment tank"? Each one of these rods is in a circular hole.

Mr. PAYNE. This is right.

Chairman HOLIFIELD. They could not be flying around in a tank, could they?

Mr. PAYNE. Well, at a surge or an excursion of this type——

Chairman HOLIFIELD. You mean in the event of an explosion?

Mr. PAYNE. Yes.

Chairman HOLIFIELD. From a mechanical standpoint could they have bolted down each one?

Mr. PAYNE. I believe they could, sir, as they were installed.

V. TRAINING

The ordinary complement of the SL–1 totals 52 persons for the four shifts. The 4 p.m. to 12 p.m. shift, or second shift as it is now well known, was comprised of three men, all military.

Sp5c. John A. Burns, 22, U.S. Army, certified reactor operator since February 26, 1960.

Sp4c. Richard L. McKinley, 27, U.S. Army.

Construction Electrician, First Class, Richard C. Legg, 26, U.S. Navy, certified February 26, 1960.

Thus, two men had received certification from Combustion Engineering as to the proficiency in operating this reactor. The third man had completed his course, but had not received the formal certificate since he had not received his final examinations.

We believe it is in order to say that there were no supervisors as such, unless it is to be considered that Burns, with a certificate nearly a year old, was not designated as a supervisor.

But Legg, with a senior rating, was so designated.

Beyond this, there was no civilian or more highly trained supervision on the job.

Following is the normal training process for military personnel which will lead to a certificate as a reactor operator:

1. Personnel must have a good background in electronics, mechanical, or instrument mechanics. This implies graduation in one of the above fields from the service operated schools.
2. An evaluation of the IQ follows, with specific emphasis on the ability to learn complex technical facts.
3. Eight months training at Fort Belvoir in (*a*) 4 months of which are spent in academic courses on reactor theory and operation; (*b*) remaining 4 months training in their specialty as applied to reactors.
4. Personnel are then transferred to the reactor itself, either at Idaho Falls or Fort Belvoir, and another 4 months of which approximately 3 weeks is classwork, then shopwork, and then training on the reactor itself.
5. Personnel then go on shift, or actual reactor operations for 2 months under close supervision.

Following this, the minimum requirement is that the operator be compelled to take the reactor on three hot scrams and one cold scram. The cold scram involves a complete startup of the reactor.

At this point, the formal training is finished. There remains three examinations, one written examination covering all the academic and practical methods discussed; oral examination by the military board; oral examination by the contractor—in this case Combustion Engineering.

Following these examinations, and contingent upon receiving good grades, the certificate of the reactor operator is granted.

As mentioned elsewhere, two of the victims had received certificates as reactor operators. One had not received a certificate pending completion of examination. A chief operator certificate is achieved by the expenditure of an additional 6 months of classroom and on-the-job training, followed by an examination and, also not to my knowledge possessed by any of these three victims.

It is also noteworthy that the contractor had no supervision of his own on the reactor or on the entire site at the time of the accident. This is explained by the military as normal since these reactors were intended to be operated at remote sites by this type of personnel.

Although the presence of a health physicist would probably not have prevented, or even mitigated the explosion or excursion, it is difficult to conceive of justifiable reasons for permitting any personnel to work about the top of an open reactor without some method other than the automatic instruments furnished for estimated radia tion doses to these personnel.

That there was no health physicist on duty on the site at that time was explained in the view of the Army by stating that all three men in the course of their training as reactor operators had been indoctrinated in the use of protective measures and devices.

Furthermore, it was stated that while this particular shift consisted of three men, the normal complement would have been two men.

A supervisor whose principal function would have been to observe the installation of the control rod motors to the rack and pinion of the control rods, would have come to work on the 12 p.m. to 8 a.m. shift, the night of the incident. Labor is concerned that this type of operation may creep into the civilian power and production program.

VI. REACTOR CONTAINMENT

This reactor was considered noncontained despite the fact that the building housing it was steel and the only apparent leaks to the outside was through the access doors, the freight doors, and the filter outlets.

The utilization of an airtight container would have prevented any contamination whatsoever to the outside. This is a significant departure from formal containment devices.

Chairman HOLIFIELD. Of course, you recognize the fact that this was in an isolated area.

Mr. PAYNE. We do recognize that fact, sir.

These departures were utilized because of the remote location of both this reactor and any which would follow, as well as the above ground character of the reactor vessel.

Although distance substituted for containment in Idaho, and likewise this reactor was much smaller than any power reactor now in operation, it is clear that power reactors, henceforth, should approach population centers only to the extent that absolute containment of missiles and fission products can be guaranteed in an accident of this or any other nature.

VII. RESPONSIBILITY

The organizing plan of the operation of the SL-1 is extremely complicated and it is difficult to determine where military and civilian operation divide. However, it is definitely established that the reactor was under civilian control even though training military personnel.

I wish to thank you, Mr. Chairman and your committee, on behalf of the American Federation of Labor and the Congress of Industrial Organizations, as well as my own brotherhood for opportunity to appear before you.

Chairman HOLIFIELD. We are certainly happy to have you appear before us.

Are you a technical man?

Mr. PAYNE. I have been in health physics for quite some time, sir.

Chairman HOLIFIELD. What is hazardous about the condition you describe on page 2, item B, in which the motors are reversed to overcome control rod sticking?

Mr. PAYNE. The control rods, I think it was very well explained in the last two sessions here, they must reverse their electronic clutch and run the control rod in by power and motor; it only runs it 3 feet per minute.

We do not think it is a very good design. Of course, design is not in our province, but we are interested in design to the effect that our people who work in these reactors—speaking of power reactors and not of military reactors—are in there and are the people who will definitely be hurt if there is anything in there.

Chairman HOLIFIELD. Your statement on page 4 that there were no supervisors as such, you mean by that, of course, that there were no men higher in technical training than those three who had taken these operational courses?

Mr. PAYNE. That is right. We don't think this is the right type of manpower in operation or in maintenance.

We also do not believe that this is a routine job.

Chairman HOLIFIELD. You mean that this particular point of maintenance is not routine?

Mr. PAYNE. That is right.

Chairman HOLIFIELD. Are there any question of Mr. Payne?

Representative ASPINALL. Mr. Chairman, I would like to ask a question.

Chairman HOLIFIELD. Mr. Aspinall.

Representative ASPINALL. As I understand your statement, Mr. Payne, you seem to feel that the design work and some of the operating principles were wrong and yet you, who represent a group of the practical workers in the matter, have been critical only after the accident. How much interest did you take in the design of this reactor and some of the working procedures before the accident?

Mr. PAYNE. That is a good question.

Representative ASPINALL. It is a fine question.

Mr. PAYNE. I do not believe that we are qualified to either say yes or no on the design problems. I believe this is up to the design people, up to the Commission, up to the Reactor Safeguards Committee to do this.

Now, we have, up to this time, been content to take their designs and try to operate them.

Representative ASPINALL. For the simple reason that there had never been an accident and therefore you went along with it. You know in my country we have accidents in mining and in other industries and always it seems as if the people who represent labor wish to put all the blame on management or the operator.

And do not get me wrong. I am interested in this and most certainly I want to do everything I can to keep an accident from happening or an injury from taking place, but no matter how far we go in these matters we are always coming up with some manmade failures and we have trouble.

Now, do you know for sure that we did not have a manmade failure in this particular accident?

Mr. PAYNE. No, I don't think I do. I don't think anybody else does.

Representative ASPINALL. I do not, either. But yet your backward glance at this time on what has happened, and we do not know what caused it as yet, your backward glance is to find fault with design and operating procedures.

Mr. PAYNE. Well, I think that we have a perfect right to an opinion on these.

Representative ASPINALL. I say that you have a right to an opinion and to question, but I would like that opinion and any question to be as constructive critically as it can possibly be.

Mr. PAYNE. We think procedures are absolutely necessary. We think that they should be drawn beforehand. We think emergency procedures are necessary.

We believe that in order to operate this business, and we think it can be operated, with a little better than normal risk, with the right type of operation, and believe me, we are interested in that right type of operation.

Representative ASPINALL. Do you think that we will ever be able to design and operate this sort of program without the possibility of an accident?

Mr. PAYNE. No, I think we will always have some accidents, but I do not think that they have to be prevalent. I think we can learn something from every accident.

Representative ASPINALL. We should.

Mr. PAYNE. We should learn. So far it does not seem we have learned too much from what accidents we have had.

Representative ASPINALL. This is the only accident of its kind.

Mr. PAYNE. So far as procedure is concerned, I could probably state a few cases where we have not taken advantage of what we might have learned.

Representative ASPINALL. That is all, Mr. Chairman.

Chairman HOLIFIELD. You are excused, Mr. Payne.

Mr. PAYNE. Thank you, Mr. Chairman.

Chairman HOLIFIELD. In addition to the statements received for the record, we have a statement which has been forwarded by the Oil, Chemical & Atomic Workers International Union, Local 2–652, Idaho Falls, Idaho.

Without objection, that statement will also be received for the record.

PETITION OF THE OIL, CHEMICAL & ATOMIC WORKERS LOCAL 2–652 PERTAINING TO THE SL–1 ACCIDENT

We of the Oil, Chemical & Atomic Workers, Local 2–652, employed at the National Reactor Testing Station, feel that it is our duty to bring to you, our Congressmen, the following, and we respectfully request that you use this appeal to bring to us, and to the general public, the whole truth concerning the hazards of the nuclear industry. We believe that more adequate legislation is sorely needed to protect atomic workers. We further believe that the SL–1 incident of January 3, 1961, as well as other incidents that have occurred at the NRTS in the past years, should be investigated by the Congress of the United States. These above-mentioned incidents have been investigated by the AEC and, we feel, whitewashed for the press and public information, what little is released. As the nuclear industry is our livelihood, we want known problems solved or removed before incidents occur. If it so happens that a radiation incident does occur anyway, we want proper and adequate means available to handle any incident of this type.

First of all, let us look at the SL–1 incident and what we know and have heard about it. Previous to the incident it was a known fact, by the AEC as well as the operating contractor, that a physical loss of the boron-burnable poison was taking place. Also, over the last 2 months of operation, approximately 40 control-rod stickings occurred. To simplify this, the very rods that control and safeguard the nuclear reactor were sticking so badly that they could not be depended on. The reactor was unsafe to operate, and, more than likely, allowing personnel to work on it shut down in this condition caused the subject incident. This is all clearly stated in the March 1961 issue of Nucleonics Magazine, which accompanies this appeal. This is not a magazine reporters version but a "most likely cause" opinion of a five man AEC Board of Investigation. It is our contention that this incident would have never occurred if the operating contractor and the AEC would have solved known problems before subjecting operating personnel to a potential hazard.

It is, of course, a fact that the SL–1 incident did occur and that other incidents have and will continue to occur in the nuclear industry. Certain problems must be brought to attention so that they can be solved.

There does not exist at the Idaho site main dispensary an isolated ward to treat radioactive patients. Suppose that victim No. 1 of the SL–1 incident would have lived longer than approximately 5 minutes (approximately 2 hours af eactor building. There was not and is not facilities fit to handle a human patient, living or dead, that is reading as high as 400 roentgens per hour. As it was, the nurse who attended the victim received approximately 3 to 4 years' dose, if not more. The first two victims that were removed were taken to the chemical processing plant. There they were put in stainless steel sinks in shielded areas, packed in ice, to await disposition. Here they lay without proper burial for a week to 2 weeks, while medical butchers removed glands, organs, blood, and what have you, for study purposes. By the time the third body was removed, public sentiment had reached a point where burial plans had to be made. Special caskets and lead boxes were ordered, but not lead boxes large enough for safe public burial with the bodies as whole men. First of all, highly radioactive parts of the bodies were removed; heads, arms, and what have you were removed and unceremoniously buried in the hot waste dump at the site. The remainder was put in small lead boxes and placed in the caskets for burial. Why, we ask, are there not lead caskets available at the reactor sites so that the next of kin may give a husband or son a proper burial, in one piece, as soon as possible after such an unfortunate thing?

Now let us discuss the radiation exposures at SL–1. The AEC informed the public that dosages were held at a minimum during the victim-recovery operation. This is not false, but again, not altogether true. An operating contractor guard received near 32 roentgens beta and 7 to 10 roentgens gamma. His work assignment is still in a reactor area. The nurse and dosages she absorbed has been discussed previously. A health physicist employed by an operating contractor at the site received enough radiation to be reassigned to the central facilities area, out of the radiation for 1½ to 2½ years. He did not, however, receive as much as the guard who is still assigned to an area where radiation could be a hazard to his life any time. His reassignment did result in a cut in pay, as he lost shift differential and overtime normally worked in his previous assignment. The health physicist employed by the contractor operating SL–1, was said to have received near 100 roentgens to the thyroid. Where he is at now and what he is doing is a mystery to this group. There are many other notable exposures incurred in the first 12 hours after the incident. Since that first 12 hours we think exposures have been kept within permissible limits. The AEC is authorizing as high as a month's dose at a time in order to investigate the incident. This, we might point out, was not common practice before the incident. We can only guess at the amount of radiation received except for hearsay and verbal slips by people who know. Information such as this is not readily available to us as a group even though we represent almost 500 atomic workers directly connected with radiation in our daily work.

The points to be emphasized concerning the last paragraph are as follows:

(1) There is not an organized shift disaster group at the NRTS, trained and equipped to handle any type of radiation incident.

(2) There were no instruments readily available to read direct radiation in excess of 500 roentgens on the night of the SL–1 incident. We do not know that there are instruments available to this date capable of high radiation disaster monitoring.

(3) Key radiation monitoring personnel were drawn from other reactors where they are needed for the last 2 hours of the evening shift on the date of the incident. This, of course, may be necessary if disaster teams are to be formed. It seems, however, that sufficient personnel should be assigned to each shift, so that all radiation areas remain covered even in event of a radiation disaster.

(4) There remains the fact that the NRTS is so located so that it is far enough from populated areas to contain the radiation incidents within site boundaries. This is all well and good, but the hazards still exist at the site for all operating and maintenance personnel. In past years this group has repeatedly tried to negotiate isolation pay, travel pay, or hazard pay—call it what you want—but have been beaten by the combined efforts of the AEC and the Phillips Petroleum Co. The radiation hazard exists and will continue to exist wherever there are nuclear reactors. The isolation of the NRTS is for a purpose, we agree, but being so creates a further hazard borne out by the SL–1 incident. If this type incident should occur again, and it could, immediate medical attention and availability of trained disaster personnel would be slow to arrive due to isolation of the site. Thus, chances of survival of an injured worker are greatly reduced. Yet we are continually stymied in our efforts to receive extra compensation for isolation or hazardous work, already compensated for in other industries and in some cases right here at the NRTS.

(5) The two AEC doctors at the NRTS were used in tests, attempted decontamination and dissection of the first two SL–1 victims. We do not know, but have reason to believe that they received a sizable amount of radiation; even though they are our only doctors, will they be expected to jeopardize their lives in the event of another incident or will they be kept back while an atomic worker lies dying in need of a doctor's attention but too radioactive for the overexposed doctors to come near. Then again we have the nurse who treated victim No. 1 at the SL–1 incident. She is still a shift nurse on off-shifts, our only immediate source of medical attention in case of another incident. Will the AEC expect her to treat another radioactive patient and endanger her life? And what about the guard previously mentioned. He is working in a reactor area after receiving a high exposure. What if an incident occurs at a plant he is working at? The inconsistencies of the AEC and contractor policies are very evident to us and we hope to you.

Now we would like to summarize this appearance with what we feel is necessary to correct the many problems stated. We have not gone into a great deal of detail as details are not available to us. Only through newspapers, magazines, and other sources of public information do we get the supposedly true facts. We wish to state, however, that any information or names we can furnish you or an investigating committee we will be more than pleased to do so. To get on with our summary we will list suggestions to correct the problems that exist here at the NRTS and perhaps throughout the nuclear industry. The suggestions are as follows:

1. A full-scale congressional investigation into the SL–1 incident at the NRTS to determine why more action was not taken to correct known potential hazards previous to the incident.

2. Legislation passed to protect nuclear industry workers and their dependents. We will break these down as items:

(*a*) That the AEC, or AEC licensee be required to carry life insurance to cover death by radiation in the peacetime nuclear industry for all atomic workers, this insurance to be of a sufficient amount to support the next of kin and/or his dependents from the time of his death by radiation accident until he would have been 65.

(*b*) That the AEC be required to inspect licensee or contractor facilities at least once a week to determine if safety regulations and recognized procedures are being followed. This is to include close scrutiny of operating logbooks.

(*c*) A Federal atomic workers compensation law to cover overexposures and radiation sickness resulting in loss of work or pay to workers in the nuclear industry.

(*d*) An AEC public information law requiring the AEC to make public the complete facts involved in all nuclear incidents. This, of course, to be within limits of security regulations. These facts to be made available and in printed form to all atomic workers.

(*e*) A law to impose heavy fines, loss of contract, or suspension of license upon findings of unsafe operating practices.

3. In addition, we believe the following items should be given consideration at the NRTS and at any other nuclear industry location where applicable:

(*a*) An isolation ward to be built at the NRTS central facilities dispensary to handle radioactive patients. This should be complete with remote handling devices and all other standard clinical equipment installed.

(*b*) Radiation disaster teams to be formed, composed of trained people with sufficient equipment to handle any type of radiation incident that might occur. There should be a team available at the site at all times. We realize such teams might be made up of personnel from operating contractors on the site. We do not, however, want key radiation monitoring personnel depleted completely from one area.

(*c*) Means and methods devised at the NRTS to handle radioactive bodies in case of another fatal incident. Decent and proper burials of entire bodies seems little enough to allow the next of kin in event of such an incident.

(*d*) In the future, when hazard pay, isolation pay, or travel pay is an issue in negotiations between the operating contractors and the unions, that the AEC recognize the justification of it and assist in arriving at a fair amount.

(*e*) That standards be adhered to concerning radiation exposures; that is, that personnel assigned on all shifts for the sole purpose of medical or other aid to accident victims not be in question for radiation victim treatment, due to past high exposures.

As we stated previously, this does not cover every incident or point of concern. We all feel that the SL–1 incident has brought some serious problems due to laxness on the part of the AEC and the operating contractor. We sincerely believe that you will help us with our problems so that the nuclear industry in Idaho as well as the rest of the United States is a safer and more organized operation.

DONALD E. SELFERT
(For the Oil, Chemical & Atomic Workers International Union, Local 2–652, Idaho Falls, Idaho).

Chairman HOLIFIELD. The next witness is General Luedecke, General Manager of the Atomic Energy Commission.

You may proceed, General Luedecke.

STATEMENT OF A. R. LUEDECKE, GENERAL MANAGER, ATOMIC ENERGY COMMISSION

General LUEDECKE. Mr. Chairman, in presenting this testimony relating to the SL–1 accident, I would like to make a brief statement of my views concerning the accident and its investigation by the Board, after which I would like to outline the corrective actions taken by AEC as a result of the accident.

Chairman HOLIFIELD. You may proceed.

General LUEDECKE. The investigation of the accident has proceeded much more slowly than anticipated. The probable cause of the accident has not been definitely established. The final report of the Board of Investigation cannot be made for some time, as it must await the availability of information from within the reactor which will be received only after a difficult, time-consuming disassembly operation. The Board has proceeded with diligence and perseverance in this difficult and necessarily exacting undertaking.

As Commissioner Wilson has stated, it appears from the investigation that there were some design features which may have contributed to the accident. In retrospect, it is clearly undesirable to design a reactor in such a way that the withdrawal of one control rod can produce criticality. Where such design is necessary, it is clear that there must be some type of special restraint provided in the design to guard against improper manual withdrawal of the control rod to the point of criticality.

Deficiencies in the safety procedures and practices of the AEC and contractor organizations also have been found which, if corrected, might have prevented the accident. Even though the cause of the accident is as yet unknown, it is known that progressive deterioration of the SL–1 core and reactor control rods had taken place. I believe that a timely and comprehensive safety reactor review by the contractor would have resulted in an order shutting down the reactor for review and corrective action prior to the accident.

I should like to note at this point that the Safety Committee of Combustion Engineering did review questions and reports referred to them from time to time, as indicated by Mr. Allred. My reference in this statement to a comprehensive review is intended to indicate a review similar to that performed by Combustion Engineering at the time they took over the reactor from the Argonne National Laboratory in March of 1959.

Adequate and timely inspection by the AEC would also have revealed conditions which might have caused the reactor to be shut down.

Although there is no evidence at this time that the operation of this reactor above the 3-Mw level directly contributed to the accident, adequate hazards review prior to a decision to operate up to 4.7-Mw level was not made. Also, in view of the deterioration of the reactor, and the maintenance work which involved manipulation of control rods, a detailed written checklist procedure should have been followed. Since such a procedure was not in use, increased attention should have been given to the technical implications of this question. In addition, reporting procedures should have been sufficiently clear to have required the reporting to AEC of the extensive control rod sticking. As the General Manager of the AEC, I have overall responsibility for its operations, including those administrative deficiencies which we find to have existed.

It should be noted that the SL–1 reactor is quite different from civilian power reactors being developed or used in that it is designed for use at remote military installations rather than in a populated area. Only one other reactor has, as does the SL–1, a control rod system design which permits the reactor to be taken from shutdown conditions to criticality by the withdrawal of only one control rod. No reactors for civilian purposes have this feature. The SL–1 was a prototype, undergoing development to attain compactness, simplicity, reliability, technical feasibility, long core life, and minimum plant cost to make it suitable for use at remote locations under primitive conditions.

Chairman HOLIFIELD. You say that only one other reactor has the same control rod design. What reactor is that, General?

General LUEDECKE. It is in the Army reactor in Greenland.

Chairman HOLIFIELD. In Greenland?

General LUEDECKE. Yes, sir.

Chairman HOLIFIELD. What steps have been taken to protect this feature?

General LUEDECKE. Definite limitations have been placed on control rod movement. I can ask Colonel Schrader to outline that in further detail.

Colonel SCHRADER. On January 8, at the time we began immediately reviewing all Army reactors while the AEC was reviewing all of its reactors, we recognized this shortcoming of the PM–2A in Greenland. We gave explicit instructions on the 8th of January that this reactor, which was shut down at the time, would not be started until we had reviewed the situation.

It was necessary for us to issue instructions to modify mechanisms of the PM–2A so that no single rod could be raised to a point where criticality could automatically occur. Specifically, an electrical stop was inserted. There had to be a manual override to go beyond this point.

Further, explicit instructions were sent to Greenland to insure that when it became necessary at subsequent maintenance to use this override, the request would have to come back to me, as the Chief of the Army nuclear power program, with appropriate procedures which my technical staff would review and, based on my approval, I would authorize that override to be accomplished.

Following these instructions, the reactor was subsequently, on January 30, authorized to proceed to criticality and on March 8 was actually accepted by the Government from the contractor as an operating reactor. It has operated for some months since that time. There have been no nuclear problems since that time.

Does this answer your question, sir?

Chairman HOLIFIELD. Do you consider that the safeguards, both mechanical and administrative, that you have taken are adequate, and will prevent any such occurrence as we had in Idaho?

Colonel SCHRADER. I do so believe. The actions which we have taken were promptly submitted to the AEC, to Licensing and Regulation for their review, and the AEC subsequently requested and with the wholehearted concurrence of the Department of the Army, that in early August there will be a further detailed technical review by Licensing and Regulation of this reactor in all of its aspects.

Chairman HOLIFIELD. Does this reactor in Greenland have containment?

Colonel SCHRADER. Let me say, sir, that this reactor is contained in a shell that is 13 feet in diameter and 28 feet in length. The thickness of the steel I believe is on the order of 1½ to 2 inches. Now this is reasonable containment. This is not containment in the sense of the word that we think of for civilian reactors or even for the SM–1, which is at Fort Belvoir, Va., where we have several inches of steel plus several feet of concrete. But for its use at a remote location, we do believe this to be adequate containment.

Chairman HOLIFIELD. Are there any questions?

Representative BATES. Mr. Chairman, I regret I had other committee meetings earlier, but as I understand the testimony, we don't know the exact cause of the SL–1 accident. Is that correct?

General LUEDECKE. That is correct.

Chairman HOLIFIELD. The gentleman just referred to one possibility for which you have taken corrective action in Greenland, is that correct?

Colonel SCHRADER. Yes, sir; the stuck rod criteria.

Representative BATES. After that was accomplished you went ahead and brought it to criticality again?

Colonel SCHRADER. Please understand that the technical review that was made on this reactor between January 8, when we gave them the order to hold, not to take the reactor critical because it was not operating as of that time, until January 30, was a very detailed technical review in all of its aspects, including the command and training procedures and training involved of the individuals.

Representative BATES. If you don't know the cause of the SL–1, how can you be certain that the one in Greenland is safe to operate now?

Colonel SCHRADER. Within known technology.

Representative BATES. If you don't know the cause, how do you have the technology?

Colonel SCHRADER. This reactor, PM–2A, a portable medium powerplant, is a pressurized water reactor. It is different from the reactor that is in Idaho. However, I do not want to put the connotation on the fact that because it is a boiling-water reactor it is not safe. I do not believe this, sir. We believe there is also a place in the Army nuclear power program for boiling-water plants, very much so in the small plant area.

Representative BATES. Then the only common factor it had was that single control rod that would bring it to criticality?

Colonel SCHRADER. That is correct, sir; plus the fact that we have learned, as has been testified earlier today, certain instruments should always be kept on in the control room when work is going on. We want to be sure that this was part of the operating procedure. There were other instructions that we issued up there to take advantage of the lessons learned from the SL–1 accident.

Representative BATES. Thank you.

Chairman HOLIFIELD. You may proceed.

General LUEDECKE. Notwithstanding the unique character of the SL–1 facility and the uncertainty as to the precise cause of its accident, we are making every effort to profit from this experience to enhance the safety of reactors generally. We are proud of the outstanding safety record maintained in our operations and in the atomic energy industry as a whole. We are determined to maintain and, where possible, to improve this safety record. Safety of both the reactor personnel and the public is of paramount concern to the Commission.

The results of the special safety review of AEC-owned reactors which we initiated on January 9, shows that the safety and control problems of SL–1 are not characteristic of other AEC-owned reactors. This review does not indicate with respect to other AEC reactors the existence of the major problems of operation revealed in the SL–1 investigation. This is not to say that our safety operations and procedures cannot be improved. It will be necessary to review and revise our safety operations, safety procedures, and safety equipment and criteria as new information becomes available which can be applied to further enhance the safety of our reactor operations.

I would like at this point to briefly outline certain corrective measures taken in the aftermath of the SL–1 accident.

On January 9 and 10, teletypes went to all AEC Operations Office Managers, instructing them to immediately examine reactors under their cognizance to verify that shutdown margins were well within the limits of safe operation, that control systems were operating according to design specifications, and that maintenance and operating activities were conducted under direct and personal supervision of qualified designated supervisors in accordance with approved written procedures. They were also directed to take actions necessary to insure that specific written procedures were established for the manipulation, during reactor operation and shutdown, of any control rod which could take a reactor from shutdown to criticality.

The information submitted indicates that all of the operating reactors and critical assemblies are in satisfactory condition with respect to the items mentioned above, except that it was reported in some instances that written procedures had not been prepared to cover maintenance operations adequately. Instructions have been issued in the field that these be prepared promptly.

These inspections generally went beyond the items specifically requested and disclosed opportunities to improve operational practices and tighten management controls related to reactor safety.

As a part of this review, a team from the New York Operations Office made a review of reactor safety at the Brookhaven National Laboratory. The committee was provided with copies of the related correspondence in my letter of March 20. The results of the review led us to conclude, even at the risk of being overcautious, that in the administration of a safety program, certain procedural changes were necessary to provide greater assurance of safety of operations. This applied primarily to independent internal periodic audit of safety procedures and requirements. Accordingly, on March 14, we decided it best to suspend operation of reactors at BNL until certain recommended procedural changes were placed in effect. The Graphite Research Reactor continued operating under special supervision until its scheduled shutdown March 17 to avoid disrupting experiments.

The Acting Director of the Laboratory and his staff cooperated fully and promptly with an ad hoc team immediately dispatched from headquarters and with the New York Operations Office. The result was that no actual operating time was lost on any of the reactors, since, with the exception noted previously for the Graphite Research Reactor, facilities affected by the directive were already shut down or scheduled to be shut down for purposes of maintenance and experiment preparation.

These actions were not based on any safety deficiencies in the reactors involved or their operation, but rather on procedural requirements for safety inspection and evaluation, which we believed were not being fully met at BNL at that time.

The Division of Inspection, in addition to its normal periodic appraisals of all AEC activities in the operations offices, is completing a special survey of operations offices reactor inspection programs, procedures, and practices. The results to date have indicated that while all operations offices have limited reactor inspection programs underway, a number of improvements are needed. For example, most offices need additional technical AEC staff to provide the necessary independent and objective inspections.

Chairman HOLIFIELD. Have you taken any action to obtain those technical people?

General LUEDECKE. We have directed the operations officer to obtain the people within their own ceilings which is necessary to give them this capability.

Chairman HOLIFIELD. They have been ordered to do this?

General LUEDECKE. They are proceeding to do that now, sir.

Most contractors have excellent safety programs; in some cases greater emphasis will be placed on their reactor safety reviews.

Instructions have been issued requiring increased emphasis on thorough reviews of contractor hazard analysis of proposed facilities or modification thereto which have a bearing on safety, by technically qualified representatives of the AEC Operations Managers. Instructions have also been issued reemphasizing the importance of independent inspection of reactor operations by AEC personnel.

Operations officers have been directed to allocate, where necessary, additional positions from within their existing ceilings to provide for any additional technical staff required in their reactor inspection work and in reactor safety review procedures.

Statements of functions and delegations to AEC line officials in headquarters and the operations offices have been revised to emphasize and clarify their safety responsibilities. Provision continues to be made for independent technical reactor hazards review of proposed reactor facilities and modifications to existing reactor facilities by the staff of the Director of Regulation.

Although the scope of our standard health and safety contract clause is sufficiently broad to cover the following matters, additional contract provisions applying to those contractors having responsibility for reactor operations are being provided for emphasis and to explicitly require the contractor, among other matters, to—

(*a*) Prepare detailed plans and procedures designed to assure the safe operation and maintenance of the reactor.

(*b*) Carry out a training program that will assure that the approved plans and procedures for nuclear safety are completely understood by all contractor personnel who will be engaged in the operation and maintenance of the nuclear reactor.

(*c*) Assure that all operational and maintenance activities are performed by qualified and adequately trained personnel and, except as otherwise agreed in writing, are conducted at all times under the supervision of personnel who are able to appraise and control emergency conditions that may give rise to the risk of a nuclear incident.

(*d*) Establish a system of inspection (including review of inspection reports by a highly competent technical group) that will (1) provide frequent and periodic checks of reactor performance and of the qualifications and training of operating and maintenance personnel; and (2) provide for investigation of any unusual or unpredicted reactor conditions that might affect the safe operation of the reactor.

(*e*) Report promptly to the contracting officer any change in the physical condition of the reactor of its operating characteristics that might affect the safe operation of the reactor.

Chairman HOLIFIELD. Will that be followed through to the point where you are sure that these reports will be carried up the line of responsibility?

General LUEDECKE. That is the real purpose of the provision.

As I mentioned, there is adequate authority under the existing safety clause, but this will assure that the contracting officer and the contractor are talking about the same conditions and that they will be in a position to appraise their operations in light of these conditions.

Chairman HOLIFIELD. What provisions have you made for those reports to come to the General Manager of the Commission?

General LUEDECKE. When the contract is made, it will be coming to the responsible officer in the headquarters, in this case to Dr. Pittman in the Reactor Development Division.

Chairman HOLIFIELD. As I understand it, there were at least oral reports to Colonel Page but for some reason those reports did not get to your office.

General LUEDECKE. Yes, sir; I thought we were speaking of these contractual provisions. Since it is a contractual legal matter it would have to be processed through those channels so there would be no doubt on that point.

Chairman HOLIFIELD. Is there going to be any kind of—outside of the items of contract—a refinement of your chain of command so that the malfunctions and so on come high enough to have something done about them?

General LUEDECKE. Yes, sir; this is inherent in the points I mentioned earlier in the testimony. When I said I would clarify the responsibilities of the staff and line organization, this is a written instruction which was specified.

Chairman HOLIFIELD. Is that on page 7 where you refer to it—functions of AEC line officials?

General LUEDECKE. Yes, sir.

Chairman HOLIFIELD. Will you present a copy of those orders to the committee?

General LUEDECKE. Yes, sir. The Commission has placed great emphasis on the safe operation of both AEC and privately-owned reactors. The SL–1 accident has underscored the importance of this policy. We believe these corrective actions will provide additional assurance that adequate competence and care are applied to the operation of all our reactors.

Chairman HOLIFIELD. Has the Brookhaven National Laboratory submitted any reports after their operations were suspended by AEC?

General LUEDECKE. They have submitted a letter outlining what has been done; yes, sir.

Chairman HOLIFIELD. We would like to have a copy of that also.

(The data referred to are on file in the offices of the Joint Committee.)

Chairman HOLIFIELD. Did your review of reactor safety following the SL–1 accident include a review of research reactors and critical assemblies?

General LUEDECKE. May I ask Dr. Pittman to respond to that?

Chairman HOLIFIELD. Yes, sir.

Dr. PITTMAN. The teletypes that went to the field covered all assemblies that were critical that could go critical under their jurisdiction, so they did include research reactors and critical assemblies.

Mr. RAMEY. Do your revised procedures provide for your Licensing Division to have any role in the review of AEC-owned reactors?

General LUEDECKE. The revised procedures insofar as I have mentioned them in this statement indicates that the staff of the Director of Licensing and Regulation is available for full review on hazards evaluation of reactors or on modifications of those reactors.

Mr. RAMEY. Is that a change from your previous position?

General LUEDECKE. This is not a change from the previous position, but I felt it appropriate to indicate it since they are now separate from the General Manager's organization.

Mr. RAMEY. Is that all? Do you contemplate making Government-owned reactors subject to regulation in the same manner as your licensed reactors, in other words, to have your experimental reactors such as the Argonne Boiling Water Reactor subject to procedures in the same way that second-round reactors would be licensed? Those are also Government-owned reactors.

General LUEDECKE. It is correct that they are Government owned. With any new facility or any modification of a facility, it would be our intent to have those referred to the Director of Licensing and Regulation for their evaluation and review and for referral to the ACRS if the Commission or the Director of Licensing deemed this desirable.

Mr. RAMEY. Referring them to the ACRS has already been a part of your practice on your own reactors?

General LUEDECKE. On most of them; that is correct. There is not an anticipated departure.

Mr. RAMEY. But you are not planning, as I understand it, to issue a regulation or publish anything in the Federal Register saying these experimental reactors are subject to the same licensing procedures as your second-round reactors?

General LUEDECKE. With respect to issuing the regulation, I have not reached the point of considering that step.

Mr. RAMEY. Is it because the standards of safety and the standards of risk from this kind of reactor are somewhat different from your power reactors and you need a little more flexibility in your own organization?

General LUEDECKE. In some cases I think this would be true, in small reactor experiments on our own site for specialized purposes.

On the other hand, the mechanism of review and evaluation could be the same.

Mr. RAMEY. Actually, you developed your ACRS procedure on Government-owned reactors and that was extended to licensed reactors, historically in terms of practice.

General LUEDECKE. That is correct.

I think I could clarify it by saying with respect to safety, yes; but with respect to licensing, no, on Commission-owned reactors.

Representative PRICE. I understand the Commission did reply to the question of research reactors and applied assemblies.

General LUEDECKE. It did.

Representative PRICE. Have you made any contracts with the different research institutions, universities, and so forth, since the accident, issuing new safety suggestions?

General LUEDECKE. This review that we spoke of was conducted after the accident; the full review and evaluation.

Representative PRICE. There is some element of a research reactor, is there not?

General LUEDECKE. Since these reactors are licensed this work was done by Mr. Price. Perhaps he should answer that question.

Chairman HOLIFIELD. General Luedecke, your statement, of course, is frank and to the point. You have stated in your statement that deficiencies in the safety procedure and practices of the AEC and contractor organizations have not been what they should have been.

General LUEDECKE. That is correct.

Chairman HOLIFIELD. You certainly stated the intent and by your action since this accident you have moved forward toward correcting this situation as near as it can be corrected and as near as you can to prevent such accidents in the future. It is not the intent of the Chair to belabor the matter, or to denounce or condemn. I think we all feel very sad about this tragic occurrence and your frankness is to be commended but this in no way erases the tragic event at Arco.

I think this may be a very salutary happening in that it may make all of us realize that in dealing with atomic energy we are not dealing with conventional types of energy and that wherever in the future there is the use of this material, the primary consideration must at all times be that of safety to the people who operate the reactors and to the surrounding population. I am convinced that in the long run this accident may have brought us up sharply at a time when the damages are slight in relation to what they could have been and what they might be in other locations.

You may be excused.

General LUEDECKE. Thank you, Mr. Chairman.

Chairman HOLIFIELD. Our next witness is Dr. Gerald Tape, of the Brookhaven National Laboratory.

Dr. Tape, I see you have a prepared statement. We are running a little behind time, so you go right ahead please.

STATEMENT OF GERALD F. TAPE, ACTING DIRECTOR, BROOKHAVEN NATIONAL LABORATORY, UPTON, N.Y.

Dr. TAPE. Thank you, sir.

We have been asked to comment on the AEC investigation of reactor safety at Brookhaven and the results therefrom. I would like first to present some background material.

The Brookhaven Graphite Research Reactor (BGRR) is a large graphite-moderated, fully enriched uranium-fueled reactor which supports an extensive program of research in the physical sciences, the life sciences, and engineering. The reactor went critical in August 1950. The only major change since that time has been the replacement of normal uranium fuel with enriched fuel. It operates on an around-the-clock schedule, with a 2-day shutdown every 3 weeks to permit changes in experiments and the loading of new fuel as required. It has been a most satisfactory research reactor and certainly has had a very impressive record of safe and reliable operation.

The Medical Research Reactor (MRR) is a small, special-purpose reactor, designed to meet various needs of the medical research program. The special features are chiefly concerned with external arrangements to permit use of the neutrons for patient treatment and animal irradiations. It is operated on an intermittent basis to meet the specific requirements of the medical research program.

The Brookhaven critical facility consists of a small complex of buildings containing a source reactor for use in carrying out exponential experiments and additional specialized areas for the study of assemblies of fissionable materials by taking them to criticality.

Brookhaven National Laboratory is organized along conventional lines with the Laboratory program being carried out in various scientific departments or divisions, each headed by a senior scientist or engineer who reports to the Director. The BGRR and the MRR are operated by the Reactor Operations Division under the direction of Mr. Robert W. Powell. The critical facility operations are under the immediate direction of Dr. Herbert Kouts, leader of the Reactor Physics Experimental Group, a part of the Nuclear Engineering Department, under the chairmanship of Dr. Clarke Williams. References will be made later in this report to the Acting Director. Dr. Haworth was Director of the Laboratory until April 1, 1961, and until that date I served as Acting Director during his absences. Following his departure from the Laboratory, the Board of Trustees of AUI appointed me Acting Director to serve until further notice.

As you know, early in January, the AEC requested an investigation of safety at all reactor facilities and teletypes were sent to the field requesting answers to several questions related to the safety of nuclear reactors under AEC jurisdiction. An investigating committee was appointed by the New York Operations Office to carry out the Brookhaven investigation. The events connected with this investigation, the AEC shutdown order, and subsequent activities on the part of BNL and AEC can best be presented in a brief chronology.

January 12, 1961: The NYO committee began its inspection at the Medical Research Reactor.

January 19, 1961: The NYO committee investigated the operation of the Graphite Research Reactor.

February 2, 1961: The NYO committee investigated the source reactor and critical experiments.

February 9, 1961: The NYO committee met with the Deputy Director of the Laboratory and a few senior members of the Brookhaven staff to present the results of its findings. The committee chairman discussed some of the items which later appeared in the report. Brookhaven staff expressed disagreement with many of his opinions. There was no feeling of urgency expressed at this meeting. No violations of rules or regulations were discussed. The committee chairman said several times that these items were being brought to the Laboratory's attention for us to think about.

March 10, 1961 (Friday): A letter dated March 9, 1961, from the Manager, New York Operations Office, was received along with the documents containing the criticisms, questions, and recommendations prepared by the NYO inspection committee.

March 14, 1961 (Tuesday): The Acting Director of Brookhaven received an oral order from the Brookhaven area manager to immediately shut down all reactor facilities. No reason for the order was given.

I immediately called together the heads of affected operating units. The order was a shock to all concerned since they had participated in the inspection and knew that no violation of AEC or BNL rules and regulations had been charged. We were all aware of the nature of our differences of opinion with the NYO inspection committee but felt that these differences could not be grounds for the order issued. I appealed directly to Dr. Pittman and he modified the shutdown order for the Graphite Research Reactor to permit operation to the end of its normal operating cycle (Mar. 16, 1961, 2 a.m.). Since the Medical Research Reactor and Source Reactor were being operated on an intermittent basis, their shutdown was of less drastic consequence. Dr. Pittman advised us of his appointment of a special committee which would visit Brookhaven the next day.

March 15 and 16, 1961: The AEC special committee arrived at Brookhaven. A session was held with the BNL Acting Director and the Chairman of the Reactor and Critical Experiments Safety

Committee at which time the contents of the New York Office report were discussed briefly. During these discussions, the Chairman of the AEC special committee was asked for the reasons behind the extraordinary measure which had been taken. He stated that there was no belief that operation of the Brookhaven reactors was unsafe but that the issue was one of managerial procedures and the lack of record material which could provide the AEC with the necessary assurances. It was pointed out that the "shotgun" approach of issuing the order to shut down all facilities was indicative of their belief.

The committee personally viewed the MRR and BGRR and had discussions with Mr. Powell, the head of the Reactor Operations Division. The committee visited the critical assembly area, saw the source reactor and the critical assemblies, and discussed operating methods with Dr. Kouts.

March 16, 1961: The Acting Director, by letter to the AEC area manager assured the AEC that safe operating measures were indeed in effect. In order that no question could be raised and that operations could be resumed, the Acting Director gave instructions in writing to operating unit heads, confirming certain procedures already in practice and placing additional temporary restrictions in effect until such time as further study could be made. As an expedient, the BNL Reactor and Critical Experiments Safety Committee was instructed to act for the Director in approving all changes in rules and procedures for reactor operations and critical experiments. Furthermore, the committee's approval was required for the insertion of inpile loops or samples for irradiation in the BGRR involving a reactivity change of more than 0.1 percent.

March 17, 1961: Informally, word was received that startup of all facilities was to be made contingent on a review of all operating rules, limits, and procedures by the Brookhaven Reactor and Critical Experiments Safety Committee. These procedures had in the past been reviewed by this committee. The operating procedures and limits were contained in the MRR hazards report which had been already approved by the AEC. Also, all limits and conditions of operation for the Graphite Research Reactor had already been reviewed and approved by the AEC at the review of the Graphite Reactor annealing operations. The safety procedures for the critical experiments had been included in the submission of the hazards reports for each set of experiments which had also been approved by the AEC.

The Reactor and Critical Experiments Safety Committee immediately went into session and in the presence of the NYO Deputy Manager reviewed the "Operating Manual for the Graphite Research Reactor." With the exception of a few minor wording changes, the addition of a temporary limit on the review of experiments and the removal of written material dealing with the equipment which had been taken out of service, the manual was approved. A letter to this effect was written by the Acting Director to the AEC area manager. Immediate permission to start up the Graphite Research Reactor was given by the AEC. Thus, this reactor's normal startup schedule was met (early morning, March 18, 1961.)

March 20 to 24, 1961: Similar reviews and exchanges of letters took place during the week of March 20 and permission to resume operation was received for the critical experiments and source reactor on March 22 and for the MRR on March 24.

May 12, 1961. Copies of Brookhaven's reply entitled "Reactor Safety at Brookhaven National Laboratory—A Reply to Recent Actions by the U.S. Atomic Energy Commission" were transmitted to the AEC under date of May 12, 1961. The report has been acknowledged by the AEC and an answer from the New York manager indicates his satisfaction to our answers and the actions already taken or proposed.

Mr. RAMEY. You leave out the various leaks in Nucleonics magazine about your troubles.

Dr. TAPE. I would be very happy to omit them for the future, too.

Action taken by Brookhaven: The SL–1 incident gave rise to self-questioning by many who are responsible for the operation of reactor facilities. Rather than confine our attention to just the four questions contained in the January 9 teletype, it was decided that at Brookhaven the responsible unit heads would answer for each reactor the 28 questions which were originally developed at Idaho for the purpose of securing information relative to reactor operation in general and specifically for the SL–1 incident. The results were discussed with the BNL Reactor and Critical Experiments Safety Committee and it was concluded that there was no cause for concern. This BNL study proceeded in parallel with the NYO investigation. Following receipt of the NYO report, further investigation was undertaken by BNL in order to evaluate its contents.

The Laboratory has taken certain actions, based upon its findings and upon the management's recognition of AEC's need for more positive assurances. Some of these actions confirm previously stated policies or procedures; others have been taken to provide mechanisms for assuring the AEC that adequate procedures and reviews are in existence. The significant actions taken can be summarized as follows:

(1) It was reaffirmed that the Radiation Safety Committee and the Reactor and Critical Experiments Safety Committee should remain advisory committees to the Director and to the heads of operating units. They are advisory to the Director on matters of policy, on matters of establishment of original rules and procedures for reactors and critical facilities, and for subsequent changes where such changes significantly affect safety. The Director weighs the advice of the Committee before requesting AEC approvals when required and before issuing internal authorizations. The same Committees are advisory to the heads of the various operating units on matters relating to radiation safety and reactor and critical experiments safety. Although advisory, these committees must be working committees in order that they can properly evaluate the problems on which they must act. In general, they will not be used for inspection, which function is served by self-inspection within the operating units, by the Health Physics Division and by ad hoc committees assigned to specific tasks.

(2) The Director has requested the Reactor and Critical Experiments Safety Committee to set up more specific criteria for the determination of matters which should require presentation to the Committee. This includes prior review of inpile experiments which could affect reactor safety and post review of unusual events which are related to safety. The past practice has been to report and discuss such matters with the Committee when in the judgment of the operating unit head the matter is significant. An attempt will be made to codify this practice, which in our opinion has been satisfactory. It is very difficult to formulate a requirement which brings the significant

matters to the attention of the Committee and yet leaves the day-to-day routine decisions to the operating unit head.

(3) Self-inspection will continue to be practiced. Although we believe that this self-inspection has been highly critical, it must be implemented by more formal procedures with a record maintained in order to provide others with the assurance that such inspection has in fact been carried out. The Director will appoint ad hoc committees to make inspections of each reactor and the critical facility annually.

(4) To protect the Laboratory and its reactor operators, we have instituted additional training activities and have arranged for formal requalification of operators and supervisors. Evaluation of operator performance is best done by on-the-job observation over a long period of time. We recognize that such evaluation is somewhat subjective. It will be necessary to devise more formal testing mechanisms against which operator and supervisor qualifications and performance can be measured; however, passing of written examinations is not alone sufficient to guarantee good operating performance on the part of an operator.

(5) An ad hoc Committee on Reactor Operator and Supervisor Training has been appointed by the Director. This committee will discuss its findings with the Head of the Reactor Operations Division and with the Reactor and Critical Experiments Safety Committee.

(6) The staff organization for medical reactor operations at the time of inspection was adequate for safe operations; it was based upon the assignment of a highly qualified operator. In view of anticipated increased activity at the MRR and to meet criticism, which we believe to be unjustified, of having only one operator on duty, we now have on duty a supervisor and an operator, both qualified MRR operators.

General considerations and conclusions: An appraisal of the various AEC and BNL actions should provide us with some constructive suggestions for use with AEC-owned reactors such as at Brookhaven.

The AEC's method for discharging its responsibility for reactor safety includes prior approvals, pertaining to design, construction, and operation, followed by periodic inspection of the operating facility. Our attention here is focused on inspection. We at Brookhaven are now cognizant of the fact that an excellent staff, safe actions, and a good record are not sufficient to satisfy the AEC's requirement. Documentation of individual actions, committee reviews and reports of events of more than routine interest are all apparently necessary to help the AEC build up the assurance which it requires. This seems to be based upon the premise that safer operations result from the collective actions of many people, rather than reliance on a few, no matter how competent the few may be. One can not find fault with this general premise; however, strict adherence is not always desirable. Responsibility for safety must be taken by individuals; a committee cannot be held responsible. Working for the record and by the rule can tend to replace judgment. We should not be panicked into providing a mass of record material in the belief that additional reviews and additional memorandums necessarily improve true operational safety. There is no substitute for staff excellence and for employees able to exercise considered judgment in positions of operating responsibility.

Inspections are for the benefit of the facility operator as well as the AEC. A clear understanding of the responsibilities of each is necessary. The director of a laboratory has the assurance of the safe operation of reactors under his jurisdiction as a result of almost daily contact with his operating staff. His needs are not necessarily the same as those of the AEC. A clear understanding of what form the assurances to the AEC should take should be established early through joint agreement. Within this framework, the self-inspection activities of the reactor facility operator can be carried out with the realization that they will also serve the needs of the AEC. The AEC's inspection can supplement and spot check without unnecessary duplication. Since contractors responsible for reactor operations can often put more competent personnel on the job, this procedure should strengthen the inspection process. Although inspection of the reactor facility is likely to occur on an annual basis, a reexamination of the managerial policies and procedures would occur less frequently and would be carried out by different AEC personnel.

Properly written inspection reports are very useful documents to both the AEC and to the management of the reactor facility. If the report is little more than a file of unevaluated data, the reader is left to draw his own conclusions without necessarily having all of the pertinent information and more harm than good can result. The best inspection reports are those which adhere to fully substantiated facts, are free of opinion, omit trivia and irrelevant data, and emphasize matters which can improve operations. In my experience, the inspectors must meet with the facility operators prior to the writing of the report and fully discuss their findings so that erroneous impressions can be corrected, trivia can be set aside, and the major points for consideration can be firmed up. This is not an attempt to stifle the investigator. In our experience, investigators are not always as well qualified in their field as many of the people they are investigating. Also, their usual rushed examination frequently misses significant facts. A report, which in itself cannot be criticized, provides a firmer base on which action can be taken.

Given a good reliable report on which action can be taken, the responsible AEC official must carefully weigh his course of action against the objectives he seeks. There can be no sympathy for the facility operator who is guilty of flagrant violation of rules and procedures which jeopardize the safety of operations. On the other hand, there are all degrees of occasional and unintentional violations which do not affect safety directly but perhaps indicate a condition which should be examined and improved. Lastly, there are cases where no violations occur, but where some consideration of change is warranted. Discussion by the responsible AEC official and the director of the facility prior to the issuance of any order may better serve both parties in achieving the desired results with the least damage to all concerned. In the case of the Brookhaven action, every improvement could have been achieved without shutting down the reactors and without the accompanying, damaging effects resulting from misconceptions by the public, effects on staff morale, and the undue amount of time required of senior responsible personnel both in the AEC and at Brookhaven to rectify a situation which was made worse by the order. The public is best served by improvements in our operation rather than by unnecessarily causing alarm and casting doubt upon the responsibility and technical ability of the operating contractor and his employees.

The Atomic Energy Commission and its contractor laboratories have many mutual problems which require joint attack. Neither one of us can operate successfully without the other's assistance and confidence. This is especially true in reactor safety. In my recent discussion with representatives of the AEC I feel that we have a mutual understanding. We, at Brookhaven, will strive to maintain our excellent staff and the operational procedures and conditions which have permitted us to operate safely and reliably. In addition, we will strengthen our efforts to provide additional reviews and fuller documentation of actions taken so that persons not intimately connected with our day-to-day work can be assured of continued safe operations.

Representative BATES. Dr. Tape, you seem to make quite a point about the closing down of these reactors.

Dr. TAPE. Yes, sir.

Representative BATES. Here we have a situation where at that time, and even at this time, the AEC was faced with a set of circumstances that they did not understand and do not understand today as to the cause of the accident. Do you not think it is up to them in the responsible position that they have to shut these things down?

Dr. TAPE. You are referring to the SL–1, I hope.

Representative BATES. Yes, sir.

Dr. TAPE. It seems to me in each one of these cases about the SL–1 or Brookhaven's reactors taken individually, their inspections should insure them and the material we supply them should insure them that we are indeed operating safely and that there are no undue hazards in terms of operations.

If they do not have that assurance it is certainly their duty to take such action as they require.

The opinion that I am expressing is that I believe as far as the Brookhaven situation is concerned, there was that assurance had the inspection and the report been somewhat more firm in reporting this situation as it actually existed.

Representative BATES. As a layman in this field and not filled with the same assurances that you are filled with, and recognizing the possibility there might be a phenomena that even you do not understand that might occur, it seems to me if I were in their position I would exercise abundant caution to make certain that the same thing was not going to happen someplace else that happened in the SL–1.

Can you give us absolute assurance without any question of doubt that your plant out there will operate consistently without any kind of an excursion? Can you give us that assurance?

Dr. TAPE. No one can give you absolute assurance, and "absolute" means 100 percent and nothing less.

In my situation I am talking about a record of experience in the operation of these reactors as I pointed out with the graphite reactor over a period of 10 years, with one major change which was reviewed by not only ourselves but the AEC, by an intimate knowledge of the responsible operating staff, by knowledge of the procedures which exist, by knowledge of the fact that others on the staff other than the responsible operating head are also reviewing and discussing the matters as they come up, and I believe, sir, that the assurance which I have by knowing the men, knowing the procedures, knowing the combination of these two as they operate, will give me that assurance that every reasonable procedure and condition has been considered.

The difficulty which I am stressing here is that as an Acting Director and living with these people and knowing the situation daily, I probably have a different point of view than someone who is somewhat removed and has to look at it periodically.

Representative BATES. And who has a certain responsibility?

Dr. TAPE. He does have a responsibility and I am not saying for one minute that he does not have to act in accordance with his belief.

Representative BATES. I would assume those in charge of the SL-1 had assurances in their own mind that it was safe; otherwise they would have exercised greater caution. I do not think that anyone who suspected there might be an excursion there would not have recommended some action, so they must have felt fairly content and satisfied that this reactor which has run for such a long time had proven itself and that the danger did not exist in their minds on that reactor any more than a danger might exist at Brookhaven in your mind.

Dr. TAPE. The shutdown order is a very drastic order, of course, and the point I was trying to make earlier was that I believe, in view of the existence of our record, our procedures, our action, our staff that this assurance could have been forthcoming to the Commission if they felt lack of it in roughly the same time that we had now given it to them and it would not have been necessary to actually order the shutdown and to go through the resulting sort of disadvantageous factors that we have experienced.

Representative BATES. What are these differences or disagreement that you have with the New York office?

Dr. TAPE. There are many of them which came up in the course of the investigation or I should say as a result of the report. A few of them I have dwelt on here. The report, for example, urged that the committees that we have be placed in a position of operating responsibility. This is my interpretation. We looked carefully at this because we ourselves feel that committees should not be in any operating responsibility when it comes to a line operation especially where safety is concerned.

Once you get this inner report, there is a tendency to say there must be something in it so, therefore, we should look carefully at it.

There were statements made about the quality of operator training, supervisory training. We have not been able to verify the specific facts as to why these doubts were cast on the training. We ourselves in observing our own supervisors and operators have that competence. However, since these questions have been raised, one must immediately prove to his own satisfaction and to the operator's satisfaction because no operator wants to have any doubts cast on his ability that this situation does not exist.

There are several cases that were brought up in the report in the sense of what are you doing about such and such an event and this particular event is not related to the safety of the reactor. It may be related to the safety of somebody else's reactor but not to the particular reactor under consideration, so we were in this process of trying to what I would say straighten out the facts of the situation as represented by misconceptions, omissions, and so on.

The remarks I had to make about the report are that with it, an audit report or an inspection report or whatever you would like to call it, the best audit and inspection report is the one that can pretty much hit those things that are really wrong and omit those which involve opinion.

Representative BATES. That is true of any inspection.

Dr. TAPE. That is true of any inspection.

Chairman HOLIFIELD. Do you not think this comes about as a result of adjustment after an emergency order goes out? I can remember back in 1932 when all of the banks were closed. Some of the banks were solvent.

Dr. TAPE. It is a shotgun approach.

Chairman HOLIFIELD. The administrative orders of the AEC would bear unequally on different laboratories no doubt where the reactors existed. It would also be tempered to a certain extent with the difference of capability in different reactor areas, and I can understand and we are very appreciative of the efforts of the Argonne National Laboratory and Brookhaven and your fine record of safety, but you are still part of the overall responsibility of the AEC on safety.

Dr. TAPE. That is correct.

Chairman HOLIFIELD. Sometimes a general order does work a hardship on some individuals but it may be very salutary on the part of others.

Dr. TAPE. This general order affected Brookhaven only.

Chairman HOLIFIELD. I notice at the bottom of page 8 you make a flat statement that one operator is sufficient for safe operations; that you have now put on an additional operator. This is a matter of compliance with the AEC's request for a general audit.

Dr. TAPE. In part. May I amplify this?

Mr. Powell, who is the head of the Division responsible for this reactor, and I have discussed many times what should be the staffing of this particular reactor. In our opinion it is a one-man job. It is a size operation that is an intermittent operation that occurs generally in the normal working hours, and in our opinion the safety which one can get is probably a higher degree if you can have a highly qualified, a well qualified operator who is devoting his full attention to the problem at hand than if one has two men standing around where one first jumps in the seat and then the other jumps in the seat and you have split responsibilities.

"We should not be panicked into providing a mass of record material in the belief that additional reviews and additional memorandums necessarily improve true operational safety. There is no substitute for staff excellence and for employees able to exercise considered judgment in positions of operating responsibility."

I think that is a very important statement and I am hopeful that as a result of this incident that there will not be a great mass of redtape developed and that safety measures can be applied as selectively as possible and that burdens will not be placed on old-line laboratories where you are doing work with reactors such as your medical reactors which are pretty well tested types, and so forth, and that the same criteria will not be applied to them as will be applied to an experimental military reactor of the type that we had out at the Arco.

I have a feeling that you will be able to work out and prove your excellence to the point there where certainly the wind will be tempered to the shorn lamb.

Could we have a copy of the Brookhaven report entitled "Reactor Safety at Brookhaven National Laboratory. A Reply to Recent Actions by the U.S. Atomic Energy Commission," under date of May 12, 1961?

Mr. TAPE. Yes, sir; you may.

(The data referred to are on file in the offices of the Joint Committee.)

Chairman HOLIFIELD. If there are no further questions, thank you very much. You may be excused.

The last witness will be Mr. Harold Price.

You may proceed, Mr. Price.

STATEMENT OF HAROLD L. PRICE, ACTING DIRECTOR OF REGULATION, ATOMIC ENERGY COMMISSION

Mr. PRICE. Mr. Chairman, I think perhaps my statement might be characterized as a footnote, you might say, to all the testimony today.

Promptly after the SL-1 accident, as soon as there were preliminary indicatioons of factors which might have contributed to the accident, the Commission took action to ascertain whether any similar situations might exist in licensed reactors.

Conditions surrounding the SL-1 reactor at the time of the accident and unique characteristics of the reactor itself suggested factors that potentially could have been involved. These included: the shutdown margin of reactivity, the worth of the control rods, the supervision and procedures related to maintenance and other nonoperating activities, and the instrumentation in use.

Accordingly, on January 10, 1961, telegrams were sent to all licensees of critical facilities and operating reactors, except AGN-201 reactors, and they got a separate telegram, which directed that each reactor be surveyed by the licensee and a report on specified items be submitted promptly to the Commission. This survey covered 72 facilities. The telegram is as follows:

We are surveying all licensed reactor facilities for information gained from operating experience which indicates confirmation of or variance from several nuclear characteristics shown in your license application at time of license issuance. This will update information on your facility which was reviewed by us during evaluation of your facility license application and during inspections. Accordingly, pursuant to section 50.54(f) of Commission regulations, you are requested to submit within 20 days of receipt of this message a report containing the following information concerning each reactor or critical experiment facility operated by you under AEC license:

1. Maximum excess reactivity of your reactor, not including the worth of control rods or other control devices such as burnable poison strips or soluble poison, or any experiments, and variation of excess reactivity over core life.
2. Total control rod worth.
3. Minimum shutdown margin both at room temperature and operating temperature.

4. Maximum worth of single control rod of highest reactivity value.

5. Description and worth of other methods used for controlling reactivity, such as burnable poison strips of soluble poison, and variation of the worth of these methods over core life.

6. Maximum total and individual worth of any fixed or movable experiments inserted in your reactor.

7. With respect to items 1–6 above, the following information should be included: Basis for reactivity values (measured, calculated, or estimated); condition of core for which values are applicable (operating or shutdown, amount of burnup); and dates on which reactivity values were last determined.

8. The following information with respect to operations which could involve changes in core reactivity when the reactor is shut down:

(*a*) Special precautions taken to prevent inadvertent criticality.

(*b*) Whether nuclear instrumentation is used.

(*c*) Methods used to limit and control rate and amount of reactivity changes.

(*d*) Minimum amount that reactor is subcritical during such operations and how the subcritical margin is achieved.

(*e*) Whether such operations are conducted under direct and personal supervision of technically qualified and designated supervisors.

(*f*) Whether such operations are conducted in accordance with written procedures.

The licensees of AGN–201 reactors were only asked to provide information in regard to special precautions and procedures with respect to operations which could involve changes in core reactivity when the reactor was shut down.

Simultaneously, with these requests to licensees, the Commission staff begin a reexamination of items related to those listed above as described in the hazards summary reports already in the files for each project.

The situation of each reactor with respect to each of the eight items specified was evaluated.

The conclusions of this study and of the analysis of the replies to the telegrams may be summarized as follows:

1. No licensed reactor was found in which removal of a single control rod could make the reactor critical when other control devices were in operation.

2. In no licensed reactor was it judged that the shutdown margin was inadequate.

3. In no licensed reactor was it found necessary to require any changes in the arrangement or condition of the control system.

4. For some licensed facilities it was concluded that nuclear instrumentation should be used during more nonoperating activities than had been the practice, that written procedures should be extended to cover such activities and, in a few cases, that more direct supervision should be required during nonoperating activities. However, none of these situations appeared to require any immediate action.

In each of these cases we have since received assurances from the licensees that these nonoperating activities will not be undertaken without use of adequate nuclear instrumentation, or without adequate written procedures and direct supervision. We are in the process of amending the licenses in the cases involved to incorporate these requirements formally in the licenses.

Chairman HOLIFIELD. Thank you, sir.

Mr. Ramey.

Mr. RAMEY. On point No. 1 you say no licensed reactor was found in which removal of a suitable control rod can make the reactor critical when other control devices were in operation. What does this phrase mean, "other control devices were in operation"?

If you were in maintenance on one of these reactors, would you not be in the same situation as they found themselves in with the SL-1?

Mr. PRICE. Yes, except here you are trying to test out whether or not the reactor meets the one rod criterion. It may have burnable poison in the reactor—the only thing we were trying to find was, could one of these reactors go critical by just removing one rod. That assumes that the other rods and other controls are in place.

Of course, we know if you pull too many rods, you can go critical.

Mr. RAMEY. On page 4 of your statement, you state that in inspection of licensed activities you found more direct supervision should be required during nonoperating activities. In how many cases was this true?

Mr. PRICE. I do not have that breakdown but I will submit it. There are 72 facilities and what happened was that in some of the cases there was a question of maybe we thought they ought to have more supervision for certain of these activities, and in another case it may have been that we thought they ought to use nuclear instrumentation during certain nonoperating activities where they had not planned to use it.

Mr. RAMEY. Perhaps General Luedecke could answer this. Do you have comparable information on the results of your survey of AEC reactors?

On point No. 1, I guess this Thule reactor is the only one that has a control rod situation which is the same as the SL-1. How about the question of requiring more direct supervision and so on? We have discussed the Brookhaven situation. Now were there others?

General LUEDECKE. Yes, sir; as I mentioned in my testimony, in the case of the No. 1 item here there was on the Greenland reactor that I talked about. I also mentioned that there were some cases in which adequate written procedures and therefore adequate supervision over some maintenance operations were necessary and instructions had been issued and these were being accomplished promptly.

There were other minor things which were found which were corrected immediately in the total survey. But the results of the AEC inspection are quite closely to what Mr. Price has given.

Mr. RAMEY. I note that you did make a review on the basis of telegrams and correspondence. Did you send out AEC inspectors to make any type of inspection comparable to the one the New York office did at Brookhaven?

Mr. PRICE. No; we did not. We figured immediately and without waiting and taking time for visits, that we ought to get out this telegram on these points which we thought we should immediately get answers to and we could not wait for those answers.

Inspections of the licensed reactors by the Compliance Division are continuing all the time and in no inspections since that time—while they have not tried to confirm all of these answers, and I am not sure that that would be wise because that might take an awful lot of time that they could more importantly devote to other things—have they discovered situations in this area that calls for any action.

Mr. RAMEY. So you do not think it is of such great importance, then, that you follow up on these things?

Mr. PRICE. I would like to ask Dr. Beck and Dr. Morris, to comment on that. I think our feeling is that on these points we are reasonably sure from the many cases that had to be reviewed to get these licensed, and by the reactor safeguards committee, that we do not have the problem of inadequate control in the control system.

Whether it was a wrong judgment not to take inspectors off their regular work to devote full time to checking these matters out, I guess people could differ.

Dr. BECK. I think about one-third of these were inspected since the telegrams came in. I do not remember the exact number, but on none of these did we find any significant information other than what we had discovered and the schedule of inspections are continuing and we are following up on those.

Most of these were quite small items which related to incidental operations and we felt the major points were well covered.

Mr. PRICE. To give you some figures, as of a few days ago, our inspectors made 42 inspections of 28 operating reactors since January 1 in addition to 56 inspections of 23 reactors under construction. You understand that while a reactor is being constructed under a construction permit, there are periodic inspections of that construction for conformance with the specifications, so that has been the pattern of that operation.

Mr. RAMEY. I have heard it said that you think this kind of accident could not happen under your inspection and your licensing program.

Mr. PRICE. I would not like to give a "yes" or "no" answer to that because I am the kind that worries about these things, but I look at it this way:

I am sure that if a licensed reactor had the history of stuck rods and deterioration in the core of such things as the boron strips, that these matters under the licensing requirements would have had to be reported to the safety people on our staff—Dr. Beck, who is head of the safety analysis staff—and furthermore, had they not been reported that they would have been discovered by the compliance inspectors.

Now, then, the next question gets harder: Had we had that information, would we have shut the reactor down some? It is hindsight to answer the question. My judgment is that we would have, but I have to admit that it is hindsight.

Mr. RAMEY. I recall that the Westinghouse test reactor had an incident under your licensing program which was not reviewed by your reactor safeguards committee so I guess we are not all perfect.

Mr. PRICE. That is right, and that is a different situation.

That accident of burning out those fuel elements during an experiment happened during operations. We immediately ordered them not to start up until we could get a review of it.

It is true, whereas we reported the situation to the ACRS and discussed it with them at a couple of meetings, we did not formally ask for their review before the startup. They later said we should have. Maybe we goofed on that one but in any event we eventually had a full-scale review of it with the ACRS.

As a matter of fact, I think some months ago we had a full-scale review of that accident with them and of the subsequent startup, and so far as I know the ACRS was satisfied with what they heard.

Let me add that since last summer when we had this problem, we have worked out informally with the ACRS that where there is any question as to whether they want to look at something or whether we should consult with them, they will let us know, and I don't think we have any problem there.

Representative BATES. A little while ago I got the impression from a question that was asked that it was only in the SL–1 and the reactor at Thule that the removal of a single rod would bring the reactor to criticality.

Mr. PRICE. That is right.

Representative BATES. On page 4 you indicate in reply to your telegram, that you found that no licensed reactor was found in which removal of a single control rod would make the reactor critical.

Did you not know that ahead of time?

Mr. PRICE. We thought so. Changes can take place and we wanted to get the latest verification we could. We were reasonably sure, but we had this accident and we thought we should make this survey.

Representative BATES. How did you find that out?

Mr. PRICE. I beg your pardon?

Representative BATES. What is the basis on which these answers were based?

Mr. PRICE. For the larger reactors they were based on measured values. On some of the smaller ones, they were on calculations.

Representative BATES. They did not give you any information more than you had before.

Dr. WILSON. The reactors change continually in their shutdown capability. There are changes going on all the time in the reactors and you might have had your reactors at a given period when one rod pulled out would not have sent them critical but in 6 months they might have accumulated fission products or burned out some burnable poison or something else that would make them change in this respect.

Representative BATES. All of this was known in the trade. You did not just accumulate this information as a result of these particular telegrams?

Dr. BECK. As we pointed out, we not only sent out the telegram, but we immediately reviewed the information we had in our files on these reports. That information had indicated to us from our reviews at the outset that these reactors were in good condition. We verified that by rechecking it. But in our telegram we asked them to give us not only those initial values but to give us the last time they had been verified or measured to be sure that we would then have up-to-date information that this was in fact still the case and in fact was verified with respect to the reports they sent in.

Representative BATES. I assumed from the answer given me earlier there was no question about it that this was known in the trade, and it just could not happen, but you were not sure about it at this time.

Mr. PRICE. We were reasonably sure but we did not think that we could take a chance of not verifying the latest information available.

Representative BATES. But you are surer now?

Dr. BECK. Yes, sir.

Representative BATES. If these safety devices do not work it could still happen?

Mr. PRICE. You can have an accident in any reactor. There is no way to guarantee positively against it.

Representative BATES. I have nothing further, Mr. Chairman.

Chairman HOLIFIELD. This will conclude the public hearings on the SL-1 incident. I have a statement from William A. Calvin, international president, International Brotherhood of Boilermakers, Iron Shipbuilders, Blacksmith Forgers and Helpers, on this subject, which I will place in the record at this point.

(The statement referred to follows:)

STATEMENT OF WILLIAM A. CALVIN, INTERNATIONAL PRESIDENT, INTERNATIONAL BROTHERHOOD OF BOILERMAKERS, IRON SHIPBUILDERS, BLACKSMITHS, FORGERS & HELPERS

This statement is filed in behalf of the International Brotherhood of Boilermakers, Iron Shipbuilders, Blacksmiths, Forgers and Helpers, affiliated with the AFL-CIO. The activities of this international brotherhood, both individually, and in association with other elements of labor which are directly concerned with nuclear energy, are, I think, well known by this committee. It has been, and will remain, our principle to be as constructive and helpful to this committee as we can be in view of the great sense of urgency with which we regard the development of peaceful uses of atomic energy. It is to this end that we dedicate this brief statement.

A member of our staff was recently designated by AFL-CIO President George Meany as his personal representative to investigate and report his findings relative to the SL-1 reactor accident. His report was made to President Meany and the executive council, following which it was made public. This report is mentioned because it has now been made an official part of the record of these hearings. We feel the findings in that report are technically self-explanatory. But in the larger and more general view and based largely upon points which are implicit in that report, we should like to contribute our thoughts relative to the regulatory program and the organization of the Atomic Energy Commission.

The fundamental significance of the SL-1 accident is that—

(*a*) this reactor was designed by acknowledged experts in the field;

(*b*) the design was checked and developed by competent groups at Argonne National Laboratory and elsewhere;

(*c*) the design was passed upon by the Hazard Evaluation Branch;

(*d*) the design was further passed upon by the ACRS and carried forward to completion of the construction phase;

(*e*) following this, the reactor was operated by a group who numbered among themselves many qualified persons and used as a training medium.

Through all these stages of design, examination, construction, and use, all the features of the reactor (some of which by virtue of hindsight are admittedly defects) were allowed to become an integral part of this and one other reactor. It follows, then, that there is really no guarantee that repeated and searching forays into the field of reactor safety alone can prevent accidents and that any program, whether a safety program, a developmental program, or a research program will benefit from an objective analysis and tightened if needed.

It is the opinion of this brotherhood that a general looseness and possibly compartmentalization in the staff of the AEC, in its procedures, in its reporting systems, in contractor relations, and other deficiencies are the real causes of the SL-1 accident. It has been brought to our attention, for instance, that the reactor was never inspected formally as a part of a regular safety inspection after it was taken over by Combustion Engineering Co. The Commission has admitted publicly that the decision was made at too low a level to operate the reactor in spite of technical difficulties.

In the face of these facts, it is now suggested by much of the testimony that further relaxation in certain matters be permitted, to which we offer our strongest objections. We disagree in the most part with certain recommendations such as the proposed method of referral of designs to the ACRS or Hazard Evaluation Branch. We recommend that these committees, and they alone, are qualified to make decisions as to whether it is or is not necessary to review a design. We feel the reason for this to be obvious, that in the event either of these committees feel that a type of reactor has been adequately reviewed, review of the construction of another reactor of that type should not be necessary unless there are substantial revisions in design parameters or features.

We strongly urge that in keeping with the spirit of the 1957 amendments, there should be reinforcement of the principle of public hearings relative to matters of reactor siting, performance, etc. The real value in any public hearing is the fact that the public has the opportunity to make its feelings known, while at the same time statements made by the parties to the hearings are on the record and available for further and future review. We feel that there has been a great deal of informality about many of the types of arrangements that may now be made with the Commission, and earnestly recommend that not only should the proceedings be formalized (and remain formal), but that these proceedings be made as public as possible. This would overcome what we discern to be the tendency today toward relaxation both in number, manner, and significance of conductance of the mandatory hearings.

Experience alone will show whether the new Division of Regulation will operate in a satisfactory manner. It is possible that in the future the promotional aspects should be separated from that of regulation, but it is in the record of this hearing that the Commissioners themselves feel that more (work) has to be done in the way of safety by the Commission as a result of the SL-1 accident. Certainly, this fact above all militates against relaxation either of public hearings or technical review.

In the event further comments are desired, we shall be happy to comply.

Chairman HOLIFIELD. We had planned to hold hearings this afternoon on the proposed reactor site criteria. I note that the witnesses who were to testify on this subject, Mr. Davis, Mr. Lowenstein, Dr. Thompson, Mr. Townsend, and Mr. Grahl are present in the room at this time. I am sorry that time will not permit us to hear their statements on reactor site criteria. Their statements will, however, be accepted and printed in full at this point in the record, followed by other statements submitted for the record, and a reprint from the Federal Register of February 11, 1961, on reactor site criteria.

(The material referred to follows:)

STATEMENT OF W. KENNETH DAVIS, VICE PRESIDENT, BECHTEL CORP., AND CHAIRMAN, COMMITTEE ON REACTOR SAFETY, ATOMIC INDUSTRIAL FORUM

Mr. Chairman, gentlemen, my name is W. Kenneth Davis. I am a vice president of Bechtel Corp. I am also chairman of the Committee on Reactor Safety of the Atomic Industrial Forum. I should like to thank the Joint Committee for its invitation to present my views on the important matter of reactor siting, particularly with respect to the AEC's "Notice of Proposed Guides—Reactor Site Criteria," title 10, Code of Federal Regulations, part 100, as published in the February 11, 1961, issue of the Federal Register.

In the preparation of this statement, I have made extensive use of the views developed by the Forum Committee on Reactor Safety in its consideration of the reactor siting problem and in its review of the AEC proposed criteria on reactor siting. I should point out that the committee's views represent those of the individuals on the working group although they do not necessarily represent those of the organizations with which the committee members are associated nor do they necessarily represent the views of other forum members.

The views of the forum committee have been made known to the AEC in the form of a summary of a meeting held by the forum on March 17 which was forwarded to Mr. Harold Price, Acting Director of Regulation, on April 6 and in the form of a proposed redraft of the criteria which was also forwarded to Mr. Price on June 6.

Copies of both documents prepared by the forum committee are appended to copies of this statement filed with the Joint Committee on June 6, and I respectfully request that they be made a portion of the record of this hearing.

The members of the forum committee's working group believe that the AEC proposed guides have already served a useful purpose inasmuch as they have focused timely attention on, and have stimulated public thinking on, the important problem of reactor sitting. The group further believes that the adoption by the AEC of site criteria guides can serve a useful and desirable purpose provided—

(1) The guides give due recognition to the importance of the engineering design of a proposed reactor as well as to the population density and use characteristics of the site environs and to the physical characteristics of the proposed site; and

(2) The guides are sufficiently flexible to accommodate and take advantage of such new information as may be gained from the experience of constructing and operating nuclear power reactors.

The basic features of the AEC proposed criteria are retained in the forum committee's proposed redraft. In particular, the committee concurs with the establishment of—

(1) An exclusion area of such size that an individual located at any point on its boundary for 2 hours immediately following onset of an estimated release of radioactive material would not receive a total radiation dose to the whole body in excess of 25 rem or a total radiation dose in excess of 300 rem to the thyroid from iodine exposure; and

(2) A low population zone of such size that an individual located at any point on its outer boundary who is exposed to the estimated release of radioactive material during the entire incident would not receive a total radiation dose to the whole body in excess of 25 rem or a total radiation dose in excess of 300 rem to the thyroid from iodine exposure.

The committee has accepted without comment the radiation exposure limits specified above. The committee members do not regard themselves qualified to make a judgment on the radiation limits that should be set for such a low probability, once-in-a-lifetime accidental or emergency exposure. The committee has, however, noted with assurance that the specified limits have been derived from limits suggested by the National Committee on Radiation Protection and Measurement and that the AEC believes them to be conservative values.

There are three ways in which the forum committee's proposed criteria differ significantly from the criteria proposed by the AEC:

1. The criteria proposed by the forum committee would apply only to power reactors and would not apply to testing reactors on the premise that the latter are designed for experimental operations and therefore should not be evaluated under the same criteria as power reactors.

2. The criteria proposed by the forum committee include, in a separate appendix, example calculations for approximating exclusion area and low population zone radii for several hypothetical reactor and sites. Although the committee believes that such example calculations should not be published as part of the guides, it does believe that it would be useful to publish such example calculations in the scientific literature; e.g., the AEC Journal of Reactor Safety. In an effort, however, to be consistent with the format adopted by the AEC, four example calculations have been included in an appendix to the criteria proposed by the committee but not as an integral part of the criteria. The AEC proposed criteria included only one example and its relationship to the criteria is not clear. The use of multiple examples (one of which is identical to that contained in the criteria proposed by the AEC) will, in the opinion of the committee, emphasize a range of possible design-site relationships. They will also emphasize that a proposed reactor site can be evaluated only after careful consideration of the engineering features of the proposed reactor and cannot be made on the basis of distance alone. It is the opinion of the forum committee that the incorporation of only a single example calculation could obscure the intent of the guides and in practice might result in the application of the arbitrary values contained in the single example in the evaluation by the AEC and the applicant of all proposed reactor sites without appropriate regard to reactor design and other pertinent factors.

3. The criteria proposed by the Forum Committee do not include, as do the AEC proposed criteria, "a population center distance of at least 1⅓ times the distance from the reactor to the outer boundary of the low population zone." In the opinion of the Forum Committee, the arbitrary value of 1⅓ has no technological basis and this concept should be replaced by a man-rem radiation exposure limit expressed as a function of population distribution and density. This approach would be more meaningful and understandable as well as more in keeping with the exclusion area and low population zone concepts. Although the committee recognizes the difficulty that would be involved in developing such

radiation exposure limits, it believes it to be the soundest of several suggested alternatives. I should like to suggest that the AEC or the Federal Radiation Council, working in conjunction with interested private groups, be requested to give consideration to this matter. The Forum Committee, I feel sure, would be willing to lend its assistance in any way possible.

It has been the intent of the Forum Committee to revise the proposed site criteria in such a manner as to bring into sharper focus not only the importance but also the interrelationship of such factors as reactor design, site characteristics, distance, and population density. The Forum Committee believes that each of these factors must be integrated into reactor site evaluation if the safety standards set forth by the AEC and subscribed to by the committee are to be met under the wide variety of circumstances that are expected to characterize reactor license applications of the future.

We should not be unmindful of the impact that the policies and precedents established in this country will have on reactor development in friendly nations outside the United States and on our participation in the reactor programs of these nations. In short, we believe it imperative that we develop reactor site criteria which will meet the needs of public safety, establish and maintain public confidence, support our prestige and leadership overseas, and permit the development of atomic power as rapidly as technological development and economic incentives warrant.

I should be pleased to try to answer any questions you may have. Thank you.

Appendix A-1.—Example of a Calculation of Reactor Siting Distances

1. The calculations of this appendix are based upon the following assumptions:

(*a*) The fission product release to the atmosphere of the reactor building is 100 percent of the noble gases, 50 percent of the halogens and 1 percent of the solids in the fission product inventory. This release is equal to 15.8 percent of the total radioactivity of the fission product inventory. Of the 50 percent of the halogens released, one-half is assumed to adsorb onto internal surfaces of the reactor building or adhere to internal components.

(*b*) The release of radioactivity from the reactor building to the environment occurs at a leak rate of 0.1 percent per day of the atmosphere within the building and the leakage rate persists throughout the effective course of the accident which, for practical purposes, is until the iodine activity has decayed away.

(*c*) In calculating the doses which determine the distances, fission product decay in the usual pattern has been assumed to occur during the time fission products are contained within the reactor building. No decay was assumed during the transit time after release from the reactor building.

(*d*) No ground deposition of the radioactive materials that leak from the reactor building was assumed.

(*e*) The atmospheric dispersion of material leaking from the reactor building was assumed to occur according to the following relationship:

$$X=\frac{Q}{\pi u \sigma y \sigma z}$$

where Q is rate of release of radioactivity from the containment vessel, the ("source term,"):

x—is the atmospheric concentration of radioactivity at distance d from the reactor,
u—is the wind velocity,
σy and σz—are horizontal and vertical diffusion parameters respectively.

(*f*) Meterological conditions of atmospheric dispersion were assumed to be those which are characteristic of the average "worst" (least favorable) weather conditions for average meterological regimes over the country. For the purposes of these calculations, the parameters used in the equation in section (*e*) above were assigned the following values:

$$u=1m/sec \quad \sigma y=[1/2Cy^2d^{2-n}]^{1/2}$$
$$\sigma u=[1/xCz^2d^{2-n}]^{1/2} \quad Cy=.40 \quad Cz=0.07 \quad n=0.5$$

(*g*) The isotopes of iodine were assumed to be controlling for the low population zone distance. The low population zone distance results from integrating the effects of iodine 131 through 135.

(*h*) The source strength of each iodine isotope was calculated to be as follows:

Isotope	Exclusion Q (curies/megawatt)	Low population Q (curies/megawatt)
I-131	0.55	76.4
I-132	0.68	1.40
I-133	1.19	18.5
I-134	0.72	0.91
I-135	1.04	5.4

These source terms combine the effects of fission yield under equilibrium conditions, radioactive decay in the reactor building, and the release rate from the reactor building, all integrated throughout the exposure time considered.

(*i*) For the exclusion distance, doses from both direct gamma radiation and from iodine in the cloud escaping from the reactor building were calculated, and the distance established on the basis of the effect requiring the greater isolation.

(*j*) In calculating the thyroid doses which result from exposure of an individual to an atmosphere containing concentrations of radioactive iodine, the following conversion factors were used to determine the dose received from breathing a concentration of one curie per cubic meter for one second:

Isotope	*Dose (rem)*
I-131	329.0
I-132	12.4
I-133	92.3
I-134	5.66
I-135	25.3

(*k*) The whole body doses at the exclusion and low population zone distances due to direct gamma radiation from the fission products released into the reactor building were derived fro mthe following relationships:

$$D=483\frac{Be^{-ur}}{4\pi r}\int_0^t t^{-0.21}dt$$

where D is the exposure dose in roentgens per megawatt of reactor power,

r—is the distance in meters,

B—the scattering factor—is equal to $\left(1=ur-\frac{(ur)^2}{3}\right)$,

u—is the air attenuation factor (0.01 for this calculation),

t—is the exposure time in seconds.

In this formulation, it was assumed that the shielding and building structures provided an attenuation factor of 10.

2. On the basis of calculation methods and values of parameters described above, initial estimates of distances for reactors of various power levels have been developed and are listed below.

Power level	Exclusion distance	Low population zone distance
Thermal megawatt	*Miles*	*Miles*
1,500	0.70	13.3
1,200	.60	11.5
1,000	.53	10.0
900	.50	9.4
800	.46	8.6
700	.42	8.0
600	.38	7.2
500	.33	6.3
400	.29	5.4
300	.24	4.5
200	.21	3.4
100	.18	2.2
50	.15	1.4
10	.08	.5

APPENDIX A–2.—EXAMPLE OF A CALCULATION OF REACTOR SITING DISTANCES

1. The calculations of this appendix have been made in accordance with the approach used in appendix A of the "Notice of Proposed Guides—Reactor Site Criteria," 10 CFR, part 100, as published February 11, 1961, and the fission product release data from the core of the reactor are identical to those assumed in the guides. The specific plant calculated is a 600-megawatt thermal pressurized water type of reactor to be constructed in an irregular rolling land area. It is assumed that the containment vessel is completely surrounded by a concrete shield and roof and that the annular space between the containment vessel and shield is ventilated to a stack so that all containment vessel leakage is discharged at the top of the stack. Provision is also made for heating of the stack to achieve additional atmospheric dispersion.

The calculations of this appendix are based upon the following assumptions:

a. The fission product release to the atmosphere of the reactor building is 100 percent of the noble gases, 50 percent of the halogens and 1 percent of the solids in the fission product inventory. This release is equal to 15.8 percent of the total radioactivity of the fission product inventory. Of the 50 percent of the halogens released, one-half is assumed to adsorb onto internal surfaces of the reactor building or adhere to internal components.

b. The release of radioactivity from the reactor building to the environment occurs at a leak rate of 0.1 percent per day of the atmosphere within the building and the leakage rate decreases because of pressure reduction throughout the effective course of the accident which, for practical purposes, is until the iodine activity has decayed away. The release to the environs is, however, through a stack at an elevation of 100 meters above grade. Further engineering of the plant has assured that the stack may be heated so that the effective stack height is 300 meters.

c. In calculating the doses which determine the distances, fission product decay in the usual pattern has been assumed to occur during the time fission products are contained within the reactor building. No decay was assumed during the transit time after release from the reactor building.

d. No ground deposition of the radioactive materials that leak from the reactor building was assumed.

e. The atmospheric dispersion of material leaking from the reactor building was assumed to occur according to the following relationship:

$$x = \frac{Q}{\nu u \quad \sigma y \quad \nu z} e^{-H}$$

Where Q is rate of release of radioactivity from the containment vessel, the ("source term"):

x—is the atmospheric concentration of radioactivity at distance d from the reactor.

u—is the wind velocity.

σy and νz— are horizontal and vertical diffusion parameters respectively.

e^{-H}—is the height of release reduction parameter.

H—is equal to $\frac{h^2}{C_z^2 \, d^{2-h}}$ where h=effective stack height.

f. Meteorological conditions of atmospheric dispersion were assumed to be those that are characteristic of inversion conditions (unfavorable) for the meteorological regimes over irregular rolling land which is characteristic of the site under consideration. For the purposes of these calculations, the parameters used in the equation in section (*e*) above were assigned the following values:

u=1m/sec; $y = [1/2Cy^2 d^{2-n}]1/2$;

$\nu z = [1/2Cz^2 d^{2-n}]1/2$; Cy=0.45; Cz=0.2 n=0.4

h=100 (Cold stack condition), 300M (Hot stack condition)

g. The whole body doses at the exclusion and low population zone distances due to direct gamma radiation from the fission products released into the reactor building were calculated and found to be less than 0.5 R per year because of the external shield surrounding the containment vessel and, hence, the direct dosage from the contained fission products does not constitute a hazard.

h. As a result of the above design bases (*g*) the isotopes of iodine are controlling for the low population zone distance and population center distance. The low population zone distance results from integrating the effects of iodine

131 through 135. The population center distance equals the low population zone distance increased by a factor of one-third.

i. The source strength of each iodine isotope was calculated to be as follows:

Isotope	Exclusion Q (curies per megawatt)	Low population Q (curies per megawatt)
I-131	0.55	76.4
I-132	.68	1.40
I-133	1.19	18.5
I-134	.72	.91
I-135	1.04	5.4

These source terms combine the effects of fission yield under equilibrium conditions, radioactive decay in the reactor building, and the release rate from the reactor building, all integrated throughout the exposure time considered. In this example, pressure reduction with its associated reduction in leakage rate is assumed, and, hence, this effect should be integrated into the source strength above. This integrated pressure correction reduces the dosage by the factor 0.5.

Further, if washdown can be assured by the use of internal or external sprays the source strength may be reduced by this decontamination factor. No such reduction has been assumed in this specific example.

j. For the exclusion distance, doses from both direct gamma radiation and from iodine in the cloud escaping from the reactor building are calculated. Exclusion distances as required are established on the basis of the effect requiring the greater isolation.

k. In calculating the thyroid doses which result from exposure of an individual to an atmosphere containing concentrations of radioactive iodine, the following conversion factors were used to determine the dose received from breathing a concentration of 1 curie per cubic meter for 1 second:

Isotope	*Dose (rem)*
I^{131}	329
I^{132}	12.4
I^{133}	92.3
I^{134}	5.66
I^{135}	25.3

2. The data developed from the preceding calculation are summarized in figure I, "Thyroid Dosage versus Distance."

Curve (A) is the dosage from a presumed ground level fission product release.

Curve (B) is the release quantity of curve (A) modified for a cold stack release.

Curve (C) is the release quantity of curve (A) modified for a hot stack release.

Curve (D) is the data of curve (C) modified for a reduced leakage because of decreasing pressure within the containment vessel.

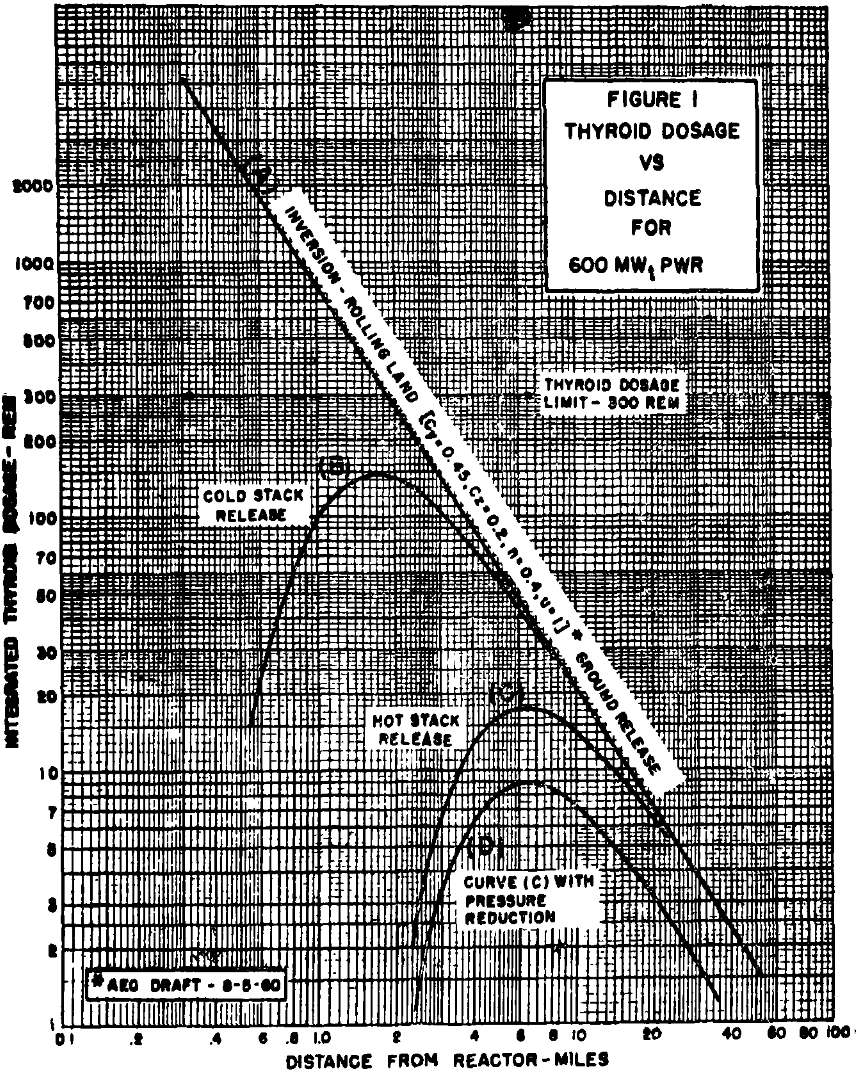
3. Summarizing the results given in figure I, the following distances can be calculated for other than the reference powel level:

a. Exclusion distance—In the case of a shielded containment vessel and stack discharge, the exclusion distance dosage criteria is not exceeded and, hence, this distance is zero.

b. Low population zone distance (miles):

Power level, megawatts	No stack	Cold stack	Hot stack
Thermal			
1,500	3.3	2.7	0
1,200	2.8	1.7	0
900	2.4	0	0
600	1.8	0	0
300	1.2	0	0
100	.6	0	0

APPENDIX A-2



APPENDIX A-3.—EXAMPLE OF A CALCULATION OF REACTOR SITING DISTANCES

1. The calculations in this appendix are for a water-cooled reactor with a vapor suppression or other type of containment in which the containment is shielded such that the gamma radiation from fission products inside the containment after an accident is very small and in which all fission products inside the containment after an accident are very small and in which all fission products leaking from the containment are collected and discharged through a stack with an effective height of 200 feet. Additional calculations are made for the case where the gases leaking from the containment are collected and 95 percent of the iodine in the gases removed with filter or scrubber. The following assumptions were used:

(*a*) The fission product release to the atmosphere of the containment is 100 percent of the noble gases, 50 percent of the halogens, and 1 percent of the solids in the fission product inventory. This release is equal to 15.8 percent of the total radioactivity of the fission product inventory. Of the 50 percent of the halogens released, one-half is assumed to adsorb onto internal surfaces of the containment or adhere to internal components.

(*b*) The release of radioactivity from the containment to the environment through the stack occurs at a leak rate of 0.05 percent per day of the atmosphere within the containment and the leakage rate persists throughout the effective course of the accident which, for practical purposes, is until the iodine activity has decayed away.

(*c*) In calculating the doses which determine the distances, fission product decay in the usual pattern has been assumed to occur during the time fission products are contained within the reactor building. No decay was assumed during the transit time after release from the reactor building.

(*d*) No ground deposition of the radioactive materials that leak from the reactor building was assumed.

(*e*) For the atmospheric dispersion during the first 2 hours after the accident a strong inversion was assumed to exist since this condition gives the largest dosages at the furthest points from the discharge stack. The stability parameter for the inversion was assumed to be n=0.5. It was assumed that the wind speed was 1.5 meters/second representative of the winds prevailing at least 80 percent of the time at the site. For evaluating the atmospheric dispersion for the entire course of the accident to the edge of the low population zone, parameters selected represent average weather conditions for the site, n=0.2 and an average wind speed of 3 meters per second.

(*f*) The atmospheric dispersion was evaluated, using the meteorological parameters noted in item (*e*), by the correlations and equations given by R. L. Seale and J. C. Couchman in their report "Predicting Atmospheric Dispersal of Fission Products From Basic Meteorological Measurements," FZM–2025, October 12, 1960.

(*g*) The source strength of each iodine isotope was calculated to be as follows:

Isotope	Exclusion Q (curies/megawatt)	Low population Q (curies/megawatt)
I–131	0.28	38.2
I–132	.34	.7
I–133	.60	9.3
I–134	.36	46
I–135	.52	2.7

These source terms combine the effects of fission yield under equilibrium conditions, radioactive decay in the containment, and the release rate from the containment, all integrated throughout the exposure time considered.

(*h*) In calculating the thyroid doses which result from exposure of an individual to an atmosphere containing concentrations of radioactive iodine, the following conversion factors were used to determine the dose received from breathing a concentration of 1 curie per cubic meter for 1 second:

Isotope	*Dose (rem)*
I–131	329.0
I–132	12.4
I–133	92.3
I–134	5.66
I–135	25.3

(*i*) It was assumed that the shielding around the containment was sufficient to reduce the gamma radiation from the fission products inside the containment to insignificant levels at the site boundary.

2. Using the assumptions noted above, the calculations showed that discharge through a stack with an effective stack height of 200 feet and the shielding around the containment reduced the dosages close to the plant such that no exclusion area is required. The dose to the thyroid was found to be controlling for the distance to the low-populated zone. If the leakage from the con-

tainment is discharged with no scrubbing to remove iodine, the following distances are calculated:

Power level	Exclusion distance	Low population zone
Thermal megawatts	*Miles*	*Miles*
<925	0	0
1,000	0	.21
1,100	0	.22
1,200	0	.23
1,300	0	.24
1,400	0	.25
1,500	0	.26

If a filter or scrubber is installed which removed 95 percent of the particulates and iodines leaking from the containment before discharge to the stack, it was found that there is no restriction on exclusion distance or low population zone distances for reactor power levels much greater than 1,500 thermal megawatts.

APPENDIX A–4.—Example of a Calculation of Reactor Sitting Distances

1. The calculations of this appendix are a pressurized water type of reactor to be constructed in a narrow river valley. It is assumed that the containment vessel has a demonstrated leak rate of 0.1 percent per day of the volume of gas contained. No credit is assumed for elevation of the sphere above ground.

The calculations of this appendix are based upon the following assumptions:

a. The fission product release to the atmosphere of the reactor building is 100 percent of the noble gases, 50 percent of the halogens, and 1 percent of the solids in the fission product inventory. At distances outside the facility controlled area it is assumed that inhalation of iodine isotopes as aerosols presents the controlling biological hazard.

Of the 50 percent of the halogens released, one-half is assumed to adsorb onto internal surfaces of the reactor building, or adhere to internal components, thus leaving 25 percent of the original core halogen inventory available for leakage.

b. The release of radioactivity from the reactor building to the environment occurs at a leak rate of 0.1 percent per day of the atmosphere within the building and the leakage rate remains constant for one day. At the end of the first day, leakage was assumed to terminate as a result of the use of water spray to reduce the pressure in the reactor building.

c. In calculating the doses which determine the distances, fission product decay in the usual pattern has been assumed to occur during the time fission products are contained within the reactor building. No decay was assumed during the transit time after release from the reactor building.

d. No ground deposition of radioactive materials that leak from the reactor building was assumed.

e. The atmospheric dispersion of material leaking from the reactor building was assumed to occur according to the following relationship:

$$x = \frac{Q}{\pi u \sigma y \sigma z}$$

Where Q is the rate of release of radioactivity from the containment vessel, the ("source term") and is stated in units of curies integrated over the exposure period,

x is the atmospheric concentration of radioactivity at distance d from the reactor, in curies per meter^3, integrated over the exposure period,
u is wind velocity (meters/second),
σy and σz are horizontal and vertical diffusion parameters, respectively.

f. Meteorological conditions of atmospheric dispersion were assumed to follow a two-stage cycle. From time=0 to t=6 hours, a severe inversion is assumed with minimum dispersion of leakage products. At t=6 and continuing to t=24, conditions were assumed to improve as a result of increased wind speed and resultant improved dispersion. Full credit is taken for isotopic decay of fission products remaining within the vapor container.

For the purposes of these calculations, the parameter used in the equation in section (e) above were assigned the following values:

	t=0 to t=6 hours	t=6 hours to t=24 hours
u	1 meter/sec	5.5 meter/sec
σy	$(\frac{1}{2}\, Cy^2 d^{2-n})^{\frac{1}{2}}$	$(\frac{1}{2}\, Cy^2 d^{2-n})^{\frac{1}{2}}$
σz	$(\frac{1}{2} Cz^2 d^{2-n})^{\frac{1}{2}}$	$(\frac{1}{2} Cz^2 d^{2-n})^{\frac{1}{2}}$
Cy	0.4	0.4
Cz	0.07	0.3
n	0.5	0.2

g. Trial calculations have shown that whole body doses from direct radiation at the perimeter of a nominal facility controlled area (radius 1000 ft.) are not significant compared to the hazard resulting from inhalation of aerosols described above. Therefore, no separate calculation of this factor is given in this example.

h. As a result of the above design bases (a and g) the isotopes of iodine are controlling for the low population zone distance. The low population zone distance results from integrating the effects of iodine 131, 133 and 135. (No significant error results from omitting the isotopes 132 and 134.)

i. The source strength of each iodine isotope was calculated as the product of the curies available for leakage out of the vapor container at the beginning of each time interval, times the leakage rate, multiplied by a time averaging factor which accounts for the length of the discharge interval and the decay rate of the isotope.

	I^{131}	I^{133}	I^{135}
Leakage rate at t=0 curies/day/megawatt	6.5	15.0	14.0
Time average factors (days):			
6-hour release	0.25	0.23	0.19
18-hour release	0.74	0.56	0.34

Source strength of the Period t=0 to t=6 hours:

	Curies per megawatt
I–131	1.62
I–133	3.45
I–135	2.66

These source terms combine the effects of fission yield under equilibrium conditions, radioactive decay in the reactor building, and the release rate from the reactor building, all integrated throughout the exposure time considered.

j. Exclusion distances were calculated on the basis of airborne activity alone.

k. In calculating the thyroid doses which result from exposure of an individual to an atmosphere containing concentrations of radioactive iodine, the following conversion factors were used to determine the dose received from breathing a concentration of one curie per cubic meter for one second.

Isotope	*Dose (rem)*
I–131	329.0
I–132	12.4
I–133	92.3
I–134	5.66
I–135	25.3

2. The data developed from the preceding calculations are summarized in figure I "Exclusion and Low Population Zone Distances."

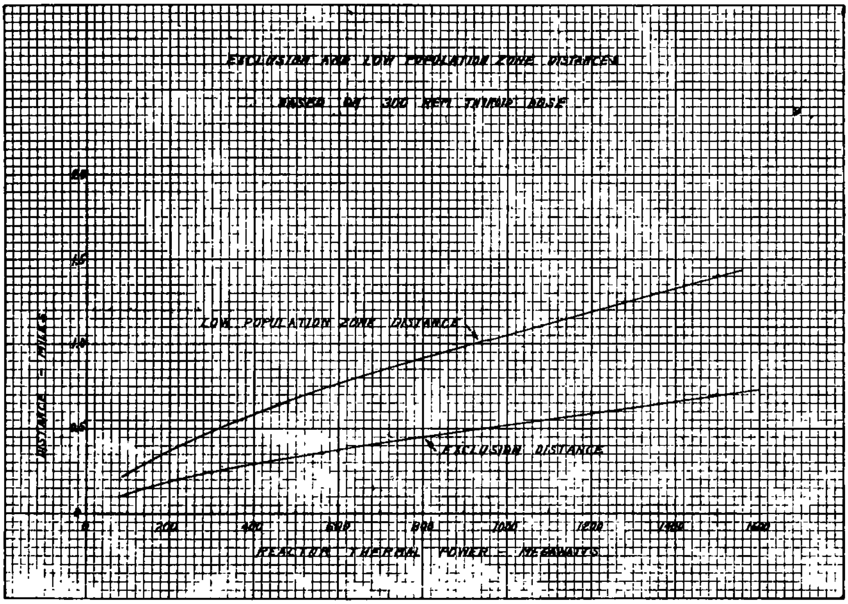
Calculations show that the dose received during the unstable periods is negligible compared to that received during inversion conditions.

3. Summarizing results given in figures I and II, the exclusion and low population distances are as follows:

a. Exclusion distance—Based on 2 hour exposure and a dose of 300 rem to the thyroid.

b. **Low Population Zone Distance—Based on one cycle of 6 hours stable and 18 hours unstable air conditions, and a dose of 300 rem to the thyroid.**

Reactor thermal power	Exclusion distance	Low population zone distance
Megawatts	*Miles*	*Miles*
1,500	0.70	1.40
900	.49	.98
600	.37	.77
300	.24	.48
100	.12	.23



Atomic Industrial Forum—Reactor Site Criteria

The following represents a modified version of the AEC's "Notice of Proposed Guides—Reactor Site Criteria," title 10, Code of Federal Regulations, part 100, published in the February 11, 1961, issue of the Federal Register. It has been prepared by the Atomic Industrial Forum's Committee on Reactor Safety.

GENERAL PROVISIONS

100.1 *Purpose.*—It is the purpose of this part to describe the criteria which guide the Commission in its evaluation of the suitability of proposed sites for power reactors subject to part 50 of this chapter. Insufficient experience has been accumulated to permit the writing of standards, which will correlate a reactor site with the design and intended use of the reactor, or to preclude the exercise of judgment by the applicant and the agency in the evaluation of reactor sites. This part is intended to identify a number of factors considered by the Commission and the general criteria which are to be utilized only as interim guides in evaluating proposed sites.

100.2 *Scope.*—This part applies to applications filled under part 50 of this chapter for power reactors.

The site criteria contained in this part apply primarily to reactors of a general type and design on which experience has been developed, but can also be applied with appropriate modifications to other reactor types.

100.3 *Definitions.*—As used in this part:

(*a*) "Exclusion area" means the area surrounding the reactor, access to which is under the full control of the reactor licensee. This area may be traversed by a highway, railroad, or waterway, provided these are not so close to the facility as to interfere with normal operations, and provided appropriate and effective arrangements are made to control traffic on the highway, railroad, or waterway, in case of emergency, to protect the public health and safety. Residence within the exclusion area shall normally be prohibited. In any event, residents shall be subject to ready removal in case of necessity. Activities unrelated to operation of the reactor may be permitted in an exclusion area under appropriate limitations, provided that no significant hazards to the public health and safety will result.

(*b*) "Low population zone" means the area immediately surrounding the exclusion area which contains residents the total number and density of which is such that there is a reasonable probability that appropriate protective measures could be taken in the event of a serious accident. These guides do not specify a permissible population density or total population within this zone because the situation may vary from case to case. Whether a specific number of people can, for example, be evacuated from a specific area, or instructed to take shelter, on a timely basis will depend on many factors such as location, number and size of highways, scope and extent of advance planning, and actual distribution of residents within the area.

(*c*) "Power reactor" means a nuclear reactor of a type described in sections 50.21(b) or 50.22 of part 50 of this chapter designed to produce electrical or heat energy.

SITE EVALUATION FACTORS

100.10 *Factors to be considered when evaluating sites.*—In determining the acceptability of a site for a power reactor, the Commission will take the following factors into consideration:

(*a*) Characteristics of reactor design and operation including—

(i) Intended use of the reactor including the proposed maximum power level and the nature and inventory of contained radioactive materials.

(ii) Physical characteristics of the proposed reactor type, especially those bearing on safe operation and maintenance such as reactivity coefficients, heat capacity and transfer characteristics of fuel and core, and shutdown margin of reactivity.

(iii) Provision of such auxiliary safety systems as decay heat removal systems, emergency core cooling system, poison injection system, and emergency condenser system.

(iv) Integrity of reactor components and facilities to contain transient pressures and potential releases of radioactive material such as fuel cladding, pressure vessel, primary shielding, and biological shielding and the extent to which reactor design incorporates well proven engineering standards.

(v) Type and integrity of reactor containment and method of operation during power operation and shutdown including provisions for such procedures as reducing pressure, controlling and disposing of leakage, and reducing concentration of contained fission products.

(b) Population density and use characteristics of the site environs, including, among other things, the exclusion area and low population zone.

(c) Physical characteristics of the site, including, among other things, seismology, meteorology, geology, and hydrology. For example:

(i) The design for the facility should conform to accepted building codes or standards for areas having equivalent earthquake histories. No facility should be located closer than one-quarter of a mile from the surface location of a known active earthquake fault in all cases, consideration should be given to the character of the fault and the type of soil or rock providing the foundation for the reactor plant.

(ii) Meteorological conditions at the site and in the surrounding area.

(iii) Geological and hydrological characteristics of the proposed site may have a bearing on the consequences of an escape of radioactive material from the facility.

Special precautions should be taken if a reactor is to be located at a site where a significant quantity of radioactive liquid effluents might flow readily into nearby streams or rivers or might find ready access to underground water tables.

The physical characteristics of a site must be evaluated in close conjunction with a safety assessment of the engineering characteristics of the reactor to be located on the site.

Where some unfavorable physical characteristics of the site exist, the proposed site may nevertheless be found to be acceptable if the design of the facility includes appropriate and adequate compensating engineering safeguards.

100.11 *Determination of exclusion area and low population zone.*—(*a*) The applicant should estimate an exclusion area and a low population zone which are defined as follows:

(i) An exclusion area shall be of such size that an individual located at any point on its boundary for 2 hours immediately following onset of the estimated release of radioactive material would not receive a total radiation dose to the whole body in excess of 25 rem or a total radiation dose in excess of 300 rem to the thyroid from iodine exposure.

(ii) A low population zone shall be of such size that an individual located at any point on its outer boundary who is exposed to the released radioactive material (during the entire incident) would not receive a total radiation dose to the whole body in excess of 25 rem or a total radiation dose in excess of 300 rem to the thyroid from iodine exposure.

NOTE.—The whole body dose of 25 rem referred to above corresponds to the once in a lifetime accidental or emergency dose for radiation workers which, according to NCRP recommendations, may be disregarded in the determination of their radiation exposure status. (See addendum dated April 15, 1958, to NBS Handbook 59). The NCRP has not published a similar statement with respect to portions of the body, including doses to the thyroid from iodine exposure. For the purpose of establishing areas and distances under the conditions assumed in these guides, the whole body dose of 25 rem and the 300 rem dose to the thyroid from iodine are believed to be conservative values.

(*b*) In estimating an exclusion area and a low population zone to meet the above prerequisites, an applicant, taking into account the type and design of the proposed reactor, the number and type of safety features incorporated in the design, and other pertinent factors, should consider—

(i) The extent of fission product release from the primary reactor system, which normally will be based on an assumed rupture of the primary loop and loss of coolant followed by substantial melting of the core. It is assumed that these circumstances could lead to the release of an appreciable portion of the fission gases and halogens contained in the core.

(ii) The extent of halogen absorption within the containment system, even in the absence of safety systems specifically designed to remove halogens and other fission products. Credit can be taken for the provision of such halogen and fission product removal systems.

(iii) The extent of long-term leakage from the containment system as a function of time based on the estimated integrity of the containment system to be demonstrated as a function of pressure and time. Credit can be taken for safety systems specifically designed to reduce the pressure within the containment system and for fission product decay.

(iv) The meteorological conditions of atmospheric dispersion pertinent to the site, assuming the probably worst or least favorable weather conditions. In estimating the size of the exclusion area, the worst weather conditions experienced at the proposed site for periods of 2 to 6 hours at intervals of two to three times per year should be used. In estimating the size of the low-population zone, the worst weather conditions experienced at the proposed site for periods of 2 to 6 days at intervals of two to three times per year should be used. Account should be taken of the point of release of radioactive material, that is, whether at ground level or from a stack of what effective height.

(v) The estimated radiation exposure resulting from direct gamma radiation from the containment system as compared with the estimated radiation exposure resulting from the radioactive iodine contained in any plume of radioactive material escaping from the containment system. The larger estimated radiation exposure should be used in determining the size of the exclusion area.

(*c*) In determining the size of an exclusion area to contain multiple reactors, consideration should be given to the following:

(i) If the reactors are in no way interconnected so that the possibility of an incident or accident in one reactor initiating an incident in, or causing damage to, another reactor is negated, the size of the exclusion area shall be based on the largest single reactor of similar types or if different types of reactors are involved, on the reactor which could conceivably release the greatest amount of radioactive material.

(ii) If the reactors are interconnected in a manner that could affect the safety of either, the size of the exclusion area shall be based on assuming that all interconnected reactors constitute a single reactor of a size equivalent to the sum of the power ratings of each.

(*d*) These guides do not consider the disposition of a reactor which has experienced an incident or accident resulting in the release of radioactive material. Nothing in these guides, however, is intended to preclude the continued operation of other nuclear and nonnuclear facilities located on the same site.

NOTE.—As a possible aid to an applicant, appendix A of these guides contains sample calculations for several hypothetical reactors and sites. Applicants are cautioned that calculations in support of a request for site approval must be submitted to the Commission in the specific terms of the reactor type, design, and size, and the population and physical characteristics of the site, which are to be enumerated in the license application.

REACTOR SITE CRITERIA

(By Robert Lowenstein, Acting Director Division of Licensing and Regulation)

The suitability of reactor sites has always been an important element in reactor hazards evaluation. Before 1954, when all reactors were Government owned, and were located at relatively isolated, Government-owned installations, there was no compelling need to articulate the criteria for site approval.

Since enactment of the Atomic Energy Act of 1954, however, privately owned utilities, cooperatives, and municipalities have become interested in the construction and operation of power reactors and, in the case of a number of corporations, testing reactors. These groups are interested in the development and use of reactors for economic purposes. They do not have the opportunity to locate reactors in vast, remote tracts, but must locate their reactors within the geographical areas they serve. In the case of municipalities, the areas served may be relatively confined and highly populated. Even in the case of our larger, privately owned utilities, many factors must be considered by the utilities in the selection of reactor locations. Obviously, the most desirable site from an economic or practical standpoint may not be the most desirable, or may be an undesirable site from a safety point of view.

For these reasons it has become important for the Atomic Energy Commission to identify the factors which it considers important in the safety evaluation of reactor sites; and to provide siting guidance to those interested in embarking on reactor projects. Lack of such guidance can lead to misunderstanding of Commission requirements and to disappointment and wasted effort and expenditure on the part of organizations interested in constructing reactors.

The problems in providing such guidance are difficult. There is not, and probably never will be, any scientific test or yardstick which serves to distinguish a "safe" from an "unsafe" site. Since a little more distance from a populated center will always provide a little more safety, and a little less distance will provide a little less safety, the problem is basically one of striking a balance and of providing general guidance as to how the Commission strikes a balance.

Another problem in developing guides is the need to avoid taking an action now which would extend present policies indefinitely into the future.

In May 1959, the Commission published a notice of proposed rulemaking which set forth general criteria for the evaluation of proposed sites for power and testing reactors. After study of comments received in response to that notice, the Commission undertook preparation of a revised set of guides. These were published in the Federal Register in February 1961. At the end of the announced period for comment (the 120-day period ends in mid-June), the Commission will review the comments and suggestions received in order to determine its further course of action.

In the preparation of the guides the Commission received many valuable comments and suggestions from members of the Advisory Committee on Reactor Safeguards.

With the permission of the Joint Committee on Atomic Energy, I should like to introduce a copy of the guides into the record of these hearings.

BASIC CONSIDERATIONS IN REACTOR SITE EVALUATION

The difficult problems involved in site evaluation do not arise from hazards of routine reactor operation or routine releases of radioactive reactor effluent. Such hazards can be controlled by appropriate facility design and procedures to whatever extent is deemed necessary. The difficult site problems arise from the need to consider potential hazards of accidents which might cause the release of extraordinary and dangerous concentrations of radioactive material from the reactor. Whether or not such accidents will occur, and what the consequences might be, are not matters that can be predicted or quantitatively measured. Obviously, no reactor would be built in which a likely potential for a serious accident is believed to exist. Any recognized potentiality for a serious accident is eliminated by design alterations, and the adoption of procedural safeguards; and by the provision of safeguards to minimize consequences of serious accidents.

Consequently, the basic questions which must be answered in site evaluation are: "To what extent can dependence be placed on engineered safeguards to prevent accidents and to minimize consequences if accidents should occur?" and "What are the upper limits of hazards from accidents having a credible probability of occurrence after all safeguards have been provided?" If accidents considered credible would have no hazardous consequences, or if complete dependence could be placed on the engineered, safeguard features, then reactors could be placed anywhere safely. On the other hand, if it were considered credible that all or a major portion of the fission product inventory could be released into the environment, despite the safeguards, then we could not permit reactors to be located near inhabited areas.

Obviously, the Commission has not adopted either of these two extremes. The Commission requires sufficient safeguards so that it appears reasonable to place a high degree of confidence in their dependability but, for added assurance, requires that reactors be so located that the most hazardous consequences would be avoided if an accident of a magnitude beyond expectation should occur despite all the precautions.

Principal considerations involved in analyzing the consequences of potential reactor accidents include the following:

1. The maximum inventory of fission products likely to be present in the reactor. This is usually related directly to the power level.
2. The quantity of fission products likely to be released from the primary system in the event of the maximum accident considered to have a credible likelihood of occurrence.
3. The rate of leakage of the released fission products from the reactor building to the environment.
4. The pattern by which the radioactivity released to the atmosphere would be transported and dispersed to surrounding areas.
5. The conversion factor of air-concentrations or radioactivity to exposure doses of individuals exposed to the dispersed radioactivity.
6. The upper limit of radiation exposure doses which are considered acceptable for such unlikely accident situations.

If values could be established for each of the foregoing parameters for a given reactor, then objective evaluation could readily be made of the suitability of any site for that reactor. Unfortunately, this is impossible. We have, however, taken these considerations into account in developing the proposed guides.

THE APPROACH TAKEN IN THE PROPOSED GUIDES

The purpose of the guides is very limited. It is not to define a "safe" site. It is to describe the criteria which guide the Commission in its evaluation of the suitability of proposed sites for power and testing reactors; and to identify a number of factors considered by the Commission in approving or disapproving proposed sites (sec. 100.1). It is made clear in the guides that they apply primarily to reactors of a general type and design on which experience has been developed. For reactors which are novel in design, or unproven as prototypes, the criteria would need to be applied more conservatively.

The guides state that, in determining the acceptability of a site for a power or testing reactor, the Commission will take the following factors into consideration, among others (sec. 100.10):

"a. Population density and use characteristics of the site environs, including, among other things, the exclusion area, low population zone, and population center distance;

"b. Physical characteristics of the site, including, among other things, seismology, meteorology, geology, and hydrology;

"c. Characteristics of the proposed reactor, including maximum power level, use of the facility, the extent the facility design incorporates well proven engineering standards, and the extent to which the reactor incorporates unusual features having a significant bearing on the probability or consequences of accidental releases of radioactive material."

As an aid in considering these factors, the guides require each applicant to determine an "exclusion area," "low population zone," and "population center distance." It should be emphasized that the calculated exclusion area, low population zone, and population center distance are not absolute requirements but only "factors to be considered" among the other factors listed above, when evaluating sites.

Under the guides, the areas and distances to be determined are the following:

"1. An exclusion area of such size that an individual located at any point on its boundary for 2 hours immediately following onset of the postulated fission product release would not receive a total radiation dose to the whole body in excess of 25 rem or a total radiation dose in excess of 300 rem to the thyroid from iodine exposure.[1]

"2. A low population zone of such size that an individual located at any point on its outer boundary who is exposed to the radioactive cloud resulting from the postulated fission product release (during the entire period of its passage) would not receive a total radiation dose in excess of 300 rem to the thyroid from iodine exposure.

"3. A population center distance of at least 1⅓ times the distance from the reactor to the outer boundary of the low population zone. In applying this guide due consideration should be given to the population distribution within the population center. Where very large cities are involved, a greater distance may be necessary because of total integrated population dose considerations."

The whole body dose of 25 rem referred to above corresponds to the once in a lifetime accidental or emergency dose for radiation workers which, according to NCRP recommendations, may be disregarded in the determination of their radiation exposure status. (See addendum dated April 15, 1958, to NBS Handbook 59.)[2]

If one could be absolutely certain that no accident greater than the "maximum credible accident" would occur, then the "exclusion area" and "low population zone" would provide reasonable protection to the public under all circumstances. There does exist, however, a theoretical possibility that substantially larger accidents could occur. It is believed prudent at present, when the practice of nuclear technology does not rest on a solid foundation of extended experience, to provide protection against the most serious consequences of such theoretically possible accidents. Consideration of a "population center distance" is therefore prescribed; this is a distance by which the reactor would be sufficiently removed from the nearest major concentration of people that lethal exposures would not occur in the population center even from an accident in which the containment is breached.

The guides provide that, for purposes of calculating the exclusion area, lower population zone, and the population center distance, applicants should assume a fission product release from the core as described in paragraph 1–*a* of the appendix to the guides.[3]

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[1] The required population and use characteristics for an acceptable "exclusion area" and "low population zone" and a definition of "population center distance" are included in sec. 100.3 of the proposed guides.

[2] The NCRP has not published a similar statement with respect to portions of the body, including doses to the thyroid from iodine exposure. For the purpose of establishing areas and distances under the conditions assumed in these guides, the whole body dose of 25 rem and the 300 rem dose to the thyroid from iodine are believed to be conservative values (sec. 100.11).

[3] The assumed fission product release to the atmosphere of the reactor building is 100 percent of the noble gases, 50 percent of the halogens, and 1 percent of the solids in the fission product inventory. This release is equal to 15.8 percent of the total radioactivity of the fission product inventory. Of the 50 percent of the halogens released, one-half is assumed to absorb onto internal surfaces of the reactor building or adhere to internal components.

The appendix also contains an example of a calculation by which the exclusion area, low population zone, and population center distance may be derived, using the assumed fission product release as a starting point. As stated in the guides (sec. 100.11), the calculations in the appendix are "a means of obtaining preliminary guidance. They may be used as a point of departure for consideration of particular site requirements which may result from evaluations of the particular characteristics of the reactor, its purpose, method of operation, and site involved."

The fission product release and illustrative calculations in the appendix do not purport to be scientifically demonstrable. In the present state of the technology, this is impossible. The appendix incorporates simplifying assumptions, omits some items of secondary importance, and arbitrarily fixes values for variable parameters as a means of reducing the calculations to manageable proportions. The net effect of the assumptions and approximations probably gives considerably more conservative results than would be the case if more accurate calculations could be made.

As previously noted, the areas and population center distance calculated by the applicant are among the factors to be taken into account in the determination as to whether a proposed site is acceptable. Thus, the application of the guides depends in the final analysis on subjective judgment. The guides do, however, identify the crucial factors considered by the Commission in evaluating proposed sites; provide a technique by which the relative advantages and disadvantages of two different sites can be roughly compared; and provide a technique by which one can roughly compare a proposed site with sites which the Commission has previously approved for particular reactors.

The Atomic Energy Commission would like to acknowledge with appreciation the many helpful comments and suggestions which have been received in response to the notice of proposed guides published in the Federal Register last February. These will all be given consideration in our further study of the siting problem and our revision of the guides.

Testimony of Theos J. Thompson, Chairman of the ACRS During the Calendar Year 1961

At the present time, I am Chairman of the Advisory Committee on Reactor Safeguards to the Atomic Energy Commission. I have been requested to appear before you this afternoon particularly to discuss with you the committee's views on site criteria.

The work of the committee this year so far has included fewer cases than in the same period a year ago. However, we have devoted extra efforts to four other important questions. These are: (1) the simplification and streamlining of the ACRS review of reactors which closely resemble past reactors that we have considered, (2) the development and correlation of reactor technology safety information to serve as guides for the atomic industry in regard to reactor safety, (3) the regulatory process, and (4) the site criteria problem. In February of the present year, Dr. David B. Hall, division leader of K Division of the Los Alamos Scientific Laboratory was appointed to the Committee.

This is the fourth year of existence for the Committee as a statutory body. In September 1961 the original members of the Committee will have served their first 4-year term as prescribed by Public Law 85–256, section 5, dated September 2, 1957. It is likely that some members will resign for personal reasons at the end of this term and several personnel changes will result. The importance of reactor safety and the present role of the Committee in giving guidance in that area assures that we will be able to obtain well-qualified individuals as replacements. In that connection, I should remark that these individuals will almost certainly be already active in the field and, hence, will likely have to excuse themselves from the discussion and deliberations regarding certain reactors. As an example, from the beginning I have been in charge of the MIT nuclear reactor design, construction, and operation. I am, and was prior to my Committee membership, a consultant to the Yankee atomic reactor. Thus, I must absent myself from considerations regarding those reactors. In the same way, Dr. Hall will not participate in any deliberations we may have in the future regarding Los Alamos reactors. In order to obtain the highest quality membership, with a solid background of experience, on the Committee, such overlaps are absolutely essential. This fact should be clearly recognized, while at the same time the overlaps should be minimized.

In regard to our simplification efforts, we are trying to develop methods of working with the staff which will enable us to minimize double review of any but new and important safety problems. I believe that we are making real progress in this effort. It is my personal opinion that the present role of the ACRS in reviewing all testing and power reactors above 10 megawatts thermal should be continued, since advice is likely to be requested of the Committee informally in any case. Thus, the Committee effort should be to minimize the detailed review of reactor types previously examined and to concentrate on only the new features. This we are currently doing more and more.

On the second point, the Committee believes that the time has now come when a set of technical guides on reactor safety can be prepared. This set, while not complete nor absolutely definitive, should aid substantially in giving guidance to the reactor community and the regulatory sections of the AEC. The preparation of such guides is absolutely necessary before technical regulations can or should be considered.

You have asked Dr. Silverman to testify on the third point, considerations of the regulatory process. I shall not comment on this subject today. I might add here that Dr. Silverman will include in his testimony a list of meetings and letters of advice written to the Commission during the current year.

The balance of my discussion will be devoted to the consideration of the site criteria which is currently before the public for comment. It seems worthwhile to point out that these criteria are based upon all of the previous steps which such criteria should go through. First, a great deal of research and knowledge, and several definitive treatments of the pertinent subjects exist. Second, a long period of study has been carried out by the AEC and the ACRS. Third, this is the second attempt to write a suitable set of guides on the subject and, even in this case, the Committee is strongly of the belief that this document should be treated only as flexible guides. The difficulties which have beset this one attempt serves to point out the folly of early regulation of the technical aspects of reactor safety without laying the preliminary groundwork.

As you know, the Atomic Energy Commission earlier developed a set of site criteria which were issued in the form of a tentative regulation. This earlier set of site criteria met with considerable criticism on the part of the general reactor community and finally was withdrawn. However, there has continued to be pressure on various sides for a clear enunciation of a set of site criteria which would lend guidance to the reactor industry in the siting of reactors, which at the same time would not be too inflexible. As you know, the ACRS has in the past given to the Commission frequent advice concerning the siting of reactors. In fact, a study of the advice of the ACRS and decisions of the AEC in regard to the siting of reactors was the basic starting point for the current regulation. In general, these AEC decisions and the committee's advice embody certain principles which are enunciated in the current suggested set of guides. The current set of site criteria then really evolved from past ACRS recommendations, from AEC decisions, from ACRS general letters of advice to the Commission, from the initial attempt of the Commission, and from a great deal of work on the part of Dr. Beck and the staff of the Division of Licensing and Regulation.

In particular, Dr. Beck undertook to do a detailed analysis and development of a set of criteria on this basis. This analysis and development resulted in a paper which he submitted to the American Nuclear Society for its San Francisco meeting in December of 1960 and is a part of the minutes of that meeting. During this same period, the ACRS had been working on an enunciation of its principles of site criteria and in studying in detail the general situation. In a series of meetings in January of 1961, a final draft of the proposed set of guides was hammered out by members of the Division of Licensing and Regulation and members of the ACRS. This document, with very few minor alterations, is the document which is currently under public consideration.

The most important single new development which is embodied in this document is the fact that it contained a set of dosage limits which can be used in the event of a very unlikely reactor accident. I believe that it is important that the Joint Committee recognize this as a real advancement. This document, for the first time, clearly enunciates the fact that such potential radiation dosages are a necessary part of the regulatory processes and form almost completely the basis for any sort of an estimate of how a reactor must be sited. These dosages are given only in the context that such accidents are very improbable indeed.

You will not also that the document recognizes tacitly that the ACRS and the AEC as a whole are not as yet completely willing to trade distance for engineering design. This is a reasonable position at this stage in the development of the atomic energy industry and in view of the projected future population growth.

The intent and desire of the ACRS is that this be a very flexible document and that deviations from this document should be allowed in cases where an applicant can show that his design or his siting of the reactor leads to a safe situation. In fact, the ACRS would like to encourage applicants to come in with deviations in those cases in which they believe that a valid reason for deviation exists. It also recognizes the need for differentiation between reactor types, uses, and methods of operation. For instance, the differences between test and power reactors can be considered in this way. Let me emphasize again that the ACRS is very anxious that the industry as a whole be governed by a flexible guide which will permit growth and development of the industry in a most natural and straightforward manner. We deplore the present tendency to state in the form of precise regulations technical matters which, if defined legally, became completely unacceptable technically.

In connection with the development of these site criteria, it is interesting to point out that the atomic energy industry itself has a somewhat schizophrenic approach to the subject. On the one hand, they would like, and in fact some members of the utility industry insist upon, guidance in the selection of sites in a simplified form such that they can, with some surety, take options on land and develop sites unobtrusively so that real estate exploiters will not take advantage of the situation. This is an understandable motive and one with which the ACRS is very sympathetic. At the same time, other members of the reactor community, and in fact in some cases even the same members, are anxious that the site criteria not be too restrictive so that they will be able to develop new sites which may be closer to major population centers. It is difficult, if not impossible, to state a simple, straightforward set of guidelines with numerical values without at the same time making these rather inflexible and quite restrictive. Therefore, it is and has been the ACRS position that this proposed regulation should be viewed as a guide and not, in a true sense, as a regulation. Further, we also believe that the example at the end should be treated simply as an example and, perhaps, should be either deleted or augmented by the addition of several other examples. For the same reason, we would like to eliminate the 2-hour provision on the 25 roentgen dose limit and substitute instead a limit recommended by the applicant on the basis of time to clear the area involved.

One other point should be mentioned. The site criteria, as published, do not completely define or take care of the problem of either genetic or somatic damage. The problem is recognized and stated in the document, but answers to this problem do not as yet exist. While other reasons have been advanced for the employment of the city distance criteria, including no lethal doses in event of a breach of the containment, the committee accepted this criteria as defined in the guides as a reasonable, though unprovable, statement of its judgment regarding the effects of genetic and somatic dose. The committee believes that the so-called man-rem dose has much to offer as a safeguard for the general protection of the population. We went so far, in December of 1960, as to suggest to the Commission that a dose limit of 4×10^6 man-rems per accident might be reasonable. This was based on a rough estimate that this dose corresponded to an average 30-year dose to 1 million people from all natural sources. We suggested that this computation of dose be cut off at 1 rem whole body or equivalent thyroid, bone, or lung dose. Assuming that one accident occurs in 30 years, the total man-rem to the population is about one one-hundred-eightieth of that due to natural causes. Since this type of accident will be very infrequent indeed, if it ever occurs, the choice is conservative. We have looked at several of our present reactors which are located near cities and we find that, on the basis of this emergency man-rem dose, the sites are about right and further agree quite well with the city distance concept as stated in the guide.

At present, we can do little more than to adopt some criteria, such as the city distance, and encourage that research be done in the area of understanding what the problems are in regard to genetic and somatic damage of large sections of the population by very small radiation doses. I should like to point out that this problem is one which exists in our entire civilization. Each year, more and more radiation is given in the form of X-rays for diagnostic and therapeutic purposes. I am particularly in a position to know since my own son has had polio and undergoes frequent X-ray studies, which they call growth studies. Further, we at MIT are at present treating experimentally cancer patients with neutron beams at the MIT nuclear reactor, of which I am the director. Therefore, the problem presented by a reactor accident, as far as total integrated dose to the entire population, is likely to be only a small part of the total problem which is presented by diagnostic and therapeutic radiation, fallout, and so on. In the long-range development of civilization, the study of genetic damage is a high priority problem and should be given considerable study.

In connection with radiation dosages, as a practical working scientist in the field of nuclear physics and reactors, it seems to me worthwhile to point out to the Joint Committee that the present part 20 of the AEC regulations, which are based on ICRP recommendations and all other current efforts in the direction of setting biological dosage limits for normal usage, has been in the downward direction. It has now arrived at the point where it is essentially impossible for any reactor or any other radiation user to comply with the existing regulations because of the fact that it is impossible to measure and identify continuously the levels of radiation which are set as tolerance limits in the AEC regulations. In order to illustrate this point clearly, I would like to cite the fact that most normal matter has of the order of 10^{-12} curies/gram of material. This means the table tops in this room, the human bodies in this room, the walls, and so on, have, on the average about 10^{-12} curies/gram. If this is translated into air equivalence, this means, since air is about 0.001 of the density of normal materials such as water, the normal nonradioactive air should have of the order of 10^{-15} curies/milliliter. This is 10^{-9} microcuries/milliliter and it so happens that this is in the neighborhood of tolerances currently set by the regulations for acceptable nonoccupational radiation levels. It, thus, is apparent that one cannot in any useful way identify radioactivity when the very chambers with which you are making detectors, and so on, are made of materials which have radioactivity of the same order of magnitude or higher. Further, the levels so set are far below those which occur due to cosmic rays and other artificial sources such as diagnostic X-rays. The main problem here appears to be that the dosage levels have, for the most part, been set by geneticists and biologists on the basis that the lower it can be set the better. It, therefore, appears to me to be wise to point out that the levels have now gotten to the point where they are ridiculously low. Some action should be taken on this topic.

Statement by Oliver Townsend, Director, Office of Atomic Development, State of New York

I wish to thank the committee for its invitation to testify on the subject of reactor site criteria.

This is a subject in which we in New York have had a strong interest ever since the lack of such criteria resulted in the fruitless expenditure of much time and effort on the 16,500 kilowatt atomic power project once contemplated for the city of Jamestown, N.Y. This project, as you know, was abandoned earlier this year because of an adverse recommendation by the Advisory Committee on Reactor Safeguards concerning the project's proposed site.

The disapproved site was situated within the city limits of Jamestown on a plot providing an exclusion radius of 1,500 feet in all directions and located 1.7 miles from the heart of the city.

Two alternate sites about 2½ miles outside of the city were subsequently proposed and approved by the Advisory Committee on Reactor Safeguards. The State offered to acquire one of these sites and make it available without charge for the contemplated atomic power project, and furthermore offered to create on the site the same exemptions from property taxes which would have prevailed within the city's limits.

In spite of these inducements, and after having taken them into account, the city concluded that the economic penalty it would incur at either of the two remote sites was so great that it offered to pay only the equivalent of 2.5 mills per kilowatt-hour for the steam from the reactor as opposed to 6.1 mills at the preferred site within the city's limits. This 6.1 mill figure, as I understand it, was by a wide margin the best price offered to the Commission for steam from this particular reactor.

The possibility of the State's attempting to close all or part of the gap between 2.5 and 6.1 mills by means of a capital contribution to the project was discussed among the parties concerned—the State, the city, and the AEC—but was ultimately rejected because the resultant distortion of the city's municipally owned power generation and distribution system was deemed by all three parties not to be in the best long-term economic interests of the city.

The preferred site within Jamestown would not have met the requirements of the example distance calculation contained in the AEC's proposed reactor site criteria as published in the Federal Register on February 11, 1961. As Mayor Sanford, of Jamestown, testified to this committee on March 3, 1961, if the criterial had been in effect at the time the city made its original proposal to the Commission in December 1959 the proposal never would have been submitted.

I cite this case as one illustration—and, as you know, there are others in other parts of the country—of the need for the type of criteria now being proposed.

I cite it also as an example of the impact that the siting of power reactors have on the economics of atomic power generation and distribution.

As to the validity of the technical data used as the basis of the proposed criteria, I do not believe that the evaluation of this should be undertaken by nontechnical people and I consequently have no comment upon it. I also do not believe that economics should be used as a rationale for doing something that places the public health and safety in unreasonable jeopardy.

I do believe, however, considering the magnitude of the impact that location can have on the economics of atomic power generation, that every effort should be made to focus the criteria as finally promulgated more on the end result to be achieved, which is the assurance of the public health and safety, and less on the factor of distance, which is but one of two principal means by which this end result can be realized.

The other principal means, besides distance, of assuring the public health and safety, is engineering design, including containment and fail-safe devices, as well as the characteristics of the particular atomic machine proposed for construction. In this respect, I would like to note that one can buy quite a lot of containment and other safety equipment for the difference between 2.5 and 6.1 mills per kilowatt-hour.

If there is, at the present stage of the technological development of atomic power, a hesitancy to rely on engineering as a substitute for distance, as the proposed criteria seem to suggest, then all I can say is that a major program to prove out the effectiveness of design and engineering techniques as an alternate means of assuring the public health and safety appears to be called for. In the absence of such a major program, which in my opinion does not now exist, it is both illogical and unfair to impose the heavy economic penalty of distance on the burgeoning atomic power industry, which is so intimately related, both by policy declarations of the U.S. Government and by world opinion, to this Nation's international reputation.

In their present form, there is no doubt in my mind that the proposed reactor siting criteria will tend to channel future atomic power development along lines of giant, relatively remotely located stations serving large integrated grids, for the most part interstate in scope. I personally have no trouble with this in principle, if it can be shown for reasons other than safety that it is best for the country, but I do not think it is fair or reasonable or logical to produce this result, almost inadvertently, on the grounds of safety until other means of achieving the goal of safety have been fully explored.

STATEMENT OF JAMES L. GRAHL, DIRECTOR OF THE ATOMIC ENERGY SERVICE OF THE AMERICAN PUBLIC ASSOCIATION, WASHINGTON, D.C.

My name is James L. Grahl. I am director of the atomic energy service and assistant general manager of the American Public Power Association, which represents more than 1,000 local publicly owned electric utility systems in 43 States and Puerto Rico. Headquarters of the association are at 919 18th Street NW., Washington, D.C.

On behalf of our association, I want to express our appreciation for the committee's invitation to present comments on the proposed reactor site criteria published by the Atomic Energy Commission on February 11, 1961.

We do have an interest in this matter and, without pretending to have an expert knowledge of this unusually complex problem, I will attempt to indicate some of the aspects of interest to local publicly owned electric systems.

Our membership is, of course, wholly in favor of whatever requirements are necessary for the public health and safety. A statement of general association policy on atomic power adopted by our board of directors in 1956 stated that "the atomic power industry and related activities should be regulated with scrupulous care and impartiality to protect at all times the public health and safety." Consequently, we would support whatever site criteria are necessary to safeguard the public health and safety.

At the same time, the great majority of local public power agencies are municipally owned systems, and so the association hopes that the site criteria for nuclear powerplants will not make it economically impossible for large numbers of the municipal systems to utilize nuclear generating units when they are developed to the point of economic practicality.

There seems to be some conflict between these two positions. The Commission's proposed site criteria require nuclear powerplants to be located some distance from the edge of a populated area, and for municipal power systems this distance requirement introduces costs and operating problems which in many cases would be prohibitive.

These distance requirements may well be necessary and prudent during the present developmental phase of power reactor technology. However, they should be recognized and established as criteria for this phase, and not regarded as necessarily establishing the pattern for nuclear powerplant location for all time. Recognition of this fact might diminish considerably the concern with which many view the current and proposed requirements for locating reactors some distance from large or concentrated populations.

From our standpoint it would be most unfortunate if the proposed site criteria led to a conclusion at this time that nuclear powerplants will always be impractical for those many municipal systems which cannot afford to locate their generating units a long distance from the edge of the city. We would hope that by the time economic plants have been developed, the technology would have advanced sufficiently to allow some easing of the distance criteria.

We recommend, therefore, that the AEC site criteria guides state explicitly that the criteria are those necessary or desirable during this developmental period—that AEC will continue efforts to develop plants which are inherently safe enough so that at some future time distance from population may be less important—and that the criteria therefore are subject to change in the future as the technology evolves and as further experience is gained in the design, construction, and operation of nuclear reactors.

My second point is concerned with what seem to be some basic inconsistencies in the Commission's applications of distance requirements to nuclear reactor installations.

The Commission's policy on the proximity of reactors to population is defined in more detail in the proposed criteria than any other single factor. The criteria define with some care the requirements for a "low population zone" around a reactor and a "population center distance" from a reactor, yet it is my understanding that the Commission provisions for enforcing these requirements once an operating license has been issued are incomplete, at best.

To my knowledge there is no definite requirement by the Commission which would prevent an industrial park or surburban housing development from springing up around a reactor, once it was licensed, and effectively abolishing the "low population zone" so carefully calculated as a requirement for issuing the license. Similarly, I understand that there is no Commission requirement which would prevent a center of population from expanding outward and decreasing or wiping out the minimum distance to the boundary of the nearest city which the Commission requires prior to granting a license.

That such development can and will occur seems certain. One possible example is furnished by a news story which appeared in the Chicago Tribune on February 2, 1961. The news item stated that "Plans for the development of more than 9,000 acres adjoining Commonwealth Edison Co's. Dresden nuclear power generating plant as an industrial district were announced yesterday by four Chicago real estate firms." This is a case of area development being planned before the nearby nuclear plant even gets its final operating license.

The proposed criteria do not indicate what the Commission does in a case like this. The industrial park near Dresden may pose no problem, but what would be done in the event that a reactor site had been approved by AEC, the utility had virtually completed the plant, and then a real estate operator started building several thousand homes in the "low population zone" around the reactor?

If the Commission were to issue the operating license anyway, it would have to ignore the requirements it previously said were necessary for public health and safety. If it denied the license or required the utility to add containment or operate the reactor at a lower power level, the financial hardship on the utility and its customers could be substantial.

A more likely possibility is that real estate development and outward growth of the nearest population center will occur after a reactor has been licensed and gone into operation. If the Commission's criteria are to be meaningful, it would seem necessary either to prevent such development, withdraw the operating license or require changes in containment or power level to compensate for the shrinkage in the "low population zone" and in the distance to the edge of the nearest population center. However, it is my understanding that the Commission does not have plans for such enforcement actions once a nuclear plant goes into operation.

If the proximity of population to a reactor is as important to public safety as the Commission's proposed criteria indicate, there should be some means established for enforcing them for the period of the operating license—or until there are solid grounds for amending the license requirements. If the criteria are not to be enforced, it is not clear what is gained by establishing them in the first place.

There seems to be another inconsistency, as far as remoteness from population is concerned, in the Commission attitude in respect to nuclear-powered civilian ships, which the Commission and the Maritime Administration are attempting to develop. If such ships are to be of practical use, presumably they will have to enter populous harbors on a regular basis, and this implies a different policy for mobile reactors than for stationary reactors despite the greater possibilities for accidents with the former.

To illustrate the point, if one applies the examples cited in appendix A of the proposed criteria to the 70,000-thermal-kilowatt U.S.S. *Savannah* reactor, it should be surrounded by a controlled exclusion area of more than 800 feet in radius and by a "low population zone" about 1.6 miles in width, and should remain at least 2.1 miles from the outer edge of any large city. Obviously, no such requirements are contemplated.

I recognize that the *Savannah* has been designed and built with special features to enhance the inherent safety of the powerplant and, furthermore, that a ship would be in port and near population only intermittently. Nevertheless the Navy apparently believes that its nuclear-powered vessels, also designed for maximum safety, require special operating limitations. Last year, Adm. H. G. Rickover testified that the Navy has been issued orders that "there must be an actual military or national necessity before a nuclear ship can go into a populated harbor."

It is not clear why the Commission should have what seems to be a different attitude toward distance from population for civilian nuclear ships than it does for stationary reactors.

The lack of population control in the vicinity of a reactor once the site has been approved and the license issued, and the seemingly different philosophies which AEC applies to stationary and civilian ship reactors appear to us to raise basic questions about the site criteria applying to the proximity of reactors to population. In raising these questions, we do not mean to imply that we are opposed to the separation of reactors from population centers. We do believe that whatever criteria are applied should be reasonably clear, consistent, and enforcible.

(Statements submitted for the record:)

ATOMICS INTERNATIONAL DIVISION,
NORTH AMERICAN AVIATION, INC.,
Canoga Park, Calif., June 29, 1961.

Hon. CHET HOLIFIELD,
Chairman, Joint Committee on Atomic Energy,
Washington, D.C.

DEAR CONGRESSMAN HOLIFIELD: The recent Joint Committee hearings on radiation safety and regulation included a session on reactor site criteria. Because of the pressure of time, this session was postponed, and we now understand that the testimony scheduled for that session will be included in the report of the hearings. We wish to submit this letter and the enclosure on reactor site criteria for consideration, and inclusion in the hearing report if possible.

The general approach used in the proposed AEC reactor site criteria published for comment has been one of considering a reactor and a site simultaneously. From assumptions on the characteristics of the reactor and information on the site, the site criteria are established. Although this approach is workable, we believe it would be more desirable, on a permanent basis, to separate the consideration of the site from the review of the reactor design.

We believe that it is better to first evaluate the site alone to establish the radiation tolerances which any reactor must satisfy to be safely placed on the site. From this evaluation, the quantitative extent to which the site will tolerate the release of radioactivity, without regard to the source, can be determined. The majority of the factors involved in this site evaluation are inflexible because they relate to natural causes such as existing meteorology, geology, hydrology, etc.

The specifications arrived at from the above study could then be supplied to a reactor designer who would have the responsibility of designing a reactor which could meet the specified site limitations.

Reactor design characteristics, such as the degree and type of containment, inherent safety aspects, and special safety features can be controlled over very wide limits by the designer and/or operator so as to meet the conditions on radiation release imposed by the site evaluation.

This approach also permits and complements the usual power utility method of selecting plant sites on the basis of power needs, distribution systems, and water availability, along with other factors.

In summary, the evaluation of a reactor installation under this approach would include the following successive steps:

1. Evaluation of the site to determine tolerable radioactivity releases.
2. Evaluation of the reactor design to assure that it meets the criteria determined by the site characteristics.
3. Review of the facility as constructed to assure that it meets the design specifications.

Enclosed is a copy of our detailed comments, essentially as submitted to the AEC, for your review and consideration.

Sincerely yours,

C. STARR,
President, Atomics International Division.

COMMENTS AND RECOMMENDATIONS ON THE AEC NOTICE OF PROPOSED GUIDES, 10 CFR, PART 100—REACTOR SITE CRITERIA

(Submitted by Atomics International Division of North American Aviation, Inc.)

I. SUMMARY

We submit evaluation of a reactor site, selected for power needs or on other bases, is best made by establishing the maximum radioactive release for the site so that there will not be radiation exposures in excess of those acceptable in the populated areas about the site. Such maximum radioactivity release would be one of the design criteria for any reactor to be located at the selected site. The manner in which this revised approach would be applied is outlined hereafter in these comments.

These comments also contain our recommendations with respect to specific sections of the guides proposed by the Commission. In addition, a recommendation is made that covers a multiplicity of reactors at a single site, a point not covered in the Commission's guides.

II. GENERAL COMMENTS AND RECOMMENDATIONS

A. NEED FOR FLEXIBLE GUIDES

The formulation of general criteria, methods, and factors which must be considered in the evaluation of reactor sites could stimulate the growth of the nuclear power industry by encouraging the development of sites for future reactor installations. At the same time, the formulation of proper criteria will prevent unnecessary expense and activity by industry in site selection and development and will provide suitable motivation for industry to pursue the development of reactor technology.

It is obvious that the types of information required in site evaluation and the methods of evaluating such information are evolutionary items. Therefore, it is not possible at this time to list explicitly either all the factors or the specific methods for treating the factors required in site evaluation. This is recognized in the "Statement of Considerations" of the proposed guides. Therefore, in the adoption of any set of guides or criteria, it is imperative that they be so written as to permit flexible administration. Such guides or criteria should specify that nothing therein shall obligate the Commission to approve or disapprove any reactor site because such site meets or fails to meet the criteria set forth in the guides. Additionally, applicants for a construction permit are free to demonstrate to the Commission the applicability and significance of site criteria other than those set forth in the guides.

B. SITE EVALUATION TO ESTABLISH DESIGN CRITERIA

The primary objective in the establishment and use of guides for reactor site evaluation is the prevention of serious injury to persons offsite and excessive exposure of large numbers of persons in terms of total population dose should any credible accident occur. In the proposed guides, a hypothetical reactor has been used, and from a consideration of the characteristics of the reactor, the site and its environs, methods are given to calculate distances which are designed to accomplish this objective. If it is possible to base site criteria on considerations of a site and its environs, and very general reactor data, as is done in the appendix A to the proposed guides, then it is also possible to determine for a given site an acceptable release of radioactivity (from a reactor or any other source) and to use this information to establish one of the design criteria for a reactor.

Since site selection for a reactor depends on many factors other than the type of reactor (e.g., a primary determining factor in selecting an electrical power station site by the utility industry is power needs), it is more logical to establish a maximum radioactivity release for a site than to select a site on the basis of an assumed release.

Approached thusly, there is no need to assume "a fission product release from the core" as provided in section 100.11(a) of the proposed guides. Rather, an exclusion area, a low population zone and population centers will be known for a given site, independent of an assumed radioactive release, by virtue of such facts as population distribution and density at the site, the area under full control of licensee, and the avenues of egress from the site and its environs. It is then possible to determine, from the meteorological characteristics of the site and its environs, for each area the radioactivity release at the site that will give the radiation exposure acceptable for that area, as defined in the guides. The worst combination of meteorological conditions at the site will be assumed in making the above determination. The radioactivity release that will give a radiation exposure acceptable in all areas will then be selected as the maximum radioactivity release for the site.

This approach assumes a definition of the radiation exposure acceptable in a population center as distinct from the Commission's proposed establishment of a distance which such a center must be from the site. We would define an acceptable radiation exposure for a population center in the same terms as acceptable exposures are defined in the Commission's guides for the exclusion area and the low population zone.

The maximum radioactivity release determined for the selected site would be one of the design criteria for any reactor to be located at such site. Accordingly, the reactor designer would be obliged to design the reactor facility so that reasonable assurance could be given that the facility can be built and operated so that any maximum credible accidental release of radioactivity would not exceed the maximum radioactivity release established for the site. The reactor designer would be free to utilize safety factors intrinsic to particular reactor types and to apply advances in reactor technology without restrictions relating nuclear power to distance.

Under our approach, any references to or assumptions of reactor characteristics need not be included in the guides. Accordingly, sections 100.2(b), 100.10(c), 100.11(b) (1) and (2), and appendix A and all references thereto would be eliminated.

C. REVIEW AND APPROVAL PROCEDURE

Under the approach recommended above, prior to selection of a reactor type, a prospective applicant would evaluate the site selected and determine design criteria for any reactor to be located at such site. Such evaluation and determination would be subject to review by the Commission.

Thereafter, applicant would demonstrate to the Commission reasonable assurance that the reactor designed for the selected site could be built and operated to satisfy all site criteria. The characteristics of the proposed reactor and the extent to which its design incorporates well-proven engineering standards and unique or unusual factors, having a significant bearing on the probability or consequence of an accident, would all be considered. Commission approval of design at this stage would result in issuance of a construction permit.

Finally, the Commission would review the as-built facility to determine that the design criteria approved had in fact been met. Granting of an operating license would proceed in fundamentally the same manner as at present.

D. MULTIPLE REACTORS AT ONE SITE

The proposed guides are not clear as to the manner of evaluating a site at which more than one reactor may be located. Since site criteria are to be based on the consequences of an unlikely but credible accident, not the probability of the accident, it is recommended that as to each independent reactor there must be reasonable assurance that any maximum credible accidental release would not exceed the maximum radioactivity release established for the site. If an incident in a reactor at the site may initiate an incident in any one or more reactors at such site or if two or more reactors are otherwise mutually dependent, there must be reasonable assurance as to the interrelated complex that any maximum credible accidental release would not exceed the maximum radioactivity release established for the site.

III. SPECIFIC COMMENTS AND RECOMMENDATIONS

The following comments and recommendations refer to specific sections of the proposed guides as indicated.

A. STATEMENT OF CONSIDERATIONS

We believe that the basic objectives in establishing guides for site evaluation can be stated more succinctly and in a manner at once clearer and less alarming to the general public.

Objective (*b*) of the proposed guides is not clear because the phrases "not normally considered credible" and "the number of people killed should not be catastrophic" are subject to a considerable range of subjective interpretation. In addition, the latter could provoke public alarm without need.

The last two sentences of objective (*c*) of the proposed guides seem to imply that, regardless of the reactor type or design or of the interrelationships between population distribution and density, special safety developments, and distances, power reactors can never be located in or very near large cities. Further, it is implied that the proposed guides are not adequate in some cases. Since it is believed that these implications should be avoided, it is suggested that the last two sentences in objective (*c*) be deleted.

It is recommended, therefore, that the basic objective in the establishment and use of the proposed guides be stated as—

"Serious injury to individuals offsite should be avoided and the exposure of large numbers of people in terms of total integrated population dose should be low, if an unlikely, but still credible accident should occur."

B. SCOPE, 100.2

With the inclusion of the words "for construction permits and operating licenses," paragraph (a) of this section indicates that the proposed guides would be applied to the demonstration of the adequacy of the site before and after construction of a facility in accord with an AEC-issued construction permit. Since under our recommendation site evaluation will establish design criteria, site approval is necessary prior, and only prior, to the beginning of construction. Further reviews would be concerned with the demonstration that the reactor had in fact been built to the design criteria established for the approved site. Thus the guides should apply only to applications for construction permits.

This section of the guides discloses that the "site" criteria therein contained must be applied more conservatively in the case of novel and unproven reactors. On the other hand, the guides we propose are directed to site evaluation, independent of any proposed reactor, and so can be applied without variance to any site being considered.

We also cannot agree with the inference apparent in this section and instinct in the Commission's concept of a population center distance that conservatism in the building of reactors and geographical isolation of reactors are analogous. We submit that the key to conservatism in this field is reactor design, not reactor location.

C. DEFINITIONS, 100.3(C)

We recommend, rather than defining a population center in terms of its boundary, such a center is better defined in terms of an area with a population density in excess of 5,000 residents per square mile, containing more than 25,000 residents.

D. FACTORS TO BE CONSIDERED WHEN EVALUATING SITES, 100.10

The second sentence of section 100.10(b)(3) stipulates that "Unless special precautions are taken, reactors should not be located at sites where radioactive liquid effluents might flow readily into nearly streams or rivers or might find ready access to underground water tables." Effluent discharge should not be based on zero as a criterion. Such a criterion would be inconsistent with 10 CFR 20, which permits the release of radioactive effluents provided that specified quantities and concentrations are not exceeded. Furthermore, this statement is inconsistent with the primary purposes of these criteria which is to set forth guides for evaluating the hazards resulting from an accident rather than ordinary operations. Since it is believed these inconsistencies were not intended, it is recommended that this section should refer to quantities of effluents resulting from an incident which would exceed maximum radioactivity releases.

E. DETERMINATION OF EXCLUSION AREA, LOW POPULATION ZONE, AND POPULATION CENTER DISTANCE

The discussion under II, "General Comments and Recommendations" above demonstrates that it is not necessary to postulate a fission product release or to estimate an expected demonstrable leak rate from the containment to evaluate a selected site. There is no need, therefore, for the calculation presented by way of example in appendix A. Further, even following the approach in the proposed guides, no sample calculation should be made a part of the guides, less the conclusions drawn therein be substituted for the guides.

However, in the analysis and evaluation of the site, the applicant should determine the radioactive release that would result in the following:

(1) An individual at any point on the boundary of the exclusion area for 2 hours immediately following the release of radioactivity would not receive a total radiation dose to the whole body in excess of the 25 rem or a total radiation dose in excess of 300 rem to the thyroid from iodine exposure.

(2) In the low population zone an individual located at any point on its nearest outer boundary who is exposed to the radioactive cloud resulting from the release of radioactivity (during the entire period of its passage) would not receive a total radiation dose in excess of 25 rem or a total radiation dose in excess of 300 rem to the thyroid from iodine exposure.

(3) In the population center, an individual located at any point on its nearest outer boundary who is exposed to the radioactive cloud resulting from the release of radioactivity (during the entire period of its passage) would not receive a total radiation dose to the whole body or to the thyroid from iodine exposure in excess of specified amounts determined from the number and density of people in the center.

COMMENTS OF GENERAL ELECTRIC CO. ON PROPOSED AEC REACTOR SITE CRITERIA

These comments are submitted on the proposed reactor site criteria published in the Federal Register of February 11, 1961 (26 F.R. 1224). The discussion is divided into the following sections:

I. The Purpose of Site Criteria and Their Limitations.
II. The Contributions of Site Considerations to Reactor Safety.
III. Criteria for Exclusion Areas and Low Population Zones.
IV. Criteria for Population Center Distances.
V. The Proposed Appendix A.
VI. Summary of Conclusions.

I. THE PURPOSE OF SITE CRITERIA AND THEIR LIMITATIONS

General Electric welcomes the development of site criteria as a useful step in the direction of making reactor regulation more predictable and less burdensome. Reactor regulation must move in the direction of standardization in order to avoid becoming a major bottleneck when a significant fraction of all new power plant additions will be nuclear. We recognize that the transition from the present pattern of regulation on a case-by-case review basis to regulation by standards must come gradually, and that regulation by standards cannot completely supplant individual review. Preservation of flexibility in the regulatory process is of great importance, particularly at the present stage of the nuclear business. However, the need for flexibility should not let us lose sight of the crucial importance of developing standards. Because the development of standards is a difficult and time-consuming task, it is desirable to start now.

We fully concur with the statement of purpose in section 100.1 of the Commission's proposed site criteria that "it is not possible to define such criteria with sufficient definiteness to eliminate the exercise of agency judgment in the evaluation of these sites. * * *" Nonetheless, the issuance of site criteria now can accomplish two useful purposes. First, they should enable a utility contemplating the construction of a reactor to make at least a preliminary determination whether a proposed site is likely to be acceptable for a reactor designed with customary safety features. In the favorable case, such a preliminary determination should be possible without extensive engineering work and prolonged consultation with AEC. A negative indication, on the basis of the site criteria, should not be regarded as conclusive. It would, however, mean that detailed engineering work and consultation with AEC would be necessary before it can be determined whether the site is or can be made acceptable, because of the range and variety of engineering features which may be available to compensate for site deficiencies.

The second purpose which would be served by issuing site criteria of admittedly limited value would be to provide a basis for their development and improvement. In the regulatory area, as well as in the technical area, much "development work" is required. In both areas, actual experience is likely to lead to the fastest progress.

To permit the site criteria to be improved in the light of greater knowledge and experience, periodic revision should be required. Such revision should take place at intervals no greater than 2 years. We regard the inclusion of such requirement for periodic revision to be of the greatest importance.

II. THE CONTRIBUTION OF SITE CRITERIA TO REACTOR SAFETY

Before commenting on specific features of the Commission's proposed site criteria, it is desirable to place site considerations into proper perspective from the standpoint of their contribution to reactor safety. One fundamental point is that the contribution which site considerations can make to the safety of the public is relatively small, when compared to the contribution made by engineering barriers to the release of fission products. The Brookhaven report estimated the probability of a serious nuclear accident to be in a range between once in a hundred thousand and once in a billion reactor years. It is doubtful whether site conditions are likely to make a contribution to this low probability greater than one or two orders of magnitude, unless reactors were located in areas more than perhaps a hundred miles from population centers.

The suggestion that reactors be "located in the desert" is again receiving some currency. A historical and an economic note are relevant. The reactors built during the first decade of the American atomic program were generally built in very isolated locations. In the early fifties it was decided that, with the addition of a pressure tight containment sphere, the SIR prototype could be built at West Milton, near Schenectady, instead of in the Idaho desert. This precedent was followed in locating the Shippingport plant near Pittsburgh. The principle that a contained reactor could be built near population centers has been followed ever since. It is clear that the economics of electrical energy transmission are such that nuclear powerplants cannot be built at great distances from the load centers which they serve. The costs of transmitting electricity 100 miles have been estimated to be in the range of 0.6 to 0.8 mills per kilowatt-hour. This is is equivalent to between one-quarter and one-third of the total nuclear fuel cycle cost of a large power reactor which can now be built.

The Anderson-Price Act, in effect, represents a congressional judgment that reactors can be built sufficient near population centers to make their use as powerplants practical, and that it is consistent with the national interest to accept the remote, residual risk of a serious nuclear incident. It is obvious that a national policy of providing liability protection, for private reactors, on the scale of the Anderson-Price Act was only called for on the assumption that reactors were to be built close to population centers. This is fully borne out by the legislative history of the Anderson-Price Act. The congressional judgment underlying the Anderson-Price Act provides the key policy decision for the establishment of reactor siting criteria.

Starting out from the premise that reactors can be built near population centers, the question becomes: How near? Two separate but related considerations are relevant. First, distance from population centers is likely to have an importance from the public acceptance standpoint, which may well exceed its significance from a technical standpoint. Second, it must be recognized that our present experience with large power reactors and their safety features is quite limited. Increased experience should result in a substantially higher level of confidence in the integrity of the engineered safety features. These considerations suggest that it may well be appropriate, for the next few years, to follow a siting policy which encourages the use of sites some reasonable distance from large population centers. As public confidence in the integrity of the engineered safety factors increases, the importance attached to distance can be progressively diminished.

Recognizing the public acceptance value of distance, it is still highly desirable to use site criteria which will make the most effective contribution to safety. As will be explained in some detail in section IV below, we believe the arbitrary population center distance factor proposed by the Commission gives little assurance that the reactor will in fact be located so as to reduce the probability of affecting population centers. We are suggesting instead an approach which combines distance, wind direction, and other meteorological and topographical conditions so as to enable site criteria to make the most effective contribution to the reduction of the probability that a nuclear incident will affect a population center.

III. EXCLUSION AREA AND LOW POPULATION ZONE

We agree with the provisions with respect to the exclusion area and the low population zone contained in section 100.11(a) (1) and (2) of the proposed site criteria. The use of a total radiation dose to the whole body of 25 rems and an iodine exposure to the thyroid of 300 rems represents an acceptable measure for use in these criteria. Similarly, the 2-hour period for the exclusion area and the period of the entire incident for the low population zone both appear reasonable.

We strongly question the desirability of specifying in appendix A any assumptions regarding the fission product release and subsequent behavior. A number of technical objections to appendix A are raised in section V below. Our basic concern however is not with the specific technical judgments underlying appendix A but rather with the assumption that uniform accident assumptions should be made. The rate of fission product release is obviously dependent on the containment system and on other features of reactor and plant design. We believe therefore that the exclusion area and the low population zone should both be based on the analysis of the maximum credible accident as calculated for the particular reactor and plant design, applicable site data, and on resonable interpretations of the laws of nature.

IV. CRITERIA FOR POPULATION CENTER DISTANCES

Section 100.11(a)(3) specifies that the distance to the nearest population center of more than 25,000 shall be 1⅓ times the distance to the outer boundaries of the population zones. We believe that the substitution of a rating system which would reflect all population centers in the surrounding area, and other environmental factors in addition to distance, would provide a much greater degree of assurance that site criteria will make a significant contribution to public safety. The use of distance alone may well be misleading. For example, it may be worse to locate a reactor a substantial distance from a city in a prevailing wind direction than at a smaller distance in an unlikely wind direction.

The location of a reactor can be used independently from the engineered barriers, to reduce the probability that fission products leaving the site will reach population centers. The additional degree of safety against such effects contributed by site selection is a function of the relationship of the plant location to nearby population centers, and the probability that an airborne contaminant would be conveyed to such centers in sufficient concentration to produce an effect of concern.

Rating method recommended

It is recommended that a numerical rating method be developed which considers the most important factors which affect the natural value of a site. Such a method should be independent of reactor type, recognizing that the engineered safety features of any plant to be built near population centers must achieve an acceptable level of safety.

It is believed that a meaningful numerical method can be derived considering—

(*a*) Number of inhabitants in each nearby population center,

(*b*) Distance from the site to each population center,

(*c*) Angle presented by population center as viewed from site,

(*d*) Fraction of time when various diffusion conditions exist, and

(*e*) For each diffusion category, fraction of time that wind is in the population center angle.

For any site, the numerical "potential risk index" would be the summation of the indexes considering each nearby population center. For each population center, the index would be the summation, for each diffusion category considered, of the products of population, diffusion factor, and fraction of time that wind is in the population center angle.

It is recognized that detailed study of this approach will probably reveal additional factors which should be included. For example, the index reduction factor due to atmospheric diffusion in a given distance should include the effect of topography.

It is suggested that all population centers within approximately 50 miles of the site be considered. This distance appears reasonable in view of the probability that the wind during any period of poor diffusion conditions probably would not continue beyond this distance. While greater distances might be affected with higher wind velocities, such velocities would be accompanied by correspondingly better diffusion conditions. Such a method properly measures the value of a site with regard to all population centers which are likely to be affected, and thus provides a more equitable and realistic approach than consideration of the nearest city of a certain size only.

Meteorological data required

This method requires the ability to postulate general fractions of the time that various broad category diffusion conditions exist at the site, and some knowledge of the wind direction distribution during each diffusion category. For most sites, these data can generally be approximated from existing nearby or regional weather stations. Due to the vast difference between good and bad diffusion conditions, the inversion period will control numerically. Great precision in the data used will not be required, as the order of magnitude of the overall index for a site will indicate its natural value in affording protection. Any necessary meteorological projections could be made by impartial consultants.

Interpretation of index

Following development of proper index factors and trial application to a number of sites, it will be possible to categorize index results as:

Index range:	*Site suitability*
Low	Suitable.
Medium	Questionable.
High	Probably unsuitable.

Some variations in the index ranges may be appropriate in order to reflect very large variations in the average inventory of fission products between different reactors.

Those sites determined to be "suitable" by this method would be eligible for reactors with engineered safety features considered appropriate in current practice. Those sites in the "questionable" or "probably unsuitable" category present the possibility of being made suitable if sufficient additional engineered barriers can be included in the plant design to reduce the probability of causing serious effects on large numbers of people to an extent at least equal to the reduction which would have been afforded by favorable site conditions. We would be pleased to cooperate with the Commission in the technical development of an evaluation method of this nature.

Meteorological conditions are usually of substantially greater importance than mileage in determining the value of a site from a safety standpoint. The Convair and Hanford studies which the Commission has sponsored have made significant contributions to a fuller understanding of the meteorological conditions which may affect fission product distribution. It is high desirable that further work in this area be done and applied to the problem of reactor location.

V. COMMENTS ON APPENDIX A

The apparent objective of the proposed appendix A is to provide a simplified accident analysis method for general application. Because the analysis of credible accidents is highly dependent upon the reactor and plant design and to a certain extent on site conditions, standardization of analytical methods does not appear desirable. The general use of oversimplified analysis methods will produce answers which may be dangerously lax for some applications and excessively restrictive in others. We question the need to publish any examples of analytical methods, since the public record, in the form of hazards reports on commercial reactor projects over the past several years, provides a wide variety of examples of analytical methods. In addition to these general comments regarding the purpose of the proposed appendix A, we have a number of comments on specific technical assumptions:

1. Appendix A considers two specific modes of exposure. We question the desirability of looking at direct radiation and thyroid dose only. A preferable analytical method would reach conclusions based upon whatever modes of exposure are of significance.
2. The fission product release assumptions are apparently based on the premise that a major portion of the fission products of the core will be available for release to the enclosure in a short period of time. We question the validity of this premise. Conservative calculations indicate that only a few percent of the core could be initially involved in an excursion, and that several hours of absence of coolant are required for a major fraction of the core to melt due to afterheat.
3. Only a minor allowance is made for fission products removed by plateout. Considering the high probability of operation of both plateout and washout mechanisms, it is probably unrealistic to picture the absence of such mechanisms, particularly when the period of interest is in the range of hours to days.
4. The uniform enclosure leakage assumed appears to ignore the phenomena which will decrease residual pressure and leakage. These are highly dependent upon type of containment.
5. In calculating decay within the enclosure, the use of gross fission product decay seems undesirable. The actual residual quantities of fission products present should be decayed in accordance with their individual half lives.
6. There is no reason for ignoring radioactive decay after leakage has occurred.
7. There is no necessity for ignoring deposit of halogen and solid fission products on the ground. In the case of halogen leakage, this actually is an important method of reduction of cloud inventory. The suggested calculation method, therefore, overestimates thyroid dose due to iodine inhalation.
8. The appendix makes no mention of elevation of release, but the results indicate that a ground-level release probably was assumed. The significance of the radiological effects is highly dependent on elevation of release, which in turn is dependent on plant design factors. Even in the case of release near the ground level, ignoring the initial dilution resulting from the wake effect of the plant buildings unnecessarily overestimates off-plan effects.
9. The calculated results apparently assume no variation in wind direction or in atmospheric stability during the entire period of release. Such assumptions appear unrealistic, particularly when a leakage period of many days is considered. The absence of wind direction diversity contributes to a serious overestimate of the hazard.
10. The appendix assumes that the enclosure is a direct radiation gamma source. This is of course dependent on plant design features. In the example, there appears to be no reason for the arbitrary shielding factor of 10 which was assumed.

VI. SUMMARY OF CONCLUSIONS

Our conclusions can be summarized as follows:

First, we endorse the development of site criteria and agree that criteria should be published at this time. The criteria should provide for periodic revision.

Second, we welcome the recognition by the Commission of the limitations of site criteria: published criteria cannot eliminate the exercise of agency judgment.

Third, we agree with the proposed provisions with respect to the determination of exclusion areas and low population zones, but recommend that calculations with respect to potential fission product release be based on an analysis of the maximum credible accident taking into account the specific reactor design, rather than on the basis of any uniform, arbitrary, accident assumptions.

Fourth, we regard the proposed population center distance factor as technically unjustified, and recommend the development of a rating system which factors in meteorology and other environmental factors, in addition to distance. Such an approach provides a much greater degree of assurance that population center distance will make a significant contribution to public safety.

Fifth, we do not agree with the general applicability or the technical validity of the proposed appendix A and urge that the appendix be deleted.

GEORGE WHITE,
General Manager, Atomic Power Equipment Department, General Electric Co.

JUNE 16, 1961.

[Reprinted from 26 Federal Register, 1224, Feb. 11, 1961]

ATOMIC ENERGY COMMISSION

[10 CFR Part 100]

REACTOR SITE CRITERIA

NOTICE OF PROPOSED GUIDES

Statement of considerations. On May 23, 1959, the Atomic Energy Commission published in the FEDERAL REGISTER a notice of proposed rule making that set forth general criteria for the evaluation of proposed sites for power and testing reactors. Many comments were received from interested persons reflecting generally, opposition to the publication of site criteria, as an AEC regulation, both because such a regulation would, to some extent, incorporate arbitrary limitations and because it appeared that in view of the lack of available experimental and empirical data specific criteria could not be established.

Judgment of suitability of a reactor site for a nuclear plant is a complex task. In addition to normal factors considered for any industrial activity, the possibility of release of radioactive effluents requires that special attention be paid to physical characteristics of the site, which may cause an incident or be of significant importance in increasing or decreasing the hazard resulting from an incident. Moreover, the inherent characteristics and the specifically designed safeguard features of the reactor are of paramount importance in reducing the possibility and consequences of accidents which might result in the release of radioactive materials. All of these features of the reactor plus its purpose and method of operation must be considered in determining whether location of a proposed reactor at any specific site would create an undue hazard to the health and safety of the public.

Recognizing that it is not possible at the present time to define site criteria with sufficient definiteness to eliminate the exercise of agency judgment, the proposed guides set forth below are designed primarily to identify a number of factors considered by the Commission and the general criteria which are utilized as guides in evaluating proposed sites.

The basis objectives which it is believed can be achieved under the criteria set forth in the proposed guides, are:

(a) Serious injury to individuals offsite should be avoided if an unlikely, but still credible, accident should occur.

(b) Even if a more serious accident (not normally considered credible) should occur, the number of people killed should not be catastrophic.

(c) The exposure of large numbers of people in terms of total population dose should be low. The Commission intends to give further study to this problem in an effort to develop more specific guides on this subject. Meanwhile, in order to give recognition to this concept the population center distances to very large cities may have to be greater than those suggested by these guides.

Notice is hereby given that adoption of the following guides is contemplated. All interested persons who desire to submit written comments and suggestions for consideration in connection with the proposed guides should send them to the Secretary, United States Atomic Energy Commission, Washington 25, D.C. Attention: Director, Division of Licensing and Regulation, within 120 days after publication of this notice in the FEDERAL REGISTER.

GENERAL PROVISIONS

§ 100.1 Purpose.

It is the purpose of this part to describe the criteria which guide the Commission in its evaluation of the suitability of proposed sites for power and testing reactors subject to Part 50 of this chapter. Because it is not possible to define such criteria with sufficient definiteness to eliminate the exercise of agency judgment in the evaluation of these sites, this part is intended primarily to identify a number of factors considered by the Commission and the general criteria which are utilized as guides in approving or disapproving proposed sites.

§ 100.2 Scope.

(a) This part applies to applications filed under Part 50 of this chapter for construction permits and operating licenses for power and testing reactors.

(b) The site criteria contained in this part apply primarily to reactors of a general type and design on which experience has been developed, but can also be applied with additional conservatism to other reactors. For reactors which are novel in design, unproven as prototypes, and do not have adequate theoretical and experimental or pilot plant experience, these criteria will need to be applied more conservatively. This conservatism will result in more isolated sites—the degree of isolation required depending upon the lack of certainty as to the safe behavior of the reactor. It is essential, of course, that the reactor be carefully and competently designed, constructed, operated, and inspected.

§ 100.3 Definitions.

As used in this part:

(a) "Exclusion area" means the area surrounding the reactor, access to which is under the full control of the reactor licensee. This area may be traversed by a highway, railroad, or waterway, provided these are not so close to the facility as to interfere with normal operations, and provided appropriate and effective arrangements are made to control traffic on the highway, railroad, or waterway, in case of emergency, to protect the public health and safety. Residence within the exclusion area shall normally be prohibited. In any event, residents shall be subject to ready removal in case of necessity. Activities unrelated to operation of the reactor may be permitted in an exclusion area under appropriate limitations, provided that no significant hazards to the public health and safety will result.

(b) "Low population zone" means the area immediately surrounding the exclusion area which contains residents the total number and density of which are such that there is a reasonable probability that appropriate protective measures could be taken in the event of a serious accident. These guides do not specify a permissible population density or total population within this zone because the situation may vary from case to case. Whether a specific number of people can, for example, be evacuated from a specific area, or instructed to take shelter, on a timely basis will depend on many factors such as location, number and size of highways, scope and extent of advance planning, and actual distribution of residents within the area.

(c) "Population center distance" means the distance from the reactor to the nearest boundary of a densely populated center containing more than about 25,000 residents.

(d) "Power reactor" means a nuclear reactor of a type described in § 50.21(b) or § 50.22 of this chapter designed to produce electrical or heat energy.

(e) "Testing reactor" means a "testing facility" as defined in § 50.2 of this chapter.

SITE EVALUATION FACTORS

§ *100.10 Factors to be considered when evaluating sites.*

In determining the acceptability of a site for a power or testing reactor, the Commission will take the following factors into consideration:

(a) Population density and use characteristics of the site environs, including, among other things, the exclusion area, low population zone, and population center distance.

(b) Physical characteristics of the site, including, among other things, seismology, meteorology, geology and hydrology. For example:

(1) The design for the facility should conform to accepted building codes or standards for areas having equivalent earthquake histories. No facility should be located closer than ¼ to ½ mile from the surface location of a known active earthquake fault.

(2) Meteorological conditions at the site and in the surrounding area should be considered.

(3) Geological and hydrological characteristics of the proposed site may have a bearing on the consequences of an escape of radioactive material from the facility. Unless special precautions are taken, reactors should not be located at sites where radioactive liquid effluents might flow readily into nearby streams or rivers or might find ready access to underground water tables.

Where some unfavorable physical characteristics of the site exist, the proposed site may nevertheless be found to be acceptable if the design of the facility includes appropriate and adequate compensating engineering safeguards.

(c) Characteristics of the proposed reactor, including proposed maximum power level, use of the facility, the extent to which the design of the facility incorporates well proven engineering standards, and the extent to which the reactor incorporates unique or unusual features having a significant bearing on the probability or consequences of accidental releases of radioactive material.

§ *100.11 Determination of exclusion area, low population zone, and population center distance.*

(a) As an aid in evaluating a proposed site, an applicant should assume a fission product release from the core as illustrated in Appendix "A" of this part, the expected demonstrable leak rate from the containment, and meteorological conditions pertinent to his site to derive an exclusion area, a low population zone and a population center distance. For the purpose of this analysis, the applicant should determine the following:

(1) An exclusion area of such size that an individual located at any point on its boundary for two hours immediately following onset of the postulated fission product release would not receive a total radiation dose to the whole body in excess of 25 rem or a total radiation dose in excess of 300 rem to the thyroid from iodine exposure.

(2) A low population zone of such size that an individual located at any point on its outer boundary who is exposed to the radioactive cloud resulting from the postulated fission product release (during the entire period of its passage) would not receive a total radiation dose to the whole body in excess of 25 rem or a total radiation dose in excess of 300 rem to the thyroid from iodine exposure.

(3) A population center distance of at least 1½ times the distance from the reactor to the outer boundary of the low population zone. In applying this guide due consideration should be given to the population distribution within the population center. Where very large cities are involved, a greater distance may be necessary because of total integrated population dose considerations. The whole body dose of 25 rem referred to above corresponds to the once in a lifetime accidental or emergency dose for radiation workers which, according to NCRP recommendations, may be disregarded in the determination of their radiation exposure status. (See Addendum dated April 15, 1958 to NBS Handbook 59.) The NCRP has not published a similar statement with respect to

portions of the body, including doses to the thyroid from iodine exposure. For the purpose of establishing areas and distances under the conditions assumed in these guides, the whole body dose of 25 rem and the 300 rem dose to the thyroid from iodine are believed to be conservative values.

(b) (1) Appendix "A" of this part contains an example of a calculation for hypothetical reactors which can be used as an initial estimate of the exclusion area, the low population zone, and the population center distance.

(2) The calculations described in Appendix "A" of this part are a means of obtaining preliminary guidance. They may be used as a point of departure for consideration of particular site requirements which may result from evaluations of the particular characteristics of the reactor, its purpose, method of operation, and site involved. The numerical values stated for the variables listed in Appendix "A" of this part represent approximations that presently appear reasonable, but these numbers may need to be revised as further experience and technical information develops.

Dated at Germantown, Maryland, this 8th day of February 1961.

For the Atomic Energy Commission.

WOODFORD B. MCCOOL, *Secretary*.

APPENDIX "A"

Example of a calculation of reactor siting distances:

1. The calculations of this Appendix are based upon the following assumptions:

a. The fission product release to the atmosphere of the reactor building is 100 percent of the noble gases, 50 percent of the halogens and 1 percent of the solids in the fission product inventory. This release is equal to 15 8 percent of the total radioactivity of the fission product inventory. Of the 50 percent of the halogens released, one-half is assumed to adsorb onto internal surfaces of the reactor building or adhere to internal components.

b. The release of radioactivity from the reactor building to the environment occurs at a leak rate of 0.1 percent per day of the atmosphere within the building and the leakage rate persists throughout the effective course of the accident which, for practical purposes, is until the iodine activity has decayed away.

c. In calculating the doses which determine the distances, fission product decay in the usual pattern has been assumed to occur during the time fission products are contained within the reactor building. No decay was assumed during the transit time after release from the reactor building.

d. No ground deposition of the radioactive materials that leak from the reactor building was assumed.

e. The atmospheric dispersion of material leaking from the reactor building was assumed to occur according to the following relationship:

$$X=\frac{Q}{\pi u \sigma_y \sigma_z}$$

where Q is rate of release of radioactivity from the containment vessel, the ("source term,"):

X is the atmospheric concentration of radioactivity at distance d from the reactor

u is the wind velocity.

$\sigma_y \sigma_z$ are horizontal and vertical diffusion parameters resp.

f. Meteorological conditions of atmospheric dispersion were assumed to be those which are characteristic of the average "worst" (least favorable) weather conditions for average meteorological regimes over the country. For the purposes of these calculations, the parameters used in the equation in section e. above were assigned the following values:

$u=1\text{m/sec}$;

$\sigma_y=[\frac{1}{2}C_y^2d^{2-n}]^{1/2}$;

$\sigma_z=[\frac{1}{2}C_z^2d^{2-n}]^{1/2}$;

$C_y=0.40$;

$C_z=0.07$;

$n=0.5$

g. The isotopes of iodine were assumed to be controlling for the low population zone distance and population center distance. The low population zone distance results from integrating the effects of iodine 131 through 135. The population center distance equals the low population zone distance increased by a factor of one-third.

h. The source strength of each iodine isotope was calculated to be as follows:

Isotopes	Exclusion Q (curies/megawatt)	Low population Q (curies/megawatt)
I^{131}	0.55	76.4
I^{132}	.68	1.40
I^{133}	1.19	18.5
I^{134}	.72	.91
I^{135}	1.04	5.4

These source terms combine the effects of fission yield under equilibrium conditions, radioactive decay in the reactor building, and the release rate from the reactor building, all integrated throughout the exposure time considered.

i. For the exclusion distance, doses from both direct gamma radiation and from iodine in the cloud escaping from the reactor building were calculated, and the distance established on the basis of the effect requiring the greater isolation.

j. In calculating the thyroid doses which result from exposure of an individual to an atmosphere containing concentrations of radioactive iodine, the following conversion factors were used to determine the dose received from breathing a concentration of one curie per cubic meter for one second:

Isotope	*Dose (rem)*
I^{131}	329
I^{132}	12.4
I^{133}	92.3
I^{134}	5.66
I^{135}	25.3

k. The whole body doses at the exclusion and low population zone distances due to direct gamma radiation from the fission products released into the reactor building were derived from the following relationships:

$$D=483\frac{Be^{-\mu r}}{4\pi r^2}\int t^{-1.2}dt$$

where D is the exposure dose in roentgens per megawatt of reactor power
r is the distance in meters
B, the scattering factor, is equal to

$$\left(1+\mu r+\frac{\mu^2 r^3}{3}\right)$$

μ is the air attenuation factor (0.01 for this calculation)
t is the exposure time in seconds.

In this formulation it was assumed that the shielding and building structures provided an attenuation factor of 10.

2. On the basis of calculation methods and values of parameters described above, initial estimates of distances for reactors of various power levels have been developed and are listed below.

Power level (thermal megawatt)	Exclusion distance (miles)	Low population zone distance (miles)	Population center distance (miles)	Power level (thermal megawatt)	Exclusion distance (miles)	Low population zone distance (miles)	Population center distance (miles)
1,500	0.70	13 3	17.7	500	0.33	6.3	8.4
1,200	.60	11.5	15 3	400	.29	5.4	7.2
1,000	.53	10.0	13.3	300	.24	4.5	6.0
900	.50	9.4	12.5	200	.21	3.4	4.5
800	.46	8.6	11.5	100	.18	2.2	2.9
700	.42	8.0	10.7	50	.15	1.4	1.9
600	.38	7.2	9.6	10	.08	.5	.7

[F.R. Doc. 61-1233; filed, Feb. 10, 1961; 8.50 a.m.]

Chairman HOLIFIELD. At this time we will adjourn until 10 a.m. tomorrow.

(Whereupon, at 4:45 p.m., Tuesday, June 13, 1961, the committee was recessed, to be reconvened at 10 a.m., Wednesday, June 14, 1961.)

RADIATION SAFETY AND REGULATION

WEDNESDAY, JUNE 14, 1961

Congress of the United States,
Joint Committee on Atomic Energy,
Washington, D.C.

The Joint Committee met at 10 a.m., pursuant to notice, in room P–63, the Capitol, Representative Chet Holifield (chairman of the Joint Committee) presiding.

Present: Representatives Holifield, Price, and Bates; and Senator Anderson.

Also present: James T. Ramey, executive director, John T. Conway, assistant director, George S. Murphy, Jr., and Jack R. Newman, professional staff members, Joint Committee on Atomic Energy.

Chairman Holifield. The committee will be in order. This morning we start hearings on problems in the operation of the AEC regulatory process.

The AEC's regulatory organization and procedures have been the object of considerable study in recent months. On March 20, the Joint Committee released a two-volume print containing studies by the AEC, the University of Michigan Atomic Energy Research Project, and the staff of the Joint Committee.

The AEC recommended, and has since adopted certain organizational changes including creation of a Director of Regulation reporting directly to the Commission. These changes were adopted on the basis that they would not prejudice a fair consideration of other proposals for a revision of the regulatory organization.

The University of Michigan study recommended creation of a separate agency to exercise the Commission's regulatory functions, while the Joint Committee staff adopted an intermediate position recommending creation of an internal Atomic Safety and Licensing Board.

Comments on all three studies have been collected in a special preprint for this hearing.

Our first witness this morning is Mr. James M. Landis, special assistant to the President. We have asked Mr. Landis to discuss the historical development of administrative regulation and current problems facing the Federal regulatory agencies. Although we have not asked Mr. Landis to discuss the AEC specifically, we would, of course, welcome his comments. Mr. Landis, it is a pleasure to have you with us.

STATEMENT OF JAMES M. LANDIS, SPECIAL ASSISTANT TO THE PRESIDENT

Mr. Landis. Thank you, Mr. Chairman. Mr. Chairman, I am grateful for this opportunity to appear before this committee because the Atomic Energy Commission presents one of the, shall I say, nice problems in administrative procedure and administrative regulation.

Unlike many of the earlier regulatory agencies, its routines have not been crystalized too definitely, and there is an opportunity, I think, to develop procedure for the Atomic Energy Commission which will avoid some of the mistakes that have occurred through the years in other agencies. I certainly don't want to pose as an expert in regard to the Atomic Energy Commission.

I have never practiced before that Commission. I had the pleasure of talking with the Commissioners and with their counsel in regard to several matters, and also with counsel for the Joint Committee on Atomic Energy. In dealing with the administrative process as a whole, the problems that occur center around the efficiency with which business is dispatched by these regulatory agencies. That problem is very serious in many regulatory agencies. It is not too serious in the Atomic Energy Commission. The regulatory functions of that Commission have as yet not become too great, and the Commission, itself, has been able to dispose of the business before it without too much delay.

The problem, as I see it, before the Atomic Energy Commission, is not dealing with a backlog of cases such as we have at the Federal Power Commission, but it is developing a system of procedure which will handle the regulatory work of that Commission effectively. The regulatory work of the Atomic Energy Commission divides itself into several categories. There is the matter of contract and patent appeals which is now, I think, being quite satisfactorily handled by the Commission. It has recently adopted a means of delegating the initial determination of these matters to persons outside of the Commission. They involve difficult questions of fact, and the Commission reserves the right to review any determination that is made by the persons to whom these matters are delegated.

The Commission also has regulatory powers with regard to the licensing of materials and of reactors. It is in that field that the prime question of what procedures should be applied comes to the forefront. The Commission also has powers with regard to the suspension of licensees, the revocation of licenses and the imposition of penalties for the violation of its regulations.

In the field of suspension, revocation, and the imposition of penalties, probably no serious problem arises. The pattern of handling cases of that nature has been pretty well determined. They are clearly adjudicatory cases in the sense that there is a conflict of interest in these cases. There are questions of fact that have to be decided and consequently they have to go to a hearing and through a quasi-judicial process.

The real problem occurs in the licensing field. Unfortunately, in my opinion, licensing, generally speaking, has been treated too frequently as an adjudicatory matter. It is, in fact, regarded as an adjudicatory matter under the Administrative Procedure Act. Consequently, the proceedings have become judicial in nature. Witnesses are called to establish certain facts. They are cross examined by intervenors, and that kind of a process goes on and involves considerable time and considerable delay. In the reactor field, and I think it is also true in the materials field, it would seem to me that a process that is more informal could be adopted. In other words, a process less judicialized then, for example, the process that characterizes the licensing of a TV station.

In the licensing of TV and radio stations there is usually a conflict of interest. There is usually a situation where two, three, four, or five licensees are asking for a frequency which can only be granted to one applicant. They are contesting with each other their qualifications to receive that kind of a license. It may be, in such cases, that it is a little difficult to get away from the adversary process.

In the reactor cases, as I have seen them—and I do not claim to have too much knowledge of them—the conflict of interest does not exist in the same terms. There are intervenors that come in both at the stage of the construction permit licensing and at the stage of the operational permit licensing. Actually, however, there is a very little conflict of interest between the applicant and the Commission itself. By the time the case is ready to be determined, the technical questions with regard to safety have generally been fully explored and are determined. I say "the technical questions" only. There are other questions with regard to safety in which intervenors come in. Some of these cases, from the way in which you have developed them in volume 2 of your report, remind me in a sense of zoning cases.

As you know, in a zoning application, whenever there is an effort to put a particular structure—or even a road or something of that nature—in a particular community, everybody is for the structure, but says, "Please put it somewhere else not in my backyard." In these instances, you have the conflict of the public interest and the private interest to resolve, and this is usually a characteristic of these cases. If we take the Detroit case, for example—I think it is called the *PRDC* case—that was just recently decided by the Supreme Court, the nature of the intervention was: "Please don't put this reactor plant in the vicinity of a city of this nature, because of safety considerations, not esthetic considerations." Thus, a broad judgment has to be made at the time when the construction permit is to be granted.

It is not so much that the technical questions have to be decided at that time, but, rather, the broad question has to be decided then. At the present time the method of determination involves a reference of the matter to a hearing examiner. Under the law, a hearing is required, and I should certainly say that a hearing should be required wherever there is a desire to contest the issuance of a construction permit.

Chairman HOLIFIELD. Mr. Ramey has a question.

Mr. RAMEY. I think you are developing the thought that in a number of cases under the law there is a mandatory hearing, regardless of intervention, and the logic of what you are saying concerning informality is even more relevant there, where you have no contest.

Mr. LANDIS. I realize that, Mr. Ramey. I think that it is section 189 that calls for the mandatory hearing in these cases. It is mandatory even though there is no contest. As I gather it, the theory behind the requirement is to make plain to the public the determination of the Commission with regard to this issue of safety which has a broad public impact. Turning to that particular point, I often wonder whether or not the device to do that is a hearing. Where a device to handle the problem of notifying the public, giving them an assurance of the conditions under which the permit is granted, and in a sense permitting them even at a later stage to enter an objection if they feel that way can best be accomplished by, say, a publication of a tentative decision on the part of the Commission, or even a press conference or something of that nature, which would explain in lay terms just what the Commission proposes to do. If there is a contest that arises later, as I say, some kind of a hearing is essential. I think one of the crucial issues involved is before whom that hearing should be held.

The objection that is advanced at the present time is that the trial examiner is not necessarily too expert in this field. This is a field that calls for a great deal of expertness. It has been suggested that a board of three men of some kind should really initially make a determination or should make a final determination with regard to that problem. I think it is a difficult thing to answer. The expertise may not be present in the trial examiner.

Of course, if these men were there for years and had preliminary scientific training, it would be different, but it is difficult to get a corps of hearing examiners who have that kind of confidence. I think we have to place finality for the ultimate determination in the Commission itself. To take away that finality and place it somewhere else would seem to me to take away from the Commission that sense of public responsibility that the Congress has imposed on it and that the people believe they should possess.

The suggestion has been made that an independent board be created. The difficulties with that suggestion, as I see them, is that a board of that nature would not have the work, the business that would really be challenging. The regulatory work of the Commission today, I think, occupies about one-sixth or one-quarter of their time. To get a group of even three men to assume this kind of a responsibility without the challenge of real work in it, I think, is a difficult thing. If you had an internal board of that nature, I think there would be some virtue to the idea. Not as an intermediate board of appeal between the hearing examiner, but perhaps a sort of ad hoc board composed of men chosen from the Commission because of their particular qualifications to handle a particular nuclear reactor safety problem. In my thinking on this question, and I have thought it over a little, I have been trying to reach a compromise—not a political compromise in any sense—but a compromise between the concept of the hearing examiner and the concept of expertness that ought to come to the handling of this kind of a problem. My own inclination would move in this direction. I would assume, however, that prior to any reference of a matter of this nature to a board of this type, there would be adequate exploration of the problem, both by the AEC staff and the ACRS group.

There have been some suggestions that ACRS is used either too much or inappropriately. I don't think the record establishes that as a fact. They should be utilized in the appropriate type of case. I thing you could cut down on the utilization of the ACRS if you felt that you could reserve certain problems for a specialized board of the type that I have been talking about. My position in other matters has been always one of trying to build up the hearing examiner as a judge. I would maintain that position if it were not that the type of problem that is faced in these cases is not a contest. There is no real issue of veracity that is involved.

It is, rather, a fundamental issue of judgment, based upon a broad and long record. In those cases I doubt whether the hearing examiner technique is the appropriate technique. However, I certainly would, as I indicated, maintain the ultimate responsibility of the Commission itself. There has been some talk of the desirability, as you know, of breaking up the Commission as between the promotional side and the regulatory side and leaving all regulations with a board and having a single executive handle the promotional operational side of the Commission.

I have heard a lot of theoretical talk on behalf of that kind of proposition. It does seem to me that at this stage of the growth of the problems in the atomic energy field, we may be a little too quick in coming to a decision along that line. As a general principle, it does seem wise to divide functions of that type. Indeed, a reorganization plan has just been presented to the Congress by the President in which he is trying to divide the Federal Maritime Board between its promotional and regulatory features. There you have a broad field of regulation. You have a long history of the desirability of getting that kind of bifurcation. Such a situation has not as yet developed in the atomic energy field, as I see it. I somehow hate to simply follow theory when the practicalities of the situation don't necessarily demand a completely theoretical approach.

Chairman HOLIFIELD. On this plan No. 7, in regard to the Maritime Commission, can you tell us what factors motivated the split of regulatory and promotional functions there.

Mr. LANDIS. Mr. Chairman, I think the prime motivating factor was that the regulatory features of the Federal Maritime Board simply were not developed. The promotional features so much outshadowed the regulatory needs that in a sense, as the chairman of a subcommittee of the House indicated, they just didn't do their regulatory work, and there is plenty of regulatory work to be done in that field.

They were so absorbed by the promotional, the substantive side of the operation, that they just allowed the other to slide, to the detriment of the public interest.

Mr. RAMEY. I think there are some analogies in that sense with the atomic energy program in terms of the money and time that is devoted to their operational and development program. There has been criticism until quite recently they had not moved quickly enough in issuing these regulations. They were bogged down in that field. There has been quite a bit of progress in the last few months.

Mr. LANDIS. Yes, I have heard that. I understand a certain reorganization has taken place inside the Commission where they separated the general manager, or took away from the general manager, the function of a director of regulation. I don't know how that has worked. I imagine that it is too recent to reach a judgment as to how it will work, and whether it will catch up on those areas that you are speaking of. I don't know. Maybe one of the Commissioners can give you an opinion on that. I do know that they did turn their attention to that very problem.

Chairman HOLIFIELD. Of course, the atomic program has been a program that has needed and has had a lot of promotion. Up until reactors actually came into being, the regulatory feature was not so important. The first thing to do is to get the industry going.

Admittedly, during that process regulations were needed. I think one of the criticisms that the committee has had has been that the regulations were not as clear and as complete as they should have been to give industry the guidelines that it needed. At the same time I want to say that I recognize that in a new industry like this you cannot foresee certain circumstances and you cannot peer into the glass ball and see what kind of regulations are going to be needed in some areas. There has been a good deal of activity more recently on the regulatory side.

We feel maybe that should have come a little earlier.

Mr. LANDIS. I won't have any comment on that except that I do know that the members of the Commission have been turning their attention to the problem of developing regulations. Of course, regulations, even in a field such as securities, from a practical lawyer's standpoint are still not as good as they should be. But that is a different problem.

Chairman HOLIFIELD. I was thinking more of the slowness with which site criteria were developed, which caused a great deal of confusion. I have felt all along that the basic problem that you face in building a reactor in any community is first to find the site. I feel that this type of thing was decided in Great Britain in most instances. The first thing done was "Is there a site available that is satisfactory?" Once that is found, then you go ahead. For several years the Atomic Energy Commission negotiated with prospective builders of reactors on the type of reactor, the cost of reactor, and the amount of Government assistance that would be given to them and more or less left the site selection floating.

It also seemed to me that first you had to find the site and get it approved and then talk about the other factors.

Mr. LANDIS. I understand that recently they have developed the site selection.

Chairman HOLIFIELD. Yes.

Mr. RAMEY. Dean Landis, you mentioned that although you may favor an ad hoc internal board in particular cases, that might adjudicate, you still would leave the responsibility for appeal, presumably, to the Commission under some circumstances. One thing that has bothered members of the committee and the staff over a period of years is this final combination adjudicatory decision making power and rulemaking power where the Commission is also the major promoter of this business.

To be more concrete, they have the power demonstration program where the Commission enters into contracts providing research and development assistance to private utilities. To take a particular case that is coming up now, the so-called Peach Bottom reactor, they have a contract with Philadelphia Electric and General Dynamics which they have signed and has been authorized by Congress for the building of this reactor. They have not come in for a construction permit yet. It has been up before their Reactor Safeguards Committee and the Safeguards Committee wrote the same kind of report that they wrote in the *Detroit Edison* case where they said that a lot of things had to be solved. We ran into the situation in our hearings this year where the spokesman for the Commission, Commissioner Wilson, in his written testimony, submitted to the Joint Committee in advance, stated that the Commission had decided that it could not grant a permit in this case at this time. This was submitted in accordance with the committee's request under the 24-hour rule. When Commissioner Wilson got up here to testify, his lawyers had apparently seen the statement and it was changed to say that the staff had not seen fit to consider this permit.

They informally talked to the utility about it. It was quite apparent that this matter must have been discussed all the way up to and including the Commission. The question is, when this case comes up, how can this utility get a fair hearing when it has already gone through the process of a contract, and the Commission has a certain commitment to build this thing promotionally. It has been informally discussed up the line.

This is the kind of problem involved in this combination of your adjudicatory and your promotional responsibility. Perhaps they could have, under the law, designated a board to decide this case. This is probably legal.

Mr. LANDIS. Wouldn't the suggestion of designating a board to decide a thing of this nature bring that to a head and a conclusion of some kind? That is the important thing; isn't it?

Mr. RAMEY. The question is should there be an appeal to the Commission? What criteria would you use for an appeal to the Commission?

Mr. LANDIS. I do not know just what the issues themselves would be after the board itself had decided. Normally, in these nuclear reactor cases, if there is dissatisfaction with the decision of the board, I would assume that the Commission itself would take jurisdiction of the case. It is so important to the public interest. It is not merely one individual against another. It is a terribly important public determination that has to be made.

I would like to make one other observation about a matter that disturbs me a little in the rules of the Atomic Energy Commission, and that is the inability today of the trial examiner and of the Commissioners to exchange ideas with other members on the staff.

As I read the Administrative Procedure Act, section 5(c), no such requirement exists with regard to initial licensing. I think these cases are initial licensing so that an injunction of this nature is self-imposed by the Commission rather than required by any statute.

In the absence of contest that kind of internal communication seems to me to be quite all right. I think if a criterion of enjoying the conversation of the members of the staff were established, the kind of criterion that is set forth in a bill pending before the House Committee on Interstate Commerce introduced by Congressman Harris, H.R. 7333, would be better. Section 3(b) of that bill says there shall be no communication with people who have been investigating or prosecuting the matter.

But beyond that, communication with experts, engineers, scientists, general counsel and so on seems to me a very desirable thing. For the Commission to cut itself off from those opportunities just does not seem to be too wise.

Mr. RAMEY. I think the argument to the contrary has been that it undercuts the hearing record.

Everything has to be on the record and, therefore, you cut yourself off from talking to people that know something about the problem.

Mr. LANDIS. I think it is just carrying the concept a little too far.

Chairman HOLIFIELD. Thank you, sir, for your attendance this morning and your testimony.

Mr. LANDIS. Thank you, Mr. Chairman.

Chairman HOLIFIELD. Our next witness will be Mr. Harold L. Price, Acting Director of Regulation, Atomic Energy Commission.

STATEMENT OF HAROLD L. PRICE, ACTING DIRECTOR OF REGULATION, ATOMIC ENERGY COMMISSION, ACCOMPANIED BY ROBERT LOWENSTEIN, ACTING DIRECTOR, DIVISION OF LICENSING AND REGULATION

Mr. PRICE. Thank you, Mr. Chairman.

Chairman HOLIFIELD. The record will show that Mr. Harold L. Price is the Acting Director of Regulation of the Atomic Energy Commission organization.

Mr. Price, you have a statement here, I see. You may proceed.

Mr. PRICE. Thank you, Mr. Chairman. I have been asked to present a factual statement on the Atomic Energy Commission regulatory organization and procedures, past and present. A detailed description of Atomic Energy Commission regulatory organization and procedure from the inception of the Commission's regulatory program was furnished to the Joint Committee staff last winter and was included in its study of this subject. I will summarize in this statement those aspects which I believe will be of most interest to the Joint Committee.

ORGANIZATION

After some temporary organizational arrangements to set up the regulatory program following the 1954 act, the Commission in 1955 established the Division of Civilian Application with responsibility for administering the regulatory and licensing provisions of the act, except for inspection.

It was also given responsibility for administering certain programs to encourage and stimulate industrial development, primarily in the materials fields. The Division of Inspection had already been established in late 1954 with responsibilities, among others, to inspect licensees for compliance with the Commission's regulatory requirements.

Since 1955 there have been three significant changes in the regulatory organization. The first was made in 1957 when, in order to separate regulatory from promotional functions below the level of the general manager, the Commission abolished the Division of Civilian Application and established in its place the Division of Licensing and Regulation with exclusively regulatory functions. The promotional functions were transferred to other divisions.

The second organizational change was made in November 1959. The position of assistant general manager for regulation and safety was established, with responsibility for the Division of Licensing and Regulation and two newly established units, the Division of Compliance and the Office of Health and Safety.

Actually, the Division of Compliance was not activated until June of 1960. Through this arrangement, all of the Atomic Energy Commission's regulatory functions were placed under the overall direction of an assistant general manager.

The Division of Compliance was given the responsibility, theretofore vested in the Division of Inspection, for compliance inspection of materials and facilities licensees. The Office of Health and Safety was established to provide staff assistance, on health and safety matters, for both regulatory and contract activities, including development of basic standards for protection against radiation hazards and implementation of the Federal-State amendments to the act (sec. 274).

In March 1961 the Commission separated regulatory functions from other functions at the general manager level. It established the position of Director of Regulation, reporting directly to the Commission, with responsibility for administering all phases of the staff work of the regulatory program, including licensing, regulation, compliance inspection, and enforcement.

The considerations which entered into this most recent reorganization will be discussed by Commissioner L. K. Olson later in these hearings.

RULEMAKING PROCEDURES

Procedures for the issuance or amendment of substantive rules by the Atomic Energy Commission are subject to the provisions of the Administrative Procedure Act and are set forth in the Commission's Rules of Practice.

The rulemaking process usually begins with staff studies and deliberations which provide the substantive content of the rule. Depending upon the complexity of the problems identified, such studies may be quite extensive and entail consultations on scientific and technical questions with experts of other staff divisions, the National Laboratories, the Advisory Committee on Reactor Safeguards, and other experts. Where the interests of other Federal agencies appear to be involved, they also are consulted.

Normally, the next step is approval by the Commission of the publication of the proposed rule in the Federal Register for public comment. At that time a news release is also issued.

For the more important rules, industry advisory conferences are convened to provide opportunity for firsthand discussions and exchanges of views by representatives of the segments of industry most likely to be affected by the rule.

The proposed rule is revised in light of the comments received, the views and suggestions expressed at industry advisory conferences, and further staff study. The rule is then issued by the Commission in final form to become effective after a prescribed period, usually ranging from 30 to 90 days, following publication in the Federal Register.

LICENSING PROCEDURES

The basic purpose of the licensing requirement is to provide reasonable assurance, before the licensee embarks on an activity, that he will conduct the proposed activity in compliance with the Commission's regulations and in such a manner as to protect public health and safety, including the health and safety of employees.

The licensing procedures with respect to reactors are more elaborate than those generally observed in materials licensing cases. Copies of each application and application amendment are filed in the public document room and are sent to the Governor of the State in which the reactor is to be located.

Recently, we have also adopted the practice of sending copies to the head of the municipality or county in which the reactor will be located. Copies of all reactor license applications are sent to the Advisory Committee on Reactor Safeguards and a notice of the filing of the application is published in the Federal Register.

The application is reviewed by the technical staff in the Division of Licensing and Regulation. If the proposed reactor is a power or testing reactor, the ACRS is required by law to review the application and furnish a public report. The Committee generally appoints, a subcommittee which meets with the staff and the applicant to discuss the safety problems involved in the project.

Before the meeting of the full Committee to review the application, an analysis of the hazards considerations involved in the application is furnished to the ACRS by the Division of Licensing and Regulation. This practice of preparing an analysis of the case for the ACRS has been in effect since enactment of the Price-Anderson Act in 1957 (Public Law 85–256). When the report of the ACRS is received, it is made publicly available and a news release is issued.

In the case of power and testing reactors, the 1957 amendment to the Atomic Energy Act requires, in addition to the review and public report by the ACRS, that a public hearing be held on the application for permit or license after 30 days notice published in the Federal Register.

This hearing is conducted by a hearing examiner under the Administrative Procedure Act. At this hearing testimony is presented by the applicant, by the members of the technical staff of the Commission who have reviewed the case, and by any person or persons who have intervened. Based on the hearing record, an intermediate decision is rendered by the hearing examiner. This decision is subject to review by the the Commission.

Prior to the intervention in the PRDC proceeding construction permits and operating licenses were issued without prior public notice and without a public hearing unless a hearing was requested by a party or intervenor. At that time the practice was to publish a notice in the Federal Register at the time of issuance of the permit providing 30 days opportunity thereafter in which interested members of the public could intervene and request a hearing. This is the procedure under which the intervenors intervened in the PRDC case.

Shortly after the intervention in the PRDC case, the practice was changed to provide for publication in the Federal Register of prior notice of intent to issue a permit or license with the notice specifically stating that interested members of the public could intervene and request a hearing on the proposed issuance.

In addition, at about the same time, the Commission adopted the practice of making available to the public a staff analysis of the hazards considerations involved in the application.

The practice of making staff hazards analyses available to the public on power and testing reactors was discontinued some time after enactment in 1957 of the mandatory hearing requirement because of the extra burden imposed on the staff to prepare both this document and the fuller testimony required for the hearing.

Discontinuance of the practice has, however, probably made it more difficult for interested members of the public to familiarize themselves with the hazards considerations involved in the power and testing reactor applications prior to the time of the hearing. For this reason, and as suggested in the JCAE staff study, we are reinstituting the publication of staff hazards analyses on initial applications for construction permits and operating licenses in the power and test reactor cases.

As a matter of fact, we have continued throughout to do this for the other cases that are issued on notice. As an additional step to provide full opportunity to interested members of the public to become familiar with proposed power and testing reactors, we plan, on an experimental basis, to hold public meetings at convenient times and places in the vicinity of such projects. At these meetings, prior to and independent of the formal hearing, the Atomic Energy Commission staff will discuss the Atomic Energy Commission's regulatory procedures, the safety considerations involved in the proposed project, and answer questions from the audience.

Chairman HOLIFIELD. A question by Mr. Ramey.

Mr. RAMEY. Is this procedure a direct outgrowth of the suggestion made by Professor Davis in his comments to the Joint Committee on this matter?

Mr. PRICE. It is. We thought it was a good idea and we want to try it out.

Mr. RAMEY. It shows flexibility and initiative.

Mr. PRICE. Appropriate news releases are issued when applications are filed, when the ACRS reports are made publicly available, when the staff hazards analyses are made available, and when the place and time of public hearings on applications have been determined.

The procedures just described are those applicable to an application for a construction permit. Substantially the same procedures are followed on the application for a license to operate the completed reactor.

RESEARCH AND TRAINING REACTORS

The procedures followed in taking action on applications for licenses to construct and operate a research or training reactor conform to those observed for power and testing reactors with the exception that the mandatory hearing procedure and mandatory ACRS review are not applicable to these types of facilities. Copies of the application, however, are always furnished the ACRS for its information and the advice of the Committee is obtained if it appears either to the staff or to the ACRS that unusual or novel safety features are involved.

Chairman HOLIFIELD. These reactors are small flux reactors and it is on that basis that you feel this is necessary?

Mr. PRICE. They can go up to 10 magawatts. These are the smaller ones. Most of the reactors in this range are similar to previous reactors, and most of them are university reactors. We have worked out a procedure here with the Safeguards Committee under which they get all the applications, we discuss with them what is pending, and we meet with them every month or two.

If there is a problem that we think we should get their advice on or that they would like to look at, we schedule a meeting.

Although no "mandatory" hearing is held on research or training reactors, notice of proposed action is published in the Federal Register, giving advance notice of the action the Commission proposes to take; and a staff hazards analysis is made public. The notice is designed to give persons whose interest may be affected an opportunity to request a hearing. A news release is also issued. Both the Federal Register notice and the news release advise of the availability of the staff hazards analysis.

Mr. RAMEY. That procedure is quite new, is it not?

Mr. PRICE. Not for these. We have put the staff hazards analysis in the public document room since shortly after the PRDC intervention in 1956. This is on research reactors.

Mr. RAMEY. How about on power reactors and testing reactors?

Mr. PRICE. As I said on one of the preceding pages, Mr. Ramey, on power and testing reactors shortly after the PRDC intervention—as a matter of fact, in October of 1956—we initiated the practice of releasing the staff hazards analysis at the time of the notice and offer of a hearing, even in those cases.

What happened was that the following year after the mandatory hearing requirement was enacted we found ourselves in a position of publishing a staff hazards analysis and a tentative position of the staff at the time of the notice of the hearing, and then we had to prepare a more comprehensive statement for the testimony.

After the Price-Anderson Act we dropped the practice of publishing the staff hazards analysis in advance of the hearing, relying on the testimony to be the method of informing the public of the staff's position.

As I also said previously, we have now reinstituted this practice even for the testing and power reactors and we are now publishing in advance of the hearing the staff's position and the staff hazards analysis.

As I said, we are going to hold a public meeting and explain it.

Mr. RAMEY. Is the hazards analysis attached to the press release?

Mr. PRICE. I am not sure it is because it is usually a bulky document. The press release says it is available.

Mr. LOWENSTEIN. Yes. In the superheat case it was attached to the press release and we are going to try to follow that practice.

Mr. RAMEY. As you know, after you dropped your initial practice, the committee brought this question up and the committee was under the impression that this was being continued, and then we were somewhat surprised to find that this method of notice had been dropped.

This was one of the recommendations the committee staff made in its report.

Mr. PRICE. That is right.

Mr. RAMEY. We are glad that this has been reinstituted.

Mr. PRICE. Shall I proceed?

Chairman HOLIFIELD. Proceed, please.

Mr. PRICE. Materials licensing: In materials licensing cases, the Division of Licensing and Regulation reviews the applicant's technical qualifications, the adequacy of the radiation safety procedures and equipment to be used, and, in appropriate cases, the applicant's financial qualifications.

When necessary, a prelicensing visit by a member of the staff is made to the applicant's premises to make an on-the-spot evaluation of the applicant's facilities, equipment and radiation safety program. Such visits are made when the proposed use presents a potential hazard which cannot fully be evaluated by application review only. Copies of materials licenses are sent to the health department of the State in which the licensee is located.

As a matter of fact, this practice has been going on since the 1946 act.

ENFORCEMENT PROCEDURES

With respect to compliance inspections of licensees, the inspectors prepare reports setting forth the scope and results of their inspections, including items of noncompliance, and recommendations for enforcement action. In any case where there appears to be a present hazard to health and safety, the field inspector is required to notify headquarters immediately of the existence of the situation so that prompt corrective action may be taken to rectify the situation.

In cases in which immediate enforcement action is not required, a letter is sent to the licensee setting forth the facts demonstrating the alleged violation and providing the licensee an opportunity to submit an explanation of the violations and the steps he will take to assure compliance in the future. In some instances it is necessary to take further action, including the issuance of appropriate orders, subject to the licensee's right of hearing.

In cases of a willful violation or of a present threat to public health and safety, an order may be issued, effective immediately, suspending a licensee's operations or permitting continued operations under restrictive conditions pending hearing.

These hearings are, of course, conducted by a hearing examiner pursuant to the requirements of the Administrative Procedure Act. Evidence is presented by the members of the staff prosecuting the enforcement proceeding and by the licensee. An intermediate decision based on the hearing record is rendered by the hearing examiner, and this decision is subject to review by the Commission.

Mr. Chairman, this, in brief, covers the main points in the development of the Commission's regulatory organization and the procedures for carrying out the regulatory program.

Chairman Holifield. Thank you, sir. Mr. Ramey has a series of questions he wishes to ask at this time.

Mr. Ramey. Mr. Price, can you tell us how the functions of the Assistant General Manager for Regulation and Safety differ from the functions of your new office, as Director of Regulation?

Mr. Price. I think, Mr. Ramey, that they differ in two respects. First, as Acting Director of Regulation, I report directly to the Commission on regulatory matters. Under the Assistant General Manager for Regulation and Safety, of course, the reporting was through the General Manager to the Commission.

Second, the Commission has more clearly—and I suppose this is really part of what you reserved for Mr. Olson's testimony—drawn up the functions of the regulatory staff than previously.

For example, I do not have under my supervision all of the functions that were formerly in the Office of Health and Safety. I have only those functions that the Commission considered primarily regulatory. That includes the work of developing basic radiation standards, the dose limit work, the work with the National Committee on Radiation Protection and the Federal Radiation Council, that sort of thing.

It also includes the work of implementing the provisions of last year's act authorizing the States to take over from the Commission some of these regulatory functions.

The portions of the Office of Health and Safety that had to do primarily with appraisal of the programs of safety in the Commission owned plants and laboratories are not under me. It was left with the General Manager.

Mr. RAMEY. Did they leave any people? For example, let us take the reactor hazards staff, did all of Dr. Beck's staff go over to you?

Mr. PRICE. All of the Division of Licensing and Regulation is under the regulatory part of the Commission. All of the Compliance Inspection Division is under the regulatory part. And the portion of Health and Safety that I mentioned. Maybe I am anticipating your question.

Mr. RAMEY. We talked about this a little yesterday. How does the Atomic Energy Commission reactor development and promotional side function? They have to come to you and Dr. Beck for review of their reactors, do they not?

Mr. PRICE. Prior to this all proposals to build new Commission reactors were required to be submitted to Dr. Beck's office. He is the head of the hazards evaluation in the Division of Licensing and Regulation—all of those proposals were required to be reviewed by that office, and by the Advisory Committee on reactor safeguards in the important cases, where we or the Committee thought they ought to.

That requirement for review is continued in force.

Mr. RAMEY. Do requests to the hazards group go through the General Manager, up to the Commission and back to you?

Mr. PRICE. No. We are all in the same organization. When the Reactor Development Division has a case pending to build a new reactor at Argonne or Los Alamos, they refer it to us and we review it just like we did in the past and we take it to the ACRS if it is a significant case, and we furnish a safety analysis.

Mr. RAMEY. In the past if there was a difference of opinion between your hazards staff and the people in Reactor Development, that was decided by the General Manager?

Mr. PRICE. In the past it was decided by the General Manager. Under the present system it would be decided by the Commission.

Mr. RAMEY. So that is something that has to go upstairs one more notch?

Mr. PRICE. Except that those disagreements just haven't happened. They are not likely to happen.

Mr. RAMEY. How about regulations? It is our understanding that one regulation was held up more than a year by reason of a difference of opinion between the Reactor Development Division and the Licensing Division. It floated around in the General Manager's Office and perhaps the Commission for that long.

This sort of thing would then have to go up to the Commission to be decided, is that right?

Mr. PRICE. Mr. Ramey, the problem of getting out regulations—you are talking about the parallel procedures regulation, I believe, and it had a lot of problems for all of us.

For sure we took a longer time in getting it out than we should have. There is no reason in the world why under this system these problems can't be ironed out at the staff level. It is a fact that if we finally resolved our own position on the regulation side and one of the divisions under the General Manager was opposed, sure the time would come to take it to the Commission where it ought to be resolved.

Mr. RAMEY. Under your interim arrangement, with you as the Acting Director of Regulation, could you describe a little bit your contacts with the Commission? How many times have you discussed regulations and licensing with the Commission?

Mr. PRICE. Counting formal meetings, informal meetings, and meetings with individual Commissioners, almost every day, Mr. Ramey.

Mr. RAMEY. How many formal meetings have you had?

Mr. PRICE. I would have to go back to the record to give you that.

Mr. RAMEY. Could you provide that for the record?

(The material referred to follows:)

ATOMIC ENERGY COMMISSION,
Washington, D.C., June 19, 1961.

Hon. CHET HOLIFIELD,
Chairman, Joint Committee on Atomic Energy,
Congress of the United States.

DEAR MR. HOLIFIELD: At the regulatory hearings on June 14 I was asked to submit for the record the number of Commission meetings I have participated in.

I have been informed by the Office of the Secretary of the Commission that from March 10, 1961, the date of my appointment as Acting Director of Regulation, to June 14, 1961, I participated in 26 Commission meetings.

Sincerely yours,

H. L. PRICE,
Acting Director of Regulation.

Mr. RAMEY. What do you discuss?

Mr. PRICE. We discuss pending work on regulations, pending matters of policy. During the first month or two after my appointment we did a lot of discussing about organizing and setting up the regulatory side.

Mr. RAMEY. You mentioned you discussed these matters with individual Commissioners. Do you discuss them with any particular Commissioner? Has any one Commissioner been designated to deal with the regulatory program generally?

Mr. PRICE. No, sir. These Commissioners are busy people and you sometimes try to catch one and you sometimes try to catch two, three, or all of them. Of course, you have them when you have them in a meeting, but there is no particular one. I have discussed matters with Mr. Olson, I have discussed them with Mr. Graham, I have matters to work out with Commissioner Haworth, and I have had matters to work out with Commissioner Wilson.

I have a few discussions with the Chairman. He has been really busy since he got in on some other things, so it has been less with him than with the others.

Mr. RAMEY. I know in terms of this study and the committee's relations on this it was Mr. Olson that was designated and our correspondence has been with him. I just wondered whether or not he was the regulatory Commissioner.

Mr. PRICE. I would have to say that perhaps if I were adding it up, that I had seen Mr. Olson more times than the other Commissioners.

Mr. RAMEY. Throughout this study, and perhaps your study, the key problem in the regulatory field has been this matter that Dean Landis mentioned, that we are dealing here essentially with a technical problem and the matter of safety. We are dealing in most cases with noncontroverted licensing cases where you do not have intervenors.

It was for this reason, perhaps, that the staff had recommended and others had recommended a separate board. The staff recommended this three-man regulatory board with two technical people on it.

In getting comments and discussing it informally, a further problem was raised on this technical consideration business and the need for the technically oriented and trained people to have some role in decisionmaking power. On the regulatory program, Mr. Price, you are the Acting Director, and you are an attorney, as I recollect.

Mr. PRICE. That is right.

Mr. RAMEY. As you know, our profession has been criticized a good deal. In the interest of bringing out the role of the administrators who are making the decisions, could you describe the background of the people that are under you in the Licensing Division who are making these technical decisions? Who is your Director of Licensing?

Mr. PRICE. The Director of the Division of Licensing and Regulation is Mr. Robert Lowenstein, on my right.

Mr. RAMEY. What is his background?

Mr. PRICE. He is a lawyer.

Mr. RAMEY. Who is the Assistant Director?

Mr. PRICE. The Assistant Director for Reactor Safety is Dr. Beck.

Mr. RAMEY. Are there any others?

Mr. PRICE. First below him is the Deputy Director, Mr. Richard Kirk, who is a chemical engineer.

Mr. RAMEY. How about the Assistant Director?

Mr. PRICE. The Assistant Director for Administration is Mr. Eber Price. As Congressman Price had to say one time in a hearing that he and I were not related, I must tell you that I am not related to Mr. Eber Price.

Mr. RAMEY. What is his profession and background?

Mr. PRICE. He has been in administration in all of his previous experience. He has studied law, but never practiced.

Mr. RAMEY. Who is your Assistant Director for Materials Licensing?

Mr. PRICE. Lyle Johnson.

Mr. RAMEY. What is his profession?

Mr. PRICE. He has been an administrator all of his life. He studied law, which is a help to him, but he didn't practice.

Mr. RAMEY. So your Director is a lawyer, the Director of the Licensing Division is a lawyer, the Assistant Director is a lawyer, and the Director of one of your other Divisions is a lawyer. Your hazards group Director is a technical man?

Mr. PRICE. Also the head of the safety standards group on materials, Mr. Rogers, is a technical man. All of the people under them are technical people, and the head of the Enforcement Branch is a technical man.

Mr. RAMEY. Going up the line, we have seen that the Commissioner that you have dealt with mostly is a lawyer. Who is the adviser to the Commission on regulatory licensing matters in terms of this arrangement for keeping the staff separated?

Mr. PRICE. I hope I am their main adviser with the help of my technical people. You will have to ask the Commissioners if they have any more. I think it would be better.

Mr. RAMEY. Do you have a function in the adjudicatory matters?

Mr. PRICE. Not in adjudicatory; no.

Mr. RAMEY. Who is the adviser to the Commission on adjudicatory matters?

Mr. PRICE. Mr. Ramey, on adjudicatory matters, as you know, we have this rule in effect that Dean Landis mentioned prohibiting ex parte communications with the Commissioners. When a case is finished with the hearing examiner, and goes to the Commission for decision, under that rule they do not consult me or anybody on my staff. I do not know who all they consult. I would prefer you would ask that question of the Commissioners.

Mr. RAMEY. I do not want to plead ignorance here, but doesn't your report and isn't it rather well known that the Commission in the past had a legal adviser?

Mr. PRICE. I am sure they consult the General Counsel's Office, but I would not be in a position to tell you who they consult.

Mr. RAMEY. Mr. Price, this amazes me. Haven't they had an established relationship of an attorney that advises the Commission on regulatory matters?

Mr. PRICE. I believe they do, Mr. Ramey, but I don't think I can give you a full answer. I am trying to be as helpful as I can.

Mr. RAMEY. There are a couple of representatives of the Commission here.

Mr. GRAHAM. What is the question, Mr. Ramey?

Mr. RAMEY. The question is: Does the Commission, as a part of its adjudicative procedure, have an established adviser in this separated staff relationship?

Mr. GRAHAM. Mr. Ramey, we rely on the General Counsel's Office.

Mr. RAMEY. Is there any one individual that has been designated for that purpose?

Mr. GRAHAM. Mr. Naiden is our General Counsel, sir.

Mr. RAMEY. Is there anyone else within the Office of the General Counsel?

Mr. GRAHAM. There could be people helping him. I will ask him who he has helping him, but I rely upon the General Counsel's office.

Mr. NAIDEN. My name is Naiden. The man in the Office of the General Counsel to advise the Commission—and they do not get much advice because they read the record—is Mr. Kingsley, who is a physicist and later studied law. I think he is a Phi Beta Kappa.

Mr. RAMEY. Did he have a predecessor in that position?

Mr. NAIDEN. Yes; he did. Mr. Oulahan did this work for about a year and a half under the jurisdiction at that time of Mr. Olson, who was General Counsel. I think Mr. Oulihan still works occasionally on a specific case because sometimes Mr. Kingsley, by reason of participation in a case when he was in the Division of Licensing and Regulation legal office is barred from participating in the case.

For example, the *Walker Trucking* case was such a case. Mr. Kingsley is precluded in that case, for example.

Mr. Ramey. Mr. Naiden, I was just trying to bring out that the Commission gets its advice on these cases from a lawyer and not from a technical man. This was a part of developing that information which is no mystery since it is brought out in our staff report and other places.

Mr. Naiden. Mr. Price had no reason to know all of these details, although he might have known them accidentally. The point I would like to emphasize is that the Commissioners usually look at these records themselves and about the only function that is performed by the lawyers in advising the Commission generally is in the preparation of some memos on the law or in assembling the record, or perhaps in aiding them in writing a decision after they make up their own minds. We do not play an enormously large role in this exercise at all.

Mr. Ramey. Does the Solicitor prepare a summary of the record of these cases for the information of the Commission?

Mr. Naiden. I think he has in many of them. In one of the recent cases—I would have to go back and check—I think generally he does prepare a summary of the important legal points. We have prepared draft decisions which, I might say, have been more often than not changed, and sometimes substantially, by the Commissioners themselves.

The point I want to make is that they do their own work.

Mr. Ramey. Thank you.

Mr. Price, could you elaborate a little more on the technique of the hearing that the Commission holds in power reactor testing cases? How is the testimony presented—orally or in writing?

Mr. Price. The testimony of the staff is always prepared by the technical people in the staff who have reviewed the case. It is reduced to writing and submitted at the hearing. I believe sometimes it has been merely submitted, but more recently I believe it has been read in open hearing.

Mr. Ramey. Do you consider that these hearings are similar to a judicial proceeding with examination and cross-examination of witnesses, and so on?

Mr. Price. Mr. Ramey, this question takes a little bit of elaboration. The Congress in 1957 imposed on the Commission the requirement that we hold a mandatory hearing in all of these cases. We have been criticized for the number of hearings we hold. We thought we were carrying out the law.

We believe that is what the law required. We believe that the law requires that it be held under the Administrative Procedure Act. I will have to say that in many of these hearings the issues of safety between the applicant on the one hand and the staff and the ACRS on the other have been satisfactorily resolved either by the applicant convincing the staff and the ACRS that he has a good point or by the applicant agreeing to make modifications in his plan or his design so that there are not or there have not been many substantive issues between the witnesses.

We do not think we have any right to regard these hearings under the present statutory requirement as anything but adversary, and that is the way we have conducted them.

Mr. RAMEY. Do you think that the number of hearings that the Commission holds, including all changes, et cetera, are required by law? As Director of the Licensing Division, did you initially agree with this position?

Mr. PRICE. I wish you would not dig so deep into some of the internal discussions that the Commission has. I work for the Commission and I support the Commission decisions while I am there.

I might have disagreed on some questions as to whether a hearing was necessary, but I cannot argue the decisions of the General Counsel and the Commission on what the law requires.

It is true I used to be in the General Counsel's office, but my business is administrative now, and I am prepared to take the advice of the General Counsel.

Mr. RAMEY. You partially answered the question. You said you might have disagreed. The question was, did you?

Mr. PRICE. I think I probably disagreed, and I think maybe they have convinced me that they were right. You see, here is the trouble, Mr. Ramey, about whether we are holding hearings that the law doesn't require.

It is easy for some of us, and maybe initially I was one of them, to take the position that the law only requires a hearing for a construction permit or a license, and you do not have to have hearings on amendments. The trouble with that is that, when you think it through, an amendment can come into a construction permit or a license raising a more important issue of policy or safety than was decided in the first place.

So it is hard to argue that we just do not have to have these hearings under the present system. I should add that all the people who have studied this procedure—your staff, the Berman-Hydeman study, and the Commission study—recognized that there was room for the Joint Committee to take a look at this and to see whether the requirements of the mandatory hearing should not be relaxed.

Mr. RAMEY. I have one last question.

On research reactor arrangements, and under the proposed rule concerning authorization for changes, this requires a determination of circumstances for referring safety questions to the ACRS. Who determines this matter?

Mr. PRICE. The determination of what cases go to the ACRS?

Mr. RAMEY. Yes.

Mr. PRICE. In the first place, the law requires all power and test reactors to go. The way this decision is worked out is like this: In the cases other than power and test reactors, we send copies of the application, as I stated, to the ACRS automatically.

If they see a problem that they would like to go into, they are able to tell us. If we think there is a significant enough problem, we ask them to take it and look at it and give us a formal report.

Mr. RAMEY. By "we," whom do you mean?

Mr. PRICE. The decision obviously, or the responsibility, rests on the Director of the Division of Licensing and Regulation, subject to any supervision that I or the Commission might want to exercise.

I assure you, Mr. Ramey, that those decisions are not terribly hard decisions to make. They are made on the advice of competent technical people. I am afraid we are getting to a question here that is a little bit embarrassing for me to try to answer. I think perhaps other people ought to answer.

I would like to point out for the record, since we have gone this far, that these questions that we are talking about are not deep scientific questions that can only be resolved back in somebody's laboratory. Sure, we need and could not move without the help of competent technical people, and we get that help.

We who are not technically trained cannot determine the calculations, and we cannot determine what the technical safety question is, and, therefore, what the risk is. But once that has been identified to us, you and we and anybody with reasonable training can make a commonsense judgment as to whether the risk is acceptable or not.

That is the posture we are in.

Mr. Chairman, I would like to amplify one thing earlier in Mr. Ramey's questioning. The record ought to show that my arrangement with the Commission on seeing the Commission includes automatically the right to see the Commissioners in a meeting of all the Commissioners at their morning meeting in the Chairman's office on Monday, Wednesday, and Friday of every week, so any time I have anything that needs their attention I am automatically invited first thing, 9:30 Monday, Wednesday, and Friday, and then any other times in between that I need them and can catch them.

Chairman HOLIFIELD. Are there any further questions? If not, thank you very much, Mr. Price, for your statement and your responses to the questions.

Mr. PRICE. Thank you, sir.

Chairman HOLIFIELD. It is going to be necessary to adjourn the meeting at this time. We are running a little late, but we will start at 2 o'clock with Mr. Trowbridge and Mr. LeClair as witnesses.

(Whereupon, at 11:45 a.m., the Joint Committee recessed, to reconvene at 2 p.m., the same day.)

AFTERNOON SESSION

Senator ANDERSON (presiding). This afternoon the committee resumes hearings on problems in the operation of the AEC regulatory process.

We look forward to the testimony of witnesses who have followed closely the development of AEC procedures over the years. We also hope to receive many valuable comments on possible improvements in the regulatory process.

Our first witness this afternoon is Mr. George F. Trowbridge, of the Washington law firm of Marks & Trowbridge.

It is a pleasure to have you with us.

STATEMENT OF GEORGE F. TROWBRIDGE, ESQ., ATTORNEY AT LAW, WASHINGTON, D.C.

Mr. TROWBRIDGE. Thank you.

Senator Anderson, my name is George Trowbridge. I have been practicing law in the District of Columbia since early 1954 in partnership with Herbert S. Marks, first General Counsel of the AEC, until his untimely death last November.

Much of my work during this period has been connected with the private development and construction of nuclear powerplants. My testimony reflects my own views and not necessarily those of any of the companies with which I work.

I plan to talk mainly about the AEC formal hearing procedure in licensing power and testing reactors. I have chosen this single aspect of AEC organization and procedure because, being a lawyer, this is the part of the AEC licensing process with which I am most familiar and with which I have had the most experience.

Also, hearing requirements can, I believe, be considered separately from other aspects of AEC organization and procedure, and changes could be put into effect before tackling broader aspects of the AEC regulatory process.

I do want, however, to record my endorsement of the general scheme of organization and procedure proposed in the Joint Committee staff study. The creation within AEC of a Safety and Licensing Board, with final authority to dispose of reactor license applications, seems to me a sound idea.

Creation of the Board would go a long way toward laying to rest anxieties about conflicts in the Commission's regulatory and promotional responsibilities. The Board, as a full-time body, would be in a position to check carefully the work of the applicant and the AEC staff and would be technically qualified to make decisions. It could relieve the Advisory Committee on Reactor Safeguards of the more routine matters which now come before that committee. These advantages and others are elaborated upon in the Joint Committee staff study, and I will not repeat here the reasons which led the staff to its conclusions.

Some of my remarks about the AEC formal hearing procedure will be critical. Formal hearings have, I think, been overdone. But I want to make it very clear from the outset that I do not advocate a return to the procedures which were put into effect during the early administration of the 1954 act and which gave impetus to the 1957 amendments and the mandatory hearing requirements.

I think it important that the process by which AEC arrives at licensing decisions, including reports of the Advisory Committee on Reactor Safeguards, be a matter of public record. I think also that members of the public with a legitimate interest in the proceedings ought to have an effective opportunity to intervene and to be heard, and that any objections that they may have to proposed licensing actions ought to be ironed out before and not after the action is taken.

To put matters bluntly, I do not favor reverting to the procedures under which the PRDC construction permit was first issued and which, I believe, were in some measure responsible for the litigation which has since plagued that project.

There is need, however, to reevaluate and to redefinite the purposes to be served by public hearings in AEC licensing proceedings. There is need to consider also to what extent these purposes might equally well be served by less cumbersome and time-consuming means than the formal hearing process.

Formal hearings on license applications must be evaluated in the context in which they typically occur and in the light of the events which precede them.

The licensing process begins, of course, with the filing of an application. Notice of the application is published by the AEC and a copy of the application and accompanying hazards report is sent by the

AEC to the Governor of the State in which the reactor will be located, or his designee. Just rcently AEC has proposed to require that copies of applications be filed also with the head of the county or municipality involved. Usually the applicant will have seen to it that other interested State and local agencies are provided with copies of the application and supporting documents.

Copies of all material supplied by the applicant are placed by AEC in the public document room. The filing of the application is picked up and reported by several services and trade publications. In addition, of course, in the case of a power reactor, the project is already likely to have received a good deal of publicity, particularly in the area which the plant will serve. All in all, interested members of the public have ample opportunity to know about the application and to find out more about it.

Depending on the nature of the license application—whether for a construction permit, an operating license, or a license amendment—review by the AEC staff and the ACRS is likely to take anywhere from 2 or 3 months on up. The applicant and the reactor designer can expect during this period to have several meetings with the AEC staff and one or more meetings with the ACRS or an ACRS subcommittee.

The applicant may be requested, following these meetings, to file supplemental information. He may also decide as a result of these meetings to change certain features of the plant or its method of operation which have been questioned by the AEC. The process of AEC review has been longer for some projects than others, but in the end all applicants to date have either satisfied AEC and the ACRS as to the safety of the project as proposed, or have made such changes in it as were necessary to obtain AEC and ACRS approval.

While there have been variations in the pattern of licensing proceedings, all power and testing reactor proceedings to date, with the single exception of PRDC, have by the time they reached the stage of a public hearing had two elements in common. First, there have been no important safety issues between the applicant and the AEC staff. Secondly, in each case State officials and other potential intervenors have either decided not to intervene in the proceedings or, where they did so, voiced no objection to the issuance of a license.

It is not easy to explain to an applicant under these circumstances just what purpose is going to be served by a further formal hearing on the application. Nor is it easy to rationalize the time and work the applicant's engineers and lawyers will have to put into the preparation and presentation of testimony which merely condenses and summarizes information already furnished in the application.

The role of the hearing examiner in the hearing is also puzzling to the applicant. If, as is normally the case, the hearing is an uncontested one, he does not play his traditional role of weighing and deciding upon conflicting claims and evidence. Being a lawyer and not a scientist or engineer, he cannot be expected—and in my view should not try—to reach an independent judgment as to the safety of the project. The matter of reactor safety is peculiarly one requiring the judgment of technical experts.

Public hearings in uncontested licensing proceedings have been advocated by some as a means of promoting public understanding of and confidence in the licensing process, and as a means of facilitating intervention by State and local officials and others in the proceedings. These are sound objectives but can, I believe, be better accomplished by less cumbersome means.

I have watched a number of AEC hearings on facility licenses. These have not been well attended by the public nor widely reported in publications of general interest and circulation.

I think the hearings have accomplished far less than other measures adopted by AEC to promote dissemination of information and public understanding about licensing proceedings. In particular, I think AEC has adopted an excellent policy in insisting that even informal communications and submissions by the applicant to AEC, as well as license applications and other formal papers, be placed in the public document room.

This greatly facilitates the job of those who have an interest in following the course and understanding the outcome of the proceedings. This policy does more in my view, than formal hearings to accomplish what I think should be the real objective of licensing procedures in uncontested cases. This objective, to borrow the words of the Joint Committee staff study, is that "AEC safety proceedings should be public and on the record."

The public hearing does under current procedures accomplish one purpose not presently served by any other means. It puts into the public record the views and conclusions of the AEC staff on the license application. This, however, could be done as well and at an earlier point in the licensing proceedings by returning to the practice formerly employed by AEC of publishing a summary of the staff safety analysis.

Mr. Harold Price testified this morning that AEC planned to return to this practice.

As to facilitating intervention by State and local officials or others, I do not think it necessary to schedule and hold public hearings simply for this purpose. The important thing is that interested persons have ample notice of license applications and sufficient opportunity to follow the course of licensing proceedings to decide whether they wish to intervene and to request a public hearing.

The time to facilitate public participation in licensing proceedings is at the beginning of the proceedings, not at the end. In this way, the participation of interested persons is most likely to result in constructive contributions and may forestall controversies and misunderstandings that could otherwise occur. Furnishing copies of the license application and hazards report to State and local officials is a good way to start.

AEC should make it easy for others to request and obtain copies of this and similar materials. Prompt publication and dissemination of the AEC staff safety analysis as well as the ACRS report would also be helpful. Intervention in the proceedings could be permitted at an early stage, so that interested parties would be sure of receiving copies of all submissions by the applicant and communications from the AEC. Such intervention need not necessarily involve a public hearing unless requested by the intervenor.

With these efforts to facilitate public participation, it should be enough for AEC to publish at the conclusion of its safety review a notice of intended licensing action to be taken on a specified date unless a request for a public hearing is filed before that time. Hearings should not be scheduled and held routinely on the off chance that an unexpected intervenor may appear at the last moment.

Procedures which are burdensome to the applicant and to the AEC staff out of proportion to their usefulness are for that reason alone undesirable. The greater concern, however, is that formal hearing requirements will cause delay in the applicant's project.

It takes time to get out a notice of hearing, observe the 30-day notice period, prepare testimony and exhibits, hold the hearing, prepare transcript corrections, and proposed findings and conclusions, and for the hearing examiner to get out his decision. Scheduling problems and conflicting demands on people's time are almost certain to add to the length of time.

Problems of timing and delay are not as likely to be acute at the construction permit stage as they are later on. The applicant can usually make allowances for the extra time consumed by formal hearings by filing his application for a construction permit at an early date. Furthermore, AEC regulations allow design, procurement, and some on-site work to proceed before the issuance of the permit, which gives the applicant leeway in scheduling licensing proceedings.

The schedule for issuance of an operating license is likely to be tighter and the consequence of delay more serious. Further, under current AEC practice, formal hearings do not stop with the issuance of an operating license, but may be required at various stages of operation or for a variety of license amendments.

It is in these areas that I would expect most problems of delay to arise. I think it relevant, in reviewing the collection of views and comments recently published by the Joint Committee, that those licensees who have commented most critically on the hearing process are those which have had experience with or are looking ahead toward operating licenses.

There is room for difference of opinion as to whether the Commission has gone further than the law requires in the number and formality of public hearings which have been held. The point is not, I believe, worth pursuing because it seems unrealistic to expect significant changes in AEC policy without change or clarification of the law.

I hope that this committee will seriously consider repeal of the mandatory hearing requirements of section 189(a), leaving intact, of course, the provisions for a hearing at the request of any person whose interest may be affected by the licensing proceedings.

If, as many have recommended, it is decided to retain the requirement but limit it to the issuance of the initial construction permit, the new legislation will have to be drawn with care so as not to include applications for amendments to construction permits.

Modifications in the facility after it has been completed ought also to be excluded from the requirement, bearing in mind that section 185 contemplates the issuance of a construction permit to cover the modification of licensed facilities.

Senator ANDERSON. Thank you, Mr. Trowbridge.

I think the one fine thing about your paper is that the layman can understand it. I appreciate that. You have done a fine job.

Mr. TROWBRIDGE. Thank you.

Senator ANDERSON. In defense of public hearing requirements, it has been stated that public hearings furnish an inducement to the applicant and staff to formulate their positions in terms as susceptible to lay understanding as posible. It has also been contended that during the homework for these hearings, the applicant and the staff sharpen up their thinking.

Would you comment on this defense for the mandatory public hearings?

Mr. TROWBRIDGE. I think in large part the same purposes would be accomplished by publication of the AEC staff analysis. I think the preparation of the AEC staff analysis will force careful and complete thinking about the hazards problem.

In the past, as I recall the analyses published, they were written in terms that were as understandable, at least, as the testimony at hearings.

Senator ANDERSON. I judge you are a little opposed to the mandatory hearing. Would you be as opposed to it if it were held before a technically competent board?

Mr. TROWBRIDGE. Yes; I would be as opposed to the madatory hearing requirement if it were held before a board as before a hearing examiner.

Let me make clear that if there are to be hearings, I would rather have them by a board. I would rather have decisions made by a technically competent board than by the hearing examiner, but I would not favor in either case a mandatory public hearing in uncontested cases.

Senator ANDERSON. As somebody who has been through the AEC hearing procedures on many occasions, do you believe it is an excessively formal procedure?

Mr. TROWBRIDGE. I believe it is more formal than necessary. I believe that public hearings, quite apart from the question of whether there have been too many of them, could have been held consistent with existing legislation on a less formal basis.

Senator ANDERSON. Would you have any suggestion for simplifying that procedure?

Mr. TROWBRIDGE. I think my suggestion for simplifying the procedure would be a methed of complying with the requirements of the law but not lending much point to them. I think it would have been possible for the AEC in cases where there was no contest to reduce the public hearing to the point where the applicant's side was represented possibly only by his application, or at most by a prepared summary of the application which made it easy to go through and sort out the contents of the application.

On the AEC side, it could have been merely a written statement of the staff position and analysis. These could have been presented to the hearing examiner along with proposed findings of fact which might be no more than the formal findings contemplated by the law and by AEC regulations.

The job of the hearing examiner would have been no more than to see to it that the proposed license, which would also have been a part of the submission by the applicant and the AEC staff, was in accordance with the Commission's regulations, and that the formal findings of fact had behind them substantial—not testimony—but data and technical judgments in the form of the application and staff analysis.

Mr. RAMEY. I might comment on that: in the staff study of the committee in 1957 we indicated that we did not anticipate that a great deal of testimony would be required at a mandatory hearing, but that parties would submit written statements.

Senator ANDERSON. When you speak of intervention on page 7, you state that such intervention need not necessarily involve a public hearing unless requested by the intervenor.

Mr. TROWBRIDGE. I may not have chosen a very happy word. I visualize a mechanism by which interested persons could indicate formally to the AEC their interest in the proceedings and would thereafter be entitled to the receipt of all documents filed by the applicant and all replies and proposed actions by the Commission. No formal hearing would necessarily result from the intervention unless requested.

Senator ANDERSON. In discussing a possible revision of the law to limit hearing requirements to the initial construction permit, you especially note that hearing requirements should not extend to amendments to the permit.

What if the amendment involves a significant hazard, a consideration which had not been previously considered?

Mr. TROWBRIDGE. This is a possibility. Let me start with the premise that I do not advocate mandatory public hearings even on the initial construction permit. I am bound to say, however, that if they do any good, they are more likely to do good at the construction permit stage than any other.

I am bound to say, too, that they are likely to be less burdensome, less of a problem in timing, at the construction permit stage than any other. So I do not have a great deal of quarrel with those who advocate one mandatory hearing at the construction permit stage.

There can be amendments to construction permits that involve safety issues as important as the initial application. Mr. Price referred to that possibility this morning in his testimony. I thnik this will be the rare instance. Therefore, if there is a mandatory hearing requirement at the construction permit stage, the problem of amendments needs to be left to the discretion of the AEC, because I know of no way of defining the kind of amendments on which AEC would thereafter have to hold hearings on and those on which it would not.

Senator ANDERSON. Thank you very much, Mr. Trowbridge. On page 9 you say, toward the end that—

> those licensees who have commented most critically on the hearing process are those which have had experience with or are looking ahead toward operating licenses.

That is the general rule of life. It is those people who have been through the operation who know what it can do to them. Unless a person had gone through the experience, they would not know how tough it would be. That is why doctors use anesthetics.

Mr. LeClair.

Mr. LECLAIR. Thank you, Mr. Chairman.

Senator ANDERSON. Mr. LeClair, you have been here many, many times. We are always glad to welcome you.

STATEMENT OF TITUS G. LeCLAIR, MANAGER, NUCLEAR POWER APPLICATIONS, GENERAL ATOMIC DIVISION, GENERAL DYNAMICS CORP.

Mr. LeClair. Thank you, Senator Anderson. Mr. Price, Mr. Ramey, it is a pleasure to respond to the invitation from your committee. I assume the invitation was received because of my experience with two different organizations, both of which are involved in the licensing of major reactor projects.

It was my pleasure to pursue the Dresden Station license directly for Commonwealth Edison Co., from the original application in March 1955 until last year. More recently I have been associated with General Atomic Division of General Dynamics Corp. as manager of nuclear power applications and as such have a vital interest in the high temperature gas-cooled reactor of the Peach Bottom project, which is to be built for Philadelphia Electric Co. and the 52 other companies of HTRDA. In this case, the applicant is Philadelphia Electric Co., not General Dynamics.

Many years in the utility industry have convinced me that governmental regulation is a working part of the American scheme. We are going through a period of learning how to regulate for safety purposes. We are also learning how to build highly technical and complex new equipment. This combination seems to multiply rather than add problems. Perhaps that is why the power reactor licensing process has required such detailed procedure.

The licensing procedure, however, in connection with the use and handling of radioactive isotopes appears to have been most effective and has been carried out with reasonable dispatch in connection with the licensing of research and other small reactors; the amount of radioactive material involved is not huge and for most of such reactor types the necessary protective measures are not complex.

The Division of Licensing and Regulation has been cooperative with builders and operators without neglect of its responsibilities. The procedures in connection with the licensing of large power reactors are vastly more time consuming, undoubtedly in part because of safety considerations. This has been so even though the Commission, its consultants, or those engaged in the hearing procedure have worked long hours and given extremely close attention to each case which has come before them.

The appendix to your committee report of March 1961 gives a list of events in the Dresden case 11 pages long. This does not include any of the backup work by the staff, applicant, or manufacturers or their informal conferences. It is practically impossible to estimate the cost involved in the preparation of reports and letters and attendance at meetings and hearings as a part of the licensing process. I, of course, recognize that Dresden was one of the first power reactor licensing cases before the Commission. With such a record in this and other cases, I certainly endorse the efforts of the Commission and the Joint Committee in analyzing the power reactor license procedure with a view toward increasing its efficiency without lessening public safety and still reducing the cost of the regulatory process. This is an objective to which I am sure everyone subscribes.

Senator ANDERSON. May I ask, do you believe that there was too much examination back and forth in the Dresden case?

Mr. LECLAIR. I think that the number of hearings in the Dresden case was very substantial and probably could have been reduced without in any way reducing the safety of the Dresden reactor.

Senator ANDERSON. Yet a good many things showed up in the final versions of the reactor that not even the makers of it nor the purchasers of it could have anticipated—whether or not their several breakdowns would occur after it got underway.

Mr. LECLAIR. There were two or three things that went wrong and those things were mechanical difficulties of the type that may occur in almost any type of powerplant, whether it is nuclear or other type.

I have had to do with starting of a number of powerplants and the startup process has been quite slow because some little thing that you didn't realize would go wrong.

Senator ANDERSON. In the ordinary powerplant if some little thing went wrong you probably only lost a day or two of operation, but you have a factor in these nuclear powerplants, as we found out in the explosion at Idaho, that is quite different from an ordinary power failure, isn't that true?

Mr. LECLAIR. That is right.

Senator ANDERSON. Doesn't that justify taking a little extra precaution?

Mr. LECLAIR. I in now way question the need to take very careful precaution. I would call the committee's attention to the fact that the difficulties were found not by the hearing procedure but by the careful scrutiny of the operating and design people on the job which is a necessary part of the activity.

Senator ANDERSON. I don't question that at all. I wonder what would happen to the production of electric energy from nuclear power if we have an unexplained and somewhat tragic occurrence in one of these plants comparable in any way to what took place at Idaho?

As I read the report on Idaho the other day, they haven't yet figured out what they can do to prevent it. Certainly the experience was a pretty bad one. Parts were blown into the top part of the container, so hot that they cannot be touched for days. The possibilities of seizing on that and building up a lot of public opposition are always present.

It is only because we can say to people that we have checked and checked and we think that this is absolutely safe that you can locate one of these great stations near a great city, don't you think?

Mr. LECLAIR. I think there is no question, Senator, that we need to take every precaution to insure that this industry is a safe one or it will not make the progress toward economy that we wish it to make.

Senator ANDERSON. Senator Cordon of Oregon used to have an expression of why he wrote certain language in a bill. He would always say that I don't think it is necessary to put these extra words in. I put them in out of a superabundance of caution.

Mr. LECLAIR. I think superabundance is a good word.

Senator ANDERSON. You may proceed.

Mr. LECLAIR. As you know, at the present time, an applicant for construction permit, and later for an operating license, must, for all practical purposes, make separate demonstrations of safety to the several different groups concerned with licensing with the Atomic Energy Commission. The first presentation is made to the Hazards Evaluation Staff. This staff in turn makes a report to the Advisory Committee on Reactor Safeguards.

May I interject that I am glad to hear that report is to be made a part of the public record.

The ACRS makes an independent judgment based on the report of the staff plus information obtained by questioning the applicant and his designers, et cetera. After both these parties have been satisfied, their views are submitted to the hearing examiner for public hearing. If the hearing is on an operating license, the hearing examiner also takes evidence in the form of an affirmative recommendation from the Division of Compliance. The hearing examiner's analysis of the record and his resultant position may differ from any of those recommended by any of the preceding parties. The Commission itself may undertake to review the decisions.

Before a layman attempts to make suggestions to very competent lawmakers, may I suggest a simple outline of what I consider the basic responsibilities of the Commission in reviewing an applicant for a license for a nuclear powerplant. This would be:

(*a*) Careful checking of those features of the design which relate to safety of the public. This includes examination of systems or inherent characteristics which will be relied upon to prevent major accidents.

(*b*) Assurance that the containment for the reactor system is adequate—that in the event of the maximum credible accident it will prevent the escape of radioactive materials beyond prescribed limits for protection of the public.

(*c*) Examination as to the competence and financial responsibility of the organizations of designer, the builder and operator of the plant.

(*d*) Examination of individual operating personnel to be assured that they are competent to operate the plant.

(*e*) The Commission and its staff should concentrate on those questions which affect the safety of the public without reference to the details or operating procedures which affect only the economics of the plant. I think we all recognize that it is impossible for a regulatory body to have experts in every detail who can supervise the design or operation of the plant.

Based on the foregoing generalities, I make the following more concrete suggestions:

(1) It is not necessary, in my opinion, that the regulatory functions be placed in a separate agency in order to assure that it functions expeditiously and fairly. I favor having it under the Atomic Energy Commission because of the Commission's familiarity with the subject material. I also believe that the licensing and rulemaking function should be part of the licensing responsibility to assure smooth operation.

(2) I believe a public hearing procedure is desirable in order to assure an opportunity for public discussion. However, I think the number of these hearings can be minimized, particularly in cases where there has been no public intervention.

(3) Although the ACRS has been acting as an advisory body, it is a group of extremely competent men serving on a volunteer basis, and the men cannot be expected to give detailed attention to a rising number of individual projects. In the case of a new concept, their intimate knowledge of the basic safety characteristics of the system is of great importance, and their analysis is most helpful to those responsible for the project. On the other hand, a second or third edition of exactly the same concept need not receive this review unless some particular new feature need be referred to the Committee. In this case, they would have more time for thorough consideration of the important special problems.

We are going through a period of transition to regulation of safety in a complicated industry. With a proper spirit of cooperation, the regulatory system can be made to work without excessive burden of cost and delay. This spirit will do much to speed the day of building better and more economical safe nuclear powerplants.

Senator ANDERSON. Mr. Price, do you have any questions?

Representative PRICE. Thank you, Mr. Chairman. Mr. LeClair, I am certainly glad to see you before the committee again. I think you are in a little different position with a different company today than you were in some of your previous appearances before the committee.

I know in your capacity with the Commonwealth Edison, working on the Dresden reactor for many years, you certainly have had an opportunity to become acquainted with the licensing process of the Atomic Energy Commission, so I think you are a very qualified witness at these hearings.

I am happy to see that you have given of your time to come here and make your presentation.

Mr. LECLAIR. Thank you very much.

Representative PRICE. On page 3 of your statement, you say that the hearing examiner's analysis of the record and the resultant position may differ from any of those recommended by another proceeding party. Has it been your experience that the hearing examiner has expressed a position different from the applicant or the staff on technical safety matters, or has he differed largely on procedural matters?

Mr. LECLAIR. As you know, I am an engineer rather than a lawyer so I get into deep water very quickly on procedural matters. In the Dresden case I believe that in the original application for the license that the staff of the Commission and the applicant both had the same position and both had adopted the same request as to form of license, and the hearing examiner went to a very substantially greater length in putting on the record additional information, some of which I am sure was of a procedural nature and some of which was the asking of questions about technical matters.

It, of course, was again the first case of this kind and I think that the hearing examiner and the applicant and the staff were all feeling their way and not knowing how far the examiner should go in this case.

Representative PRICE. On page 4 of your statement, you say that it is not necessary, in your opinion, that the regulatory functions be placed in a separate agency in order to assure that it functions expeditiously and fairly.

Would you care to comment or would you be inclined to oppose the creation of an internal atomic safety and licensing board as proposed by our Joint Committee staff?

Mr. LeClair. I think that the distinction I was making there is that I would favor the position of this committee staff rather than the position of the University of Michigan men in saying that it ought to be separated completely from the Commission.

Representative Price. You make a distinction that this licensing board stay within the framework of the Commission?

Mr. LeClair. Yes. In other words, the Commission has within its scope a large number of qualified people, and therefore, is more likely to be able to supply the people who can do this job. I do not, however, favor anything which will increase the number of steps through which a license would go. If there were another board, for example, placed between the Commission itself and the Hazards Evaluation Branch, and then have the Commission also have the right to overrule what the internal board may do, that would add a step rather than simplify it.

But I am not in a position to comment on the detailed duties that might be given to such a board.

Representative Price. On page 3 and 4 of your statement, you outline a number of basic responsibilities in reviewing an application for a license for a nuclear powerplant.

Do you feel that the present formal hearing process aids materially in the effective exercise of those responsibilities. Cannot technical people make the judgments called for in your five major points?

Mr. LeClair. I agree with one or two other witnesses that I have heard that this is a technical subject and the basic judgment to be made is primarily technical. The amount of procedure necessary is not something on which I am really competent to comment.

But I do think that the basic judgment should be on a technical level. I do not know whether that has answered your question very well or not, Mr. Price.

Representative Price. That is satisfactory.

On page 5 of your statement, you call attention to the need for limiting the ACRS considerations to important special problems in reactor safety.

What criteria would you suggest for determining which cases should be reserved or referred to the Reactor Safeguard Advisory Committee and which cases need not be referred?

Mr. LeClair. Again, there is no pat answer that can be spelled out in advance, but I think that Mr. Harold Price this morning mentioned the fact that in the research reactors, for example. where a substantial number of research reactors of a type have come up for license they are similar in their safety features, and it does not seem to be necessary to refer them to the ACRS.

But the staff of the Commission should be competent to decide whether or not a new application involves sufficient new detail or new safety features to warrant the device of this Advisory Committee.

Representative Price. Who would you say in the Atomic Energy Commission should have responsibility for making the decision?

Mr. LECLAIR. All presumably subject to review by the Commission, I would feel that the staff of the Commission should be in a position with their technical help to analyze the application and decide whether it needed to be referred to the Advisory Committee.

Representative PRICE. That is all, Mr. Chairman.

Mr. RAMEY. Mr. LeClair, in line with the previous questions on the number of hearings required in the Commonwealth Edison case, do you think that if there had been a technical board such as the staff has recommended that would watch the submission of all of the technical data; and that these data would be submitted to that board and on the record and in the public document room; and then the board finally decided on the permit and on the changes on the record; that that kind of a procedure would perhaps expedite matters and also give the public a view of it?

Mr. LECLAIR. Yes. I fully agree that if that board would have the right to decide that this is the thing which does not call for a public hearing unless there is a formal request, that they could use that as a means for simplifying the procedure.

If it were a competent board, both technically and legally, they would be in a very fine position to so decide.

Senator ANDERSON. Thank you very much, Mr. LeClair.

Our next witness is Mr. William K. Kennedy, counsel of the atomic products division, General Electric Co.

STATEMENT OF WILLIAM F. KENNEDY, COUNSEL, ATOMIC PRODUCTS DIVISION, GENERAL ELECTRIC CO.

Mr. KENNEDY. Thank you, sir. Senator Anderson, Congressman Bates, Congressman Price, the effectiveness of the AEC regulatory process is of central importance to atomic development. Recent studies of this process are in agreement that changes are called for. These hearings are, therefore, timely and significant and I appreciate the committee's invitation to participate in them.

General Electric's views on AEC regulation have been set forth in two papers which are part of your printed record—a December 1 memorandum of my colleague, Mr. Heimann, and myself, and Dr. Fink's letter of May 17 to Chairman Holifield. In my statement today, I will try to cover briefly the principal points made in these papers.

THE NEED FOR STANDARDS

It is fashionable to say that the nuclear art is in too early a stage to make standardization feasible. However, there are experienced technical people who believe that this statement, although true in a sense, misses a significant point. No one contends that it is possible to establish overnight criteria for all aspects of design and operation of all reactors. But there are competent people who believe that an aggressive effort now could lead to the formulation in a few years of useful standards for key phases of design and operation of water reactors.

These standards would, of course, be guides rather than inflexible rules. They would require continuous reexamination and revision.

However, even the initial formulation of such standards would be a considerable achievement. The standards would assure greater protection for the public while substantially simplifying regulatory reviews.

I emphasize this point at the outset because in the long run it should be more significant than questions either of organization or of formal procedures. Procedures and organization are important but the crucial problem is to make the technical reviews at once more effective for the public and more rational and predictable for industry.

The job of developing standards is the joint responsibility of nuclear scientists and engineers, of the Commission, and of industry. Substantial efforts are now going on but they should be pressed vigorously.

GOVERNMENT-OWNED FACILITIES

The committee staff study and the Michigan study concur in recommending that, except for military reactors and production reactors, Government-owned facilities should be subject to the same regulatory reviews as privately owned facilities. Our own memorandums have also suggested that Government-owned facilities should go through the same review procedures as private facilities, except to the extent that national defense considerations make this inappropriate.

Nuclear facilities present essentially the same safety problems regardless of how they are owned. The scientists and engineers engaged in a nuclear project should benefit from the regulatory review, regardless of whether the facility is being built for the Government or for a utility. It is pertinent to recall that the Advisory Committee on Reactor Safeguards was originally established as a review body for Government reactors. When Congress authorized indemnity coverage for Commissioner-owned as well as licensed reactors, it recognized that the hazards problems were in many ways similar. Moreover, the public is entitled to the same degree of assurance about the safety of Commission-owned reactors as it is with respect to private reactors.

Senator ANDERSON. May I stop you here just a second and ask if you confine this to power. I am thinking of Project Turret, that is being revived again at Los Alamos. It is a reactor, but would you make it go through all these safety procedures. It is not a case of military necessity either, because I don't think Turret has any military significance. It does have some importance to the proposed high-temperature gas-cooled reactor. I am just curious as to how far you would go with this.

Mr. KENNEDY. I think you have to take each case. The power reactors are the clear case, Senator.

Senator ANDERSON. I think power reactors are a clear case.

Mr. KENNEDY. I say this is true even though there are no generating facilities coupled to the reactor. If it is a reactor designed as a prototype for eventual production of power, I think it would be appropriate.

The clear cases on the other side are military reactors where national defense would make it appropriate to have some safety reviews but clearly not the public hearing procedures, and so on. Between those two cases you can have a spectrum of situations.

I would say the question is how significant the safety problem is. There always ought to be a safety review by people other than those associated with the project. I think your principle that where the matter is not national defense there ought to be openness about this so that the public has assurances is a very sound principle. This is what I understand to be the sense of the 1957 legislation.

Senator ANDERSON. I am sure you are familiar with that very early reactor which they called, at Los Alamos, Godiva. It was unclad. If safety requirements were applied to it, they probably never could have operated at all. They went ahead with it. They learned something from it. They had a little accident.

Mr. KENNEDY. Godiva is a good case. I think there are things you do, recognizing that there are safety risks that are beyond those that are reasonable, where you are interested simply in electric power. You want to be prepared sometimes to take those risks. But if you are taking them, you ought to acknowledge that you are, and the public ought to understand this.

Senator ANDERSON. I was hoping that I might get a little modification so that we might indicate that if this was a Government-power reactor then I think it ought to be subject to the same sort of safety checks that others are. There are certain advanced designs and concepts that the Government tests out that might not be possible to measure in the same way and maybe we both would agree in those cases reasonable precautions should be required but not quite the same steps that Mr. LeClair objected to in the Dresden reactor.

Mr. KENNEDY. I would agree that the clear cases are power reactors and the other is a debatable question, certainly.

ROLE OF THE ACRS

Presently, the Advisory Committee on Reactor Safeguards must examine all facility applications. I share the view that this requirement should be modified. The ACRS should be continued as a part-time advisory body. But ACRS can do this only if, as in the case of many appellate courts, there is some control on the matters that come before it.

ACRS review should be held (*a*) whenever ACRS itself considers the review appropriate, or (*b*) whenever the agency requests it, but it should not be automatic. This policy would permit ACRS to utilize its time effectively on the more significant problems and would eliminate time-consuming double reviews in some cases.

HEARINGS AND DECISIONS

There is a general industry conviction that the AEC hearing and decision procedures have become too cumbersome, too time-consuming, and too expensive. The committee staff study, the Michigan study, and your recently published comments all make some penetrating criticisms on this point. Reforms are recommended and I hope they will be made.

Reforms should begin with some philosophy as to what Government safety reviews and hearings can and cannot accomplish. A system of Government review is essential. But the public's major reliance must be on the competence and the sense of responsibility of the scientists and engineers working on the particular project. The principal value of Government review probably lies in the challenge to these scientists and engineers, which mere existence of the review system constitutes. To the extent that Government review can make a contribution to identifying or resolving safety questions, this contribution will almost always be made before the hearing by the hazards evaluation staff and by ACRS.

To my mind, these realities were recognized in the 1957 amendments and in their legislative history. Read in the light of their history, the 1957 amendments were intended (1) to being the results of the technical reviews into the open and thereby to provide public confidence in the integrity and competence of these reviews; and (2) by requiring the Government reviewers to articulate to the public the reasons for their judgment, to challenge these reviewers to do their most careful and conscientious job.

These legislative purposes are not served by observance of procedural formalities which were historically developed to resolve disputes between adversaries. Neither are they served by proceeding as though an examiner who is not technically trained can discover and help solve safety questions which have escaped successively the scientists and engineers on the project, the hazards evaluation staff and the ACRS.

Moreover, although an interested member of the public must have a right to intervene and to challenge an application, the public generally cannot evaluate the technical questions presented in a reactor license proceeding. Their reliance must be on the responsibility of the designers, builders and operators of the plant and on the regulatory reviews.

All these considerations argue strongly in support of the recommendation of the Committee staff study and of the Michigan study that in uncontested cases there be only one mandatory public hearing, to be held at the construction permit stage. They also argue for the further suggestion that after some trial period, say 5 years, the Joint Committee reexamine the value of any mandatory public hearing requirements. Any amendments should however preserve the basic principle of the 1957 legislation, the principle of openness, namely that the results of the Government review should be fully articulated, and should be disclosed to the public.

I concur also in the suggestions made in the Committee staff study for simplifying and expedting hearings in uncontested cases. If a licensing board or a separate agency is established I hope that this body can itself conduct the hearings until such time as its workload makes this impractical. Again, I believe that decisions need to be made and written either by technically qualified people or at minimum with the advice of such people, rather than as at present by an examiner with no access to technical help.

ORGANIZATION—LICENSING BOARD OR SEPARATE ACENCY

The Michigan study has recommended establishment of a separate agency to perform the regulatory function. In general, I share the viewpoint of this study. The Committee staff study recommends establishment, within AEC, of an atomic safety and licensing board with final authority on license applications and with authority to recommend rules. Others in industry and the Commission believe that major organizational changes, at least at this time, are either unnecessary or undesirable.

Experience teaches us to avoid dogmatism on organizational choices. In the present case there are conflicting considerations and the question is: What is the proper balance of these considerations? Moreover, most of the other reforms which have been suggested in the various studies and by industry are compatible with any form of organization, including the present one. These reforms ought to be considered independently of the organization question.

With these preliminary observations, I believe that some change in the present organization is desirable, principally for two reasons. The first is that the current organization continually invites questions as to the Commission's detachment in resolving regulatory issues. The point is not that these questions are justified but simply that they are bound to recur. The questions can impair essential public confidence and can produce a tendency to overcorrect and to make regulation unduly onerous. The second reason for change is that I question whether in the light of their other responsibilities—for civilian atomic development, for defense, and now for space—the Commissioners will be able to pay adequate continuing attention to regulatory questions.

If some change is desirable, two of the principal choices are the licensing board and the separate agency. To my mind, the significant distinctions between the two choices are these:

(1) The staff recommendation would place final authority on license applications and final authority on rules in two places—the board and the Commission. A separate agency would combine final authority on both matters in the same body.

(2) A separate agency would also combine with the licensing function other radiation safety functions—authority to establish radiation protection criteria, responsibility for liaison with the States and responsibility to review and make recommendations on research and development programs of AEC and other agencies relating to atomic safety.

(3) The licensing board contemplated by the Committee staff study would have only a minimal staff of its own and AEC would retain essentially all its present staff. A separate agency presumably would take over most of the staff presently reporting to AEC's Director of Regulation.

Of these three issues, the most critical is whether rulemaking authority should be separated from licensing authority. Such a separation would be a cause for serious concern. The development of technical standards should increasingly become the focus of regulatory efforts. These standards must grow out of and reflect experience in reviewing individual reactor designs and operating procedures. Moreover, they must become the basis for subsequent licensing reviews and therefore must have the wholehearted acceptance of the licensing body. Separating the two functions could impair the most effective performance of each of them.

It would be useful to give the Commission with its developmental responsibilities, a voice in formulating regulations. This could be accomplished by a device like that suggested in the Michigan study—a representative of the Commission could sit with the regulatory body when it considered and issued rules.

A good case can also be made for assigning to the licensing body related radiation safety functions, including those presently lodged in the Federal Radiation Council. The National Committee on Radiation Protection should be continued in its present role.

The final question is where the staff should be located. The Committee staff study makes a strong case for keeping the staff with the AEC. On the other hand, this could prove the source of conflict with the licensing board. One solution might be to leave the staff with the AEC and then review the matter again after, say, 5 years.

In brief, I believe that the separate agency is on balance the best course. If Congress believes that this is premature, an Atomic Safety and Licensing Board would be a sound interim step but it would be highly undesirable to separate final rulemaking authority from licensing authority.

Let me say a few words in closing. I believe that the Commission and its staff have done to date a conscientious and careful job of regulation. The industry is now at a stage where a reexamination and some changes are called for. The studies by the Commission, the Committee staff and by the Michigan group have made outstanding contributions in identifying the major questions and in formulating suggestions for improvement. These hearings should also make a significant contribution.

However, the technology and the industry will continue to evolve and even a reformed system of regulation will very probably require further changes. I hope, therefore, that this committee, with the aid of scientists and engineers, the legal profession and industry, will continue to study and appraise the regulatory process.

Senator ANDERSON. Thank you, Mr. Kennedy, for a very fine statement.

Mr. KENNEDY. Thank you, sir.

Senator ANDERSON. The procedure where they have a public hearing in the nature of a press conference has been suggested by some. Would you care to comment on it.

Personally, I want to say to you that I thought it had some merit, because it gave an opportunity for full examination of the situation. Would you care to comment on that?

Mr. KENNEDY. This will be put into effect for the first time for our superheat plant which we are proposing for construction at Vallecitos. My own initial reaction was the other way, Senator. I question whether this is going to be a useful thing. However, I would also say that it is certainly something that may be useful to try, and I would be willing to abide by experience on it. I would not do it myself.

Mr. RAMEY. Are you afraid it might stir things up and create more of a problem?

Mr. KENNEDY. This is always the possibility. On the other hand, the response to that is that if there are no real problems there is nothing to stir up and if there are problems they ought to be stirred up.

Senator ANDERSON. I think my reaction to it was that so many people say, "You don't give us ample notice." Certainly, this would take care of the ample notice part of it very adequately.

Mr. KENNEDY. This certainly meets that.

Senator ANDERSON. It will not deal with the technical problems involved and I do think those technical problems are separate and probably need to be separated. It did strike me that having a full day in court here with any representative of the public able to come and ask a question had some attractive possibilities although it may not be the scientific way to do it.

Mr. KENNEDY. I think my reservation goes to the question of whether the general public can be expected to really comprehend the issues here. Dr. Wolman's testimony the other day, I thought, made a very good point, which is that if you talk to the members of the public their reliance is on the fact that there is somebody responsible here who is reviewing it and who has made a decision. I think that is the psychological reality of the matter. The public counts on the Commission and they count on the people who are doing the job, to do it right.

Mr. BATES. Do you have a particular agency in mind or do you envisage the development of a new group in your recommendations to provide for licensing and regulation?

Mr. KENNEDY. There would be a new group. One point that has been discussed is whether this should be within the AEC. To my mind that is not a major issue. If it seems better to do it within the AEC, I don't think there is any problem about that. The one thing I would question about the committee staff recommendation, which I think otherwise is quite sound, is the separation of the authority to issue rules and the authority to decide cases. They have met that in part by giving the licensing body authority to recommend rules but I would be disturbed at the division of the two final authorities there. If it is better to do this within AEC, I don't believe that is a serious problem one way or another.

Mr. BATES. It is still pretty much in a formative stage and we are still learning an awful lot about this field. I was wondering whether at this time you would want to divorce the AEC from these other functions. It seems to me that this is the time when we ought to have somebody sitting right on top of it with the full knowledge and scope of all developments and all the problems.

Mr. KENNEDY. This is an argument against separation. There are several arguments against it. I think it is a question of how you add them up. I would say that the things I have mentioned seem to me, on balance, to outweigh this. People differ about it.

Mr. BATES. You think that these could be accomplished in the AEC?

Mr. KENNEDY. Yes. What I meant by this is that I think you can create a body which would have the regulatory responsibility and be as a formal administrative matter, within the AEC and I think this is a perfectly reasonable thing to do. But it would be a new distinct body with final authority on regulatory matters.

Mr. BATES. Would the Commission have the right of appeal?

Mr. KENNEDY. No. I would envisage that they would not have that.

Mr. BATES. You would have a separate and independent group under the AEC, with final authority themselves.

Mr. KENNEDY. Yes. They would be within AEC, I think it is fair to say only for formal purposes, administration, budget, housekeeping.

Senator ANDERSON. Thank you very much, Mr. Kennedy.

Mr. KENNEDY. Thank you, Mr. Chairman.

Senator ANDERSON. Mr. Upton.

STATEMENT OF ARVIN E. UPTON, SECRETARY, ATOMIC POWER DEVELOPMENT ASSOCIATES, INC.

Mr. UPTON. Thank you, Mr. Chairman.

My name is Arvin E. Upton. I am and have been since late 1953 the Washington resident partner of the law firm of LeBoeuf, Lamb & Leiby, which has its principal office in New York City.

During the past 7 years I have studied numerous legal problems involved in the peaceful application of atomic energy. In addition, I am secretary of Atomic Power Development Associates, Inc., a nonprofit atomic research and development corporation, and am also chairman of the Atomic Industrial Forum's Special Committee on Federal-State Relations. Immediately before entering law practice here in Washington, I was on the civilian legal staff of the Department of the Air Force and from early 1952 until I left governmental service I was the Deputy General Counsel of the Air Force, first under Secretary Finletter and then for a short period under Secretary Talbott.

In my letter of April 29 to the chairman, I stated my agreement, with some qualifications as to duties, with the recommendation made in the committee staff study to establish a licensing board within, and not independent of, the Atomic Energy Commission. In the time available today I can do little more than reiterate that agreement.

You have invited my opinions about some of the aspects of the present atomic regulatory system. If there are any weaknesses in that system, they certainly cannot be charged to any lack of integrity or of zeal on the part of the Commissioners or their staff. On the contrary, the competence of people working in the Atomic Energy Commission is higher, I believe, than in many other regulatory agencies. The weaknesses have mostly arisen from superimposing conventional administrative procedures upon a foundation of comprehensive technical review; and thereby overcomplicating atomic regulation.

With the use of more imagination the Commission might have evolved new techniques reflecting the lessons learned since most of the present Federal regulatory agencies were established in the 1930's. I can only speculate about the reasons for this lack of boldness. Probably some Commissioners did not focus sufficiently upon the regulatory program. Possibly the lack of regulatory experience by many in the Commission staff was a factor. Perhaps the detailing of so many procedural safeguards in the statute convinced the Commission that it should follow the most conservative and legalistic approach to regulation.

Until recently this lack of boldness manifested itself, not only in a lack of direction about hearings but also in silence on regulatory policies about which the Commission should have spoken out. If the reason for silence had simply been a fear of hardening too quickly a new regulatory mixture, it would have been admirable. One felt at times, however, that the Commission and its staff simply had not developed a position, and that silence resulted from inattention rather than from calculation. The uncertainty about the content of technical specifications illustrates this point very well. Fortunately, the silence on this and other matters has now been broken; evidently the Commission is concentrating its attention much more than formerly on regulatory policy. The appointment of a Director of Regulation should be of great help in this respect.

There is no similar easy solution of the difficulties attending the Commission's adjudicatory functions which now include four repetitive reviews of the safety aspects of a proposed reactor plant. Of these reviews, two are administrative and expert while the other two are regulatory and nonexpert. One of these reviews consists of a formal hearing, even in noncontested cases, the Joint Committee and others have for the past few years debated whether all these reviews are necessary.

The aim of these reviews is, of course, to satisfy the Commission that the construction and operation of a reactor will not endanger the public health and safety. Since law, policy, and substance are in my opinion involved in all stages, they cannot be separated even though the proportion of each may vary at the different levels of review: First substance predominates, then law, and finally, in the case of action or considered nonaction by the Commissioners, policy.

Adjudication proper is often preceded by informal discussions on site criteria but the process truly begins after an application and supporting documents have been filed. These documents are then subjected to a thorough examination—often continuing over several months—by the experts in the Hazards Evaluation Branch and by Commission consultants. Most applicants, I believe, recognize this review to be necessary and endorse the competence of those conducting it and the manner of its performance generally. So long as reactor technology is experimental such a prolonged staff analysis is essential before beginning any formal proceeding.

The next review, by the Advisory Committee on Reactor Safeguards, is also conducted by experts and duplicates to a substantial degree the analysis already made by the Hazards Evaluation Branch. Fortunately, the ACRS and the Hazards Evaluation Branch are now attempting to evaluate some projects on a joint basis.

The record of the past 5 years shows that ACRS action determines ultimate Commission action on a project. Undoubtedly, the reputation of the ACRS has been a major influence in developing public confidence in the safety of reactor plants. In my judgment this influence would be more usefully directed if the ACRS did not examine individual projects but devoted itself to general problems of reactor safety. The second expert review could then be conducted by another instrumentality, such as a licensing board, composed in part of persons skilled in nuclear technology.

Even if the ACRS should retain its present functions, certain improvements should be made in its practices and procedures. ACRS reports are not always precise. For example, they do not always distinguish between design features which the committee believes necessary for safety and those it considers only worthy of further examination.

The anomaly of the atomic regulatory process becomes clear after the completion of the two expert reviews I have mentioned, since by law they must then be followed by two other nonexpert reviews which conceptually are supposed to test the soundness of the views of the experts. The third review is by the hearing examiner, while the fourth is the decision by the Commissioners further to review, or not to review, the conclusions of the hearing examiner.

Two points are clear to me: First, a right to a formal hearing by an applicant is constitutionally required; and second, a hearing is advisable in a contested case even if not required by law.

About uncontested proceedings for an initial facility license the conclusion is more arguable. There appears to be no constitutional reason for a hearing in such a case, although the statute now requires it. Thus, two further questions must be asked:

Whether a hearing serves any useful purpose as such and thus should be mandatory; and

Whether a hearing should be conducted by a nonexpert presiding officer.

There are several possible reasons for a hearing, and these apply not only to uncontested cases but to contested cases.

First, to utilize our traditional adversary system to choose between competitors for licenses.

Second, to evaluate protests by opposing economic or social groups or individuals purporting to represent such groups.

Third, to inform the public.

Fourth, to reflect that decisions are reached in an aboveboard manner.

Fifth, to isolate and fit into a legal framework the factors of special significance to a decision.

Under the present AEC system, only one of the stated purposes of a hearing seems to have been achieved in practice with one exception—reassurance as to the integrity of the decisional process. Competition to build reactors has not been heated. Protests by the coal and oil industries have not been forthcoming. The public derives little real information from highly complex presentations filled with engineering terms. Factors of special significance have not been isolated at the hearings but prior thereto, with a result that the hearing examiners have been relegated to the function of clothing the skeleton of an accomplished fact with the flesh of legal formality. Since the essential decisions about safety are made by experts prior to the inception of a hearing, the hearing process can add nothing of substance to those decisions.

The situation would be different if some of the basic determinations on safety were left for the hearing, as they would be if a hearing board, consisting of persons skilled in science, engineering, and law, were established.

In this way, the present four safety analyses could be reduced to two without any effect upon the depth of the review made. If the decisions of this board were final, of course, the Commissioners would also be removed from possible criticism as to conflict of motive.

It may be asked why any hearing is needed in uncontested cases if safety review is adequate without a hearing. Despite concern with the way some hearings have been conducted and unduly prolonged, I remain of the opinion that one mandatory hearing should be held, in most instances at the construction permit stage, on all applications for licenses to operate power and testing reactors. Such a hearing, if held by the proposed Board under improved procedures, would be able to achieve several of the purposes I have referred to. Prehearing conferences could be freely utilized and off-the-record discussions could be encouraged at these conferences. All testimony at a hearing in an uncontested case could be written and exchanged in advance. Oral examination by presiding officers could be limited to eliciting relevant matters not covered in the testimony. Brief and relatively nontechnical summaries of all testimony could be prepared by the parties for the benefit of the press and public; and the presiding officer or officers could, after decision, prepare and publish, separate from a decision, a similar brief and relatively nontechnical summary which would fix the decision in the perspective of nuclear health and safety generally.

I may say in that regard, Senator, that I do not consider that the staff analyses would really serve that purpose. It is true that the staff analyses are less technical than the testimony is, but in my opinion it is still too technical to be understood by an educated layman. I think it is possible to put these things within the context of the general principles involved, to be understandable to an educated layman.

Senator ANDERSON. I thoroughly agree with you. If they are understandable, they are very much better. I also like the fact that you have suggested a prehearing conference to be freely utilized and off-the-record discussions should be encouraged at these conferences. I would think that would be extremely useful. I don't think it is being done now. I am not a lawyer and as I have told Mr. Ramey, it gives me a great deal more freedom to comment on legal things, but it does seem to me that some of the pretrial conferences, in ordinary litigation are extremely helpful. I would think this would help to resolve the difficulties and if there was an unreconciled difficulty both sides might agree to try to obtain further technical advice or expert advice upon that one point and thereby make it much simpler for all concerned.

Anyhow, I like the suggestion.

Mr. UPTON. Thank you. The last suggestion I have just referred to is especially important. The public is entitled not only to be informed but to be informed so far as possible in language which the educated layman can understand. Only in this way—rather than through the exercise of a right to intervene—can the press and the public form the judgments needed to call both the Commission and applicants to account for any lack of respect for safety considerations.

Such a hearing, conducted by such a Board with final regulatory authority and under such revised procedures, could convince the press and public, already persuaded of the integrity of the hearing process, of its significance as well.

Once a facility operating license has been issued, the hearing process should terminate except in special circumstances. Continued supervision of operations should be carried on by the Commission staff and not by a hearing board or examiner. On this point, the change procedure adopted by the Commission in one case and recently proposed for general adoption is a progressive step. The Commission, whether through the hearing process or otherwise, should avoid supervision of the details of reactor operation once it has found the operating company technically qualified to conduct the operation. The definition of technical specifications should be related clearly to the change procedure so that, on the one hand, matters essential to safety are subject to Commission approval, and, on the other hand, matters not so essential are left to operating discretion.

To be just, the Commission should be complimented for the progress made thus far in setting up a new regulatory system rather than damned for its failure to attain perfection. The deficiencies in the present system are not fatal or even alarming. Nor have they contributed materially to slowing up reactor projects which thus far have required prolonged experimentation and testing in any event. But the system can be improved, and the time to improve it is not when sclerosis of the administrative arteries has developed but now, when experimentation is possible before too many precedents have accumulated. But we should not press too much for improvement. There is no present urgency to create a regulatory paradise when the number of inhabiting angels may be somewhat sparse for the next few years.

Senator ANDERSON. On page 4 of your statement, you indicated that the ACRS could be utilized more effectively if it would not examine initial projects but devote itself to general problems of reactor safety. Would your view be the same if the Commission's regulatory organization remained unchanged? Would you still feel that way about it?

Mr. UPTON. You mean if the licensing board should not be set up?

Senator ANDERSON. Yes.

Mr. UPTON. I am not sure, Senator, because I believe two reviews are necessary.

Senator ANDERSON. On page 6 of your statement, you indicated if a licensing board were created, the present four safety analyses could be reduced to two. Does this imply that you favor elimination of the ACRS review?

Mr. UPTON. I favor elimination of the ACRS review in particular cases if the licensing board is set up, composed of persons skilled in nuclear technology. Otherwise, I would hesitate to advocate elimination of ACRS review.

Senator ANDERSON. On page 7, you state that one mandatory hearing should be held, in most instances at the construction permit stage. You mean by that that the hearing might be held at different stages of the licensing procedure in different cases?

Mr. UPTON. Yes; I do mean that and I might explain that. In some instances when the construction permit proceedings are held, the particular application of the technology is still so tentative that it is impossible to present very substantial evidence on exactly what the design of the eventual plant is going to be. It seems to me that if you hold your hearing at that point you are going to be able to really disclose very little information which will be of benefit to the public or to others. So it is better to hold the hearing at a time when the particular technological application has jelled. In most cases that might be at the construction permit stage. It might be on an amendment to a construction permit. I would tend to give discretion to the hearing board or the Commission, if the hearing board is not established, to determine this issue.

Senator ANDERSON. Thank you, Mr. Upton. I think you have been a fine witness and I have appreciated it.

Mr. Bates?

Mr. BATES. You feel that the second hearing after construction generally serves no purpose unless there is an adversary request?

Mr. UPTON. That is correct, sir.

Mr. BATES. In which case you keep the door open for hearings.

Mr. UPTON. Yes. I would always keep the door open for a right to a hearing in case there is an adversary proceeding.

Mr. BATES. These construction hearings are pretty much pro forma now and you don't learn very much from them in the absence of adversary requests.

Mr. UPTON. Mr. Bates, I wouldn't say either the Commission or the hearing examiner considers them pro forma. I think they probably consider them very important.

Mr. BATES. I am asking what you think.

Mr. UPTON. I think they are unnecessary.

Mr. BATES. If they are unnecessary, they are pretty much pro forma.

Mr. UPTON. All right.

Mr. BATES. That is what I am trying to determine. You think they are unnecessary.

Mr. UPTON. Maybe I am hedging about the meaning of the word pro forma.

Mr. BATES. Perfunctory.

Mr. UPTON. Yes.

Mr. BATES. Unnecessary, use what you want.

Mr. UPTON. All right.

Senator ANDERSON. In view of what you said about putting this in layman's language you might be interested in a quote from Professor Davis, who is going to be here again tomorrow. This is from "Views and Comments on Improving the AEC Regulatory Process," which we published:

> The public, in my opinion, should be informed in four principal ways: One, the report of the ACRS should be full and detailed, giving a full statement of pros and cons with respect to each facet of safety and the report should be published in full in whatever technical language the ACRS chooses to use. Two, the report of the AEC staff should similarly be full and detailed and it should be published in full. Three, a translation of both the ACRS report, the AEC staff report should be prepared by the AEC staff in layman's language, going as far into technical questions as is feasible in such language but presenting fully the final practical judgment on the question of how much risk is too much in the circumstances of a particular case. Four, as the part of notice to the public, a conference, somewhat in the nature of a press conference, should be held where reporters and anyone else having a legitimate interest would have an opportunity to question the technical people. To the extent it is feasible not only AEC staff members, but also representatives of the ACRS and of the applicant should be available for questioning.

We get all sorts of opinions of how this might be done and that is why these hearings are being held, hopeful that we will arrive at some worthwhile conclusions.

Thank you very much.

Mr. UPTON. Thank you, sir.

Senator ANDERSON. Mr. Lester Rogers.

STATEMENT OF LESTER R. ROGERS, ASSISTANT DIRECTOR FOR MATERIALS STANDARDS, DIVISION OF LICENSING AND REGULATION, ATOMIC ENERGY COMMISSION

Mr. ROGERS. Thank you, sir.

The objective of the Atomic Energy Commission's regulatory program in licensing the possession and use of byproduct, source and special nuclear material is to assure protection of the health and safety of employees and the general public from the hazards of radioactive materials under the Commission's jurisdiction. This program is carried out by a specific and general licensing procedure and by the establishing of general radiation protection standards, such as the Commission's 10 C.F.R., part 20, "Standards for Protection Against Radiation."

The specific licensing procedure requires an analysis by the Atomic Energy Commission staff of the adequacy of equipment, operating and emergency procedures, and training and experience of personnel in relation to the potential hazards of the applicant's proposed activities. A specific license is issued upon a showing by the applicant that his operations will be conducted in accordance with Commission standards and will not present undue risk to public health and safety.

About 7,400 persons and firms hold specific licenses for materials. This includes about 6,100 byproduct material, 900 source material and 400 special nuclear material licensees.

Although the part 20 regulation is generally applicable to all Atomic Energy Commission licensees, specific additional requirements are included as license conditions where necessary with respect to equipment, facilities, operating procedures, and training of personnel which vary widely with the type and quantity of radioactive material and the type of use.

1. BYPRODUCT MATERIAL (RADIOISOTOPES)

Radioisotopes are more widely used than any of the other materials regulated by the Commission. Because of their diverse use in different forms and quantities, radiation control problems vary greatly.

There are more than 2,600 licensees that use radioisotopes for medical diagnosis and therapy. More than 350 cobalt 60 teletherapy units, and 19 cesium 137 teletherapy units have been licensed. The quantity of material in each unit varies from about 225 curies to 6,000 curies.

Cobalt 60 teletherapy sources fabricated several years ago and sealed with lead gaskets, a practice considered acceptable at that time, have, in some cases, developed leaks of small particles of radioactive cobalt. As a result, the Commission last year added a condition to all teletherapy licenses, requiring that the sources be leak-tested periodically and results of such tests be made available to the Commission.

Fortunately, those sources that developed leaks have been discovered and corrected before any serious radiation hazards developed. The Commission now requires all new teletherapy sources to be sealed by heliarc welding, an improved method of sealing.

About 1,880 byproduct material licensees can be roughly classified as industrial users of radioisotopes. Radioisotopes are most widely used in industry as sources of radiation for (1) industrial radiography for nondestructive testing; (2) gages for measuring and controlling the thickness or density of materials and levels of liquids; and (3) irradiators for irradiating materials.

Safety problems encountered in industrial radiography have been related primarily to inadequate training and instruction of radiographers, lack of proper field supervision of radiography operations, inadequate management administrative control, and failure of individual radiographers to follow written operating procedures.

The Commission has issued a regulation, part 31, "Radiation Safety Requirements for Radiographic Operations," that deals specifically with safety standards and requirements for radiographic operations.

About 7,400 industrial gages of various types utilizing radioisotopes are now in use. Since gages are installed in plants where employees are not necessarily trained in radiation safety, a high degree of safety must be built into the gage. This is accomplished by (1) sealing the radioactive material in a container to prevent leakage; (2) designing to incorporate adequate shielding of the radiation source and multiple safety interlock mechanisms; and (3) appropriate labeling of gages with simple precautions in operation of the gage.

Because of the inherent safety built into gages, experience has shown that certain types can be distributed under a general license when manufactured and labeled according to specifications in a specific license. Part 30 of the Commission's regulations was amended in February 1959 adding such a general license.

Gamma emitting radioisotopes are used for irradiating materials to determine radiation effects on their structure, to initiate chemical reactions, in studying preservation of foods, to sterilize equipment, et cetera. The Atomic Energy Commission has issued licenses to 135 concerns for irradiator sources. The quantity of material used in irradiators varies from 100 curies up. The largest quantity the Atomic Energy Commission has licensed for a single irradiator is 50,000 curies. It is estimated that the licensed use of cobalt 60 in irradiators during 1962 may exceed 1.5 million curies.

Although large quantities of radioactive material are used in irradiators and high radiation levels exist in the vicinity of the sources, radiation safety problems are simplified by proper sealing of the sources and by proper design of the irradiator and the installation. In addition to safety design of the equipment, strict adherence to detailed written operating procedures is essential for safety.

The Commission has received several applications for licenses to possess and process from kilocurie up to 15 megacuries of radioactive material in various forms. The proposed operations include research studies of irradiated fuel elements containing megacurie quantities of fission products; processing of up to several thousand curies of cesium 137 into sealed sources for teletherapy and irradiation use; processing of thousands of curies of strontium 90 and curium 242 into radioisotope power sources. Sources containing from 30,000 to 250,000 curies of strontium 90 are being designed as auxiliary power sources for uses such as in navigational aids and remote weather stations.

Processing of high levels of radioactive materials will increase as additional uses develop. The site locations, equipment, facilities, and operating procedures for such operations must be such as to assure public health and safety under all routine and credible accidental conditions. The development of criteria for, and hazard analysis of, such facilities is a complex technical problem and requires technical skills in many fields.

Radioisotopes may appear in products reaching the public from two sources: (1) trace remanents of radioisotopes in extremely low concentrations in commercial and industrial products where tracer quantities have been introduced in the manufacturing process; and (2) products which utilize radioisotopes for luminescence or other purposes, such as luminous dial watches.

The Commission has amended its part 30 regulation, "Licensing of Byproduct Material," to exempt from licensing control, byproduct material when contained in products in specified trace remanent concentrations. The exemption is intended to facilitate the distribution of products where radioisotope tracer studies or control procedures have been carried out under a specific license.

The products in which license-exempt concentrations are permitted are items such as oil, gasoline, plastics, steel, and similar commercial or industrial items where inhalation or ingestion is unlikely. The concentrations permitted are so low that it is unlikely that any member of the public could receive measurable radiation exposure.

The Commission has taken a conservative approach to permitting the use of radioactive material in consumer products. A few devices such as static eliminators and electron tubes containing microcurie quantities of certain isotopes have been placed under general license.

The Commission also amended the part 30 regulation to exempt from licensing requirements certain luminous time pieces containing tritium. Under the amendment tritium may be applied to timepieces only under a specific license.

There are numerous possible uses of radioisotopes in various devices such as luminescent light switches, automobile dials, house numbers, dials on home appliances, and lock illuminators for use by the general public. The radiation levels from any one of such devices is so low that the radiation dose is insignificant.

However, in deciding whether to authorize any of these uses, the Commission must consider the precedent set for licensing other uses. The combined radiation dose to the population from all authorized uses of radioisotopes in consumer products must be considered.

To obtain the views of interested persons on this question, the Commission has requested public comment as to whether it should authorize the use of radioactive materials in consumer goods where control over the disposal of the radioactive materials cannot be exercised, even though the radiation dose to individuals in the population may be extremely low compared with natural background. The request for public comment was in connection with a petition requesting an exemption from Commission licensing requirements for automobile lock illuminators containing up to 15 millicuries of tritium.

2. SOURCE MATERIAL

There are more than 900 source material licensees. The principal radiation problems with use of source material is exposure to airborne radioactive material and disposal of waste effluents. This problem is related primarily to large scale processing operations including the uranium and thorium milling process. The dust hazard is controlled by enclosing operations creating dust and by good ventilation. Control of waste effluent is exercised by proper monitoring procedures, by the use of holdup settling ponds, and by chemical waste treatment methods. Some of the mills have been required to make substantial modifications in their milling and ventilation equipment and waste treatment facilities and procedures to comply with 10 C.F.R. 20.

During the past 18 months the Atomic Energy Commission has worked closely with the U.S. Public Health Service and appropriate State health departments on mill waste problems as related to a long-term study by the Public Health Service of overall waste pollution of the Colorado River and its tributaries. Data from this study on radionuclide concentrations in streams should be helpful to the Atomic Energy Commision and the mills in further evaluation of uranium mill waste effluent problems.

3. SPECIAL NUCLEAR MATERIAL

The principal radiation safety problems associated with special nuclear materials are in the processing of uranium 235, uranium 233, and plutonium.

In processing special nuclear material, inhalation hazards may arise because of the presence of dust containing radioactive material. These hazards are controlled by containment systems such as completely enclosed boxes or hoods with efficient ventilation and filter systems.

An additional hazard unique to special nuclear material is the possible accidental accumulation of sufficient quantities to create a critical mass. Criticality is avoided by proper geometrcal design of containers and by strict observance of operational procedures to prevent accumulation of sufficient quantities of material to form a critical mass during processing and storage of the materials.

4. WASTE DISPOSAL

The types of waste generated by materials licensees consist primarily of low concentrations of radioactive material in liquid waste and low levels of solid wastes. The problem is usually that of dealing with bulk and volume rather than high levels of radioactive material.

Under part 20, waste in air and water effluent in specified low concentrations may be discharged under controlled conditions. Small quantities of waste may also be buried in soil or discharged into sanitary sewer systems under specified conditions. However, the bulk of licensees' radioactive waste must be disposed of by return to the Atomic Energy Commission for land burial or by transfer to waste disposal licensees who, in turn, dispose of it by return to the Atomic Energy Commission or by burial in the ocean.

The Atomic Energy Commission has not issued a license for the commercial disposal of waste by land burial. Because of the requirement for long-term maintenance of a burial ground for radioactive materials, the Commission amended its part 20 regulation early this year to provide that—

> the Commission will not approve any application for a license to receive licensed materials from other persons for disposal on land not owned by the Federal Government or by a State government.

Land burial services are provided to licensees at the Commission's Oak Ridge National Laboratory in Tennessee, and National Reactor Testing Station at Idaho Falls, Idaho.

Recently, the States of New York and Nevada have indicated their intent to set aside land for a burial ground for low level radioactive waste. The Atomic Energy Commission intends to work closely with State governments to assure that proper consideration is given to long-term maintenance of such burial grounds and that sites to be used have been thoroughly evaluated and are suitable for the use.

A total of 12 commercial concerns now hold waste disposal licenses. Four of these are licensed for ocean disposal only, four are licensed to collect, package, and ship waste to an Atomic Energy Commission installation and four are licensed to do both.

A great deal of public concern has been expressed regarding sea disposal operations. During the past year the Atomic Energy Commission has initiated studies to develop information on the proper design of sea disposal containers to provide greater assurance that they will withstand pressures encountered in descending to 1,000 fathoms without loss of contents.

In addition, the Commission has cooperated with the National Academy of Sciences, Committee on Oceanography, in studies of disposal areas to assure proper consideration of the location in which the radioactive material is disposed.

Recent experience has suggested a possible need for an amendment to Commission regulations to establish requirements for financial guarantee bond for licensees authorized to receive licensed materials from other persons for the purpose of disposing of these materials to provide reimbursement to the Atomic Energy Commission for any costs that the Atomic Energy Commission may incur in the event such licensees fail to fulfill their obligation to dispose of the waste materials.

We believe that the above steps, together with a more comprehensive public information program, will help gain better public understanding of licensed disposal operations.

5. TRANSPORTATION

All of the radioactive materials previously discussed must be transported about the country. Safety in transportation is largely dependent upon proper design of shipping containers to assure that external radiation levels are within safe limits and that containers are not likely to rupture and release their contents.

In addition to other Federal transportation regulations, Atomic Energy Commission licensees must comply with Atomic Energy Commission regulation of 10 C.F.R. part 71, "Regulations To Protect Against Accidental Conditions of Criticality in the Shipment of Special Nuclear Material."

In anticipation of the requirements to ship irradiated fuel from domestic and foreign reactors to chemical processing plants, the

Atomic Energy Commission published a proposed rule last year, 10 C.F.R. part 72, "Regulations To Protect Against Accidental Criticality and Radiation Exposure in the Shipment of Irradiated Fuel Elements."

In developing this regulation, we have encountered difficult technical problems on heat transfer and structural integrity criteria. We have worked closely with industry during the past year to resolve these problems. In particular, the American Standards Association's work on this problem has been of assistance to us. The Commission has also initiated stress analysis studies through a contract with Franklin Institute of Philadelphia to obtain data to resolve structural integrity requirements.

In May of this year the Atomic Energy Commission staff held a meeting with representatives from 19 groups of shipping cask fabricators and designers, reactor licensees, and others concerned with fuel element shipments, to review a revised draft of part 72 prior to submission of the regulation to the Commission.

Regulations on the transportation of radioactive materials are coordinated with an Interagency Committee consisting of representatives from the Interstate Commerce Commission, Coast Guard, Federal Aviation Agency, Post Office Department, Bureau of Explosives, and the Atomic Energy Commission.

The purpose of this Committee is to assure uniformity of Federal transportation regulations and that safety problems in the transport of radioactive materials are adequately dealt with in Federal regulations. This Committee has proven to be very helpful in accomplishing these objectives.

DEVELOPMENT OF REGULATORY STANDARDS AND CRITERIA

A systematic program of regulatory standards and criteria development is essential to orderly, consistent, and effective administration of the Commission's materials licensing program. The purpose of such a program is to set forth in the regulations the conditions and criteria under which licenses will be issued and the performance standards required of activities carried out under such licenses.

To be effective, a regulatory standard must be based upon the most reliable information available and must generally represent a consensus of the experts on the subject. The standard must be practical, enforceable, and provide sufficient flexibility to encourage unique ideas and efficient approaches to meeting the standards.

It must be subject to change as experience and knowledge dictate. Thus, the process of development and issuance of regulatory standards is, by its very nature, tedious and time consuming.

In the early stages of a regulatory program, general performance-type standards such as the Commission's 10 C.F.R. 20, "Standards for Protection Against Radiation," is the first phase of standards development. As experience is gained in the licensing of specific uses of materials, a need for more specific standards applicable to a particular area of use may be indicated.

Examples of such standards are the Commission's regulations, 10 C.F.R. 31, "Radiation Safety Requirements for Radiographic Operations," 10 C.F.R. 71, "Regulations To Protect Against Accidental

Conditions of Criticality in the Shipment of Special Nuclear Material," and the proposed regulation, 10 C.F.R. 72, "Regulations To Protect Against Accidental Criticality and Radiation Exposure in the Shipment of Irradiated Fuel Elements."

Some of the other areas in the materials licensing program in which the possibility of more specific performance-type standards is being examined include: (1) fabrication and use of sealed sources; (2) land and ocean disposal of radioactive waste; (3) safety design of devices such as irradiators, teletherapy equipment, gaging devices, radiography cameras, et cetera; (4) performance criteria for personnel dosimetry; (5) processing of high levels of material; and (6) maintenance and disposition of records of individual radiation doses, radiation surveys, material inventories, et cetera.

In addition, staff studies are being made of other uses of materials where specific licensing control may be safely relaxed by exemption from licensing or by the issuance of a general license.

For example, it seems likely that certain medical radioisotopes for established diagnostic and therapeutic uses might safely be placed under a general license coupled with a registration requirement.

In all standards development the cooperation, assistance, and participation of the atomic energy industry, professional societies, standards groups and other interested parties is welcomed by the Commission; indeed such participation is essential to the development of regulatory standards.

Mr. BATES. Thank you. You referred to the general license. What do you mean by a general license?

Mr. ROGERS. A general license, Mr. Bates, is a license which is published in the Federal Register and it is not necessary to file an application to the Commission and receive a specific piece of paper for this license to be effective. It is simply published in the Federal Register and its states to whom it is applicable.

Mr. BATES. There is a type of approval given to a licensee, isn't there, of some nature?

Mr. ROGERS. There are certain conditions in the general license which specify the safety requirements which must be met in order for this general license to be effective.

Mr. BATES. How about the materials that are involved? Do you know where these materials are at all times, where they are located? What control do you have over them?

Mr. ROGERS. In some cases, yes. It depends upon the type and nature of material and the degree of hazard which one might have. For example, with some gaging type devices where the quantities of material are substantial, although they are well encased in capsules and sealed, we do have a requirement that the manufacturer report to us on a quarterly basis the devices which they have distributed under this general license, the location to which it has been distributed, and in this manner we have a mechanism of finding out where the gage is so that if necessary we can inspect.

Mr. BATES. Do the States check into some of those as well?

Mr. ROGERS. In many cases the States' inspectors accompany our inspectors and go in with them to check on these activities.

Mr. NEWMAN. Mr. Rogers, some people have suggested that for some materials you might substitute a registration requirement such as many States have now for the general licensing requirement. Have you given any consideration to that possibility?

Mr. ROGERS. Yes, sir, we certainly have. We think that a general license coupled with a registration system may be indicated for some areas. With respect to registration and a general license, I think that the first step is that one must develop standards and criteria in those specific areas where safety can be built in and where the degree of the hazard is not such that you require unique equipment and facilities which would require preevaluation. So I think that certainly there are some areas where a general license coupled with a registration system would be indicated.

Mr. BATES. Mr. Rogers, you recall the hearing we had on the disposal of low level waste a year or so ago?

Mr. ROGERS. Yes, sir.

Mr. BATES. At that time there were suggestions of various areas considering disposal on land as well as in sea. I note here that New York and Nevada are contemplating such disposals on land. Is that as far as we have gone on that now?

Mr. ROGERS. Yes, sir. I believe that is the stage that it is in right at the moment. They are in the preliminary stages of simply considering this and considering setting aside land for this purpose.

Mr. BATES. The economics depend upon geography.

Mr. ROGERS. Yes, sir, I believe that is primarily correct.

Mr. BATES. You take New York, at least toward the sea, is it a lot cheaper to dispose of it at sea?

Mr. ROGERS. I don't think that this would necessarily be true, Mr. Bates. I can't give you figures on that. There are such questions as the cost of packaging, which probably is considerably more for sea disposal. So I think it is not only a question of location with respect to a burial ground, but also the question of cost of transportation and the question of packaging.

Mr. BATES. There is no relative difference in safety?

Mr. ROGERS. I think that statement is correct.

Br. BATES. On the next page you indicate that recent experience has suggested a possible need for an amendment to the AEC regulations establishing requirements for a financial guarantee bond for licensees engaged in waste disposal. Is this a performance bond?

Mr. ROGERS. Yes, sir, this would be a performance-type bond.

Mr. BATES. Today we don't have such a thing?

Mr. ROGERS. At the moment we do not have, that is correct.

Mr. BATES. So, if someone defaults, he just defaults.

Mr. ROGERS. That is correct.

Mr. BATES. So, the AEC moves in and does it themselves or gets somebody else to handle it for them.

Mr. ROGERS. That is right.

Mr. BATES. In the meantime, it is just hanging around.

Mr. ROGERS. I don't think I would characterize it just like that. It is there, but we have inspectors in the area who assure that proper precautions are taken to make it safe. In other words, proper safeguards. But it is there.

Mr. BATES. I was hoping you would say that. What are these recent experiences that you refer to?

Mr. ROGERS. Specifically an incident out on the west coast where it was necessary to revoke a license. The licensee was not financially in a position to move the waste right at that time so the Commission went in and moved it themselves.

Mr. BATES. Is that the only experience we have had?

Mr. ROGERS. I believe there have been two experiences such as that, Mr. Bates.

Mr. BATES. How about on the transportation of this material? Many of the toll highways, I understand, prohibit the transportation of this material over these toll highways, is that correct?

Mr. ROGERS. Yes, sir. I think this is true. Many of them have certain limitations that they will let very small quantities go across. But I believe in some cases they prohibit altogether.

Mr. BATES. What are you doing about that? Are you trying to work that out?

Mr. ROGERS. Mr. Bates, I think there are two problems here. One is the question of insurance. I think this is the one that they are most concerned about, that is, the question of getting insurance to not only protect them from the standpoint of liability from a safety standpoint but the question of loss of toll as the result of the facility being tied up because of decontamination or for other reasons. So insurance is one problem.

Mr. BATES. Do I understand that the carrier has no insurance for this purpose?

Mr. ROGERS. I can't answer that question. I think the problem is the question of the toll facilities themselves having sufficient insurance to cover themselves in the event this happens. I am sorry I can't answer the question about the relationship between the carrier and the toll roads.

Mr. BATES. At this point we will adjourn our hearing until 11 o'clock tomorrow morning, when we will begin with Commissioner Olson. Tomorrow's hearings will consider the alternative proposals on the AEC regulatory organization and will wind up with a panel discussion. At 2:30 we will hear from Admiral Rickover as to the safety performance on naval reactors.

(Whereupon, at 3:55 p.m., Wednesday, June 14, 1961, the hearing was recessed to reconvene at 11 a.m. Thursday, June 15, 1961.)

RADIATION SAFETY AND REGULATION

THURSDAY, JUNE 15, 1961

CONGRESS OF THE UNITED STATES,
JOINT COMMITTEE ON ATOMIC ENERGY,
Washington, D.C.

The Joint Committee met at 11 a.m., pursuant to notice, in room P–63, the Capitol, Representative Chet Holifield (Chairman of the Joint Committee) presiding.

Present: Representatives Holifield, Price, Van Zandt, Morris, Bates, and Senators Jackson and Bennett.

Also present: James T. Ramey, Executive Director, John T. Conway, Assistant Director, George S. Murphy, Jr., and Jack R. Newman, professional staff members, Joint Committee on Atomic Energy.

Chairman HOLIFIELD. The committee will be in order. This morning the committee will consider recent proposals for revision of the AEC regulatory organization.

In recent months a number of studies have been made of the AEC regulatory process. The AEC has recommended and adopted certain internal organizational changes. The University of Michigan Atomic Research Project recommended creation of a separate agency. Finally the Joint Committee staff proposed the creation of an internal atomic safety and licensing board. Proponents of all of these views will be here today. Our first witness is Commissioner Olson.

Mr. Olson, the Chair knows of your great interest in this subject and the time and energy you have put into studying this problem. We are happy to have you with us this morning. You may proceed with your statement.

STATEMENT OF COMMISSIONER L. K. OLSON, THE ATOMIC ENERGY COMMISSION

Mr. OLSON. Thank you, Mr. Chairman. As you say, I have been invited to discuss the changes recommended, and adopted by the Commission as a result of our study last fall of the AEC's regulatory program.

The Commission's study was conducted to determine what improvements should be made in the conduct of its regulatory activities. In the course of our study we considered whether there should be any fundamental change in our organization, such as separation at the Commission level into two separate agencies, or the creation of a board to exercise the Commission's review function within the framework of our present organization. We concluded that no such fundamental change is desirable at this time.

As a result of the study which we adopted February 1, the following organizational changes, which we consider important to the effective administration of the regulatory program, were made effective March 10:

1. Complete separation of regulatory activities from promotional and development activities at all levels below the Commission. We transferred the regulatory functions from the General Manager to a newly created Director of Regulation, who reports directly to the Commission. The Director of Regulation was given complete authority over the entire regulatory staff, which includes the Division of Licensing and Regulation, the Division of Compliance, and the Office of Radiation Standards. The latter office is composed of those regulatory personnel formerly in the Office of Health and Safety, who are engaged in basic radiation standards work and implementation of the Federal-State legislation.

2. Transfer of regulatory field inspection personnel from the authority of the Operations Offices to the authority of the Director, Division of Compliance. This established direct line authority by the Director of Compliance over the field personnel who perform regulatory inspections.

3. Restatement and clearer definition of the authority and responsibility of the regulatory staff.

These steps have simplified and strengthened the regulatory organization.

Having the head of the regulatory staff report directly to the Commission brings the Commissioners into much closer touch with regulatory problems.

We are confident these changes will go a long way toward meeting the major problems which were identified in our study.

As a subsidiary step in the reorganization of the Commission's regulatory program, some changes have been made in the organization of the Division of Licensing and Regulation to place the responsibilities of each of the branches on a functional basis. The result is to divide into separate organizational components the responsibilities for licensing, for enforcement procedures, and for the development of guides and regulations. One of the main objectives was to free the technical people working on guides and regulations from other assignments.

In line with suggestions made in both the JCAE staff study and the AEC report, we have adopted new procedures in reactor and waste disposal cases which will provide more complete and meaningful information to local officials and the public prior to hearing. In connection with applications for construction permits and operating licenses for power and test reactors, we are attempting to make public a staff hazards analysis and the ACRS report well in advance of hearing. Notice is being served on the chief executive of the municipality or county in which the project is located. A similar procedure will be followed in waste disposal proceedings. These steps will give local officials, and the public, comprehensive information at the earliest possible time concerning the safety issues involved in a proposed activity, thus enabling them to make an informed decision as to whether or not they wish to intervene. We hope that these steps will give local officials, and the public in general, a feeling of confidence that the

Commission is conducting the public business in an open and forthright manner, and is alert to the paramount issue of public health and safety.

As a further step in making information available to the local community we are trying a new approach in connection with the application by the General Electric Co. to construct a superheat reactor at its Vallecitos site. I might say that Professor Davis deserves credit for initiating this new approach. A public meeting will be held on June 19 in Pleasanton, Calif. This meeting, which will follow by approximately a week the release of a staff hazards analysis, is designed to give the public a better understanding of the issues, and of our regulatory procedures, and the nature and extent of our review of the proposed project, and to answer any questions. The meeting will be held in the evening at a local school house. Such a meeting is, of course, not a substitute for the hearing required by statute.

The Commission frankly concedes that in the past it was slow in developing rules and regulations for the licensing of utilization facilities and materials. Since completion of the AEC study, there has been intense effort to prepare and issue standards and regulations. This effort will be expanded as fast as we can build up our standards staffs. Since January 1, 1961, we have approved 10 effective regulations and amendments of regulations and 8 notices of proposed regulations covering both procedural and substantive rules. They cover such procedural requirements as notification of local governing bodies of reactor licensing proceedings and the establishment of parallel hearing procedures for second-round reactors, to substantive rules to establish the content of technical specifications for reactor licenses and proposed reactor site criteria.

Much attention has been devoted in the studies of AEC regulatory procedures to what has been referred to as overjudicialization of our hearings and to so-called overburdening of the ACRS, and the Commission.

The mandatory hearing requirement and the requirement of referral to the ACRS were adopted by the Congress on the recommendation of your Committee in 1957. The Commission did not at that time provide for development of a full public record in power or test reactor cases, or publish reports of the ACRS, or provide for a full public exploration of safety questions before issuance of a construction permit. These factors, you will recall, led to intervention in the PRDC case. In view of the gravity of the issues involved, the interveners followed the procedure then established by the Commission for such cases and exercised the right of intervention to obtain a public exploration of the facts. That intervention had a very healthy effect upon development of our licensing system.

I might say it would be appropriate to say on the record that I think that Ben Sigal and his sustainers performed a great public service in their participation in this case.

The 1957 legislation requires, as a matter of law, that power and test reactor cases be referred to the ACRS for report; that ACRS reports be made public; and that the finding of safety be based on a public record made at a mandatory hearing. That legislation was necessary and appropriate at the time. The Commission has faithfully endeavored to carry out the purpose and intent of this amendment.

The February 1961 report of the Commission, the study by the staff of the Joint Committee, and the Berman-Hydeman study, have all concluded that some relaxation of the mandatory hearing requirement should probably be considered at this time.

The Joint Committee might well conclude that the mandatory hearing requirement of 1957 legislation has accomplished its purpose and that the time has come to consider a relaxation or some modification of the mandatory hearing requirements. Such a relaxation would make it possible, without violating the spirit of this legislation, to reduce the number of hearings without prejudice to the public's right of access to full and timely information; and without prejudice to any interested party's right and opportunity to intervene. Where a hearing is necessary, the established system of hearing before an examiner, with review by the Commission—and the courts, if necessary—is a sound, tested system. This decisional process is to be distinguished from the technical evaluation process performed by the Hazards Evaluation Branch and the ACRS.

The ACRS, which this Committee made statutory in 1957, has done a fine job. It has kept pace with development and has kept up with its calendar. The members are all men who have heavy commitments outside the Commission. The work they have performed is a public service which the Commission acknowledges. The advice and recommendations of an independent group of 15 men with such a diversity of technical and industrial experience is a most valuable contribution to the safety review process that would be difficult to obtain in any other conceivable way.

Any relaxation of the mandatory hearing requirement should also provide some flexibility in referring cases to the ACRS so that they will need to consider only safety questions of real significance in connection with power and test reactors and real significant safety questions in connection with any other reactor in which we might be interested. If there is a relaxation in this requirement, we would ask the ACRS to recommend the areas in which they feel referral is no longer necessary.

In the Commission's study of its regulatory program we considered whether it would be in the public interest to establish a separate agency to provide complete separation of regulatory functions. Although we think the time may well come when such a step will be desirable, we think the time has not yet arrived. The JCAE staff study appears to have reached a similar conclusion.

One of the most serious disadvantages to complete separation identified by the Joint Committee study would be the "obstacles to informal consultation and communication between the new agency staff, on the one hand, and the AEC staff and contractors engaged in operating and safety research programs on the other hand." The ease of access which the Commission's regulatory staff has to the people and the experience in the Commission plants and laboratories and the ability to obtain assistance from those people on short notice has been of inestimable value in the conduct of the regulatory program.

The Commission does not believe that its promotional responsibilities prejudice the proper discharge of its regulatory responsibilities. With promotional responsibilities being discharged by the General Manager, and regulatory responsibilities being discharged by a separate organization under the Director of Regulation, both under the supervision of the Commission, the Commission, we think, is in a good position to achieve a proper balance between the two during this period of development. Until the technology in this important area is more fully developed, we believe there are distinct advantages in continuing single direction of the total atomic energy program by the Commission. Safety is clearly an overriding responsibility. The program to promote the development and use of atomic energy cannot properly serve the public interest in disregard of safety considerations. Similarly, the regulatory program cannot properly serve the public interest in disregard of the need for progress in the atomic energy field.

Although we do not believe the Commission's regulatory and other responsibilities should be divided between separate agencies at this time, the reorganization which the Commission has adopted is clearly consistent with, and a logical step towards, ultimate separation.

The Commission has considered the independent Licensing Board recommended by the staff study and has concluded that it would be unwieldy. The Commission would prefer either the present system, or total separation. The proposed Licensing Board would leave divided responsibility for regulatory functions between the Board and the Commission. The regulatory staff would be placed in a position of divided responsibility and loyalty. We think the situation would breed conflict.

I might say in this regard that many of the people who commented at your request, Mr. Chairman, seemed to share that view. I note that it is shared by Professor Davis at page 28; by Mr. Fink of General Electric at pages 38 and 40; by Willis Gale at page 43; by Mr. King of Northern States Power at page 51; by Mr. McMeekin of CVNP at page 54; by Mr. Nelson of Los Angeles Power & Light at page 58; by Mr. Roscia of North American at page 63; by Mr. Upton at page 75; and by Mr. Webster at page 87. (Committee print, June 1961, "Views and Comments on Improving the AEC Regulatory Process.")

Chairman HOLIFIELD. Mr. Ramey has a comment on that point.

Mr. RAMEY. On the other hand, I think if you would look at the comments and if you are weighing it on the basis of who is in favor of what, I think you would find a far greater number of those who are commenting, favor the staff study. Going through a list, the Advisory Committee on Regulatory Safeguards, page 1; the Atomic Industrial Forum, which represents a great number of industries and utilities and individuals in the atomic energy field, at page 3; Mr. J. H. Campbell of Consumers Power Co., page 19; W. Kenneth Davis, page 32; Professor Davison, page 34; Mr. Dorn of Phillips Petroleum, page 35; Mr. Grendon, coordinator, State of California, page 43; Mr. Joslin, Commonwealth Edison, page 49; Mr. Leggett of Alcoa, page 54; Arthur Murphy, Law Firm, page 56; Mr. Philip Sporn, page 69; Mr. Harold Thayer, Mallinckrodt, page 73; Mr. Upton, generally I believe, favored it, page 73; Mr. Charles Weaver of Westinghouse, page 82.

Mr. OLSON. Mr. Upton said yesterday that he felt the Board should be under the supervision of the Commission and the Commission should have review authority. I believe Mr. Upton's position was clarified yesterday.

Chairman HOLIFIELD. The Chair observes that there seems to be a slight difference of opinion on this point.

Mr. OLSON. I don't deny that others agreed with you, Mr. Ramey, but it is only natural that I should seek to associate myself with those who supported our position.

If and when the time comes from complete separation of the regulatory functions of the Commission, the committee might wish to consider the concept of a specialized three-man adjudicatory board as an appellate procedure before an applicant reaches the circuit court of appeals. This is similar in concept to the Tax Court which has served with distinction in the specialized field of taxation.

The conclusions which the Commission has reached are not dramatic. Neither are they based on new or untried schemes. We do not believe that we have a situation calling for drastic departure from well-proven administrative procedures. I took heart yesterday from Judge Landis' testimony that, while there seemed to be a great deal of theoretical support for change, he did not observe any practical requirement therefor.

Mr. Chairman, I should like to thank you and the members of the committee for this opportunity to present the Commission's views. These matters are of great importance to all of the people in the administration of our national atomic energy program.

In the performance of our duties under the Atomic Energy Act, including specifically the 1957 amendment, we have tried to carry out the purposes the Congress has expressed in the act. We welcome constructive criticism of our work. We have received a great deal of it as the result of this look-see into the regulatory process. We believe that such criticisms as the Joint Committee staff has made in its report can effectively be met by the changes which we have already made in our organization and procedures. Legislation is the responsibility of this committee and of the Congress. The Commission, of course, will faithfully administer any changes which may be made in the act.

Now if I may, Mr. Chairman, I would like to sort of review briefly the thrust of our own report.

Chairman HOLIFIELD. Would this be contained in the additional statement?

Mr. OLSON. Yes; I would like to proceed with it, if I may.

Chairman HOLIFIELD. Very well.

Mr. OLSON. In our report we considered whether there should be any fundamental change in our organization, such as separate agencies, or the creation within our organization of a regulatory board to exercise regulatory or quasi-judicial functions. We concluded that no such fundamental change should be recommended.

We concluded that we should adopt, and we have adopted, significant changes in our internal organization and functions: We have completely separated the regulatory function from promotion and development at the General Manager level. Authority and responsibility for the regulatory function has been delegated to a newly created Director of Regulation, who reports directly to the Commission.

We have transferred regulatory inspection personnel in the field from the authority of various managers of operations, to whom they then reported, to the authority of the Director of the Division of Compliance. We thus established a direct line of authority to field inspectors as elements of the regulatory staff.

We have clarified the areas of authority of the Inspection Division, the Compliance Division, and the Division of Licensing and Regulation by amendments to our delegations of authority.

We have intensified our efforts toward the development of regulations in many substantive and procedural areas. We have established within the Division of Licensing and Regulation and the Office of General Counsel small organizational units whose primary function is the development of regulations. This has already resulted in substantial acceleration of work in that important area, and we look forward to greater benefits in the future. As a matter of fact, we are receiving complaints that we are getting regulations out so rapidly now that people cannot keep up with them. But at least there has been a change in tempo.

In our report we indicated that it was desirable to define by regulation the respective roles of the Division of Licensing and Regulation, the Advisory Committee on Reactor Safeguards, and separated staff in reactor licensing proceedings. This is a task of primary importance and of some delicacy, and will be accomplished in consultation with the Advisory Committee.

We pointed out the desirability of amendments to the Atomic Energy Act which would assist in accomplishing the changes we feel are useful. This would include amendment of section 189 of the act, and of 182.b, to relax the requirement for mandatory public hearing and referral to the ACRS, which would substantially reduce the hearings, burdens, and expenses of the licensing process while preserving the opportunity for a hearing at the operating license stage and for any amendments. As Mr. Ramey, executive director of this committee, said in his letter of transmittal of the staff report—

> with respect to the hearings themselves the Commission with some justice can point out that it was the Joint Committee and the Congress which instituted the mandatory hearing procedure.

Chairman HOLIFIELD. I think Mr. Ramey has a question at this point.

Mr. RAMEY. I just have a comment. I would like to point out that we did say that, and I think it is justified. However, the remainder of the paragraph in the letter of transmittal in which that is the lead sentence states as follows:

> However, as this report indicates, the Commission has gone further in some respects than the law required, particularly in regard to the number of hearings required and the formality of procedures. The intent of the 1957 staff report was that AEC safety proceedings should be public and on the record. It would appear that the Commission has utilized the hearing process to extend the Commission's affirmative control over licensing to include startup operations and changes. While such control may be desirable, it might be accomplished without unnecessary hearings, but on the public record with a later opportunity for hearing in the event of exceptions filed by any party or intervention.

Mr. OLSON. This is quite correct and this is a matter of opinion. In my firm legal opinion we followed the law. In view of the history of these amendments, I don't think we would have been authorized to take much license with interpretation of this section. The proper place to get interpretation of language of this sort is before the Congress. As I have indicated, we would now recommend that there be a relaxation of this section of the law, but I think that this is a matter of legal opinion, and it was our considered opinion that these hearings were necessary.

I might illustrate how mockery could be made of the system if we were to have a hearing only on the initial application and the real substance came up in connection with an amendment. I assume from my study of the Joint Committee report that this committee wanted the proceedings to be formal and on the record. We may have been over zealous in our interpretation of the intent of this committee, the legislative intent behind the law, but I think that under the circumstances the resolution of doubt should come from here and not by license within our Commission.

Chairman HOLIFIELD. But in the last analysis, by your suggestion to amend 182.b, and section 189, you do in effect say that if you have gone beyond the intent of Congress—and it is always difficult to know what that is unless it is spelled out in detail—that in any event you wish to be relieved or be in a position where you can exercise judgment as to not going as far as you have in the past on mandatory hearings?

Mr. OLSON. That is right.

Chairman HOLIFIELD. So regardless of what has happened in the past, there does seem to be a meeting of minds on the problem of relaxation of what you consider from the legal point is a mandatory position in order that you might proceed administratively and in a less formal way?

Mr. OLSON. That is right, Mr. Chairman. I think that everyone pretty well agrees that if you will trust us now that it is high time we be given some discretion in this field.

Chairman HOLIFIELD. I think a period of 3 years that we have had, or about 3 years, to practice in this field has now given us some experience where we can look at it from the standpoint of experience rather than projecting our judgment in the future, as we did in the 1957 act.

Mr. OLSON. In all fairness to those that have preceded me on the Commission and in the Office of General Counsel, this was a difficult area in which to develop perfect regulations on the first try. I think that 3 years of trial and error is not a long period when you consider the time that the other agencies have had to work on their problems.

We particularly suggested that the Joint Committee consider amendment of section 189.a to permit the Commission to dispense with the mandatory public hearing prior to the issuance of an operating license, in a case where the reactor presents no novel safety questions.

Our position is pretty much in agreement with the Joint Committee staff position, set forth at page 49 of its report which I might well quote:

> * * * There is value in having at least one public hearing on every license application for a power or test reactor. The gravity of the safety questions decided whenever a license is issued makes it important to provide an opportunity for interested members of the public to attend and to furnish an induce-

ment to both applicant and staff to formulate their respective views in terms as susceptible to lay understanding as the subject permits. Moreover, in doing "the homework" for such a hearing, the applicant or the staff may view the problems they have been considering in a new perspective and may become aware of the need to rethink or reexamine some facet of a problem. The AEC has rightly stressed the significance of this aspect of the hearing process in discussions held with the JCAE staff in the course of this study.

These merits of the formal hearing rapidly encounter the law of diminishing returns as successive hearings are held to pass either on proposed amendments to the construction permit or on the operating license. Only occasionally will the matters at issue justify the time-consuming, expensive business of preparing testimony and finding an opportunity to fit its presentation into a schedule of a busy hearing examiner—and I would add, all the other busy people involved. When no substantial safety question is involved in the conversion of a construction permit to an operating license or the amendment of either in some particular, the public interest would be protected by the filing of the proposed action in the public document room, the publication of an apt notice in the Federal Register and the giving of an opportunity to any interested party to intervene with respect to any new matter raised by the action.

We have approved 18 regulations since January 1, either finally, or for comment, including a regulation which will establish criteria for the choice of sites of power and test reactors. Against this background of effort to get out regulations and criteria, dispensing with the mandatory hearing at the operating license stage will, in our judgment, be substantially more practicable.

In our report, we considered carefully all the arguments which have been advanced in favor of vesting responsibility for the regulatory function, or the quasi-judicial aspects of that function, in a separate agency or in an independent licensing board within the Commission's structure. As we pointed out in our report, there are many ways of accomplishing such a purpose. Each possibility has some disadvantages and some advantages.

One principal reason why we concluded that no such board or separate agency should be established is the need for a single source of responsibility for the Government's activities in regulating atomic energy. The exercise of the present functions of the Commission by a single organization headed by a Commission makes the administration of this technically oriented and highly important area an integrated process, with one body to which the regulated industry and the public may turn for information, guidance, and regulation.

We note that the Joint Committee staff agrees that this is not the time for the establishment of a separate regulatory agency, and that a number of others agree, including Mr. Sporn, of American Electric Power Corp., and Mr. Thayer, of Mallinckrodt Chemical Works.

We have also taken steps to enhance the use of industrial advisory groups at an early stage in the development of regulations, a course particularly supported by Mr. W. Kenneth Davis, of Bechtel Corp. We have formed a committee on regulations within the regulatory staff in order to coordinate that work.

The appointment of the Director of Regulation, with direct formal and informal access to the Commission on a continuing basis, has in our view solved the problem of communication which had plagued the development of regulatory policy. As we pointed out in our report, the problem of regulation and law enforcement in an area affecting the public health and safety, so impregnated with scientific and technological information, requires such continuing consultation and direct and speedy communication, both oral and written, in order to develop policy and deal directly and immediately with problems as they arise.

The simplification of the staff structure which we have accomplished is an orderly and natural development of the separation of the regulatory function at the staff level which began in 1957 with the abolition of the Division of Civil Application and the formation of the Division of Licensing and Regulation with regulatory responsibilities alone. We believe that our development of policy and the speed, certainty, and soundness of performance will continue to improve.

Among the areas in which we are now pressing toward the development of regulations is the elaboration of part 50 of our regulations covering licensing and regulation of reactor and other facilities, and the general codification in regulations of directives which are now in the form of conditions of licenses.

In the evaluation of reactor safety, our report pointed out that the hazards evaluation staff is not in a position to design reactors, and that it must necessarily devote its attention to probing sensitive points of design and operation and evaluating the technical competence of the designers. The ACRS, in its comment in response to the request of the chairman of this committee, has recognized the complexity of the review problem and recommended that an applicant be subjected to one, and only one, complete and detailed review at the construction permit stage and the operating license stage, to be conducted by the full-time staff.

We expressed the opinion in our report that with the increased maturity of technology, the Advisory Committee should concern itself progressively with broad principles of safety rather than the details of individual reactors, thus using the time and energy of its members at an appropriately high level. We suggested that the Joint Committee consider an amendment to section 182.b of the act, adopted in 1957, which requires that the Advisory Committee review each facility license application for a power or test reactor. It appears from the comments which this committee has received that among those who agree with this suggestion are Mr. W. Kenneth Davis, of Bechtel Corp., Mr. Fink, of General Electric Co., and Mr. Joslin, of Commonwealth Edison Co.

In order to limit the burden of the Advisory Committee in accordance with the view that the Advisory Committee itself has since expressed to this committee, we recommended in our report that presentations by applicants to the Advisory Committee be limited to the necessities of clarification and illustration in order to avoid duplication of the work of the staff or the hearing examiner.

We said that we have no doubt of the adaptability of the quasi-judicial process to the determination of the issues in reactor licensing cases and compliance cases, and that our experience has shown that the adjudication of these issues is no different from that of proceedings before other agencies. I should like to point out that other agencies deal with extremely complex technical questions and that our reactor licensing proceedings, in which there is only one ultimate technical issue of safety, represent in a sense a simpler adjudication problem although the technology is less well defined.

We believe that the division of the Commission's functions between two agencies in the light of Government sponsorship of research and development and participation in this industry might leave the two agencies working at cross purposes. We are glad to note that the Joint Committee staff study has pointed out that a separate board might fail to give adequate recognition to development needs. Prof. Kenneth Culp Davis, whose position does not agree with the Commission's in every respect, has been particularly forceful in saying that this possibility of conflict is inherent in the creation of any new board, whether within or without the Commission's organization:

A difference in point of view between the AEC and the new board seems to me to be built into the proposed system of organization. The difference in point of view will inevitably lead to frustration and stalemate.

As another consideration opposed to total separation of the regulatory function, we pointed out in our report the disadvantages which would accrue through separation from the regulatory process of the wealth of technical and scientific information in the AEC staff and contractors. We note that many of those who have responded to this Committee's request for opinions have regarded this as perhaps a controlling factor in opposition to complete separation. We feel that the sound development of regulatory standards, in an area where technology is so fluid, requires that the flow of scientific and technical information into that process be as close and continuous as possible.

We indicated in our report, that if a board were created it should function under review by the Commission in which rulemaking authority should remain, in order to avoid the danger of a conflict between the board and the Commission in the development of policy. If its decisions were not open to review by the Commission, then there would be no particular advantage to retaining it within the existing organization because it would be in effect a separate agency. Separation of the quasi-judicial or regulatory function at this stage would require it to be performed without an adequate set of standards to apply, and without the substantial resources of our present organization to develop standards soundly on the basis of current technology.

In reviewing the replies of those who responded to Mr. Holifield's request for comments on the reorganization of the Commission, the proposals for the creation of a separate agency or for a Licensing Board within the AEC, and procedural changes, there are substantial areas of general agreement with the points of view expressed in our February report, in addition to those I have already mentioned.

There appears to be practical unanimity that the development of standards deserves a high priority, that the appointment of a Director of Regulation and the simplification of the structure of our integrated regulatory staff are steps in the right direction. I note particularly the comments of the Advisory Committee on Reactor Safeguards, the atomic industrial forum seminar, General Electric Co. and the JCAF staff and others approving that step.

There is also virtual unanimity in favor of some limitation of the scope and detail of hazards review by the Advisory Committee on Reactor Safeguards. There is also agreement, at least between us and the staff, that there should be a mandatory public hearing prior to the issuance of a construction permit, and that steps should be taken to modify the mandatory hearing requirement for subsequent stages.

I find also substantial recognition that the regulatory function necessarily requires the resolution of conflicting policy considerations.

I refer particularly to the responses of Dr. Doan, formerly a member of the ACRS, Mr. Sporn, Mr. Webster, Mr. Roscia, of North American Aviation, Dr. Grendon, coordinator of atomic energy for the State of California, and numerous others. I am especially pleased to note that representatives of licensees whose applications have been subjected more recently to the hearing process have been most heartily in favor of our mode of approach. This appears from the statements of Mr. McMeekin, president of Carolinas-Virginia Nuclear Power Associates, and Mr. King, president of Northern States Power Co.

Thank you very much for this chance to summarize the thrust of our own report.

Chairman HOLIFIELD. You are to be commended for your report. Is the chair to assume that this is the concensus of opinion on the Commission?

Mr. GRAHAM. That is correct, Mr. Chairman.

Chairman HOLIFIELD. Are there any additional views that the Commissioners would like to present at this time?

Mr. GRAHAM. Mr. Chairman, I was not scheduled as a witness, but I have a few brief observations with your permission that I should like to make.

Chairman HOLIFIELD. I think it is in order for you to go ahead. Then we will go into the question period with the full case of the Commission before us.

Mr. GRAHAM. Thank you, sir. As noted, Mr. Chairman, I was not scheduled as a witness. However, after listening to the interesting discussions which took place yesterday, I have jotted down a few notes here which I would like to use to refresh my recollections. First of all, Mr. Chairman, it seems appropriate to recall that the Commission expressed a hope to this committee slightly more than a year ago that you and the AEC bring up to date the regulatory study of 1957. This, as we know, has been done and this is the basis of your hearings. A lot of hard work followed and many people were involved in this effort.

It is my impression that these people, as well as others who have studied the reports and appeared here as witnesses believe that the undertaking was worthwhile. Constructive steps have resulted in the AEC, stemming from this study. Perhaps all of us in this business have a better understanding of the problems and the possible solutions now that the microscope of this committee has been focused on this matter.

These hearings seem to me to have a dual purpose. First, the performance of the Commission as a regulatory body is being assessed, and secondly, there is the question as to whether or not some legislative changes would be desirable. As has been pointed out by nearly all the witnesses, the starting point was the 1957 amendments, as they are called. The amendment to section 189(a) to require mandatory hearings imposed an extraordinary procedural requirement on the Atomic Energy Commission.

This was in addition to the existing law which provided that the procedural requirements of the Administrative Procedure Act would also apply. We are all familiar with the requirement and why it was instituted. It was unfortunate that such a change should have been necessary.

Turning now to the first question, that is, the assessment of the performance of the Commissioners with respect to the mandatory hearing requirement. Some people may have regarded the deliberate amendment of section 189(a) as a vote of no confidence in the Commission. In any event the Commissioners took seriously the attitude that the Congress wanted the Commission to establish a better public posture. This has been our aim.

In effect, we adopted a quasi-judicial procedure under a hearing to provide for the public record by direct and cross examination or otherwise sufficient evidence to sustain a finding and conclusion as to reasonable assurance of the safety of the public.

If the record were insufficient in the opinion of the Commissioners, then we remanded the proceedings. Thus, we in substance regarded such proceeding as "adversary." I put that in quotes, Mr. Chairman. The contest being the paramount issue of public safety versus the private motivation to get a construction permit or operating license with as little inconvenience as possible.

If industry had hopes for self-regulation by going through the motions of a hearing but not coming to grips with the substance, then they have been disappointed. A so-called consent decree would not be adopted by the examiner unless, in fact, the record supported the independent finding and conclusion that is required. It was in this spirit of having the public record speak for itself that the Commissioners adopted the ex parte rule in November 1959. Such rule is nothing more or less than a pronouncement that the Commissioners will rely on the record to support a finding and conclusion that a reactor can be constructed or operated with reasonable assurance. So much for the past.

Now, to the second point, the future. It has been suggested that the mandatory hearing requirements be relaxed. We have not objected on the theory that perhaps our public performance in carrying out the 1957 amendment has warranted some confidence. Mr. Upton was kind enough yesterday to acknowledge the integrity and zeal of the Commissioners, although, Mr. Chairman, he seems to deplore that some of us have learned nothing since the 1930's.

The witnesses here seem to support the idea of a relaxation of the mandatory hearing requirement, and certainly at the construction stage I believe all witnesses here have been of the opinion that that mandatory hearing would be desirable in the first stage.

When construction has been completed and the public informed of the hazards analysis, the Commissioners, in my view, should be given the discretion to either offer a public hearing or to have a mandatory hearing on the license application. Now, this exercise of judgment at that point, Mr. Chairman, would undoubtedly vary in different circumstances dependent upon the nature of the reactor, the scope of any amendments, the adequacy of the analysis, and the thoroughness of the training and operating procedures.

The objective, Mr. Chairman, to be achieved in any kind of a proceeding, in my opinion, is to avoid any implication that a decision has been made under what might be called car-pool conditions. That is no way to resolve the important questions of health and safety.

Commissioner Olson has stated our belief that the regulatory function should be cut away from the promotional function at some future time. This is also my own view, and I think that the split can and should be made when the regulations and the technology have sufficiently developed. I think, Mr. Chairman, those witnesses yesterday who seemed to have the same view premised their conclusions primarily upon that same fact.

Mr. Chairman, there is just one more point to which I should like to invite your attention to. I was impressed yesterday by Mr. Leclair's comments, I believe, in answer to Senator Anderson's question when you were not here. Senator Anderson asked him about the Dresden reactor case. Mr. Leclair promptly said that all of us were feeling our way. I think that was true.

There was no witness yesterday, Mr. Chairman, who cited a decision and then claimed that it had been either an injustice to the public or to the applicant. I am using the applicant in the sense that I do not believe there has been any charge of any serious delay.

In closing, Mr. Chairman, I just wish to say that whatever may be the viewpoint of people as to the decision process, I can speak of my own knowledge that the Commissioners have taken this earnestly and seriously as a personal matter and we are responsible for and do our own work. But I would like to close on this note. I want to express our thanks to you and the committee for having devoted so much time and thoughtful consideration to this very important matter.

Thank you, sir.

Chairman HOLIFIELD. Thank you, Mr. Graham, for those additional comments.

The Chair would just like to say that the present hearing into this matter is being conducted with complete objectivity and with a desire to completely cooperate with the Commission. Our responsibility, I think, is that of trying to find out how the Commission's procedures are working out in their contacts with the people who have to have construction permits and operating licenses, and the efficiency with which it is being handled.

The fact that we are having a hearing is not to be considered as being condemnatory in any way. In fact, I have been very much pleased that the Commission has been proceeding as energetically as it has in the last year, let us say, to try to set its house in order. As you said, there were certain things that happened before 1957 which caused the committee to feel that decisions were not being made with the degree of formal consideration that was needed.

In some instances decisions were being made on more of a personal basis than on a general consensus of opinion among the Commission itself. We have now had some time since the 1957 amendments and we are looking at it again to see where we go from here, or if it is necessary to go anywhere from here. So the questions that we will ask will be in the nature of exploratory questions to try to get on the record an analysis of the situation as it is, and as it has been worked out, and also to see if there are areas where it can be improved in the future.

You have suggested some amendments and the committee will look at those amendments very carefully, of course, and proceed to put them into effect if the majority of the committee deems that they are worthy. I have a few questions which I would like to direct to Commissioner Olson. The first one is, Have you found that establishing the position of Director of Regulation reporting directly to the Commission actually makes communication of Commissioners with the regulatory staff more effective?

Mr. OLSON. Very much more effective. We see Mr. Price regularly at 9:30 every Monday, Wednesday, and Friday if he has anything at all he wants to take up with us, or if we should send for him. He has access to us at any time. I think that this accounts for the rapid outflow of work in recent months.

We have considerably shortened the lines of communication. This is in no sense to be understood as a reflection on our General Manager. He has a tremendous job operationally and promotionally. You know the magnitude of the establishment, the number of people and the problems that he has. This, in my view, is a separate problem and belongs in a separate group reporting directly to the Commission. It is a check and balance function below the Commission. The Commission is sensitive to this need for checks and balance, the safety versus the need for getting on with the development in the field.

In order to assure balance we have two different people heading two different functional divisions of our responsibility, and it makes it much easier to bring into focus the conflict problem which the Commission is in a position to resolve because it has the total responsibility. I have been eminently satisfied with this division, yes, sir.

Chairman HOLIFIELD. Referring to Mr. Price's testimony yesterday on that point, it certainly established that he has ample access to you, both on a formal and informal basis to the Commission in the case of any problem that he has. What effect does your internal organization have on the operation of the staff continuing under the direction of the General Manager?

Mr. OLSON. I am confident that it has had no adverse impact whatsoever. Mr. Price's regulatory office still affords the General Manager the same technical service that was available to the General Manager before in the event that hazards reports are desired. I would say that there has been no adverse impact whatsoever.

Chairman HOLIFIELD. Have there been any difficulties in transferring the field compliance inspection personnel from the direction of the Managers of Operations to the authority of the Director of the Compliance Division?

Mr. OLSON. No, sir. That has proceeded very smoothly, in my opinion.

Chairman HOLIFIELD. Have you found any difficulties arising because the hazards evaluation staff is no longer under the direction of the General Manager.

Mr. OLSON. Not at all. They previously performed services for the General Manager on request, and they will still do that. Of course, the General Manager and Mr. Price both work for the Commission so there is no problem of complete correlation and service there.

Chairman HOLIFIELD. Do you think that the notice of filing applications given to representatives of local communities likely to increase the number of interventions in reactor licensing cases.

Mr. OLSON. It may, but only if it should. I think the public must be considered. The affected public is definitely a party in interest here. As Dr. McCullough has told you, there is no such thing as absolute safety. In every case where you build a reactor it is a relative proposition of how much risk is imposed upon the public as opposed to the cost in additional safety features.

Increased safety costs money. On the other hand, we have to strike a balance between those needs. I think the public should be an informed participant here. There may be more interventions, Mr. Chairman, but I am not fearful of that at all because these people do have an interest.

Chairman HOLIFIELD. You have described the extent to which the Director of Regulations has access to you on a formal and informal basis. Do you have similar communication with the General Manager about the functions under his directions?

Mr. OLSON. Yes, sir.

Chairman HOLIFIELD. That is a constant and close association.

Mr. OLSON. That also is every Monday, Wednesday and Friday morning. Since his are more extensive contacts usually—Mr. Price comes in first because it takes less time—the General Manager and Mr. Price both have access to the Commission daily. So there is complete access to both of them.

Chairman HOLIFIELD. Do you anticipate any substantial enlargement of the regulatory staff in the future?

Mr. OLSON. I would expect that there would be an enlargement because this is a growing function and the staff has not increased in proportion to its increase in work at all in the past 2 or 3 years. I would expect that there would be a fairly substantial growth in the Regulatory Division, yes, sir.

Mr. RAMEY. Do you anticipate any enlargement of the staff of the General Manager with respect to safety activities related to AEC?

Mr. OLSON. Yes, we do, but not because of the separation. Only because we have decided as the result of a bitter experience in the SL-1 incident that we need to do more than we were doing.

Chairman HOLIFIELD. What is the nature of the review exercised by the Commission of a decision of the hearing examiner in order to determine whether the Commission will undertake formal review if no exceptions are filed.

Mr. OLSON. What is the nature of the review? It has been variously suggested that we look at it from a purely procedural standpoint or that someone else looks at it for us. But the facts of the matter are that each Commissioner takes a good deal of interest in looking over these decisions of the examiner before they become final and looks at them from every point of view, procedural and substantive. We usually ask for a briefing of the decision, and we study it ourselves and decide whether we are satisfied with it or not and consider the policy ramifications that this particular case raises.

We have had to proceed very much on a case-by-case basis so far, particularly before the separation of the Regulatory Division. Primarily the regulatory matters came to the Commission only in the form of individual cases for review. I think we will have less case-by-case development now as the result of the separation.

Mr. RAMEY. Past testimony and reports, particularly the testimony by Mr. Graham, indicate that the role of the Commission on these licensing cases has seemed to be like a circuit court of appeals, merely reviewing from the standpoint of law and policy. I notice that you mentioned that you would go into the substance of things.

Mr. OLSON. It is a little hard to recall offhand these cases but in WTR we certainly looked at the substance. We said there was not enough evidence in the record to warrant the issuance of that license. In the *Industrial Waste Disposal* case we said that we were not sure of the integrity of these containers. There have been cases, Mr. Ramey, where we have looked other than at the form.

Mr. RAMEY. How about the role of the hearing examiner? We have discussed this problem. The focus of all of this is the technical problem of safety. The hearing examiner is not a technical man. Is he merely applying the general rules of administrative law to the facts? Does he go into the substance?

Mr. OLSON. Mr. Ramey, the hearing examiner is supposed to make a decision based upon the record on the ultimate question of safety. He is not to contribute evidence from his own mind to that record. He is to take the evidence of the record and to try to conclude whether all evidence available, whatever it be, fact and opinion, is expressed on the record. He then proceeds to try to evaluate the record and to try to evaluate this question of risk as identified on the record, to ascertain whether that record supports a conclusion, a policy and technical judgment on the ultimate question of reasonable assurance of safety. I think that he has a broader function than just to be a notary taking a deposition.

This question of the presiding officer being a technical man is certainly a matter that lends itself to a lot of difference of opinion. I know from my own experience in private practice that there were cases where I would have found it much easier if the judge had all the knowledge in his own head, so I did not have to produce the witnesses. But on the other hand that would have made it awkward for me because there would not have been an adequate record to support his decision. I think when you get a technical group of people that they are apt to come to the ultimate conclusion without the attention that our system properly directs toward legal policy and criteria.

The policy is enunciated in the statute. You cannot escape the conclusion that as of today there is a lot of policy involved in any decision to locate a reactor. There are no numerical equations that will say that it is safe.

Mr. RAMEY. You appreciate, of course, that the staff recommendation did not necessarily propose that a technical man chair the proceedings. As a matter of fact, they recommended that a person trained in conducting administrative proceedings be on the Board and two technical people be involved. One further question.

Mr. OLSON. Yes, I do recognize that was present in your recommendation.

Mr. RAMEY. We have heard a rumor—I do not know that we have ever gotten official notice—that the Commission's hearing examiner does have a technical adviser—Is that true?

Mr. OLSON. May I here confirm the rumor. As a matter of fact, that was very much as the result of some of our discussions, I believe, Mr. Ramey, at one time you and I and Mr. Newman and others discussed it further. We took it up with the Commission. We decided that it might be well to try this out, to give him a law clerk, so to speak, with a technical background who could go through the testimony, the narrative testimony, the application, so that the examiner could discuss it with some technical competence. We are trying this out. It has not been startlingly successful, but we are continuing with it.

Mr. RAMEY. What if you gave him one more technical assistant and called it a Board.

Mr. OLSON. I think that has a lot of merit. I think that has a lot of merit provided you would not clothe it with complete independence of authority and make it separate but within the Commission. I think that has a lot of merit.

Mr. RAMEY. So you have a little Board there. Then the other thing that has happened since the committee's staff report was that the Commission established this rule of a certiorari procedure so that the decision of your hearing examiner or if you went to your hearing examiner and two technical assistants, is final so far as the applicant is concerned.

Mr. OLSON. Subject to our right to review on our own motion.

Mr. RAMEY. Subject to the right of the Commission if it so determines to review. There is no right by the applicant, as such, to have a further review. All he can do is go to court; is that correct?

Mr. OLSON. Yes, that is right.

Mr. RAMEY. So in a sense you have already limited your review.

Mr. OLSON. We have limited the right to review but not our right of review. We had some cases where we thought there were a lot of specious exceptions and it took a lot of time to answer them seriatim. Then the President came out with this recommendation and it was in close proximity to our experience and we got out the rule. But there has been no change in our procedure. We still look over every single decision of the examiner before it becomes final. We, the Commission.

I think there is a lot of merit to the suggestion that Mr. Ramey has just made of having a Board like this, provided it still was under the single authority of the Commission. I would say that whether I was on the Commission or not. I think there is some advantage to this unitary command in the whole atomic energy program.

Mr. RAMEY. I gather that is also the view of Dean Landis, generally speaking. He talked of an ad hoc board. Of course, you do have a Patent Appeals Board within your own organization that decides cases.

Mr. OLSON. Yes, and subject to our review.

Mr. RAMEY. It once was independent.

Mr. OLSON. We never reversed them, but we do look at each of their cases.

Chairman HOLIFIELD. The Chair notes that Dr. Seaborg and Dr. Hayworth of the Commission have been present now for some time. Thus, all the Commissioners are in the room. I might inquire at this time the same question I gave the other Commissioners that were at the table, if Mr. Olson, in presenting the statement, also presented the viewpoints of you, Mr. Chairman, and Dr. Hayworth.

Mr. SEABORG. Yes, sir.

Chairman HOLIFIELD. I believe at this time we will excuse the present witness and try to get in Dr. Silverman's testimony before we adjourn. We are running a little late and it may be necessary to call you back.

Dr. Silverman, will you come forward, please.

STATEMENT OF DR. LESLIE SILVERMAN, FORMER CHAIRMAN OF THE ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

Dr. SILVERMAN. Thank you, Mr. Chairman.

Chairman HOLIFIELD. As you heard me announce, we are working under pressure here.

Dr. SILVERMAN. I will do my best.

Chairman HOLIFIELD. You testified before us before. You have quite an extensive statement here.

Dr. SILVERMAN. If you have no objection, Mr. Holifield, I would just as soon comment on each section rather than read it directly.

Chairman HOLIFIELD. Will you please do that. That will help.

Dr. SILVERMAN. To begin with, the first three pages of my testimony really deal with the history of ACRS actions during my tenure as Chairman.

Chairman HOLIFIELD. We will accept the whole statement in its entirety for the record.

(The statement referred to follows:)

Testimony of
Dr. Leslie Silverman
(Chairman of the ACRS During the Calendar Year 1960)
Advisory Committee on Reactor Safeguards, USAEC
Before the
Joint Committee on Atomic Energy
Radiation Safety and Regulation Hearings
June 15, 1961

As Chairman of the Advisory Committee on Reactor Safeguards during the last year, it is my pleasure to appear at your request to discuss briefly the activities of the ACRS during the last calendar year and to give an extended discussion of the viewpoint of the Committee on the proposed alternate organizational and procedural changes which have been suggested to improve the AEC regulatory process.

During my tenure as Chairman, the Committee had several consultations with the Atomic Energy Commission to discuss their plans for improving, as well as reviewing, the present regulatory process. To keep my written comments within the time limit allocated, I propose to cover essentially three areas. The first is purely a matter of reporting the activities of the Advisory Committee on Reactor Safeguards during the calendar year 1960, the second to indicate the present membership of the Committee, and the third to discuss in more detail the advice we have already submitted to the Atomic Energy Commission and the Joint Committee in regard to the various proposals for improving the AEC regulatory process.

In regard to the activities of the ACRS during the calendar year 1960, I have listed in Appendix A all of the meetings of the full Committee and its subcommittees during the calendar year 1960. The location for the meetings was Washington, D. C., unless another location is identified. In subcommittee meetings where the ACRS was represented only by a single member, it is so indicated. Appendix B lists all the meetings of the ACRS and its subcommittees for the calendar year 1961 through May 31st only. Lastly, in Appendix C, I have listed the subject and date of letters written by the ACRS during the calendar year 1960 and for 1961, through May 31st. I would like to point out that both Appendices B and C include material which is the responsibility of the present chairman whose tenure began on January 1, 1961.

It is customary for the Committee to identify its current membership, and we are doing this by the information presented in Appendix D. No changes were made during the year I functioned as the ACRS Chairman. However, Dr. Richard L. Doan had submitted his resignation earlier to become effective December 31, 1960. He completed nine years of important service to the Committee and its predecessor. We believe his resignation was a great loss to the Committee. His long experience in supervision and administration of reactor operations was of great benefit to the important work of the Committee. It is necessary to recognize, however, that there will most likely be a continuing rotation of membership in order to prevent overload in part-time efforts by qualified scientists and engineers.

The nuclear technology field is now important enough, however, so that the Advisory Committee will be able to obtain well-qualified individuals for replacement should the need arise. There is a tremendous value to continuity and overlap of membership. Since the regulatory changes proposed indicate that advice from an Advisory Committee of this stature will continue to be needed, it is important that eminently qualified people be retained as long as possible. This becomes especially important for the new and novel projects which are under consideration and development.

Proposed Changes in Regulatory Procedures

You have asked that I specifically comment on the suggested organizational and procedural changes proposed by the AEC and the Joint Committee. You are aware, I am sure, that the Committee has submitted two letters that pertain to this subject, one of which appears on pages 590 and 591 of Volume 2 of the Joint Committee on Atomic Energy Print entitled "Improving the AEC Regulatory Process." For purposes of reference, a copy of that letter is attached herewith as Appendix E. I am also attaching a copy of the letter we submitted to Mr. Ramey in reply to his letter of March 22, 1961, which is attached for reference as Appendix F. The latter now appears on page 1 of the June 1961 Print entitled "Views and Comments on Improving the Regulatory Process."

I think it is worth noting at this time that during the various reviews of the regulatory process, the Committee met with Mr. Slaton and other Commission staff and reviewed the compilation that they prepared (Volume 2 cited above) as to its activities under the present regulatory procedure, particularly in regard to ACRS reviews.

This involved assistance from our small technical staff, our procedures subcommittee and the full Committee. We also had an opportunity to discuss various ramifications of the AEC regulatory process with Mr. Olson and to a lesser extent with other Commissioners. We also met with Messrs. Ramey, Toll, Cavers and Mitchell to discuss our procedures and their proposal prior to its publication as a Joint Committee document.

Since these two letters are now in the record, it is perhaps desirable to comment more fully upon them at this time.

In regard to our first letter, which was dated December 13, 1960, and itemized as Appendix 10 of Volume 2, we pointed out that there are four important areas of concern, namely, responsibility; staffing; assistance from an advisory committee; and improvements in procedure. I believe that these points on which the Committee has made some positive statements to the Commission are still essentially the viewpoint of the Committee at the present time. I would like to comment that when this letter was written the Committee did not have available the draft proposals of the Joint Committee with regard to an Atomic Safety and Licensing Board. It was aware, however, in general terms of the considered approaches of the Joint Committee staff. We suggested at that time that a single Commissioner of the AEC group of five might concern himself only with safety matters, but that the line organization would thus be separated from the promotional and developmental activities of the Commission. I believe that the question of a Commissioner devoting himself exclusively to safety has already been commented on, and in view of the content of our March 22nd letter of reply to Mr. Ramey, I do not think this calls for further consideration at this time.

We believe that the important thing to call to your attention is that the final paragraph on improvements and procedures of this letter is the most essential one, namely, that the regulatory procedures should be responsive to the technical as well as the legal requirements. We should also like to emphasize that the procedures should be kept to a minimum of necessary steps in order to prevent unnecessary efforts on the part of applicants as well as overlapping and perhaps conflicting reviews of licensing cases.

Our letter of April 8th, in reply to Mr. Ramey's letter of March 22, 1961, summarized our viewpoints on the proposed ways in which the regulatory process and the safety of nuclear reactors could be improved. Since it is my understanding that Dr. McCullough has commented on the technical safety aspects, I think the specific remarks in our letter of April 8, 1961, devoted to improving the regulatory process are the only ones upon which I will comment at this time, although they are almost self-explanatory.

We indicated that any one of the three proposals could be made to work. It is apparent that the one with the minimum number of changes is the approach proposed by the Atomic Energy Commission. The one with the most drastic action perhaps would be the creation of a separate regulatory agency. It seems to us that the middle course was the one proposed by the Joint Committee, which while it does not completely separate the regulatory process from the Commission, and provides assurance of a technical judgment and a direct responsibility for the licensing to a board with a major technical representation. In our opinion, a board can represent an improvement over the present hearing system if it provides a complete technical record for public review in any possible future hearing. It is the Committee's viewpoint that a technical and policy judgment is required to assure that all of the technical safety considerations of the reactor are in the record. We emphasize this point because final safety features are decided on technical appraisal. Legal decisions can often decide whether or not a given criterion or regulation is satisfied.

I would like to point out, however, that I do not believe there have been any basic or serious problems created by the present regulatory procedure. However, there appear to be some questions in the minds of those in the reactor industry as to whether or not the final judgment, as rendered by a lawyer serving as hearing examiner and reviewing the evidence from the legal standpoint, is necessarily a technical judgment. Further, since the license is reviewed by the Commissioners before it is granted, it would seem that this is an implied technical judgment when in fact it may not be. It can often be a policy judgment. The addition of some technical review at the highest possible level, such as proposed in the Atomic Safety and Licensing Board, appeals to the Advisory Committee as a very positive step forward in providing technical judgment. It is necessary to point out, however, that we do not believe that this technical board would have to include a complete technical review in the same detail as that now carried out by the present staff. We find no problem with a review of the final judgment by the Commissioners.

Needless staffing and duplication of effort is one of the inherent problems associated with the creation of new review boards. In our opinion, a complete and thorough technical review with all safety items evaluated and checked at the staff level is essential. The Atomic Safety and Licensing Board and its personnel should have the opportunity to review certain aspects of the case, but a complete technical review of what has been previously done is not indicated. Consequently, there must be some positive limit to the size of staff of the proposed Board. The JCAE staff proposal says small without definition.

The ACRS position in the case of the Atomic Safety and Licensing Board, as well as in regard to the present regulatory procedures, is that we would favor an opportunity to review the new and novel programs which are accelerating. It is not essential, in our opinion, that we review every power and test reactor case in the same detail in the case of those reactors above 10 megawatts thermal where there are features similar to those already evaluated in depth in past cases.

The present regulatory procedure has not resulted, in our opinion, in delays but may perhaps be described as adding legal complications. Frequent reviews of numerous amendments not always concerned with the health and safety of the public which have been submitted by applicants have added unnecessary work to the regulatory load, both for ACRS and the staff.

The ACRS, as you know, is composed of technical men. We believe that judgments of safety are technical and policy judgments. There is some difficulty at the present time in obtaining enough high-caliber scientists and engineers in Government service to conduct the safety reviews to the depth that they are needed. Considerable reliance, therefore, must be placed upon the competence of the licensee, some of which we and the staff have had to judge from the capability of the applicant and his experience.

In regard to the present technical staff, we believe they are rapidly developing as a sound and mature technical group. These positions pay well enough to attract high-caliber scientists and engineers. It must be recognized that safety reviews and hazard report evaluation are a "negative function" in many respects. It is not a very rewarding position from the standpoint of creative work, although the monetary return is certainly comparable to similar positions in the nuclear industry. There is, therefore, an inherent problem in assessing how long before enthusiasm and interest for this type of effort will wane. Certainly, considerable maturity and judgment are necessary in making over-all appraisals. The detailed checking and satisfying of "check list" or "evaluation scoring" may become a somewhat monotonous and lack-luster operation. For this reason, many of our members believe that rotation of staff for field assignments such as reactor safety research or reactor technology studies may be desirable to provide stimulation and vitality to the safety review staff. Certainly attendance at technical meetings and participation in various conferences is helpful, but undoubtedly participation in operational or safety research assignments would be much more fruitful.

One other area on which I believe comments are useful pertains to the development and strengthening of the reactor inspection group in the Compliance Division. Certainly this is a most vital function and an essential one in providing feedback and information to the regulatory staff. We cannot be too strong in emphasizing that this group should continue to be strengthened regardless of any other changes which may be made in the regulatory procedures.

The proposal has been made that we restrict our efforts to the construction permit phase of licensing and not be concerned with operating license aspects in any detail. As a matter of fact we have usually concentrated major emphasis in our technical reviews to site selection, reactor concept, and design features. Establishment of proper barriers in the first instance can protect health and safety of the public even if operational difficulties arise or an accident takes place within the capabilities of the containment, confinement, the exclusion or low population density distances.

It has been our recent experience, however, that several important changes in regard to safety features have taken place after the construction permit, and in some cases after the operating permit. Hence, it is not possible to generalize completely in this regard.

The judgment as to what is to be reviewed and its extent has been decided as much in the past by ACRS as by the staff of the Commission. In the event an Atomic Safety and Licensing Board as proposed is created, the judgment as to what is to be reviewed by ACRS will be dependent upon this Board for such requests. We will provide the staff with advice for reviews in the preliminary hearings for construction permits and occasionally for operating licenses. Whether or not this will reduce the workload of the ACRS can only be determined by experience. We believe that we should retain the privilege of reviewing any case we consider has features of safety significance. The proposed Board composition represents a majority in the technical aspects relevant to safety. There is a point to be made that the Board could perhaps be enlarged to increase its technical emphasis.

There have been many comments that ACRS efforts should be restricted to new and novel problems or act in other ways in which the word "advisory" is stressed. In our opinion we have acted in an advisory capacity in all respects. In addition to our efforts in complying with the statutory requirements, we have often advised the Commission on many other safety matters such as in the case of site and reactor control criteria and safety research. We have initiated and spurred investigations, research, and reviews we felt were essential to reactor safety.

Speaking for myself, I believe we have never felt we were above criticism and have tried to give every applicant ample opportunity to state and defend his concepts and design features for protecting the public. I have stated before that since our reports must be made public as specified by law, it is apparent that they will necessarily be as explicit as possible in defining to the public the general opinion of the Safeguards Committee on technical matters which pertain to areas of health and safety associated with reactor location and operation. Where it is inadvisable to proceed with a facility, it is the obligation of this Committee to so inform the public and, in doing so, it will provide direct information of its concern to reactor designers and license applicants.

During my tenure as Chairman of ACRS and that of the other incumbents, in my opinion, we have adhered to this policy. The choice of language and length of our reports is not in the nature of a legal decision or a condensed review of all the technical data submitted in the record. It is a condensed technical opinion conveying to the public and the applicant our considered judgment on the feasibility and limitations of the over-all proposal. The documentation reviewed and considered is always listed. Where sites were rejected our reasons were given in the best manner in which we felt our technical judgment could be conveyed to the public. We have also avoided writing reports which might immediately raise public concern when we believed that remedy could be readily made without imposing delay or serious change. We have been cognizant of the economic factors involved but have not let them sway our judgment in regard to protecting the health and safety of the public.

In conclusion, I would like to make the following general remarks. We believe that regardless of the procedural changes to be made, all power and test reactors (above 10 MWt) whether privately-owned, government-owned and/or contractor operated, or military should be subject to the same scrutiny, analysis and safety standards.

There is a wholesome but perhaps premature desire by industry to achieve economic nuclear power as soon as possible. We recognize and support this need for economic achievement at the earliest reasonable date. In our opinion, health and safety of the public must not be compromised in attaining this goal. For this reason, we have acted with what we believe is reasonable caution so that the public is protected and so that industry and Government would not suffer setbacks as the result of a major accident. In all safety reviews there is a distinct value in having a disinterested outside opinion from an expert group not subject to pressures within or without the Government.

In our opinion, the nuclear industry is still quite young. As experience grows, less concern and perhaps less investment, presently required in safety features may be necessary for protecting the public. Certainly one thorough review with certain limited re-evaluations is more than justified at present. Until more experience is gained the amount of safety review and evaluation necessary should not be reduced. Unnecessary legal steps and complications should be eliminated wherever apparent, but even in this area the effect has not been to create any serious delays.

We appreciate the opportunity to express our opinion on the proposed regulatory changes as well as the conduct of ACRS activities. I will be pleased to discuss any points raised or answer any questions at this time.

APPENDIX A - ACRS Committee Meetings and Subcommittee Meetings, 1960
APPENDIX B - ACRS Committee Meetings and Subcommittee Meetings, May 31, 1961
APPENDIX C - Letters of Advice, 1960 and through May 31, 1961
APPENDIX D - Membership, May 31, 1961
APPENDIX E - Letter dated December 13, 1960 to AEC
APPENDIX F - Letter dated April 8, 1961 to JCAE

Testimony of
Dr. Leslie Silverman
Advisory Committee on Reactor Safeguards, USAEC
Before the
Joint Committee on Atomic Energy
Radiation Safety and Regulation Hearings
June 15, 1961

APPENDIX A

Listing of ACRS Committee Meetings and Subcommittee Meetings

NOTE: Location of meeting was Washington, D. C., except as otherwise specified.

Calendar Year 1960
Dr. L. Silverman - Chairman

Meetings of full ACRS

January
March (Special)
March
May
June (Special) - Boston, Massachusetts
June - Livermore and Moss Landing, California and NRTS, Idaho
July
September
November
December

Subcommittee Meetings

January 7	NS SAVANNAH
January 15	GE-VBWR
January 20	Yankee
February 6	Point Loma (ELPHR) at Point Loma - L. Silverman only
February 11	Consumers of Michigan
February 12	NASA at NASA
February 16	BONUS
February 17	Peach Bottom
February 17	HTRE-3A
February 18	NPR
February 25	Humboldt Bay
March 9	PRDC
March 9	SSPWR - Jamestown at Jamestown, New York

ACRS Subcommittee Meetings for 1960 (Continued)

April 6	Dresden
April 7	S2C & SEAWOLF at Groton, Connecticut
April 8	Environmental
May 1	Point Mugu (ELPHR) at Point Mugu, Calif. - C. R. McCullough only
May 4	PRTR
May 13	PRDC
June 4	ICBWR at Los Angeles, California - C. R. McCullough only
June 21	Southern California Edison at proposed sites
June 21	PG&E at proposed site (for large units)
June 29	NASA
July 19	PRDC
July 20	NS SAVANNAH
August 21	A2W-C1W at Newport News, Virginia
August 23	Environmental
September 9	Elk River at Elk River, Minnesota
September 13	Saxton
October 19	NS SAVANNAH at Camden, New Jersey
October 20	Elk River
October 21	Peach Bottom
October 22	Procedures
November 2	Consumers of Michigan
November 9-10	PRDC at Monroe-Detroit, Michigan
November 30	HTRE-3A
December 1	Procedures
December 2	NS SAVANNAH at Camden, New Jersey

APPENDIX B

Listing of ACRS Committee Meetings and Subcommittee Meetings

NOTE: Location of meeting was Washington, D. C., except as otherwise specified.

January 1, 1961 through May 31, 1961
Dr. T. J. Thompson - Chairman

Meetings of full ACRS

January
January (Special)
March
April
May - Cambridge, Massachusetts

Subcommittee Meetings

January 4	Consolidated Edison at Indian Point, New York
January 11	Environmental
January 17	Environmental
January 18	PRDC
January 31	Consolidated Edison
February 24	Dresden
March 14	Dresden at San Jose, California
March 14	VESR at San Jose, California
March 15-16	Peach Bottom at LaJolla, California
March 16-17	City of Los Angeles at Los Angeles, California
March 17	PRDC at Idaho Falls, Idaho
March 18	EBR-II at NRTS, Idaho
April 20	Piqua at Piqua, Ohio
April 25	VESR
April 26	Naval Reactors
April 28	Yankee at Boston, Massachusetts
May 12	Standards & Criteria at Cambridge, Massachusetts

APPENDIX C

Listing of Letters of Advice Written by ACRS

Calendar Year 1960
Dr. L. Silverman - Chairman

Specific Reactors

Advanced Testing Reactor (NRTS)	November 7
BONUS - Puerto Rican Water Resources Authority	March 14
BORAX-V (NRTS)	September 26
Brookhaven High Flux Reactor	September 26
Carolinas-Virginia Tube Reactor (Parr, S.C.)	February 1
Consumers of Michigan - Big Rock Plant	March 14 and November 5
DASA Triga (Bethesda)	September 26
Dresden Nuclear Power Station	May 6 and September 24
Elk River (RCPA)	November 5
Experimental Boiling Water Reactor (ANL)	February 1
Experimental Low Temperature Process Heat Reactor	March 14 and May 6
Experimental Organic Cooled Reactor	May 6
Hallam Nuclear Power Facility	February 8
Hanford Reactors	March 14
Heat Transfer Reactor Experiment-3A	December 13
High Flux Isotopes Reactor (ORNL)	May 9 and July 25
Humboldt Bay Power Plant	March 14 June 27 July 25
Improved Cycle Boiling Water Reactor	June 8 June 27 July 25
Limited Melt Experiment	July 25
Lockheed Radiation Effects Reactor	December 10
National Aeronautics & Space Administration Reactor	March 14. July 25 September 26 November 7
Naval Reactors Program	May 9 July 25 September 26 November 5
New Production Reactor	March 14

Letters of Advice, 1960

Specific Reactors (Continued)

Northern States Power Company - Pathfinder	February 1 and November 5
Nuclear Merchant Ship - NS SAVANNAH	January 21 February 1 July 25 December 13
Philadelphia Electric Company - HTGCR - Peach Bottom Plant	March 14 and December 10
Plutonium Recycle Test Reactor	February 1 (2 letters) May 9
Pratt Whitney Facility (NRTS)	September 26
Savannah River Reactors	July 25 and September 26
Saxton Nuclear Experimental Corporation	September 26
Shippingport Pressurized Water Reactor (Core II)	December 13
Small Size Pressurized Water Reactor	March 14 June 30 July 25 November 7
SM-1 (Fort Belvoir)	July 25
SM-1A (Fort Greely)	November 7
Sodium Reactor Experiment	September 26
Southern California Edison Company	July 25
Vallecitos Boiling Water Reactor	February 8
Yankee Atomic Electric Company	February 1 May 9 June 27

Miscellaneous

Control Rods	May 6
Criticality & Chemical Processing (Reactor Safety)	December 9
Nuclear Power Plants in California	March 6
Pool Type Reactors	December 13
Reactor Accidents	December 10
Regulation & Safety of Nuclear Reactors (Reactor Safety)	December 13
Site Criteria	September 26 October 22 December 13

Listing of Letters of Advice Written by ACRS

January 1, 1961 through May 31, 1961
Dr. T. J. Thompson - Chairman

Specific Reactors

City of Piqua, Ohio	May 20
Consolidated Edison Thorium Reactor	March 4
Dresden Nuclear Power Station	March 4 and April 8
Elk River (RCPA)	March 4
Experimental Breeder Reactor II	April 10
Improved Cycle Boiling Water Reactor	January 14 and May 20
Lockheed Radiation Effects Reactor	March 4
Naval Reactors Program	May 20
Prototype Organic Cooled Reactor	April 10
Sandia Pulsed Reactor Facility	April 10
Savannah River Reactors	January 14
Vallecitos Experimental Superheat Reactor	May 20
Westinghouse Testing Reactor	March 4
Yankee Atomic Electric Company	May 22

Miscellaneous

Multiple Reactors	January 16
Radiation Damage to Pressure Vessels	May 20

APPENDIX D

Membership -- Advisory Committee on Reactor Safeguards
May 31, 1961

Dr. Theos J. Thompson, Chairman - Professor of Nuclear Engineering, Massachusetts Institute of Technology, Boston, Massachusetts - Director M.I.T. reactor. Former staff member, Los Alamos Scientific Laboratory, and Chairman, Design Committee Omega West Reactor.

Dr. Harvey Brooks, Dean of Engineering and Applied Physics, Graduate School of Arts and Sciences, Harvard University, Cambridge, Massachusetts - An acknowledged leader in nuclear physics with a special competence in solid state theory and reactor physics.

Dr. Willard P. Conner, Jr., Manager, Physical Chemical Division, Research Department, Hercules Powder Company, Wilmington, Delaware. Specialist in Physical Chemical Effects, plus a recent period of experience on reactor principles and operations at the National Reactor Testing Station.

Dr. William K. Ergen, Principal Physicist, Oak Ridge National Laboratory, Oak Ridge, Tennessee. Responsible for primary theoretical work on non-linear reactor kinetics. An expert on reactor core calculations.

Dr. Franklin A. Gifford, Jr., Meteorologist-in-Charge, Oak Ridge Office, U. S. Weather Bureau, Oak Ridge, Tennessee. Meteorologist with an international reputation on the theory and practice in his field.

Dr. David B. Hall, Division Leader, Los Alamos Scientific Laboratory. Physicist; primary work in the development of plutonium fuels for reactor applications and operation of fast reactors.

Dr. C. Rogers McCullough, Director of Reactor Safeguards (for foreign reactors) and Scientific Adviser to Board of Directors, Nuclear Utility Services, Washington, D.C. Chemical and nuclear engineer; director of the Power Pile Division at Oak Ridge, working on the Daniels Pile. First Chairman of Statutory Committee.

Dr. Henry W. Newson, Professor of Physics, Duke University, Durham, North Carolina - Nuclear Physicist. Member of the Physics Group on the Manhattan Project.

Mr. Kenneth R. Osborn, Manager of Industrial Development, General Chemical Division, Allied Chemical Corporation, New York, N.Y. Chemical and mechanical engineer with broad knowledge of industrial processes.

ACRS Membership (cont'd)

Mr. Donald A. Rogers, Manager, Central Engineering, Allied Chemical Corporation, Morristown, New Jersey. Mechanical Engineer with considerable experience and knowledge of pressure vessels.

Dr. Leslie Silverman, (Chairman - 1960) - Professor of Engineering in Environmental Hygiene, Director of Radiological Hygiene Program, Harvard University School of Public Health, Boston, Massachusetts. Industrial Hygiene Engineer with a special knowledge of air and gas cleaning, control of environmental hazards, and radioactive waste disposal.

Mr. Reuel C. Stratton, Consulting Engineer. Chemical engineer with a long experience in explosives and hazardous activities.

Dr. Charles R. Williams, Assistant Vice President, Liberty Mutual Insurance Company, Boston, Massachusetts. An expert in industrial hygiene and protection of workers from radiation and other health hazards.

Dr. Abel Wolman, Head, Department of Sanitary Engineering, Johns Hopkins University, Baltimore, Maryland. Sanitary engineer with broad knowledge of environmental problems.

Technical Staff - (Full-time except for Dr. Duffey)

Dr. Dick Duffey (Professor of Nuclear Engineering, University of Maryland) - Technical Secretary

Mr. James B. Graham (Reactor and Radiation Specialist) - Executive Secretary

Mr. Raymond F. Fraley (Reactor Engineer) - Assistant to the Executive Secretary

APPENDIX E

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
UNITED STATES ATOMIC ENERGY COMMISSION
WASHINGTON 25, D. C.

December 13, 1960

Honorable John A. McCone
Chairman
U. S. Atomic Energy Commission
Washington, D. C.

Subject: REGULATION AND SAFETY OF NUCLEAR REACTORS

Dear Mr. McCone:

This is in response to a request for any suggestions contained in Commissioner Olson's letter of August 29, 1960.

The Committee believes that there are general principles which can be stated.

I. Responsibility

There should be a separation at the highest level practicable between the responsibility for promotion and the responsibility for regulatory and safety activities. This separation might be obtained by having two separate agencies in the Executive Branch of the Government, but the Advisory Committee on Reactor Safeguards believes that at the present time the two separated groups should exist within the Commission itself. It is the view of the ACRS that a satisfactory solution could be obtained if:

A) a Commissioner were to concern himself with regulation and safety as his special sphere of interest, and

B) the line organization to implement safety review, inspection, licensing, and hearings were to be entirely separate from the promotional and developmental activities of the Commission.

II. Staff

A. Adequate review of reactor proposals requires the services of a large technical staff. This technical staff should be composed of highly competent technical persons representing all of the necessary disciplines. For the present it seems certain that the existing staff will have to draw upon consultants in special areas.

B. This technical staff should have direct access to the information developed by and some influence on the AEC program of research in safety matters. The stature of this group will be enhanced in the atomic energy field by such a close relationship.

III. Advisory Committee

There is a continuing need for a technical committee, group, or organization free from self-interest and promotional pressure to give advice as to the policies and means by which the public is protected from radiation hazards in connection with reactors or other large nuclear facilities.

This Committee should concern itself with: the critical technical safety features of specific reactors; with safety in chemical nuclear processing plants; with aerospace nuclear problems in which there are significant health and safety problems affecting the public; and technical advice on safety criteria and standards. The Committee should give independent advice. However, in studying the problem, the Committee should work closely with the full-time technical staff mentioned in II above. As time goes on, the staff should gradually assume the responsibility for review of all reactors except new and unique types and the Committee should confine its duties more and more to safety policy matters and to unique nuclear safety problems.

IV. Improvements in Procedures

A. The regulatory procedure should be responsive to the technical as well as to the legal requirements. The procedure should be designed to keep its necessary steps to a minimum.

B. Licenses should be written in sufficiently basic terms so that future amendments refer to major safety problems and not to minor details.

Sincerely yours,

Sgd/LESLIE SILVERMAN

Leslie Silverman
Chairman

cc: L. K. Olson, Commissioner
J. T. Ramey, Exec. Dir., JCAE

APPENDIX F

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
UNITED STATES ATOMIC ENERGY COMMISSION
WASHINGTON 25, D. C.

April 8, 1961

Mr. James T. Ramey
Executive Director
Joint Committee on Atomic Energy
Congress of the United States
Washington, D. C.

Subject: JOINT COMMITTEE'S STAFF STUDY ON IMPROVING THE AEC REGULATORY PROCESS

Dear Mr. Ramey:

This is in reply to your letter of March 22. The Advisory Committee on Reactor Safeguards is pleased to submit its views on methods for improving the regulatory processes and the safety of nuclear reactors.

In reply to your questions regarding the three specific proposals for modification of the regulatory organization and procedure, we believe that any one of these proposals may be workable. However, the problem is to select the organization and procedure which is most advantageous in assuring the safety of nuclear reactors in the light of the present knowledge and state of development of the field, and at the same time to set up an organization and procedure which can develop to meet the needs of reactor regulation in the future.

Although it is our belief that any one of the three proposals can be made to work -- given the proper high quality of leadership and personnel -- there are points in each of the proposals which require modification in order to conduct the safety review of reactors efficiently and to keep to a minimum the burden upon the applicant, the AEC staff, and the ACRS in giving these projects adequate review.

Specifically, the Committee's comments on your points are as follows:

1. It is the Committee's view that separation of the regulatory organization from the promotional activities of the AEC is desirable as we previously stated (See JCAE Study, "Improving The AEC Regulatory Process," March 1961, Volume II Appendix, Page 590). The creation of a Director of Regulation reporting

directly to the Commission is a step in this direction. Many of the problems which existed under the earlier systems can be solved under the AEC organization plan, if properly implemented. However, it appears that the final judgment of reactor proposals may not receive the desired technical emphasis or simplification of procedures. It should be pointed out that reactors owned by the AEC and operated for the promotion of peaceful uses of atomic energy should give the same degree of protection to the public as licensed reactors. It is not yet clear how this activity will be coordinated with that of the organization under the Director of Regulation.

2. The ACRS recognizes the problem of promotion and regulation within the same agency and is sympathetic with the motivation for the study by Messrs. Berman and Hydeman. However, it is the consensus of the Committee that the large body of information and technical competence which resides in the AEC and its contractors can be most effectively made available if the regulatory agency requiring this information is in the same governmental agency, namely, the AEC. Adequate separation of promotion from regulation can be achieved within the agency using either the organization recently adopted by the AEC in setting up a Director of Regulation reporting directly to the Commission, or by the proposal of the staff of the Joint Committee on Atomic Energy, or some modification of either plan.

3. The proposal of the JCAE staff for an Atomic Safety and Licensing Board, containing both technically and legally trained persons, has considerable merit. The Committee believes that the problem is primarily technical. It also realizes the need for some formal public record. The proposal for a Board includes both aspects. If this proposal should be adopted, to be effective it must clearly state the interrelation of the various parts of the regulatory organization. We hope that there will be a direct relationship among the Board, the ACRS, and the technical staff. Unless the relationships are specified and duplication of staffs avoided, there exists in this plan a distinct possibility that an applicant may be subjected to two, or even three, independent safety reviews. This may negate one of the principal stated reasons for the proposed changes.

4. The ACRS favors the JCAE proposal for a Board as being a sound framework for the future growth of the hearing and licensing process. It is important that changes in the regulatory process provide for a continual review of current needs instead of relying on an intensive analysis every three or four years.

It is also important to the assurance of safety of the public that regulatory processes provide for the continuous growth of technical understanding of the physical problems which are not yet completely understood. The Committee believes applicants should be subject to one, and only one, complete and detailed review at each licensing phase. This review should be conducted by the full-time staff.

The regulatory organization, whatever its form, should have means of keeping informed concerning the experience with reactor operation and research and development.

There is a need for additional effort to write technical specifications and terms of reactor licenses so that reasonable flexibility of operation can be obtained without sacrificing safety. It is probable that some degree of uniformity in the terms of the licenses can be achieved.

5. Finally, you have invited the Committee's comments on current problems in reactor safety. There are a number of such problems which are being given varying but not necessarily adequate attention. To avoid a lengthy discussion at this time, a list follows which is illustrative but not all inclusive.

   Aging of reactors -- deterioration of pressure vessels and reactor systems during operation.

   Collection and evaluation of operating experience.

   Competence of designers, constructors, and operating organizations.

   Control requirements.

   Corrosion.

   Heat transfer and burn-out correlations.

   Means of detecting and predicting instability.

   Radiation effects on materials.

   Site criteria -- man-rem dose, unusual meteorological conditions, large city distance, multiple reactor installations, and emergency tolerance doses.

   Testing for nuclear service.

These problems are not all independent and thus research in reactor safety should be set up in an organized way.

Sincerely yours,

/s/ T. J. Thompson

T. J. Thompson
Chairman

cc: Commissioner L. K. Olson

Dr. SILVERMAN. Starting on page 3 I discussed briefly what you have asked us to comment on before; namely, the regulatory process. We have two letters, one to the Commission and a later one to Mr. Ramey, with a copy to Mr. Olson, which is now a part of the committee prints. I won't go into any detail here except to point out that we have met with Mr. Ramey, Mr. Toll and discussed how we conduct our affairs in the ACRS.

Mr. RAMEY. I might comment, there, Mr. Chairman, that the ACRS kindly let our whole group of consultants and staff sit in on one of their meetings and watch their procedure work. I must say we were very much impressed as to the competence and the way they go about it. We characterized it as something like a Ph. D. thesis examination.

Dr. SILVERMAN. Thank you, Mr. Ramey. I would like to point out that in our letters at the bottom of page 5 we make the point clear, that anyone of the three proposals we believe can be made to work. However, there are certain ramifications in each one. I won't comment on the Commission's proposal, nor on the total separation of regulation or the idea of having one of the Commissioners act as a "safety" Commissioner.

I think these are all discussed in my testimony in its written form. I would like to point out, however, that I do not believe there have been any basic or serious problems created by the present regulatory process. I think that should be clear for the record. We on ACRS have felt that there have been some reactions in the reactor industry that perhaps they were being held up, by the regulatory process including ACRS, but I do not think the facts in this matter justify this contention. I think if you make a scoring on the green book replies you will note that the ones that have been among the loudest in protest against the present system, if I can use that expression, are the ones that have had more problems than others and they have perhaps felt that they were being criticized a little more than necessary. We do not think the criticism was unconstructive, and was done to protect the public. This is a sort of personal opinion of some of the comments that were made in the various documentations that were submitted.

I think you gather from our letter as well as my written testimony presented here that the Atomic Safety and Licensing Board appeals to us as a positive step forward in providing technical judgment. This judgment might be obtained in other ways, but it appeared on the face of the proposed approach that this Board had technically trained individuals who could evaluate and comment on the safety features much in the same way that we might do in the ACRS. We want to caution, however, that the Atomic Safety and Licensing Board, if it were to be created, always possesses the inherent problem of another review. We hope that this review would not be in the department of the staff review. This would be unfortunate. We hope that it would try to raise questions where they were novel features or unusual points rather than trying to go right back through from start to finish. This would be a logical source of complaint from an applicant.

We prefer, as expressed in our letters, to give most of our time to the new and noval programs which are essential. We do not feel that we have to review every power and test reactor case in the same detail, in the case of those reactors above 10 megawatts, 10 MWT where there are features similar to those already evaluated in depth. If somebody decided to build another Dresden as a carbon copy, there is no need for us to go back through this same evaluation. It would be our concern as to where they located it, of course. In terms of going over every specific detail that had a bearing on safety, this would not seem to be essential.

We believe that safety is not absolute, as Mr. Olson has indicated Dr. McCullough has stated. This is correct. We do feel that there are some policy problems that we have handled and have commented upon them.

I would like to say that in our opinion the present technical staff is a sound and mature technical group. We believe they are rapidly developing and improving and that the positions are at a high enough level to attract capable scientists and engineers. I do state in my testimony that their type of review is somewhat of a negative function and that it is not rewarding from the standpoint of creative work.

We hope that there might be some way to stimulate frequent contacts with safety research and other available areas for direct experience for the staff. We think that this is something that might be considered for future improvement. The area that I would like to comment on specifically, and I do on the top of page 9, is that the strengthening of the reactor inspection group, we feel, is of paramount importance. This group is improving tremendously, but this is certainly one of the most vital functions that the Commission has. We feel that it provides feedback to the reactor safety evaluation staff. This group should continue to be strengthened regardless of what organizational changes are made.

Chairman HOLIFIELD. Dr. Silverman, I have to answer a rollcall. So at this time we are going to have to interrupt your testimony, I am sorry we cannot let you finish it. Will you be back in the chair at 2 o'clock?

Dr. SILVERMAN. Yes, sir.

Chairman HOLIFIELD. Thank you.

The committee is adjourned.

(Whereupon, at 12:20 p.m., the hearing in the above-entitled matter was recessed, to reconvene at 2 p.m., the same day.)

AFTERNOON SESSION

(Representative Price presiding).

Representative PRICE. The committee will be in order.

This afternoon the committee continues hearings on alternative proposals to revise the AEC's regulatory organization. In addition, we shall receive testimony from Admiral Rickover on the technical aspects of reactor safety. We plan to conclude these hearings with a panel discussion, if we have time, on the alternative reorganization plans.

When we concluded our hearing this morning, Dr. Silverman was testifying. Dr. Silverman, you may proceed with your statement.

We have Dr. Silverman, Dr. Thompson and Mr. J. B. Graham.

You may proceed.

STATEMENT OF DR. LESLIE SILVERMAN, AEC ADVISORY COMMITTEE ON REACTOR SAFEGUARDS—Resumed

Dr. SILVERMAN. I have been summarizing my testimony up to this time in order to expedite this morning's proceedings. I would like to start at the top of page 9 and simply clarify the matter of strengthening the reactor inspection group in the Compliance Division. What is meant is that we believe they are doing a good job and that the number of inspectors and other personnel should be increased. This is in no way meant that what they have done is not a very competent job. What we are concerned with is that there ought to be more inspectors of their caliber.

The proposal has been made that we restrict our review efforts to the construction permit phase of licensing and not be concerned with operating license aspects in any detail. As a matter of fact, we have usually concentrated major emphasis in our technical reviews to site selection, reactor concept, and design features. Establishment of proper barriers in the first instance can protect health and safety of the public even if operational difficulties arise or an accident takes place within the capabilities of the containment, confinement, exclusion, or low population density distances. It has been our recent experience, however, that several important changes in regard to safety features have taken place after the construction permit and in some cases after the operating permit. Hence, it is not possible to generalize completely in this regard.

The judgment as to what is to be reviewed and its extent has been decided as much in the past by ACRS as by the staff of the Commission. In the event an Atomic Safety and Licensing Board, as proposed, is created, the judgment as to what is reviewed by ACRS will be dependent upon this Board for such request.

We will provide the staff with advice for reviews in the preliminary hearing for construction permits and occasionally for operating licenses. Whether or not this will reduce the workload of the ACRS can only be determined by experience. We believe that we should retain the privilege of reviewing any case we consider has features of safety significance.

The proposed Board composition represents a majority in the technical aspects relevant to safety. There is a point to be made that the Board could perhaps be enlarged to increase its technical emphasis.

In the next paragraph I talk about the fact that ACRS has been advisory in all respects. Speaking for myself, I believe we never felt we were above criticism. I think the nuclear press has made it clear that we were not. We have tried to give every applicant ample opportunity to state and defend his concept and design features for protecting the public.

I have stated before that since our reports must be made public as specified by law, it is apparent that they will necessarily be as explicit as possible, in defining to the public, the general opinion of the Safeguards Committee on technical matters which pertain to areas of health and safety associated with reactor location and operation.

I might interject here by saying that this has been somewhat of a problem. We have been accused of writing enigmatic letters and there are comments in some of the documentation that we have not made our viewpoints clear. I think they are not clear when there is a turndown because most applicants come in with the idea they have satisfied all needs. When they find this is not so our letters become less clear to them. Where it is inadvisable to proceed with a facility, it is the obligation of the ACRS to so inform the public. In doing so it provides direct information of its concern to license applicants and reactor designers.

I might say that even though our letters are relatively brief, we do not feel that we should be providing an elaborate technical documentation. I think the applicants, when they have had an opportunity to discuss their application before the ACRS, have a pretty good notion of the types of unresolved problems we feel exist. The letters usually point these out.

During my tenure as Chairman of ACRS, and that of the other incumbents, in my opinion we have adhered to this policy. The choice of language and length of our reports is not in the nature of a legal decision or a condensed review of all the technical data submitted on the record. It is a condensed technical opinion conveying to the public and the applicant our considered judgment on the feasibility and limitations of the overall proposal. The documentation reviewed and considered is always listed. Where sites were rejected, our reasons were given in the best manner in which we felt our technical judgment could be conveyed to the public.

We have always avoided writing reports which might immediately raise public concern when we believed that remedy could be readily made without imposing delay or serious change. We have been cognizant of the economic factors involved, but have not let them sway our judgment in regard to protecting the health and safety of the public.

In conclusion, I would like to make the following general remarks: We believe that regardless of the procedural changes to be made, all power and test reactors above ten megawatts thermal, whether privately owned, Government owned, and/or contractor operated or military, should be subject to the same scrutiny analysis and safety standards. This does not mean that if below 10 megawatts they should not be scrutinized. It simply means we do not feel that the ACRS has the obligation in this respect. But certainly the Commission has, and recognizes that it has this obligation.

There is a wholesome but perhaps premature desire by industry to achieve economic nuclear power as soon as possible. We recognize and support this need for economic achievement at the earliest reasonable date. In our opinion, health and safety of the public must not be comprised in attaining this goal. For this reason we have acted with what we believe is reasonable caution so that the public is protected, and so that industry and Government would not suffer setbacks as the result of a major accident.

In all safety reviews there is a distinct value in having a disinterested outside opinion from an expert group not subject to pressures within or without the Government. I might interject here by saying that as a member of the ACRS and I am sure my fellow committee members feel the same way, we do not feel that if somebody decided tomorrow to abolish the ACRS that it would be a great loss as far as the conduct of our own personal affairs. It has been somewhat time consuming. But we do feel that this kind of review from a group such as our does provide a valuable service.

In our opinion the nuclear industry is still quite young. As experience grows, less concern, and perhaps less investment presently required in safety features may be necessary for protecting the public. Certainly one thorough review with certain limited reevaluations is more than justified as present. Until more experience is gained, the amount of safety review and evaluation necessary should not be reduced. Unnecessary legal steps and complications should be eliminated whenever apparent. But even in this area the effect has not been to create any serious delays.

We appreciate the opportunity to express our opinion on the proposed regulatory changes as well as the conduct of ACRS activities, and I will be pleased to discuss any points raised or answer any questions at this time.

Representative PRICE. Mr. Ramey.

Mr. RAMEY. There is one question on your workload. I think you testified on this last year at the indemnity and safety hearings. Do you think your existing and future workload over the next 5 years, and looking at cases to the extent that you do now, would overload you?

Dr. SILVERMAN. In answer to that, I would say that during my tenure as Chairman we cut back the number of meetings we held. We had fewer meetings than in the previous year. I personally do not feel that the workload is overwhelming. As I said earlier, in my testimony we do not want to review cases that are repeat cases. But aside from that, I thing we have managed to keep up with the load.

Unless the obligation comes for us to write a lengthy detailed technical public report, we think we can keep up with it.

Dr. Thompson may wish to comment here.

STATEMENT OF DR. THEOS J. THOMPSON, AEC ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

Dr. THOMPSON. Perhaps I should say that the committee has spent some time this year in working on ways to improve our efficiency and the uniformity of our reviews and we have been working rather closely with the staff on developing means and are hopeful that within the next few months we will be able to have a system whereby routine investigations can be carried forward without getting into very much detail, and that we ourselves can then concentrate even more fully on the new and novel features of designs as they reflect upon the safety of the reactors without getting too much into the details of things that have already come before the committee.

Dr. SILVERMAN. I might add one more thing here. The committee this past year spent much time on the site criteria problem and on the procedures problem. We have therefore had a chance to look into other areas and have also raised some concern about safety research programs. We think this effort fulfilled all our functions in these areas without overburdening our efforts.

Representative PRICE. Dr. Silverman, in your statement you call attention to the importance of the creation of sound and mature technical groups in the Division of Licensing and Regulation. Do you believe these is a need for more technical direction of the regulatory program at the staff level?

Dr. SILVERMAN. I think for the technical effort there is adequate direction. We have raised concern about the limited numbers of people, and we have pointed out to the Commission that we thought the staff could be increased to handle the newer cases. I think steps are being taken to make this increase in personnel.

Representative PRICE. Thank you.

Dr. Thompson, would you want to comment on that or any other comment that you care to make.

Dr. THOMPSON. Thank you, Mr. Chairman.

I would like to say only one or two things. It seems to me personally that there should be more technical direction near the top of the regulatory process. The fact that three of the five present Commissioners are technically trained men is, to me, a clear indication that it is the intent of the administration of the Government at this time that there be a clear emphasis on the technical potentialities of atomic energy. It seems to me that this technical flavor should permeate through all levels of the Commission. At the same time, legal judgments and legal advice are clearly required. This simply means that technical judgments should predominate over legal judgments in this agency if it should in any agency of our Government. Perhaps for the first time in our Nation's history, we have created an entire technical industry of great importance to the national welfare which is completely financed, regulated, and promoted by the Federal Government. It seems, therefore, that this may be an opportune time to consider new legal approaches to the problems of administration of this new type of industry.

The question, then, is how can we achieve a Government by law and not men and still give sufficient weight to the technical judgments that should come with almost every decision? This is a really challenging problem and I am sure that we do not know all the answers. It is certainly one that the AEC itself and I know you gentlemen are working very hard on.

As a policy matter, I think the President has designated that there shall be reactors. The AEC in its turn, as a policy matter, has indicated that there should be reactors. I think it is clear that anyone who has participated in the recent blackout of New York City and San Francisco due to the loss of electricity should realize how dependent we are on electrical power and that, therefore, this country must develop all its potential sources of electricity in order that these be available for the future.

Mr. RAMEY. And also make better circuit breakers.

Dr. THOMPSON. That is right. I think there can be no question of the wisdom of these policy decisions to build reactors. Thus, the Commission has, as a policy matter, to be able to encourage the growth of this reactor technology and reactor industry and at the same time they must insure that the industry is safe in all respects. This puts a dual responsibility on them to balance the achievement of their aim of safe nuclear power and at the same time they must be sure not to stifle this budding industry and its goal of economic nuclear power with overregulation. This is indeed a difficult problem. The problem of overregulation is one which is very important in many of our minds.

For a moment, let us consider the fundamental requirements for a reasonable regulation. I believe the Commission is doing this. No regulation, it seems to me, should be promulgated without a real and demonstrable need for such a regulation. No regulation should be written unless it is based upon careful technical studies, reviews of good practice, and careful projections as to the effects of such regulation—not only on safety—but also on the growth and flowering of the industry. Any regulation written should be written in the broadest possible terms to carry out its aims, and in the most nonrestrictive manner possible. Regulations probably should not be written piecemeal but should be written by area (for example, containment, controls, operations, etc.) in such a way that they form an integrated whole. Regulations should at this time avoid numerical limits wherever possible, since such numerical limits would be subject to change as the field progresses.

I believe that it is possible to write a relatively simple regulation which might say, for instance, that any reactor may be shut down at any time for poor practice, design, construction flaws, or other reasons which could cause a hazard to the health and safety of the general public. This general regulation coupled with a manual of good practice would then give a flexibility which I believe would lead to a safe, and at the same time technically flexible, reactor community.

In order to do this, it may be necessary that the Congress provide the AEC with some flexibility in the ways of communicating with the public. As I understand it at the moment, the Commission can only communicate with the public in the form of regulations.

If there were some more informal means of doing this officially but without the force of regulation, some means of providing official information, you might say, it might be very helpful in providing direction and guidance to the industry, setting up good practice without at the same time forcing the premature evolvement of regulations.

Representative PRICE. Thank you very much, Dr. Thompson.

Thank you, Dr. Silverman. We appreciate your testimony.

The next witness is Mr. William Berman, University of Michigan atomic energy research project.

STATEMENTS OF WILLIAM BERMAN, UNIVERSITY OF MICHIGAN ATOMIC ENERGY RESEARCH PROJECT, AND LEE HYDEMAN, WASHINGTON ATTORNEY, LAW FIRM OF SHARLITT, HYDEMAN & BERMAN

Mr. BERMAN. Thank you, Mr. Chairman.

I appreciate participating in these hearings. The gentleman with me is Lee M. Hydeman. He and I are codirectors of the atomic energy research project of the University of Michigan Law School.

As you may know, we have coauthorized a study entitled the "Atomic Energy Commission and Regulating Nuclear Facilities." Copies of the complete study have been made available to the committee.

In addition, we have provided you with written comments on the committee staff study and on the proposals which the AEC has submitted to the committee. Because my time today is extremely limited, I shall pass over or summarize quickly the early portions of the prepared statement which I made available to the committee in advance and shall direct my remarks primarily to very brief summaries of our views of the AEC and Joint Committee staff proposals, and to an explanation of our own recommendations.

First, however, let me give the committee some notion of the scope of our study. The primary purpose of the study was an analysis of the AEC's organization and its procedures in relationship to regulating the peaceful uses of atomic energy. Nevertheless, we broadened the scope of our study in two respects. First, we concerned ourselves to some degree with the AEC's nonregulatory functions. In this connection we endeavored to assess the effect of the Commission's nonregulatory functions on its performance of regulatory functions, and to determine what type of policymaking body is best suited to each of these functions.

Second, we considered the overall responsibilities of the Federal Government in the field of radiation protection with regard to research, basic guides and State regulations.

Mr. RAMEY. Is it possible to follow you from your prepared statement?

Mr. BERMAN. You can pick this up, I believe, at about page 5 as soon as I finish this paragraph.

In both these respects our study goes well beyond the scope of the analyses made by the committee staff and the AEC. We felt that this broader scope was necessary to avoid a piecemeal approach to all of the problems engendered by the AEC's present organizational structure. Our study identifies a number of objectives which any reorganization of the AEC should seek to achieve. These objectives are outlined beginning at page 4 of the prepared statement. I won't go through those.

An analysis of these objectives suggests that the AEC's operational and promotional functions on the one hand, and its regulatory functions on the other, should be clearly separated. The only objective of reorganization which could be fulfilled to any degree without such separation might be the development of a less burdensome licensing process.

The Commission has now proposed a number of changes to that end, but it is safe to predict that the most significant disabilities of the present licensing process such as the number of hearings on uncontested cases and the extensive involvement of the ACRS in individual licensing actions will not be remedied to any significant degree while the Commissioners themselves retain both promotional and adjudicatory functions.

In addition, it is even more clear that few other objectives of reorganizing the AEC, such as fortifying public confidence, can be accomplished unless separation is carried out up through the level of the Commissioners.

I am now beginning with the formal statement again at the top of page 7. As evidenced by the several points of view being expressed here today, the manner and degree to which promotional and regulatory functions can be separated may vary significantly. In our study, and in the committee staff study, three basic approaches to separation are identified. One is to establish a separated licensing board. A second is to create a separated licensing board with some authority to recommend rules of general applicability. A third is to establish a separated board with final rulemaking as well as adjudicatory authority.

With respect to the establishment of a board with only licensing functions, we found one fault which seems to us to preclude this conclusively as a realistic approach to separation at the present time. The problem is that this approach contemplates a division between licensing and rulemaking. We believe that any division of responsibility for these functions in relation to unstandardized activities is unrealistic.

Let us take power reactors as an example. The formulation of detailed safety criteria applicable to most reactor types simply is not possible at this stage of the development of major reactor facilities. By and large, sound and detailed policy on reactor safety can only be achieved through the gradual process of decisions in individual licensing cases. Certainly it is hard to conceive of individuals who have not participated in specific cases bringing the necessary degree of experience and sophistication to the task of rulemaking. It was primarily for this reason that we rejected the concept of a separated board with only licensing functions.

The idea of creating a separated licensing board with some authority to recommend rules appeared to us to be less undesirable in several respects. The principal drawback to this approach to separation is that it would place the rulemaking function in a jurisdictional no man's land between governmental organizations. One can just envision harried officials looking to one another to initiate rules for which each has some responsibility. The job may never get done. Since detailed safety criteria of general applicability will be vital in ultimately reducing the burden of regulation, the diffusion of responsibility for developing such rules could hinder the growth of the industry. Certainly the staff study did not make clear what a licensing board's functions would be with respect to rulemaking. It seems to us that this ambiguity with respect to the responsibility for making rules stems from an effort to divide a function which, for the present at least, is indivisible. Mainly for this reason we rejected the approach to separation proposed in the staff study.

I now turn to the approach which we recommend in our study. Essentially that of a separated regulatory board with final adjudicatory and rulemaking authority. Before I discuss our proposals, however, I should like to clarify one point. Our study has become identified with what one might call an extreme point of view on this subject, namely, the creation of a completely independent regulatory agency in the field of atomic energy.

Although our ultimate proposal is couched in terms of the creation of an independent agency, I would like to make it clear to the committee that we do not recommend a complete separation of promotional and regulatory functions. In addition, let me state that we do not feel that the creation of a new and separate agency is essential. While we do suggest the creation of a separate agency, we make a number of recommendations to assure close coordination between such a regulatory body and the organization responsible for the development and promotion of nuclear facilities. We also indicated that we would find the creation of a separate board within the AEC an acceptable alternative so long as that board were vested with final responsibility for all regulatory functions. In essence, our view is that the functions assigned to a separate body for making regulatory policy are far more important than whether that body is located within or without the AEC.

When we suggested a separate regulatory body outside the AEC we did so in the belief which we still hold that the disadvantages of such separation could be overcome. The principal reason for our suggestion was our feeling that public confidence would be bolstered more by the creation of an independent regulatory agency than by the establishment of a regulatory board under the wing of the AEC. The difference, however, is more one of form and emphasis than substance.

The crux of our proposal, then, is the establishment of an atomic energy regulatory board with final authority on those rulemaking and licensing functions presently within the scope of the AEC's regulatory jurisdiction. In addition, we would expand the formal functions of such a board beyond the present regulatory jurisdiction of the AEC. We would do this in order to take full advantage of the Board's objectivity and expertness and to assure a well-coordinated national program of radiation protection. To this end we would give the Board responsibility for evaluating the safety of all Government-owned facilities and for granting or denying approval of the construction and operation of all such facilities except those which are primarily of military significance. We also would give the Board the task of assessing the overall adequacy of the Federal research program in the field of radiation protection. Additionally, the Board should be assigned the function of formulating broad policy and basic standards for radiation safety and should be responsible for coordinating Federal-State activities on radiation protection.

At the present time these various responsibilities are diffused among a number of agencies, including the recently created Federal Radiation Council. This diffusion of responsibility can cause confusion and may result in an inadequate effort. It is, then, with respect to the jurisdiction of a regulatory board rather than with respect to the Board's locus, that we find ourselves in real conflict with the recommendations of the staff study.

The establishment of the type of board we propose raises three principal questions. First, can we assure that regulatory and developmental policies will be sufficiently integrated to achieve a proper balance between safety and progress.

Second, can we maintain open lines of communication between the technical personnel of the Board and their counterparts engaged in research and development activities for the AEC?

Third, can we provide the board with enough prestige to make it attractive to personnel of high caliber?

Unquestionably these are serious questions. They do not, however, pose insuperable barriers to a clear-cut separation of functions. We have suggested in our study a number of means for alleviating or eliminating these potential difficulties.

To assure the Board's awareness of developmental goals, we would have the AEC participate in the Board's rulemaking function. A representative of the AEC with one vote would sit with the three-man

Board when rules of general applicability are being formulated and adopted. He could thereby influence policy without controlling it. To supplement this means of preventing the Board from losing perspective of developmental goals, we have recommended that the Joint Committee retain cognizance over both organizations. Having, a representative of the AEC participate in the Board's rulemaking activities also should do much to encourage communication between the technical personnel of the two agencies. Joint participation normally engenders an atmosphere of cooperation. As a further means of preventing a failure of communication, we have suggested that the two agencies be located together physically. And as I have already noted, we would have the Board assess and evaluate the safety of all facilities operated under the aegis of the AEC. By tying the two agencies together in these respects, we believe that communications between technical personnel would be preserved. Our anticipation in this connection is reinforced by our conviction that communication between scientific and technical personnel, as contrasted with administrators, normally is not inhibited by organizational barriers.

It is our judgment also that a disaffiliated regulatory board would, by reason of prestige, be more able to attract competent personnel of high caliber than an independent board within the AEC. If such a board also were assigned the broad functions we have recommended, it certainly should be more attractive to competent personnel than a board with the very limited function recommended by the staff study.

It would seem, then, that means are available for minimizing, if not eliminating the most serious problems which can be contemplated in connection with a clear cut separation between the AEC's regulatory responsibilities and its developmental and promotional functions. Not only will this approach to separation avoid what appears to be an unrealistic division of regulatory responsibilities, but it should alleviate any real concern that developmental goals could have an undue influence on safety policy.

Alleviating concern about the objective of safety determinations in the atomic energy field could have a number of salutary effects pertaining to the objectives of reorganization which we have identified in our study.

Public confidence in the new technology will be bolstered. A much simplified licensing process could evolve. Board members would have time to participate meaningfully in regulatory matters. In addition, the Board members could assess objectively the adequacy of the Federal research program in the field of radiation safety, and could, by reason of their extensive contact with day-to-day regulatory problems, develop broad policy and basic standards for radiation protection with full cognizance of the practical problems of regulating. Establishing a separated regulatory board also would permit the operational and promotional functions of the AEC to be exercised by a streamlined organization headed by a single executive. Such an administrator could make rapid operating decisions, would be subject to Presidential control with respect to all his responsibilities, and would remain free to promote the development of the peacetime uses of atomic energy without interruption or concern about his conduct during the pendency of licensing applications.

In closing, let me emphasize again that the essence of our proposal is the separation of inherently conflicting functions—promotion and regulation—and the continued unification of functions—rulemaking and adjudication—which do not appear to be separable at this stage of nuclear development.

Whether this proposal is effectuated by the creation of a disaffiliated regulatory board or by the creation of an independent regulatory board within the AEC, is primarily a matter of emphasis and convenience. Just when this should be done poses a difficult question. We do feel, however, that the change may be simpler and less disruptive if it takes place relatively soon. We would like to see legislation proposing fairly comprehensive changes developed promptly, and at least considered at hearings during the next session of Congress.

Thank you, Mr. Chairman.

Representative PRICE. Thank you, Mr. Berman.

Your full statement will be inserted in the record at this point.

(The statement referred to follows:)

STATEMENT OF WILLIAM H. BERMAN AND LEE M. HYDEMAN, CODIRECTORS, ATOMIC ENERGY RESEARCH PROJECT, UNIVERSITY OF MICHIGAN LAW SCHOOL

Several months ago, after more than a year's work on the subject, the Atomic Energy Research Project of the University of Michigan Law School published a volume entitled "The Atomic Energy Commission and Regulating Nuclear Facilities," a study coauthored by Lee M. Hydeman and myself. A portion of the study was reprinted in volume II of the Joint Committee's print, "Improving the AEC Regulatory Process" and copies of the complete study have been made available to the members of the Joint Committee, the committee's staff, and the AEC. In addition, we have provided the committee with extensive written comments on the AEC's present proposals for reorganizing and improving the regulatory process and on the Joint Committee's staff study.

The principal goal of our study was to assess the effectiveness of the AEC's facility licensing program. We endeavored to evaluate the licensing program in two contexts: first, as a mechanism for protecting the health and safety of the public and, second, as an effective control system in terms of the burden imposed on the atomic energy industry. At the risk of oversimplifying in order not to devote too much time to preliminary conclusions, I will say that we found the AEC's licensing program lacking in both respects. It seemed to us that the whole process for licensing major nuclear facilities was unduly complex and, as a result, that it was unnecessarily burdensome not only to license applicants, but to the AEC and the ACRS as well. We also concluded, although there has as yet been no real indication that the safety of the public has been jeopardized in any unreasonable way in the interest of achieving developmental goals, that the combination of promotional and safety regulatory functions in a single policymaking body is a cause for legitimate concern. Certainly a continued combination of these functions could, from the standpoint of safety, lead to the premature licensing of specific facilities and activities. Finally, we concluded that concern on the part of Congress and the Commission about this admixture of functions has been largely responsible for the evolution of the burdensome licensing process.

In addition to these observations about the AEC's facility licensing program, our analyses led us to several other general conclusions. First, the Commissioners, who have political responsibility for policymaking, seem to be devoting too little time and effort to important regulatory functions. We have concluded from this that the Commissioners probably are burdened with too many responsibilities of too diverse a nature.

Second, the commission form of organization may well have outlived its usefulness for the exercise of the AEC's operational and promotional functions, although a board form of organization probably remains justified for the conduct of regulatory functions. Certainly the original reasons for adopting the commission form of organization for the AEC are less compelling than they were in 1946 and it is possible to identify a number of reasons why a single administrator now seems preferable for exercising the Agency's executive-type, nonregulatory functions.

Finally, we concluded that there are several elements of the Federal Government's overall responsibilities in the field of radiation protection which either are not being performed at all or are being performed inadequately. We believe that there is a total lack of coordination of the research on radiation safety carried out by a variety of Federal agencies, that basic guidance on radiation protection and the development of basic standards are responsibilities which are inappropriately vested in the Federal Radiation Council, and that relations between the Federal and State Governments are unnecessarily confused for lack of a primary point of contact in the Federal Government for the States on matters pertaining to radiation protection.

On the basis of these and other preliminary conclusions, we formulated a series of objectives which we believe should guide any proposed alteration of the AEC's regulatory procedures and organization. I believe it is important that I restate these objectives.

1. Public confidence in the conduct of the AEC's present regulatory responsibilities must be enhanced.

2. We must assure that public safety is not jeopardized; therefore, we must prevent any possibility that developmental goals could have an unwarranted impact on safety determinations.

3. A corollary to the previous objective is that we must avoid the development of an unnecessarily restrictive philosophy on the safety of nuclear facilities; one possible consequence of placing conflicting responsibilities—namely, promotion and regulation—in the same individuals is that they may err excessively on the side of caution.

4. We must develop licensing procedures that impose the least possible burden on license applicants, and on Government personnel who play a part in the regulatory program, consistent with sound safety evaluations.

5. We should endeavor to make it possible for those who have political responsibility for guiding and enunciating regulatory policy to devote sufficient time to this function so that informed and seasoned judgments can be brought to bear on the problems.

The five objectives I have stated so far are directly pertinent to improving the AEC's regulatory program. As I have already suggested, however, our study also deals with other implications of the AEC's organizational structure and we have identified four additional objectives which we believe merit attention in connection with any AEC reorganization plan.

First, we believe that serious consideration should be given to improving the AEC's operating efficiency by vesting all nonregulatory authority in a single agency head. Second, we believe it desirable that the responsibilities of Government in the atomic energy field should be assigned within an organizational framework that establishes relatively well-defined boundaries between those functions over which the President properly can, and must, exercise control and the adjudicatory function which should be exercised relatively free of political considerations. Third, we believe it desirable that there should be no hiatus in communications on developmental matters, between license applicants and Government officials responsible for promotion, during the pendency of a license application; the present ex parte contact rule of the AEC, which is entirely proper as a means of assuring judicial impartiality on adjudicatory matters, could cause communication lapses that may hinder progress. Finally, we think it is essential that there exist a working agency, of unquestionable objectivity, in which Congress could, with confidence, vest responsibility for establishing basic guides and broad national policy on radiation protection, for coordinating and evaluating the radiation protection research programs of all Federal agencies, and for serving as the initial and principal point of contact in the Federal Government for the States on matters of radiation safety.

An analysis of these nine objectives suggests that the AEC's operational and promotional functions on the one hand, and its regulatory functions on the other, should be clearly separated. The only objective identified which might be fulfilled to any degree without separation, and even that not very completely, would be the development of a less burdensome licensing process. The Commission has proposed a number of changes to that end, but it is safe to predict that the most significant disabilities of the present licensing process, such as the number of hearings on uncontested cases and the extensive involvement of the

ACRS in individual licensing actions, will not be remedied to any significant degree while the Commissioners themselves retain both promotional and adjudicatory functions. In addition, it is even more clear that few, if any, of the other stated objectives of reorganizing the AEC can be accomplished unless the concept of separation is effectuated up through the level of the Commissioners.

As evidenced by the several points of view being expressed here today, the degree to which promotional and regulatory functions can be separated may vary significantly. In our study we identified three basic approaches to separation, noting, of course, that a considerable number of detailed variations would be possible. The study prepared by the Joint Committee's staff also reflected the basic choices between a separated licensing board, a separated licensing board with some authority to recommend general rules, and a separated board with final adjudicatory and rulemaking authority.

With respect to the establishment of a board with only licensing functions, we found one fault which seemed to us to preclude this conclusively as a realistic approach to the separation of regulatory and promotional functions at the present time. The problem stems from the fact that the approach contemplates a division between licensing and rulemaking functions. We believe that any division of responsibility for these functions in relation to nuclear facilities or activities that are relatively unstandardized is impracticable. Taking power reactors as an example, the formulation of detailed criteria of reactor safety, generally applicable to most reactor types, is not possible at this stage of the development of large reactor facilities. By and large, sound and detailed policy on reactor safety can only be achieved through the gradual process of decision on individual licensing actions. Not only is it still difficult to formulate and enunciate detailed safety criteria and policy for such facilities through the rulemaking process, but it is hard to conceive of individuals who have not participated in specific cases bringing the necessary degree of experience and sophistication to the task. It was primarily for this reason that we rejected the concept of a separated board with only licensing functions. The fact is, that for the present, and probably for some time to come, the licensing and rulemaking elements of regulating major nuclear facilities are inextricably interrelated.

The second basic approach to separating the regulatory and promotional functions of the AEC—that of creating a separate licensing board with some authority to recommend rules—appeared to us to be more advantageous in a number of respects than the first approach. The principal drawback to this second approach is that it would create an entity that is neither fish nor fowl. In effect, the rulemaking function would be placed in a jurisdictional no man's land between governmental organizations. Under these circumstances, it is not difficult to envision harried officials looking to one another to initiate rules for which each has some responsibility; as a result, the job may never get done. Since the formulation of detailed and generally applicable safety criteria is a vital element of ultimately reducing the burden of regulation, the diffusion of responsibility for developing such rules could be most unfortunate. In this respect, I think it is not inappropriate to observe that a licensing board's functions with respect to rulemaking is one area in which the recommendations in the staff study are equivocal. I refer to page 70 of the study where it is stated: "The exact scope of the Board's functions with respect to rulemaking cannot be spelled out in detail at the present time. This is a function which would evolve with time and experience." It seems to us that this ambiguity on the responsibility for making rules stems from an effort to divide a function which, for the present at least, is indivisible. It was primarily for this reason that we also rejected the approach to separation that is recommended in the committee staff's study.

I now turn to the approach which we recommend in our study—essentially that of a separated regulatory board with final adjudicatory and rulemaking authority. Before I discuss our proposals, however, I should like to clarify one point; our study has become identified with what one might call an extreme point of view on this subject, namely, the creation of a completely independent regulatory agency in the field of atomic energy. Although our ultimate proposal is couched in terms of the creation of an independent agency, I would like to make it clear to the committee that we do not recommend a complete separation of promotional and regulatory functions. In addition, let me state that we do not feel that the creation of a new and separate agency is essential. While we do suggest the creation of a separate agency, we make a number of recommendations to assure close coordination between this separate regulatory body and the organization responsible for the development and promotion of nuclear facilities. Moreover, we have indicated that we would find the creation of a separate board within the AEC an acceptable alternative so long as that board is vested with final responsibility for all regulatory functions. In essence, our view is that the functions assigned a separate policymaking body are far more important than whether that body is located within or without the AEC. When we suggested a separate regulatory body outside the AEC, we did so in the belief, which we still hold, that the disadvantages of such separation could be overcome and because we felt that public confidence would be bolstered more by the creation of an independent regulatory agency than by the establishment of a regulatory board under the wing, so to speak, of the AEC. The difference, however, is more one of form and emphasis than substance.

The crux of our proposal, then, is the establishment of an atomic energy regulatory Board with final authority on those rulemaking, as well as licensing, functions presently within the scope of the AEC's regulatory jurisdiction. In addition, and of vital importance, are the respects in which we would expand the formal functions of such a Board beyond the present regulatory jurisdiction of the AEC in order to take full advantage of the Board's objectivity and expertness and to assure a well-coordinated national program of radiation protection. First, the Board should be given responsibility for evaluating the safety of all Government-owned facilities and for granting or denying approval for the construction and operation of all such facilities except those which are primarily of military significance. Second, the Board should be given the task of assessing the overall adequacy of Federal research in the field of radiation protection. Third, the Board should have the task of formulating board policy and basic standards for radiation safety. And, fourth, the Board should be responsible for coordinating Federal-State activities in the field of radiation protection. At present these various responsibilities are diffused among a number of agencies, including the recently created Federal Radiation Council. This diffusion of responsibility can cause confusion and may result in inadequate effort. It is with respect to these matters of the jurisdiction of a regulatory Board, rather than with respect to the Board's locus, that we find ourselves in real conflict with the recommendations of the committee staff's study.

In suggesting the establishment of an entirely separated regulatory board, as opposed to an independent board within the AEC, we have not been unmindful of the possible problems that such separation may engender. First is the problem of assuring that regulatory and developmental policies are sufficiently integrated to achieve a proper balance between safety and progress. Second is the problem of maintaining open lines of communication between the scientific and technical personnel of the regulatory board and their counterparts engaged in research and development activities on behalf of the Agency. Third is the problem of providing the regulatory organization with enough prestige, and sufficiently broad responsibilities, to make it attractive to personnel of high caliber. Granted, these are serious problems; they are not, however, insuperable barriers to a clear-cut separation of functions. We have, as I have stated, suggested a number of means for alleviating or eliminating these potential difficulties.

The Board's awareness of developmental goals should be assured if the Agency which retains operational and promotional functions is permitted to participate in the Board's rulemaking function. This could be done by having a representative of the Agency, with one vote, sit with the three-man Board when rules of general applicability are being formulated and adopted. He could, thereby, influence policy without controlling it. To supplement this means of preventing the Board from losing proper perspective of developmental goals, we have recommended that the Joint Committee retain cognizance over both organizations. Admittedly, these devices afford no absolute guarantee that safety and progress will not get out of balance, but this approach to separation does tend to assure that any imbalance which does develop would favor the goal of safety.

Having a member of the promotional Agency sit with the regulatory Board also should do much to encourage communication between the scientific and technical personnel of the two agencies. Certainly joint participation can be expected to engender an atmosphere of cooperation rather than competition. As a further means of preventing a failure of communications, we have suggested that the two agencies be located together physically and that they utilize certain common services such as personnel and financing. We also would give the Board regulatory jurisdiction over all facilities operated under the aegis of the operational and promotional Agency except those which are primarily of military significance. By tying the two agencies together closely in these respects, we believe that communications between their scientific and technical personnel would be assured. Our anticipation in this connection is reinforced by our conviction that communication between scientific and technical personnel, as contrasted with administrators, normally is not inhibited by organizational barriers.

It is our judgment also that an independent regulatory Board, by reason of its added prestige, would be more able to attract competent personnel of high caliber than an independent Board within the Agency. If the Board also were assigned the broad functions we have recommended, it should be more attractive to competent personnel than a Board with the very limited functions recommended by the committee staff's study.

It would seem, then, that means are available for minimizing, if not eliminating, the most serious problems which can be contemplated in connection with a clear-cut separation between the AEC's regulatory responsibilities and its developmental and promotional functions. Not only does this approach to separation avoid a patently undesirable diffusion of regulatory responsibilities, but it should alleviate any real concern that developmental goals could have an unwarranted impact on safety policy.

Alleviating concern about the objectivity of safety determinations in the atomic energy field could have a number of salutary effects pertaining to the objectives I identified earlier. Public confidence in the new technology predictably would be bolstered. The way would be cleared for the evolution of an increasingly simplified licensing process, eliminating all the cumbersome procedures now necessary merely to assure objective decisions. Without direct promotional and operational responsibilities, the Board members would have time to participate meaningfully in regulatory matters. In addition, they could assess objectively the continuing adequacy of the research program of the Federal Government in the field of radiation safety and could, by reason of their extensive contact with day-to-day regulatory problems, develop broad policy and basic standards for radiation protection with full cognizance of the practical problems involved. Vesting the responsibility for all safety regulatory matters in a separated Board also would permit the operational and promotional functions of the AEC to be placed in a streamlined organization headed by a single executive who: (1) could make rapid operating decisions; (2) would be subject to Presidential control with respect to all his responsibilities; and (3) would remain free to promote the development of the peacetime uses of atomic energy without interruption or concern about his conduct during the pendency of license applications.

In closing, let me emphasize again that the essence of our proposal is the separation of inherently conflicting functions—promotion and regulation—and the continued unification of regulatory functions which do not appear to be practicably separable at this stage of nuclear development. Whether this proposal is effectuated by the creation of a completely separate regulatory Board, or by the creation of an independent regulatory Board within the AEC, is primarily a matter of emphasis and convenience.

Representative PRICE. On page 2 of the prepared statement you say that concern on the part of the Congress and the Commission regarding the Commission's mixture of functions have been largely responsible for the evolution of the burdensome licensing process. Would you elaborate a little on that statement?

Mr. BERMAN. Our examination, sir, of the Commission's licensing process indicated to us that after the 1957 amendment the Commission went a great deal further to judicialize this whole licensing process, both in terms of the formality of the process and the number of hearings that were held in uncontested cases than the Joint Committee had indicated was necessary.

Our analysis suggested to us that this resulted from, shall we say, self-consciousness on the part of the Commissioners about their conflicting promotional and regulatory functions. In a sense they were bending over backward to show that they were being objective about these decisions and relying on procedural safeguards to assure safety, procedural safeguards that do not necessarily assure safety but do encumber the regulatory process.

Representative PRICE. The committee had two types of concern. It had concern as to the adequacy of regulation to promote safety. It also had concern over a procedure that would be evolved with considerable redtape. You are talking about the concern of the committee of the Congress over matters pertaining to safety that resulted in certain procedural requirements, is that right?

Mr. BERMAN. Yes.

Representative PRICE. On page 5 of your statement you mentioned that the Commission's ex parte contact rule may hinder communication between applicants and staff on developmental matters. Is it your belief that this has, in fact occurred?

Mr. HYDEMAN. Mr. Price, it is very difficult for us to assess whether or not it has in fact occurred. We have talked to some people in the industry who have dealt with the Commission. I think a number of them indicated that they have not had serious difficulty. In one or two instances apparently there was indication that there might have been. I think our feeling was that the nature of the rule is such that it could lead to difficulty. Let me add that I think the rule is perfectly appropriate. It is the combination of functions together with this appropriate rule that may cause some difficulties in communication. I would think that it is more likely to be difficult in the event of a contested situation where there is a hearing extending over a long period of time.

Mr. BERMAN. Let me just say one thing. We certainly would not recommend any abandonment of this rule while the Commission does have combined promotional and regulatory function. We feel, however, that by separating these functions up through the level of the Commissioners, the rule would be unnecessary.

Representative PRICE. Thank you very much, Mr. Berman, and Mr. Hydeman.

We appreciate having your testimony this afternoon.

The next witness will be Admiral Rickover.

Admiral, we are always glad to have you before our committee. We value your testimony at all times.

STATEMENT OF VICE ADM. H. G. RICKOVER, CHIEF, NAVAL REACTORS BRANCH, ATOMIC ENERGY COMMISSION

Admiral RICKOVER. Thank you, sir.

Representative PRICE. Sir, will you proceed with any statement that you care to make on this subject of reactor safety.

Admiral RICKOVER. I have no prepared statement, Mr. Chairman. I believe you know that over a period of many years the Naval Reactors Branch has had an inhouse headquarters organization responsible for the design and development of reactors, the construction of the nuclear powerplants that contain the reactors, the training of officers and men, and for the constant observance of all the major and minor technical details that occur. We are involved in these details and we follow them thoroughly on a day-by-day basis. This is the way we make sure that our reactors are designed and operating properly.

Representative PRICE. How many nuclear reactors have been built under your supervision and how many of these are in operation now?

Admiral RICKOVER. We now have 21—we will have, by Sunday, 21 submarines in operation. We have actually operated, counting the initial and the replacement cores, 44 power reactors. I believe this is probably more than all other power reactors in the world put together.

Representative PRICE. You do not know of any other group that has built more reactors than the Naval Reactor group?

Admiral RICKOVER. I doubt there is, sir.

Representative VAN ZANDT. Did you say 21 submarines on Sunday?

Admiral RICKOVER. Yes. We are going out on trials of the *Ethan Allen*, our sixth Polaris submarine early Sunday morning.

Representative VAN ZANDT. Overall, 44 reactors?

Admiral RICKOVER. Yes, sir. That includes the nuclear cores that have been replaced; it includes the eight cores in the aircraft carrier, the two in the cruiser and the Shippingport reactor. So that I have been responsible for a total of 44 nuclear power reactors.

Representative VAN ZANDT. From a time standpoint, how far back does this take you?

Admiral RICKOVER. It goes back to May 31, 1953, when the first reactor core of the *Nautilus* prototype started operating at Arco, Idaho.

Representative VAN ZANDT. The 44 reactors that you mentioned are both land based and sea based.

Admiral RICKOVER. They are land based and seagoing, with the great majority being seagoing.

Representative VAN ZANDT. How many people would you say have been employed in this effort, both civilian and military-wise?

Admiral RICKOVER. I suppose if you took into account the manufacturing industries there would be about 100,000 people. This is a rough figure, Mr. Van Zandt.

Representative VAN ZANDT. To the best of your knowledge, without having to get records, have you had any accidents?

Admiral RICKOVER. No sir; fortunately we have had no accidents.

Representative VAN ZANDT. Have you had any personnel that absorbed any unusual doses of radiation?

Admiral RICKOVER. No, sir; we have had none.

Representative VAN ZANDT. You credit this, of course, to the reply that you made to Mr. Price a moment ago about the type of an organization that you maintain day in and day out for the purpose of safety?

Admiral RICKOVER. Plus the fact that I have found favor with this committee, with the Atomic Energy Commission, and in the eyes of the Lord.

Representative VAN ZANDT. Thank you for including us.

Representative PRICE. The Members of the House are going to have to leave for a moment to answer the rollcall in the House, but Senator Jackson will continue the hearing.

(Senator Jackson presiding.)

Senator JACKSON. Admiral Rickover, you have maintained an outstanding safety record. I wonder if you would indicate some of the important factors that make this possible.

Admiral RICKOVER. The first factor is to have people in charge who are thoroughly competent in the design and operation of reactors, both the scientific and engineering aspects—people who follow the work every minute of the day and night and do not depend on anyone else to do this for them. The second factor is the acceptance of personal responsibility. Without acceptance—unlimited acceptance—of complete responsibility by the individual you cannot avoid ultimately having accidents.

Senator JACKSON. Of course, the selection of people is very vital.

Admiral RICKOVER. Yes, but that is a part of the responsibility, Senator Jackson. If you feel yourself to be personally responsible for everything that happens, then, to carry out your responsibility you must select and train the people and check on the operation of the ships. You must check on the design, make sure of the excellence of the laboratories doing the work, see to it that the industrial organizations manufacturing the individual items are doing their job right, prepare new specifications as necessary. You must be personally and emotionally involved in every single feature of the program. Otherwise, you will inevitably run into trouble.

Senator JACKSON. Referring to Navy reactors, who is responsible now?

Admiral RICKOVER. I am surprised you ask me such a question, sir.

Senator JACKSON. I wanted it for the record. I think we know.

Admiral RICKOVER. I am responsible, of course.

Mr. RAMEY. Which hat are you wearing?

Admiral RICKOVER. I don't know. I am not wearing any hat right now. I never know which hat I am wearing. I understand there are job descriptions in the Navy and in the AEC which say what I am supposed to do, but I have been too busy to read them. I only know that I am responsible. That's enough.

Senator JACKSON. Do you do it better without wearing a hat?

Admiral RICKOVER. Yes, sir.

Senator JACKSON. You have demonstrated, I think, over the years how to wear them and how not to wear them.

Admiral RICKOVER. I understand the scientists have now computed that 25 percent of the heat escaping from the body is from the head. If I wore a hat it might slow me down.

Representative VAN ZANDT. Admiral, I have always been amazed at your ability to select military personnel to do the job on these submarines that is necessary. How much training do you give these people before they actually find themselves in a command slot, or even in an organization slot aboard one of these nuclear powerful subs?

Admiral RICKOVER. As you know, I have had quite a problem with the Navy over the last 10 to 12 years in the selection of personnel, particularly officers. But the Navy now agrees that only intelligent people who are dedicated and capable of improving should go into this program.

The Navy permits me to interview every officer who enters the program and to make recommendations to the Chief of Naval Personnel. Those selected, both officers and men, are given an intensive course of training. Six months of this is theoretical and 6 months practical.

Representative VAN ZANDT. Where does the training take place?

Admiral RICKOVER. The 6 months theoretical training takes place at New London, Conn., or at Mare Island, Calif. The practical training takes place at the land prototypes. These are located at West Milton, N.Y., where we have the *Triton* prototype; at Windsor, Conn., where there is the *Tullibee* prototype; and at Arco, Idaho, where there is an aircraft carrier prototype and the *Nautilus* prototype. All of the men must learn the theory and the practical details of operating a nuclear powerplant.

But the education and training does not stop there, because after they are assigned to a ship they must continue to learn. Even after he is on a ship he must remain qualified or he will be detached. We have adopted a new practice for ships completing at a shipyard where, instead of the shipyard or Navy yard employees testing the propulsion plants, getting them ready to go to sea and operating the plants on sea trials, we have that done by the officers and crew. This is different than the practice on other naval ships where the yard personnel do all the testing and conduct the sea trials.

About a month before a reactor is ready to go critical, a group of my senior people and I spend 2 days examining the officers and men in the engineering department—about half the crew—to ascertain whether they are fully qualified. This examination is very strict. If the crew is found to be qualified, they are authorized to bring the reactor critical. If we find them not qualified, we indicate the areas of weakness and the additional work they must do, and we reexamine them later.

On top of this I have been in charge of the first sea trials of every nuclear ship. Senior members of the Naval Reactors Branch and I are responsible for conducting the propulsion-plant trials of each ship.

Representative VAN ZANDT. What percentage do you wash out?

Admiral RICKOVER. About 25 percent of even the highly selected people fail during our training course. Training is a most important part of our program, because unless a man has the mental capacity to learn modern technology and to understand the dangers inherent in radiation he cannot do his job adequately. This is a hard lesson for many to learn because nuclear power, as does every new development, brings its attendant train of problems. This must be recognized and taken into account by all in authority.

Senator JACKSON. While on the subject of training, Admiral Rickover, I wonder if you might describe the conditions precedent to the construction of a nuclear-powered ship, training, development and so on that takes place, and what you are doing about it.

Admiral RICKOVER. That is a timely question, sir, because the Navy is now in the process of training two new yards: the Charleston Navy Yard and the Puget Sound Navy Yard. The latter one should be of particular interest to you.

Senator JACKSON. As you know, Admiral Rickover, I have taken an interest in this for over a number of years, and I have previously written to the Secretary of the Navy asking Puget Sound Navy Yard be considered.

Admiral RICKOVER. May I briefly describe the process we go through in training a new yard.

Senator JACKSON. Yes.

Admiral RICKOVER. It so happens I discussed this very subject with Admiral Dolan, commander of the Puget Sound Navy Yard, this morning. At my request he is making a survey to find the best people in the yard. He and his production and planning officers will personally interview the engineers and select about 30 or 40 of the very best ones. Then I will have senior members of my organization visit the yard and personally interview each of these engineers to decide whether they are capable of being trained for nuclear power work. Some of those selected will be trained at other yards where nuclear ships are being built; they will become the nucleus of the nuclear power organization at the Pugent Sound yard.

Senator JACKSON. When do you plan to do this out there?

Admiral RICKOVER. I expect to be at Puget Sound the end of this month.

Senator JACKSON. Around the 30th?

Admiral RICKOVER. Somewhere around there.

Senator JACKSON. 29th or 30th?

Admiral RICKOVER. Yes, are you going to be out there, sir?

Senator JACKSON. You never know.

Admiral RICKOVER. We will also have to train several hundred of the yard workmen in special welding techniques and in radiological safety. This will be part of setting up the nuclear organization.

Senator JACKSON. How many key engineers do you have to train to start with?

Admiral RICKOVER. We will train somewhere between 30 and 50 key engineers.

Senator JACKSON. And then it will take several hundred.

Admiral RICKOVER. Several hundred workmen especially trained to do this work; yes, sir.

Senator JACKSON. Do you send the key engineers to yards that have had previous experience?

Admiral RICKOVER. Yes, sir. Some will be sent to activities such as our nuclear laboratories and yards. Some will be trained locally.

Senator JACKSON. Then the workmen will be trained right in the yard?

Admiral RICKOVER. Yes, sir. The workmen, with a few exceptions, will be trained in the yard. I will assign an experienced officer from my organization to be in charge of the nuclear work at Puget Sound.

Senator JACKSON. I understand that the program you are talking about takes a year and a half.

Admiral RICKOVER. It takes at least a year and a half for a yard that already has sufficient human potential. If a yard does not have this personnel potential it will take much longer. They will have to acquire people. I know from my own experience that Puget Sound is a good yard. You ought to be proud to come from a State which has such a yard.

Senator JACKSON. That is why I wrote the letter to the Secretary of the Navy. It was not because the yard was located in the State. It is one of these outstanding yards. I was glad to have your corroboration of my completely natural interest in this problem.

There is one other matter that I want to inquire about, Admiral Rickover. How do you resolve the Navy's responsibility for operating nuclear ships with the Atomic Energy Commission's responsibilities which require that standards and adequate regulations are properly set to protect the public?

Admiral RICKOVER. The Atomic Energy Commission, as you have just said, sir, is responsible for the overall safety of all nuclear powerplants and installations. My primary duty is with the Atomic Energy Commission. There, I am in charge of the Naval Reactors Branch which has to do with the design of nuclear propulsion plants, the nuclear laboratories, the land prototypes, and the training of naval personnel for nuclear duty. I have additional duty in the Navy Department as Assistant Chief of the Bureau of Ships where I am responsible for the construction of the nuclear part of the propulsion plant, and for the testing and operation of the nuclear plants. The Atomic Energy Commission has agreed that the AEC laboratories will supply people to help in this function. Because I head the work in the AEC and in the Navy, these two organizations, the AEC and the Navy, are combined in this effort. In this way the work is done without duplication and with minimum cost.

As you know, whenever one of our new types of plants is ready to go critical we notify the Licensing and Regulation Division of the AEC. We also notify the Reactor Safeguards Committee, and we have these two groups evaluate our design and operating procedures. No ship goes to sea without having had such an investigation. They get into such questions as whether a ship can operate out of a particular port, at what power level it can operate in that particular area, and so on.

We go over this in detail with them before each new class of nuclear ship goes into operation. This is a continuing process, and may require several actions by the Reactor Safeguards Committee.

In the case of the *Nautilus*, we had four separate reviews by the Reactor Safeguards Committee. I think we have had nearly 40 sessions with this committee about various aspects of our reactor plant designs and operations. We keep the committee currently informed of what is going on. We very much welcome their advice. We have great respect for their abilities. They are frequently hard on us, but then they have a difficult job to do and they have to be tough. We have found they are quite helpful and fair to us.

Senator JACKSON. I have one other question in this general area. One of the problems concerning the committee is the pinpointing of responsibility in the event of nuclear accidents. We had one at Arco, the SL–1. How can the Joint Committee ascertain what individual or individuals are responsible for a specific project?

Admiral RICKOVER. That is very simple. The man who comes up and asks you for money is the one who is responsible.

Senator JACKSON. Is he, necessarily? He asks for money but then someone else is operating it and running it.

Admiral RICKOVER. Someone else is operating it? What does he want, just the glory, then when something goes wrong someone else is responsible?

Senator JACKSON. I wanted to give you this opportunity to comment on the problem that we face here in the committee.

Admiral RICKOVER. I do not believe you face a problem there. I think you are creating a problem for yourselves. The answer is self-evident.

Mr. RAMEY. On the question of responsibility for regulations and for operational safety in the Navy, as I recall last year, or the year before, there may have been some problems with respect to more or less standardized Navy safety procedures that were not adapted to the nuclear problem. In other words, there was some inclination in the Navy to look at nuclear safety as a standardized matter.

Admiral RICKOVER. Mr. Ramey, you know that military people traditionally like to operate their equipment, weapons, and ships in the way they have been used to and without interference from outside. It is very difficult for people who have spent the greater part of their lives in a prescientific age to understand that they are now dealing with a force that must be handled in an entirely different manner than they have been accustomed. This is recognized by the top military and civilian people. It is not thoroughly recognized by others who believe their prerogatives to be invaded when someone suggests to them that if you do such and such a thing you may incur danger. This idea is very difficult to get across. We have been fairly successful in convincing some people of these truths; in some cases we have not. I think if your committee and if the AEC do not constantly follow this matter, the situation will inevitably deteriorate. It is hard to get people to understand that when they deal with radiation they are not dealing with ordinary phenomena which can merely do local, transitory harm.

With radiation you can also do harm to posterity. This is a concept which is difficult for many to understand.

Representative VAN ZANDT. Admiral, probably the greatest concentration of reactor activity from the standpoint of Naval vessels is at New London and Groton, Conn.

Admiral RICKOVER. Yes, sir.

Representative VAN ZANDT. In your opinion, do you think that the regulation applied, both civilian and militarywise, is adequate to protect the safety of the population in that area?

Admiral RICKOVER. Yes, sir, it is. New London was chosen as a home port for our nuclear submarines. You must remember that a dead reactor, that is, one that is not operating is not dangerous if it is properly designed and maintained. So the fact that you have 5 or 10 reactors in an area, with only 1 or 2 operating, does not mean that you have 5 or 10 potentially dangerous cases.

We have issued specific instructions on the operation and maintenance of our reactors. We have also issued instruction books that have been very carefully prepared by our laboratories and checked by us. The operators are thoroughly instructed and examined. No one is allowed to operate one of our reactors unless he is thoroughly qualified. Also, proper supervision must be present to assure that all specific instructions and procedures are followed.

We have done everything humanly possible to prevent accidents. Furthermore, a Navy order provides that no one unqualified may work on a reactor, nor can any change be made in any reactor without prior official authorization. As you are aware, sir, we train the officers in our schools, except the commanding officers who are trained right in my own headquarters organization. These spend a year with my leading people. We teach them and indoctrinate them in nuclear power as well as in the principles of ship and machinery design. The commanding officers spend a considerable part of their time during this year at a land prototype where they learn to operate the plant.

While they are at the prototype, for several weeks at a time, they work 16 hours a day, 7 days a week.

The fact that a nuclear ship may go to sea for 2 months at a time, and be away from the United States, does not in itself relieve me of my responsibility even though an operational commander has charge. I have been responsible for the design of the reactor plant, the training of the crew, the installation and test, the issuance of instructions. So no matter where an accident might happen, I am still personallv responsible.

Responsibility is a unique concept: it can only reside and inhere in a single individual. You may share it with others, but your portion is not diminished. You may delegate it, but it is still with you. You may disclaim it, but you cannot divest yourself of it. Even if you do not recognize it or admit its presence, you cannot escape it. If responsibility is rightfully yours, no evasion, or ignorance or passing the blame can shift the burden to someone else. Unless you can point your finger at the man who is responsible when something goes wrong, then you have never had anyone really responsible.

Representative VAN ZANDT. Going back again to the New London-Groton area, what about the contamination of the waters?

Admiral RICKOVER. We keep a record of all radioactive water.

Representative VAN ZANDT. I am speaking of the bay.

Admiral RICKOVER. I am glad you asked that, sir. We keep a record of the minor amount of water that is discharged from each submarine. In fact, even the water going right through the reactor while it is operating is generally so pure from a radioactivity standpoint that it is within drinking water tolerance. This is so because of the way we design our reactor plants. The amount of radioactivity we have discharged into New London harbor has been checked by the local authorities, by the Connecticut State Department of Health and by the U.S. Public Health Service and it is well within drinking water tolerance. We have never had a single case where it has been otherwise.

To give you another example, the amount of radioactivity being discharged into the Ohio River from the Shippingport reactor is about one-millionth the radioactivity that is discharged into the Columbia River by the Hanford reactors.

Representative VAN ZANDT. Admiral, is it not true that in a nuclear powered submarine—we have experience yet to gain as far as surface ships are concerned—the control room is manned around the clock.

Admiral RICKOVER. Yes, sir.

Representative VAN ZANDT. Whether the ship is at sea or whether it is at port?

Admiral RICKOVER. We have qualified people on board at all times, even during overhaul, yes, sir.

Senator JACKSON. You mentioned the contamination in the Columbia in comparison with your record in connection with the nuclear powered submarines. I want to say that the proposed dual purpose reactor will help to eliminate that situation.

Admiral RICKOVER. Yes, sir, I know that. I am glad you put in a plug for your State.

Representative VAN ZANDT. One more question, Admiral. Over a period of years there has been some resistance on the part of those who control harbors in foreign countries admitting nuclear powered submarines. I take it from your statement that there is nothing to fear as far as the water of the harbor is concerned from the standpoint of contamination. But there is always the possibility of an accident. What would you say the ratio of the accident is?

Admiral RICKOVER. I do not think you can talk about the ratio of an accident. It is my firm conviction that a reactor properly designed and properly operated will not have an accident. Nevertheless, since there is always such a potential, I consider it unwise and unnecessary to send a nuclear powered ship into a foreign port unless there is a real purpose or a need. I would like to amplify this because it is an issue which is under discussion and will continue to be under discussion from now on. For example, suppose you have a choice of sending a nuclear powered ship into one of two ports, one being a populated area or close to a populated area and one is not. I would always pick the one that is less densely populated.

We try in the Navy only to send ships into ports, or we should, where there is a military necessity. But military necessity can mean several things. In wartime, of course, the issue would not arise. In peacetime it may be connected with fleet operations. We may want to put ships in the Mediterranean, and we will have to put nuclear ships into ports along with the other ships, for logistic support and because we have to give our sailors liberty. We also have to shut down various parts of the plants for maintenance and repair purposes.

I believe there is justification for sending ships into ports for these purposes. But we should always remember that there is some finite chance of accident. So we should not take unnecessary chances where they are avoidable.

I do not know whether I have answered your question exactly. I am not fearful of contaminating harbor waters. I am not really fearful of any accident, although with a nuclear powerplant, if it does have an accident, the consequences will be more serious than with any other type of powerplant.

Representative VAN ZANDT. One final question.

I know you will probably make a frank statement. Based on what you read in the press and probably the access you have had to official records, what is your opinion of the accident at Arco?

Admiral RICKOVER. I believe it was an avoidable accident. There may have been some errors in design. There may have been inadequate training or faulty operation. I think that to have an accident you have to have a combination of several circumstances. One error by itself will not cause an accident. For example, in that reactor, had there been adequate training and proper operation the design alone would have not caused the accident. Proper training even with faulty design could have prevented the accident. Good supervision could have prevented the accident, even with faulty design and bad training. All nuclear accidents that have happened so far could have been avoided if the training and operation had been adequate.

Representative VAN ZANDT. The other day we received information as to the training of the military personnel who lost their lives in the Arco accident. At that time I was of the opinion that the training they received in no way compared with the training that you require of naval personnel.

Admiral RICKOVER. Mr. Van Zandt, I am not familiar with the training they had.

Representative VAN ZANDT. This is my own opinion.

Admiral RICKOVER. I would go back further than that. I think you have to go back to the man who came up here and asked you to appropriate for that reactor. You had a right to assume at that point, when you were recommending assignment of Government funds to him, that he was going to be responsible for it.

I suggest that from now on when a man comes to your committee and requests money, you ask him, "what is going to be your responsibility?" If he is not responsible, you should not give him the money. Find out who is responsible. If no one is responsible, then Mr. Dillon will be very happy.

Senator JACKSON. Thank you, Adimral Rickover. We appreciate having your helpful testimony today.

Admiral RICKOVER. Thank you, sir, for the opportunity.

Senator JACKSON. The last witness this afternoon, Mr. William Mitchell, consultant to the committee and former General Counsel to the Atomic Energy Commission, Professor Cavers, is here also.

Mr. Mitchell, I understand you have a prepared statement.

STATEMENT OF WILLIAM MITCHELL, WASHINGTON ATTORNEY

Mr. MITCHELL. Yes, sir; I have a short prepared statement.

The plan proposed by the Joint Committee staff for a change in the regulatory organization of the AEC represents a middle ground between the position taken by the Commission and the proposals made by the University of Michigan Atomic Energy Research Project. Before outlining the plan, I would like to mention briefly some of the considerations which led to our conclusions.

The difficulties which exist today seem to stem primarily from two sources. The first of these is the present combination of regulatory and promotional functions within the AEC. It is not unusual for a regulatory agency to be charged with responsibility for the economic health of the industry it is regulating, but no other agency is subjected to the kind of strain which is often imposed upon the AEC in attempting to view objectively from a safety standpoint the same reactors which it has already viewed and approved from a promoter's or a developer's viewpoint. These dual responsibilities have led to the imposition of unduly formal and burdensome requirements on the hearing process and they may, if not remedied, lead to a lack of public confidence in the safety determination.

The other principal source of existing problems lies in the fact that conventional administrative proceedings are not appropriate for the special type of determination which is involved in AEC facilities licensing. In a typical case, the AEC staff is not called upon to resolve a controversy between competing private interests or between a private interest and a public interest, but simply to reach a sound judgment as to the safety of a proposed reactor; this staff judgment is not based upon facts alone but upon a mixture of facts, scientific and engineering theory and experimentation, and considerations of policy; and the proper task of review is not merely to determine the fairness of the staff's judgment and the adequacy of the supporting record, but to decide whether the staff's safety findings, on which so much depends, were the right ones.

Because of these factors, a hearing before a lawyer-examiner is not likely to get at any real sources of possible dangers. The kind of review which would be meaningful must be one conducted by persons who are qualified to probe deeply if they have any doubts concerning the safety of the facility. The Commission at present includes members who have the needed qualifications, but they lack the time for the kind of painstaking inquiry which would be necessary to pass upon the adequacy of the staff's findings. It is not enough for the Commission to make a quasi-judicial review of a summary of the record before the hearing examiner.

The Commission has made a vigorous and honest effort to deal with the new and complicated problems which have confronted it in the regulatory field. Some of the progress necessarily has been achieved by a process of trial and error. Nevertheless, there is need for further improvement, and enough experience has been gained so that it now appears appropriate to decide whether a mere internal rearrangement of the AEC's existing functions will be sufficient. If it is decided that something more needs to be done, the element of timing becomes important. At some point, it may be desirable to make a complete separation of the regulatory from the operating and promotional functions. However, the Joint Committee staff believes that a less drastic change should be sufficient for the next decade—a period which promises expanded uses for atomic energy and a consequent increase in the regulatory workload of the Commission.

The plan which the Joint Committee staff proposes is designed to accomplish three principal purposes—to separate the final responsibility for decisionmaking in licensing from the responsibility for operating and promoting; to combine in a single expert body the functions now performed at the initial hearing by the examiner, who necessarily has no expertise in scientific and technical matters, with the functions now performed on appellate review by the Commissioners; and at the same time to preserve the close working relations which are necessary between the regulatory divisions of the AEC staff, on the one hand, and the operating divisions and field laboratories of the AEC, on the other hand. The plan is compatible with the Commission's interim reorganization creating the Office of Director of Regulation and also with the continuance of a five-man Commission or the substitution of an administrator for the Commission.

Under the plan, there would be created within the AEC a three-man Board to be designated the "Atomic Safety and Licensing Board," whose members would be appointed by the President with the advice and consent of the Senate. Two members of the Board would be specifically qualified by training and experience in fields of science or engineering relevant to safety. For the third position, it would be advantageous to have a person knowledgeable in the conduct of administrative proceedings. The terms of the Board members would be 5 or 6 years, appropriately staggered. The Chairman of the Board would be appointed by the President from among the members of the Board. The members would receive salaries comparable to those of other Federal regulator boards, as provided by the Executive Pay

Act, currently $20,500 for the Chairman and $20,000 for other members.

The Board members would serve full time without other vocation or occupation. The Board would be aided by a small, permanent staff but might also make use of consultants with expertise in various scientific and technical disciplines. For such other legal and technical assistance as it might require for the discharge of its functions, the Board would ordinarily request the aid of the Licensing Division and other divisions of the Commission.

The Board would submit an annual report to be transmitted to the Commission, and to the Congress through the Joint Committee on Atomic Energy. Its member would be free to testify in hearings before the Joint Committee and other congressional committees.

The Board would have final authority, subject to review by the courts, to grant or deny licenses under the Atomic Energy Act (including facilities, materials, operators', and export and import licenses). Ordinarily the Board itself would sit on the granting of construction permits for major facilities. At the operating license stage, the decision of the Board would issue after publishing notice of intent to do so, but without a hearing unless the Board determines that a hearing would be in the public interest. Intervention at that point would be limited to matters which were not determined at the previous hearing, unless the intervenors show that subsequent events or findings indicate the existence of new questions of health and safety.

The Board would also review all proposed Government-owned reactors. Where these are for peaceful purposes or for the production of electricity, the Board's authorization would be required prior to construction and prior to operation, and the Board's decisions would be made public. In the case of Government-owned nonpower producing military or production reactors, the Board would make safety recommendations to the AEC or other Federal agency.

The Director of the Division of Licensing and Regulation would continue to exercise, by delegation from the Board, those functions in issuing or denying licenses which he presently exercises by delegation from the Commission. This would include the issuance of major facilities licenses, pursuant to decisions of the Board, and also the issuance, modification, suspension, and revocation of licenses for minor facilities, operators, and materials, both general and specific. If a contest arose in the latter type of case, the hearing would normally be conducted by a hearing examiner and his decision would be reviewable by the Board, either on its own motion or on appeal by the AEC staff, the applicant, or an intervenor.

The Licensing Division would evaluate applications, propose actions in facilities licensing cases, and appear before the Board or the examiner in all licensing hearings. The Board would avoid general participation in the consideration of licensing cases before they are scheduled for hearing, but would be available to rule promptly on questions submitted by the staff as to whether particular safety matters should be referred to the ACRS before hearing.

The ACRS would be continued as a committee of highly qualified experts, available part time to advise the Board and the Commission. It would continue to aid the hazards evaluation staff of the Licensing

Division in the prehearing review of applications for construction permits and sometimes for operating licenses. The Board itself might refer to the ACRS cases presenting important or novel safety questions. The opinions of the ACRS (except for Government-owned nonpower producing military and production reactors) would be made public by the Board. In addition, the ACRS would report to the Commission on matters on which the Commission had requested its opinion. The ACRS would also continue to have the authority and obligation, on its own motion, to review cases or other matters which it believes raise important or novel safety questions and report its view to the Board or the Commission, as appropriate.

The exact scope of the Board's functions with respect to rulemaking cannot be spelled out in detail at the present time. This is a function which would evolve with time and experience. Initially, it is anticipated that the Board's recommendations with respect to rules and standards would grow out of its handling of specific cases. However, it would seem that, as it gains experience, the Board would review and propose regulations of general applicability governing not only licensing but also radiation safety generally.

By reason of its composition and duties, the Board would become an important source of ideas for needed research in the field of reactor safety. It would review the programs of safety research conducted by the Division of Reactor Development and other divisions of the Commission and, if additional programs seemed desirable, the Board would recommend these to the Commission and the Congress.

The Joint Committee staff study recommends a number of improvements in regulatory procedures. Time does not permit mention of them here. Generally speaking, they are designed to simplify the process, to relieve some of the burdens on the ACRS, and to reduce the number of hearings while still preserving the assurance of adequate notice to the public. Some of these improvements could be accomplished by regulation. I might add that the Commission already has done this to some extent. Others would require statutory changes.

There are, of course, disadvantages to this plan for an internal board. The choice of a new organizational arrangement is, in large measure, a function of the time at which the choice is made, the regulatory workload of the Commission, and the state of technological development. Any proposal represents, to some extent, a compromise between various considerations. However, the staff study concludes that, at least for the developmental period ahead, an internal Atomic Safety and Licensing Board will best serve the Nation's atomic future.

I might say that I was talking about compromise on organizational plans and not compromise on safety.

It may be, Mr. Chairman, that Professor Cavers would like to make some remarks at this time, with your permission.

Mr. CAVERS. I have just been informed that the panel will be convened.

Representative PRICE. Perhaps he can make his remarks during the panel discussion. Thank you very much, Mr. Mitchell. We are certainly glad to have your statement and we want to express to you the thanks of the committee for the work that you have done.

Mr. MITCHELL. I want to thank the committee for the opportunity to serve you. I found it a very interesting and pleasant experience.

Representative PRICE. Thank you. The proposal for the creation of an Atomic Safety and Licensing Board has been criticised primarily on the ground that the rulemaking would be separated from licensing responsibility. Would you comment on this criticism?

Mr. MITCHELL. Yes, sir. I recognize that there is a close relationship between the kind of a rule that evolves from a particular adjudication and a rule of general applicability. It seems to me, though, that if you place final responsibility both for adjudication and for rules of general application in the same group, then no matter what you call it you have in effect created a completely separate agency.

Furthermore, I see no real reason why adjudication and general rulemaking need necessarily to be vested in the same group. It seems to me that the body which makes the rules of general application under our suggestion—and this would still be the Commission—can take into account the experience which develops in the particular cases, especially since, as we suggest, this Board would have an opportunity to comment on rules of general application and in a good many instances, as it gains experience, might even originate them.

Representative PRICE. Thank you very much, Mr. Mitchell.

At this point we will have a panel discussion of the various problems and alternatives covered in the hearing. Our panel includes Prof. Kenneth Culp Davis, University of Minnesota School of Law; Prof. David F. Cavers, Harvard University School of Law; Commissioner Loren K. Olson, Atomic Energy Commission; Mr. Lee Hydeman, Washington attorney, of the law firm of Sharlitt, Hydeman & Berman; and Dr. Theos J. Thompson, of the AEC Advisory Committee on Reactor Safeguards.

I wonder if Professor Davis would lead off the panel discussion with any comments he cares to make.

PANEL DISCUSSION

PARTICIPANTS: PROF. KENNETH CULP DAVIS, UNIVERSITY OF MINNESOTA SCHOOL OF LAW; PROF. DAVID F. CAVERS, HARVARD UNIVERSITY SCHOOL OF LAW; COMMISSIONER LOREN K. OLSON, ATOMIC ENERGY COMMISSION; LEE HYDEMAN, ESQ., WASHINGTON ATTORNEY, OF SHARLITT, HYDEMAN & BERMAN; AND DR. THEOS J. THOMPSON, AEC ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

Mr. DAVIS. Mr. Chairman, my interest is administrative law. I am not competent in the area of atomic energy except to the extent that the problems involve administrative law.

Representative PRICE. I understand, Professor Davis, you are recognized as one of the outstanding authorities in the country on administrative law.

Mr. DAVIS. Thank you.

Representative PRICE. Any comment you would make would be of great value to the committee.

Mr. DAVIS. As I look around Washington, I am of the opinion that a contagious disease is affecting many of our administrative agencies. I think that administrative agencies, like men, can suffer from disease.

I have long thought that some of the older agencies have administrative arteriosclerosis. I believe this young agency, the Atomic Energy Commission, is suffering from a serious disease which I shall call "dueprocessitis." "Dueprocessitis" is a disease that is induced by legal advice which is so fearful of possible violation of due process that the agency tends to be partially paralyzed.

I believe that this is what is happening in the Atomic Energy Commission today, especially in the licensing of reactors. The Commission is holding hearings of a trial type in cases in which there are no issues and no opposing parties.

In only one reactor licensing case to date has there been any contest, and yet the Commission is appointing a legally trained examiner who conducts the proceedings as if it were a trial, even though there are no issues and no parties who are opposing each other.

The Commission is necessarily violating its own rules of formal procedure, because its rules of formal adjudication are designed for cases in which there is a contest. For example, one rule provides for a default for a failure to file an answer. In a case in which there are no opposing parties there would be a default if the rule were applied because presumably a nonexistent opponent is unlikely to file an answer. The rule is a misfit.

Another important rule discussed yesterday by Senator Anderson is the rule that provides for prehearing conferences. The rule provides "for the settlement of the issues and for a written stipulation reciting the matters upon which there has been agreement."

The idea behind the rule is, of course, that parties who are opposing each other may come together and work out an informal settlement or a partial settlement of the issues that divide them.

Senator Anderson favors a more frequent use of prehearing conferences in these cases. But if the cases are without contest and without opposing parties, it is pretty difficult to apply the rule. How does one negotiate with a nonexistent opponent?

Another rule provides, "The parties shall be encouraged to present evidence in written form." In an ordinary administrative proceeding, it is the issues about which there is little or no contest which will normally be presented in written form and without an oral process.

In these cases, with the exception of the one case, there is no contest on any of the issues. That being the case, why is not the entire case presented in written form? I think that it should be.

I see no reason for an oral process in absence of content and especially no reason for a trial process. After the staff of the AEC and the applicant has come to an agreement, and after the ACRS has approved the plan, after all of the parties are in agreement, the reasons for a trial process seem to me to be completely absent.

I think that the trial process is harmful in that it is expensive to the parties and expensive to the Government. But the harm goes beyond that in my opinion. Giving the technical problems of reactor safety to a legally trained lawyer who has no technical capacity to pass on the technical problems and forbidding the examiner to consult the AEC's technicians whose skills can assist him to understand the problems is a good way to endanger the public safety, it seems to me.

The Commission has forbidden the examiner to consult with the technical staff, apparently in the view that section 5(c) of the Administrative Procedure Act should be applied. But in a case in which there is no contest, section 5(c) has no application for many reasons. The case is not in adjudication if there is no contest. It is not an adjudication required by statute to be determined on the record within the introductory clause of section 5. It is an application for an initial license which is exempt from the provisions of section 5(c). Each one of these three reasons, each one taken alone, is a sufficient reason for refusing to apply section 5(c). The three in combination, of course, are overwhelming.

I believe that the Commission is further harming this process with its "dueprocessitis" by forbidding the Commissioners at the stage of final decision to consult the technical staff. I will agree that in a contested case in which members of the staff have taken positions of advocates, and are trying to win for one side, it would be inappropriate for the Commission to consult the staff behind the scenes.

But in an uncontested case there are no advocates. There is not any contamination of a presumed judicial process. The Commission should be free, especially the Commissioners who have no technical background on problems of reactor safety, in making their decision, to consult any members of the staff as they see fit.

I would discontinue an oral process in an uncontested case except to the extent that any special problem and any special circumstances may indicate the desirability of such a process as a matter of convenience.

Representative PRICE. Thank you very much.

Commissioner Olson, would you care to comment?

Mr. OLSON. I think I pretty well covered this this morning, but since there are four distinguished members of the committee this afternoon who were not here this morning, it probably would be worthwhile to go over it again because we are seeking each vote on this matter.

I have not been in the hallowed halls of the law school since 25 years ago this June, so I have sort of forgotten the techniques that Professor Davis reminds me of now. I am awfully pleased that he started out by admitting that his knowledge of the atomic energy business is meager, because I think that may account for the fact that he has built a beautiful house on his neighbor's lot.

I wish that Professor Davis had been here in 1957 when you gentlemen passed the mandatory hearing requirement. That was your idea, not the Commission's. However, I want to say that I agree with it and I think it served a very useful purpose.

The purpose of the mandatory hearing is best set forth in your own staff report at page 49, and since I read it this morning to make sure that everybody was aware of it, I will merely ask that you gentlemen take note of the very special benefits of the mandatory hearing as observed by your own staff set forth at page 49 of your own report.

I think that the basic error assumed by Professor Davis is that there is no issue here. I think it is pretty clear that there is an issue. It is the interest of the applicant versus the interest of the public. I sincerely believe that it is an issue that has to be adjudicated.

All of our technical people have told us unequivocally "You cannot have absolutely safety." All of them have told us that additional safety costs additional dollars. We have those that are interested in promotion exclusively because those are their assigned functions. Each time a reactor license is granted upon the basis of an application, some new risk is imposed upon some people or some group of people, and a fairly large group of people.

I want to emphasize that the risk is small, but there is, nevertheless, some risk imposed. The risk within the exclusion area is of sufficient magnitude so that we keep out all of those except the ones that are employed. Within the evacuation area there are private citizens who live, but it is recognized that we must be able to move them within a certain time period. Certainly the person who lives within the evacuation area has had some new factor injected into his life without his choosing it to be so injected. He may not be aware of it.

I have always felt it was the Commission's function to represent that member of the public who was affected upon whom additional risk was being imposed, but who may have been unaware of it. It is indisputable that the amount of risk can be adjusted by dollars. Piqua is one of our best examples, where to reduce the risk to the public, $1 million was added for containment.

Therefore, it seems to me that there is, in fact, something to be adjudicated here. I think, for example, that the element of judgment in the SL–1 as to whether the design was satisfactory, the element of judgment as to whether the supervision was satisfactory, were all elements of judgment that affected three individuals who died.

I think that this is illustrative of the adjudication that is presented in the regulatory case where this is of record. True, the SL–1 was not a regulatory case. That was a Government-owned reactor. This is our basic difference, Professor Davis. I think there is something to be adjudicated.

Mr. Ramey. Perhaps Professor Cavers might have some comment.

Mr. Cavers. Mr. Chairman, members of the committee, I believe that Commissioner Olson has indicated that whether we have an issue for adjudication or not, there does appear to be occasion for a review of the decision reached at the staff level in recommending the issuance of license or construction permit.

My question goes to the nature of the review which the present regulatory procedure provides. I gathered from Commissioner Olson's testimony this morning that he understood it essentially as a review of the record made before the hearing examiner to see whether there was sufficient evidence to sustain the conclusions. This, it seems to me, is not the kind of review which would go to the merits or depths of a safety issue. It is, rather, one of an appellate court review and in the vast majority of the cases I would expect the staff to meet its requirements readily.

I would be surprised if the staff could not provide evidence sufficient to sustain its findings even though a probe in depth by technically qualified persons on review might reach a conclusion that would be to the contrary. This the Atomic Safety and Licensing Board which the staff study suggests would, I think, be equipped to do.

I do not believe the hearing examiner is equipped to do it. The Commission, I think, lacks the time to do it. Hence, it seems to me that we have a real problem here which has not been resolved even by the helpful changes in procedures suggested by the Commission and put into execution.

Representative PRICE. Mr. Davis, I think, wanted to respond to Commissioner Olson, so I think probably this would be an appropriate time to do it.

Mr. DAVIS. I do not agree with Commissioner Olson that the statute requires a trial-type of hearing. I know that the 1957 statute makes the hearing mandatory in an uncontested case, but this Joint Committee, in enacting the 1957 statute, made this very significant and, to my way of thinking, controlling statement:

> The Joint Committee concluded that full, free, and frank discussion in public of the hazards involved in any particular reactor would seem to be the most certain way of assuring that the reactors will, indeed, be safe and that the public will be fully apprised of this fact.

What the committee had in mind, it seems to me, is full, free, and frank discussion in public. I think that full, free, and frank discussion in public is desirable and does serve a useful function.

It is because of the mandatory hearing requirement and because I think it does serve a useful function to have public discussion of the problem of safety that I have recommended that the Commission should follow a procedure of publishing the AEC's staff study and then giving an opportunity to the public to come in with questions or discussion, holding a hearing in the nature of a press conference, as I have characterized it, and the Commission has adopted that proposal for a proceeding shortly to be held in California.

I would say that is in compliance with the mandatory hearing requirement. This is a sensible procedure that meets the needs in all respects. This will inform the public of what is going on. It will provide an opportunity to protest, an opportunity to make statements or arguments against what is proposed. It is not a circumstance calling for a trial procedure, as if it were a murder case with testimony subject to cross-examination and a determination on the record.

It seems to me that the Commission should do what it is proposing to do in California, and that that procedure should be deemed to be a satisfaction of the mandatory hearing requirement.

Representative PRICE. Mr. Hydeman?

Mr. HYDEMAN. Mr. Price, I find myself in agreement with a good deal of what Professor Davis has said, but I think it is modified by Dean Cavers.

I think the trial-type hearing in the present context in which it is held before a hearing examiner is totally anomalous. I think whoever is responsible for the decision in the licensing cases must and should have free communication with staff and should not be cut off from the technical staff.

I would think there are some values of a hearing or at least one open public check on the staff, perhaps for a temporary period of time, until we learn a little more about the art of reactor safety. I think the nature of hearing could have two purposes. One is to constitute a check on the understanding of the staff, and the applicant, of the safety issues involved in the project, and the other, if you establish a new board, that board itself, it seems to me, can gain a good deal of education from the process of an exchange of views on the technical safety problems involved.

It is for these reasons that I would think that one hearing, not one in addition to the ACRS, but just one process of review of the staff might be desirable at the time that major policy determinations are made, namely, at the time of issuance of a construction permit, for a 3- to 5-year period, with the cutoff so that the matter would be reconsidered.

The hearing, per se, in this type of uncontested proceeding has to be especially justified because it is not within the context of the normal hearing processes as Professor Davis pointed out.

Representative PRICE. Dr. Thompson?

Mr. THOMPSON. Mr. Chairman, Professor Davis has stated that the agency was partially paralyzed by this legal process. I do not worry quite so much about the agency as I do about the industry.

First of all, with four legally trained minds to one technically trained mind, I am as a lamb among the wolves today. So far as I am concerned, I have never seen anywhere in my life so many investigations conducted of a system which is basically functioning fairly well and in a reasonable manner.

As far as I know, there has been no breath of scandal, no accusations of collusion, no real, demonstrable holding up of operation of the major reactors. They system, while it can be improved, has been working reasonably well.

We have presently been putting quite a bit of effort in worrying about how it should be readjusted when the same effort might well have gone into consideration of actual cases and carrying on the basic work of the program.

I think as far as the ACRS is concerned, our general feeling is basically that we would like to have more technical judgment nearer the top of the regulatory process. In some cases it has occurred that judgments have been made and agreements reached without any participation on the part of technical people at all.

I call to mind an instance in which in an argument between the General Electric Co. and the hearing examiner, an agreement was reached on a waiting period without any consultation with technical people. This particular case set a precedent that has been used ever since, and the technical people in the General Electric Co. and in other companies have objected rather violently to this.

I might point out that the power industry as a whole is, itself, partially rsponsible for this. The power industry is used to working with regulatory agencies, and to taking directly the advice of their legal counsel. Therefore, the tendency is to match counsel with counsel and very soon the technical part of the examination is reduced in importance.

As far as putting all of the material in the record is concerned, I seriously doubt that it is possible to present testimony which is complete enough to be technically valid on safety features of such a highly technical piece of hardware as a nuclear power reactor, while still making it simple enough so that the man on the street can really understand it.

It should be possible to make a very good record in each case at the construction stage. Here we consider the more or less simple problem of whether or not a reactor of a certain general type can be located at a particular site. This is a matter which is demonstrable with a simple presentation. It can also be made sufficiently technical to make good sense.

Perhaps the AEC should consider holding one public hearing at the construction permit stage in all uncontested cases. This has been suggested several times by various people. Then at subsequent stages of the case, including the detailed technical design of the reactor, startup operation, amendments, and so on, the AEC could present in the record simply the hazards summary reports, a report from the staff, and an ACRS letter. They could then allow for a waiting period and intervention by a presumable intervenor.

If this intervenor does appear, he should then be allowed to question people either from the Commission, from the applicant, or from the ACRS, to develop whatever points he may desire. But in order to do this, I am certain that, to make sense, the intervenor must bring technical witnesses and review the entire scope of the matter with technically expert people. It will never be in any true sense a problem which you can present in the "man-on-the-street" fashion at the complicated hardware stage.

I believe this is impossible, technically.

Mr. RAMEY. We have been discussing procedure. Another main question involved has been this combination of promotional and development functions.

Commissioner Olson mentioned the *Piqua* case situation in which the Commission had entered into a contract several years before the safeguards aspect was ever looked at.

One of the reasons they had to spend a million dollars extra was because it was discovered too late that they needed additional containment. They had to move the reactor from one side of the river to the other and add containment to it.

Dr. Thompson mentioned that there had never been any significant problems—I think he used the word "scandal" which is probably true—but there were some difficulties that brought about the 1957 amendments that were mentioned.

There was the *PRDC* case, as I recall, which was recently just approved by the Supreme Court in terms of its legal aspects. But several members of the Joint Committee did raise a rather severe question.

For example, Senator Anderson, chairman of the Joint Committee at the time, issued a statement saying that "the method of issuance of this permit raises serious questions as to whether the Commission has violated established legal principles by the confusion of its development and promotional functions with its regulative and quasi-judicial responsibilities."

Congressman Holifield, chairman of the Subcommittee on Legislation, also sharply criticized the procedures followed, especially the refusal of AEC to make public the ACRS report and the intention of the then AEC Chairman who announced that he was going to attend the ground-breaking ceremony. Does anyone wish to comment on this problem of the combination of development and regulatory responsibility?

Mr. THOMPSON. I will take a crack at it, if I may. I believe Commissioner Olson said earlier that a good deal was learned through the *PRDC* case, just as a great deal was learned from the SL-1 incident, We are, indeed, feeling our way and a great deal of caution is needed.

He pointed out the *Piqua* case as another one of the same kind. The ACRS has found more recently that the Commission and the Division of Reactor Development within the Commission now brings to the attention of the safeguard groups within the Commission and the ACRS these safety problems at a much earlier stage.

I think this is partly as the result of what happened in those earlier cases. In more recent cases, this question is not arising to any great extent.

As I pointed out a little earlier in my testimony, there is always the problem of balancing the safety of reactors against the gains to be made by building them. This is clearly a policy decision.

Obviously, the safest reactor is one which is never built. If you make a policy decision to build a reactor, you have then to make some sort of decision as to how safe it should be. You have also to make the decision as to what procedures you will carry out to insure the desired level of safety. Thus, development and regulatory responsibility are inextricably interlocked.

Professor Davis has pointed out that there will be a hearing in California on the 19th in regard to the superheat reactor of the General Electric Co. I think a great deal will depend on how this hearing is treated and what people make the presentation and how this will be accepted by the public.

In the field of atomic energy, we have, I think, a most difficult problem. This involves safety, public relations, and policy. To illustrate the problem, I will cite a hypothetical situation. If we look at World War II, we find that in the Japanese war there were more people killed with fire bombs than there were by atomic bombs.

If it had so happened that fire bombs had been the initial way in which gasoline had been used, this would have resulted, I think, in a great deal of public resistance to the development and building of the motorcar industry. In fact, we would have said these gasoline powered motorcars would be exploding on every corner, killing people everywhere. Since the atomic industry started not from the peaceful aspects, like the gasoline engine did, but from the warlike aspects, we have a very difficult public relations problem in assuring people that these reactors have a high level of safety.

I look at the SL–1 as an industrial type accident, not as a serious hazard to the general public. Even though we try to do everything we can to prevent such accidents, I suspect, in the long run, that we will have to expect to have occasionally an accident involving one or two people in a reactor site or in a critical facility, and I think critical facilities are the more likely source of such accidents. These accidents should not cause the people who compose the general public to become alarmed about the possible implications of such a situation to them.

Following my hypothetical example, I would like to compare the SL–1 accident with that of a welder who welds up a gasoline tank of a car without taking proper precautions. This is just bad practice. He is likely to get blown to bits.

This is exactly what happened in the SL–1.

Mr. RAMEY. Mr. Hydeman, would you care to comment?

Mr. HYDEMAN. As you know, we spent a good deal of time on this question of combination of functions. I think from our standpoint our review and analysis of the situation did not disclose incidents or instances in which the Commission's promotional responsibility in the past several years has seemed to result in unnecessary safety risks, with respect to private reactors.

However, we were concerned and still are concerned, with the combination of functions from two other viewpoints. One is that the procedures that have been built up, which in part were to overcome the potential disabilities of the combination, have become extremely burdensome.

Secondly, we are concerned over the fact that as long as the functions are combined a problem of public relations exists.

I think Dr. Thompson put some emphasis on this. Dr. Wolman on Tuesday said something which I think is very important, and that is that public apprehension can be more decisive than economic factors with respect to the development and operation of reactors.

I think that you have a potential explosive situation from a public relations standpoint where an agency is first in many instances deciding to promote a reactor project, may have actively gone out to seek participation in a particular project, and then subsequently has to determine the safety of the project.

I think that the Commission has done a very excellent job of exercising independent judgment in this respect, but I also think it is very difficult to convince the public in the event there is an incident or, in the event that anybody comes in to intervene, that such a group can be totally objective.

Representative PRICE. Professor Cavers has not had too much time.

Mr. CAVERS. If I may add a short comment concerning the problem of the public relations type proceeding which is being experimented with, in the light of what Mr. Hydeman said, it seems to me that this may complicate the problem that now faces the Commission as the result of its having already in effect made tentative commitments for the construction of a reactor.

Under this type of public relations meeting, I gather representatives of the Commission will go to the public in the vicinity of the reactor and tell them it is found thus far to be a very safe reactor.

The Commission is still, however, to reach its judgment whether this is a safe reactor, sufficiently safe to be licensed.

It seems to me that this public proceeding is going to put the Commission in even a more embarrassing situation having taken a public stand on the safety of the reactor through its staff and then later reviewing that stand in its proceeding.

Hence, it seems to me for this type of proceeding, it would be much better to call on the applicant. If there is a statement to be made on behalf of the reactor, let the applicant do it and explain through the Commission representative the procedures that still have to be followed.

For the Commission to go forward to the people of the neighborhood and through its staff tell them that this is a good reactor and then reserve the problem of deciding finally whether it is a good reactor is to create an accentuation of the problem we have had thus far.

Representative PRICE. Commissioner Olson.

Mr. OLSON. I have several questions that I wanted to answer but if we could work backward, I think it would be well to comment first on this experiment at Pleasanton, Calif.

I would like to ask Mr. Lowenstein to comment on this.

Mr. LOWENSTEIN. I was just going to say that the public meeting which will be held on the superheat reactor does not involve a case where there is any Government money involved. This is strictly a licensing case.

I think that the point that Dean Cavers raises may be something for us to think about in a case where there is some Government money.

Mr. OLSON. Since this was actually done as the result of a suggestion earlier made from the staff and then later made by Professor Davis, who actually urged us to go ahead and try it, it might be well to have Professor Davis comment before we get off the subject of the press conference.

Mr. DAVIS. I am concerned about the question that Professor Cavers has raised but it seems to me that it is not necessary for the representatives of the Commission at the public meeting to take a defensive position about the safety question that will go beyond what they will say in their published statement.

It is and has been the practice of the Commission to publish the statement by the AEC staff. It is now, as I understand it, the practice to publish the findings of the ACRS. These statements can be made public, and at the public meeting there can be discussion.

The staff can limit itself to answering questions about the meaning of the statements that are made, and the staff need not take a position as if they were advocating anything in any direction.

The analogy would be to an examiner's report at a tentative stage of any administration proceeding. The examiner may take a position as a tentative decision for the Commission and then the examiner may be consulted by the Commission in making the decision.

There is no good reason for forbidding consultation. The fact that the examiner has publicly taken a position does not prevent that consultation, and it does not prejudice the examiner and contaminate him in any way so that he cannot participate in the judicial function later.

The practice is somewhat like the old practice in Massachusetts where Mr. Justice Holmes would sit as a circuit judge and then Mr. Justice Holmes would sit as a judge of the Supreme Judicial Court. As long as he is acting in a judicial capacity in both instances, there is no harm in the system.

And this is the attitude we have in the administrative process.

Mr. RAMEY. Like when Admiral Rickover is wearing his AEC hat and then his Navy hat.

Mr. OLSON. He looks good in both of them.

Mr. Chairman, may I proceed to answer some of the statements that have been made?

Representative PRICE. Mr. Olson.

Mr. OLSON. With respect to the Licensing Board and Professor Cavers' comment as supported by Mr. Hydeman, the thing that troubles us is the concept of having the Board, the decisional group, actually contributing to the evidence.

I am perhaps a little old-fashioned, admitting as I did earlier it has been a long time since I got out of law school, but my concept has always been that the judge or adjudicator, marshaled and evaluated the evidence rather than supplying testimony from his own omniscience.

This is the thing that bothers me, the concept of having the technical experts at the decisional point. If there is evidence, fact or opinion, skimpy or solid, why can't we get it on the record?

I think it can be gotten on the record, and our experience has shown that it has gone on record easily.

Representative PRICE. Mr. Ramey would like to ask a question at that point.

Mr. RAMEY. How do you fit this technical assistant to the hearing examiner within the concept of doing these things on the record?

Does everything he says to the hearing examiner have to be put on the record?

Mr. OLSON. I think there is a distinction between the law clerk parallel to his function and the actual contribution to the evidence.

Furthermore, there has been extreme care exercised so far that the assistant to the examiner does not furnish evidence. He merely discusses with the examiner the narrative testimony that has been supplied and assists him to translate from the scientific language to the lay language in which the examiner attempts to write his decision.

There is a more basic problem here that I think must be answered. And that is that the Commission is here defending this hearing process and that we went further than we had to. I want to refer you to page 580 of volume 2 at which point we recite from the 1957 hearings with respect to the mandatory hearing requirement in which the report quoted extensively from the Attorney General's report and then went on to make clear in our opinion, by my interpretation, that you wanted a formal hearing of record.

I think that I would like to offer to submit for the record a memorandum opinion with respect to this since there seems to be considerable difference of opinion as to whether we were legally justified in placing upon the act the interpretation that we have up to date.

May I submit such an opinion for the record?

Representative PRICE. It will be received for the record.

(Material referred to follows:)

AEC MEMORANDUM CONCERNING MANDATORY HEARING REQUIREMENT UNDER ATOMIC ENERGY ACT

1. The reasons for recommending the mandatory hearing requirement were stated as follows in the 1957 JCAE staff study, "A Study of AEC Procedures and Organization in Licensing of Reactor Facilities," 85th Congress, 1st session (1957):

(a) "*Increased public confidence* in the regulatory agency, because of *more formalized and open proceedings, separation of prosecutor and judicial functions*, and *provision of a quasi-judicial body* which is not the primary competitor of the new industry" (p. 9). [Emphasis added.]

(1) "Maximum detachment and objectivity [required] in hazards evaluation" (p. 8).

(2) Mention of 1956 Michigan Workshop recommendation for mandatory hearings on the grounds that "the public information provided by such a hear-

ing would serve to foster and maintain the confidence of the general public and State and local authorities in the proposed project" (p. 25).

(3) "Nondiscriminatory, objective system of facilities licensing" (p. 37).

(*b*) *"Increased emphasis upon safety in the new industry,* to protect both the private and public investment in the program, and to take maximum precautions to prevent a serious reactor accident which would set the program back many years" (p. 9). [Emphasis added.]

(1) "The special problem of safety in the atomic field is the consequence of the hazards created by potentially harmful radiations attendant upon atomic energy operations" (p. 4).

(*c*) *Needed even in so-called noncontested case—*

(1) "The purpose of such a [mandatory hearing] requirement would be to obtain an open forum in which matters of reactor safety and comparative merits of competing applications could be thoroughly aired and made known to the public, *even in noncontested cases*" (p. 17).

(2) Reference to 1956 Michigan Workshop recommendation for mandatory hearing requirement for "a formal hearing * * * [to] make available a procedure appropriate to the protection, at the earliest possible stage, of all affected legal interests" (p. 25).

(d) *Importance of matters involved—*

(1) As noted by 1941 Attorney General's report, formal adjudication procedures should be employed "when the investigation and the possible resulting action are of *such far-reaching importance to so many interests that sound and wise government is thought to require that proceedings be conducted publicly and formally, so that the information on which action is to be based may be tested, answered if necessary, and recorded,*" or where conflicting applications involved (p. 20). [Emphasis added.]

(2) *"Applying these general standards, the licensing of reactors could be considered to be of far-reaching importance to many interests and therefore to warrant formal public proceeding.* Similarly, the denial of an application for a reactor license might be regarded as the type of situation in which the differences between private and public interests and public officials required settlement through formal proceedings including a public hearing" (p. 20).

(e) *"Not unduly burden" AEC to have mandatory hearings.* "The need for hearings in all cases of applications for construction permits or operating licenses for facilities under sections 103 and 104 of the Atomic Energy Act of 1954 is a question that must be considered from a number of aspects. *There are the factors of time and numbers, which at present would appear to indicate that a formal hearing requirement on all applications, to be preceded by ample notice of proposed action thereon, would not unduly burden the AEC as compared with the volume of cases the FCC and the FPC have recently had to handle.* On the other hand there is the factor of much greater complexity and difficulty of preparation and decision which must be met in current AEC applications, particularly for construction permits in new fields at the present time, and later perhaps also in the applications for operating licenses.

"Also to be weighed is the public interest, the interest of potential competitors or additional applicants and above all the intangible item of public confidence in the AEC programs for civilian application of the sources of atomic energy. Only by an adequate public record will all these interests be aware of what can be done, and what has been done. Only in that way will the fear of the safety hazards involved in a reactor accident be alleviated, with the knowledge and understanding of the safety factors and the care and consideration given to these matters by the applicants and the AEC" (p. 206).

2. In introducing legislation which later became 1957 amendments to the Atomic Energy Act, Senator Anderson stated (Congressional Record, pp. 4093–4094 (Mar. 21, 1957) [emphasis added]:

(*a*) "It is my privilege to introduce a bill to amend the Atomic Energy Act of 1954 to require that the AEC shall follow certain important procedures in connection with applications for construction permits or licenses to operate nuclear reactors. These procedures are intended to help increase public knowledge of reactor safety problems and control, and also to help assure fair and impartial administrative actions on applications."

(*b*) "The bill proposes to require public reports by the Reactor Safeguards Committee as well as public hearings on applications to construct and operate most power and testing reactors, but it leaves the AEC flexibility as to procedures on applications to construct and operate research reactors."

(*c*) "The AEC has had an excellent safety record in the past, but I believe that we should take every possible step to protect the health and safety of the public in the future as more reactors are constructed and operated throughout our country. We should strive to prevent, through every possible means, the occurrence of an atomic catastrophe which could cause widespread damage and set the atomic energy program back many years. We should establish procedures which are open to all, with a maximum of information disseminated as to the hazards and safety of each proposed design of a reactor, and as to the administrative considerations and actions taken on each application. The public has a substantial investment in the atomic energy program and has a right to know and analyze the steps being followed by administrative officials."

(*d*) "When the Atomic Energy Act was amended 3 years ago, I made the following statement on the floor of the Senate on July 14, 1954, expressing my opinion as to *the advisability of public hearings on reactor license applications:*

" 'But because I feel so strongly that nuclear energy is probably the most important thing we are dealing with in our industrial life today, I wish to be sure that the Commission has to do its business out of doors, so to speak, where everyone can see it.

" 'Although I have no doubt about the ability or integrity of the members of the Commission, I simply wish to be sure they have to move where everyone can see every step they take; and if they are to grant a license in this very important field, where monopoly could so easily be possible, *I think a hearing should be required and a formal record should be made regarding all aspects, including the public aspects.*'

"*Almost 3 years have now passed and I believe my words of 1954 are still applicable.*"

3. In House Report No. 435, 85th Congress, 1st session (1957), the Joint Committee stated with respect to the mandatory hearing requirement:

(*a*) "The first, and by far the more important, is to see that the reactors which are built are designed, constructed, and operated in the safest fashion. It was in an effort to assure the continuous safe operation of reactors that the Joint Committee decided in 1957 to add to the indemnity bills provisions which would make the Committee on Reactor Safeguards a statutory committee, require publication of its reactor hazard reports prior to hearings on construction permits and require public hearings on applications for certain facility licenses" (p. 10).

(*b*) "The provisions of S. 1684 and H.R. 6604 were added to the indemnity bill since it was felt that the Congress should not only try to give financial protection to innocent members of the public who might suffer in the unexpected case of a runaway reactor, but that the Congress should also provide all possible statutory requirements for assuring that reactors should be as safe as possible. A study of the problems of the Commission-licensed operations was made by the staff of the Joint Committee and published in April 1957, as a Joint Committee print entitled 'A Study of AEC Procedures and Organization and the Licensing of Reactor Facilities.'

"This study summarized the facility license procedures of the AEC and the role of the Committee on Reactor Safeguards in the evaluation of the hazards in reactor construction and operation.* * *

"Having established the committee under the bill, it was thought that its functions would be best served if its reports should be made public, and if the facilities of the type on which its report were required should be licensed *only after a public hearing*" (p. 12). (Emphasis added.)

(*c*) "Section 7 [of the bill] requires the Commission *to hold hearings* after 30 days' notice for applications for licenses filed under section 103 or 104 b. or for any application for license for testing facility filed under section 104 c. Under the present provisions of section 189 a. the Commission is not required *to hold a hearing* on all applications, but merely on those applications for which *a hearing is requested* by any interested party" (p. 25). (Emphasis added.)

4. In House debate on the proposed bill, Representative Holifield stated, in part (Congressional Record, p. 9551 (July 1, 1957)):

"Seventh. To complete the statutory provisions for the reasonable safety of reactors, as I have mentioned before, the bill would make the Reactor Safeguards Committee a statutory committee and would make its reports public. It would require the Reactor Safeguards Committee to pass on applications for those licenses for reactors which, by their nature, are the less safe. In addition, the Commission is required to hold hearings on each facility which would be licensed, either as a commercial facility or as a facility looking toward the demonstration of its practical value, or a testing facility. These are the facilities most likely to have the hazards against which this bill seeks to provide additional protection."

Mr. OLSON. Then, with respect to the question that Dr. Thompson raised, I think that there is a very appropriate quotation from Dr. Marver Bernstein that might be put into the record at this time from his book, "Regulating Business by Independent Commission," page 123:

> The expert doctor does not become by virtue of his expertness a great source of wisdom about the public's requirements for medical care, nor does the social worker by virtue of his expertness acquire a superior right to make final judgments about the proper elements of an adequate standard of living or about the architecture of a State institution for the feeble-minded.
>
> The limitations of the expert are relevant to all public agencies. But they do not appear to apply with special force to independent commissions. In commissions the staff experts are rarely balanced by commissioners who possess not the detailed knowledge of the experts but the aptitude for gaging the public mind and for integrating the points of view and proposals of the experts into a policy in the public interest.

There has been a feeling starting with the experts and technicians that design the reactor, that having put all this work into their creation that it should not be reviewed. It is reviewed by the HEB, the Hazards Evaluation Branch, which is again technical.

After they work it over very carefully to make sure that every potential has been properly reviewed and that the designer is competent and the operator will be competent. It is then reviewed by the ACRS.

Each review level always seems to resent the subsequent review level. I think there was much merit in the system that this Joint Committee devised and the system that we have.

I think it is completely defensible. On the other hand, it is not so perfect that it can't be subjected to change. I simply wanted to get clear on the record that all of this formality and the so-called overjudicialization was not a creature of our own choosing.

We thought we were carrying out the will of this Joint Committee.

Mr. RAMEY. Wasn't there also a situation within the Commission, Mr. Olson, as to a difference of opinion between the General Counsel's Office and the Licensing Division on the question of holding hearings?

That was brought up, I think, with Mr. Price.

Mr. OLSON. Yes, there were differences of opinion.

Mr. RAMEY. And the question of the use of the hearing process was to what extent the Commission would exert control over the licensing procedure and to what extent the lawyers would, as against the Licensing Division.

The Joint Committee's intent may not have been important as the power struggle within the Commission.

Mr. OLSON. Sir, I would state that lawyers were not craving any particular power. If there is one thing a lawyer has it is a respect for law. I happened to be the general counsel at the time that this came up, and as I said this morning, we called the shots just the way we thought this Joint Committee intended, to try to give full faith and credit to your legislation.

If we overshot our mark, the method of correction is very simple. We think, too, that it would be highly desirable at this time to amend the mandatory hearing requirement. We didn't want to take the initiative in it because it was so recent that the Joint Committee and the Congress placed this in the law.

The AEC feels as most everybody else appears to feel that if the Congress can place sufficient trust in the Commission at this time there should be a relaxation of the mandatory hearing requirement and the mandatory referral to ACRS.

The lack of any latitude has made it difficult. The problem is are you going to have just one hearing at which the uncontested, uncontroverted issues are resolved and then you come in at an amendment stage with a real difficult problem.

Obviously, that would permit a loophole that would circumvent the mandatory hearing requirement. The question of whether an amendment should be subjected to the mandatory hearing requirement and mandatory referral to ACRS is a matter of legal opinion.

It seems to me that it would certainly be a very devious interpretation of that law that would allow amendments to be treated differently from the original application. You would not have to be very bright to completely circumvent the law if that were the interpretation placed upon it and we were not anxious to be accused of circumventing this law in view of the history of its enactment.

Representative PRICE. Professor Davis.

Mr. DAVIS. I do not agree with Commissioner Olsen about the interpretation of legislative history. In fact, I have gone over the legislative history very carefully and searched for any words that indicate an intent that the hearing should be on the record. That is, that it should be a trial type of hearing. I find no such words. I do find words about discussion in public.

However, I do agree with Commissioner Olson in his statement this morning—and this responds to Mr. Ramey's earlier question—that the Commission can properly engage in promotional activities and still keep a judicial balance in determining contested cases about safety where a judicial balance is required.

It does seem to me that the Commission can commit itself, wearing its promotion hat, but subject to the condition that the requisites with respect to safety shall be satisfied. And then it can independently and properly examine into the question of safety. I believe that there is some disadvantage in this combination because it may be thought, whether rightly or wrongly, by some people that the combination may be harmful.

But I would offset whatever disadvantage there may be by pointing out that there is a disadvantage in the idea of having a tribunal which will focus only upon safety and not upon promotion or upon development.

I would say that the ordinary problem of safety is not a problem of assuring some kind of absolute safety. The problem is rather one of balancing the degree of risk against the advantage of the project. I do not see how we can get good decisions by men who have responsibility only for safety and not for development.

If the problem of balancing risk against achievement is to be decided soundly, it seems to me it should be decided by men who have responsibility for both safety and development.

This is what the Commission now does. I would not upset the present system in that respect. In this problem I am wholly in agreement with Commissioner Olson.

Representative PRICE. The Chair regrets that we will have to break off the discussion because we have a very important meeting downstairs in a few minutes.

I will give every member an opportunity to say something within a minute each to wrap up the discussion.

Dr. Thompson?

Mr. THOMPSON. I simply wanted to say that I agree with Professor Davis and Commissioner Olson, that the ACRS as such has considered and does consider and has discussed quite freely what we call the problem of "the gain versus the risk."

There is no question that even a body which is completely involved and solely interested in safety must consider this dual role problem to some extent. There is no way of completely divorcing promotion from safety since, if you want absolute safety, you must not build any reactors whatsoever.

If you make the policy decision to build reactors, then you have incorporated a certain amount of risk and you have incorporated certain gains. This policy decision is up to the AEC.

We advise them on the fine structure of that basic decision in regard to the safety of various facilities on the basis again of trying to set up a system which is at least as safe as normal industrial practice.

Representative PRICE. Professor Cavers.

Mr. CAVERS. It seems to me that Dr. Thompson has given the answer to Mr. Davis and Commissioner Olson in pointing out that even the ACRS, concerned as technicians primarily were the safety problem, must recognize that safety and progress are intertwined.

Hence, any Atomic Safety and Licensing Board charged with the primary responsibility of safety would view it as a problem of safety in a developing industry.

You would not expect that men of the caliber that we would contemplate that they could divorce these two intertwined matters. But they would not approach them with a background of having entered into a contract with the licensee to provide research and having had the specific connections with the particular project that I think makes the Commission's task very hard.

Moreover, they would have time and expert knowledge to go into the problem with thoroughness and this the Commission at the present time is unable to do.

Mr. HYDEMAN. I would agree completely with what Dean Cavers said. I would add one thing. If a board is to be created I feel very strongly that such a board should at least have the clear responsibility for initiating rules so that there is not a separation between the rulemaking and the licensing function.

I would also like to comment, Mr. Price, very briefly, on this problem of a press conference. To the suggestions that have been made in defense of this concept, I would say there is a considerable difference between preparation of a published report and the answering of questions at a press conference.

I think that the answering of questions may lead to considerable difficulties at a time when the staff is making declarations of its position, knowing that it has to reserve to the Commission or Board the final determination of the safety.

I can only say that I believe that questions will be asked which will cause bad press relations, I would further suggest and strongly urge that before this device is used even for the first time that opportunity for public comment by those people who are going to be most affected, namely, the applicants and other interested persons, be provided opportunity for comment in order to air this concept which is a very new one.

Representative PRICE. Thank you very much. Commissioner Olson.

Mr. OLSON. I think that from all of this discussion has come some good, namely, everybody seems to be in agreement that if the Congress is willing, it might be time to relax the mandatory hearing requirement.

I wanted to say with respect to the press conference that it is an experiment. I am not as apprehensive about it as Mr. Hydeman or Dean Cavers is. I never took much stock in trying to solve a problem by keeping people in the dark.

I would like to try this and see how it works, it may stimulate more interventions but I think that is something that we have to be willing to face up to. Certainly we don't want to avoid trouble by keeping the affected parties in ignorance.

Another good observation that has come out of this is, I think, a hybrid of the licensing board concept recommended by the staff as modified by Mr. Ramey's suggestion this morning. This is something that no one has really explored and I think it has more potential than anything else that has been proposed, namely, the addition of two technical people to the examiner to get a three-man board at that stage.

This is something that certainly would warrant further exploration. It would not bifurcate the Commission as has been suggested by some.

I would like to say with respect to the Licensing Board that although it is said to be within the Commission, I think that you have to, in all honesty, view it as completely independent. It has its own authority. True, it is too weak to really exercise its authority because it depends on staff of the Commission and it only has half a loaf. It has the licensing authority without the rulemaking authority. I think that will breed a lot of trouble. I would prefer to see the modifications with respect to which there is a concensus here and the continuation of the unitary command of the atomic energy program.

But if that is not possible, I think, speaking for the Commission, we would prefer to have complete separation rather than half-separation.

Representative PRICE. Thank you very much. Professor Davis.

Mr. DAVIS. If the Commission should decide on reexamining the legislative history that this committee and Congress in enacting the statute intended discussion in public instead of a trial-type hearing, I hope the Commission will give consideration to a procedure that resembles the present procedure of the ACRS in passing upon problems of safety.

Representative PRICE. Thank you very much.

Mr. RAMEY. Commissioner Olson mentioned the suggestion I made this morning. I was making that suggestion somewhat humorously thinking that a trial examiner and two technical assistants would end up being a board of the nature that the Joint Committee staff was talking about, except that the Commission would appoint it.

I do think it is worthwhile thinking of an ad hoc board like your Patent Board. This is not the best solution. It is another alternative.

Representative PRICE. You might get too many ad hoc committees.

Gentlemen, the committee thanks you for your participation in the discussion this afternoon, and all of the witnesses that participated in the hearing.

Without objection, the witnesses who have appeared and presented their papers may present any additional information or papers they desire for the record.

This concludes the Joint Committee's hearing on radiation safety and regulation.

(Whereupon, the Joint Committee concluded the hearings at 4:25 p.m., Thursday, June 15, 1961.)

APPENDIXES

Appendix 1

Atomic Energy Research Project,
University of Michigan Law School,
Ann Arbor, Mich., June 1, 1961.

Hon. Chet Holifield,
Joint Committee on Atomic Energy,
Congress of the United States, Washington, D.C.

Dear Mr. Holifield: This is in response to your letter of March 18 inviting us to provide the committee with comments relating to the forthcoming hearings on the AEC regulatory process and more particularly relating to the materials contained in volumes I and II of the Joint Committee print entitled "Improving the AEC Regulatory Process." Our proposals for creating a separate regulatory body, and setting forth other means of improving the Commission's regulatory program, are incorporated in the portions of our study which were reprinted in volume II of the committee print. The full text of our study, entitled "The Atomic Energy Commission and Regulating Nuclear Facilities," was made available to the committee's staff and to each member of the committee several weeks ago. Therefore, we are limiting our comments to the proposals of the Atomic Energy Commission and the recommendations contained in the committee's staff study.

I. SUGGESTIONS OF THE ATOMIC ENERGY COMMISSION

In general, we do not feel that the Commission's suggestions go very far toward alleviating some of the disabilities of the AEC's regulatory process that have been identified in the staff study and in our own study. Moreover, we do not believe that the analysis gives full recognition to some of these disabilities.

The AEC's proposals for clarifying the authority of the divisions and offices concerned with the regulatory program, modifying the statutory responsibilities of the Division of Inspection, and giving the Division of Compliance direct responsibility over field inspectors are desirable changes of relatively little consequence.

The creation of a Director of Regulation constitutes one further step in the separation of the AEC's regulatory responsibilities from its promotional and operational responsibilities at the staff level; this is a desirable change but likewise not of major significance. As a practical matter, there already was considerable separation at the staff level and the change does not result in any separation at the policymaking level. While this change may result in greater attention by the Commissioners to regulatory matters, it seems unlikely that the burden of the Commissioners' total functions, which remains unchanged, will permit them to devote a significantly greater amount of their time and attention to the regulatory program. In this same vein, we approve of the AEC's objective of further developing regulations, but we question whether any change suggested by the Commission will accomplish this laudable goal. The problem, as we see it, is not a lack of consideration or action by the Commission's staff, but a lack of action and attention by the Commissioners.

We agree with the Commission that a clearer definition of the responsibilities of the Advisory Committee on Reactor Safeguards is desirable and that any unnecessary burdening of the committee should be avoided. We also agree that the Advisory Committee should look primarily to the AEC hazards evaluation staff as the principal source of its information in order to avoid conflict and competition between the committee and the staff. However, as indicated by the recommendations in our study, we do not feel that the Commission has gone far enough in its suggestions with respect to the Advisory Committee; in this connection, we believe it extremely important that the case-by-case review function of the Advisory Committee be lightened so that it can devote more of its time and attention to matters pertaining to reactor safety generally.

We do not believe that the creation of Motions Commissioners is a sound means of attacking the problem of overburdened Commissioners. In effect, this proposal constitutes one more step in the over judicialization of the licensing process in an area of regulatory activity in which the most significant cases are uncontested; the object of regulation in this context is not the resolution of competing claims, a function which is best accomplished through an adjudicative process, but rather, assuring a thorough technical analysis of a project and superimposing policy determinations thereon. To the extent that the purpose of the proposal for creating Motions Commissioners is to reduce the burden on all of the Commissioners, we regard it as additional evidence that the real problem lies in the fact that the Commissioners have too many other functions to give adequate time and attention to their regulatory responsibilities.

As to the proposal for eliminating mandatory hearings except prior to the issuance of construction permits, the Commission's proposal seems to be a change of form rather than substance. Although a hearing subsequent to the issuance of a construction permit would appear to be made a matter of discretion instead of mandate, the criterion for ordering a hearing would not appear to lessen the existing burden of mandatory hearings. It is difficult to conceive of a case in which a hearing has been held on amendments or at the operating license stage that could not be said to have involved a "substantial novel safety question." It is our view that the Commission has failed to justify amply a second mandatory hearing in uncontested cases even when the proposed criterion is met. The justification, set forth in a letter from Commissioner Olson to Mr. Ramey dated November 30, 1960, and reproduced at page 578 of volume II of the Joint Committee print, certainly does not seem adequate in light of the burden which formal hearings impose on the AEC staff and applicants. We have dealt with this matter in detail at pages 208–220 of our study, a portion that was not reproduced in the Joint Committee print. With respect to the Commission's explanation of the reasons for the mandatory hearing requirement, it should be pointed out that the quotation from the report of the Attorney General's Committee on Administrative Procedure set forth in Commissioner Olson's letter (Joint Committee print, vol. II, p. 580) is not in context; the discussion in the report of the Attorney General's Committee pertained only to initial licensing in contested situations and did not relate to uncontested cases. An entirely different set of considerations arises with respect to contested and uncontested cases.

II. PROPOSALS OF THE JOINT COMMITTEE STAFF

While the staff study does an excellent job of analyzing the problems raised by the present organization and regulatory procedures of the AEC, and of setting forth many of the conflicting considerations involved in seeking improvement, the study, in our judgment, falls short in two principal respects.

First, no consideration is given to various difficulties which arise from the Commission's nonregulatory functions, and which have an impact on the performance of its regulatory responsibilities. The most significant of these difficulties are the burden on the Commission of its total responsibilities, the ineffectiveness of the Commission-General Manager form of organization, and the need for a different degree of Presidential authority over policymakers having executive-type functions and those having adjudicatory functions. Each of these somewhat separable problems should be considered as a part of an overall analysis of how to reorganize the AEC's regulatory responsibilities. Although the consideration thereby becomes much more complicated, it seems to us that anything less constitutes a piecemeal determination of less utility and one more likely to lead to an academic, rather than an effective, solution to the problems that have arisen.

Second, the staff study fails to consider the problems which arise as a result of the diffusion of functions pertaining to radiation protection among a variety of Federal agencies and the relationship of those problems to the organization and operation of the AEC's regulatory program. While it may be that these problems cannot be resolved fully, and that they are subsidiary to the principal issue at hand, they should not be ignored in devising a more logical and effective organizational framework for the conduct of the AEC's present regulatory responsibilities.

We would, therefore, strongly urge the committee to consider the problem of reorganizing the AEC in relation to these other aspects of the Federal atomic energy program and Federal activity in the field of radiation protection before reaching any final judgment.

We agree heartily with most of the observations in the staff study regarding the disabilities of the present licensing procedures, particularly the hearing process, the role of the Advisory Committee on Reactor Safeguards, and the role of the Commissioners in the decisionmaking process. For the most part we are in accord with the statement of difficulties outlined on pages 48–54 and with the statement of objectives set forth on pages 61–62 of the staff study. Our sole reservation in this respect relates to the third difficulty discussed on pages 50–51; there seems to be an implication that one additional technical review beyond that made by the staff and the ACRS might be desirable. While we agree that the policymaking body should be competent technically to undertake a general review of safety determinations, and should undertake such reviews, we feel that normally this should be in place of, and not in addition to, the ACRS review.

Moreover, despite the implication in the staff study to the contrary, we are fully in accord with the concept expressed on page 67 that there is an undesirable tendency on the part of critics of the status quo to propose a new agency. In fact, following the excellent commentary of Earl W. Kintner, Chairman of the Federal Trade Commission, in 69 Yale Law Journal 965 (1960), we made a considerable effort in our study to avoid this tendency by exploring a variety of alternatives which did not involve the creation of a new agency. We found, however, that most of the possible alternatives fell considerably short of the goals and objectives of reorganizing the AEC that we had identified. We might also point out in this regard that there frequently exists an equally undesirable reluctance to alter existing governmental structures; all too often change comes only after an unfortunate and dramatic event. A good example is found in the field of air safety. It took a series of disasters, culminating in the Grand Canyon crash of two commercial aircraft, to provide sufficient impetus for the creation of the Federal Aviation Agency and the realinement of functions formerly in the Civil Aeronautics Agency and the Civil Aeronautics Board.

It should be noted further that our study recognizes that a complete separation of promotion and regulation, is undesirable and that the creation of an entirely separate regulatory agency is not essential. However, we are firmly convinced that a separation of policymaking responsibilities in connection with the regulatory and nonregulatory programs of the AEC is absolutely necessary. Herein lies our principal point of disagreement with the recommendations of the staff study. As we understand those recommendations, the primary responsibility of the board would be to review and license reactor projects from the standpoint of safety. The rulemaking function would remain in the Commission and the Board would only have recommendatory powers with respect to the formulation and promulgation of rules. We disagree with this proposal for the reasons set forth in detail on pages 303–319 of our study, reproduced at pages 534–545 of volume II of the Joint Committee print. In summary, we believe that there are at least five specific disadvantages to this approach beyond those set forth at the top of page 66 of the staff study.

(1) A diffusion of responsibility for rulemaking could very well result in a failure of either the board or the Commission to do an effective job.

(2) Difficult problems of relationships are likely to result because the staff of the Division of Licensing and Regulation would be responsible to two policymaking bodies in connection with the formulation of rules. The very fact that the staff study hedges in the last paragraph on page 70 is indicative of the difficulty of resolving the problem of the staff's concurrent relationship to the proposed board and the Commission.

(3) The division of regulatory functions between the board and Commission will make it much more difficult to decide where responsibility should be lodged for establishing basic guides and for coordinating the activities of State agencies and other Federal agencies with respect to radiation protection.

(4) It is likely to be difficult to attract highly qualified individuals to serve on a board with the very limited responsibility of licensing nuclear facilities. A board with broader responsibilities in the field of radiation protection would proffer a greater challenge to individuals. The problem of obtaining the services of qualified individuals also is likely to be greater if the board is kept within the AEC rather than being given the prestige of being a separate agency.

(5) The creation of a licensing board may have the very effect which we and the committee's staff have concluded should be avoided; namely, the continuation of an unnecessarily burdensome licensing process. If the sole policy responsibility of the board is licensing, there may well be an increase, rather than a reduction, in the number of hearings and procedural delays. As conceived by the staff study, the board will have little else to do than hold hearings.

Beyond these additional disadvantages, we feel that the disadvantages cited on page 66 of the staff study are critical and that they should be conclusive. In particular, we believe that it is totally unrealistic at this stage of reactor development to separate the rulemaking and licensing responsibilities. The formulation of policy inherent in rulemaking must, because the technology involved is relatively new, be a slow evolutionary process from decisions in individual licensing actions to the promulgation of rules of general applicability. Moreover, it seems obvious that those individuals who will have achieved expertness in reactor safety by dealing with actual cases invariably will be in the best position to determine what general rules can be formulated and when they can be formulated. The separation of rulemaking and adjudication, particularly at this time, can only lead to confusion and disruption, rather than to the orderly development of policy.

We urge, therefore, whether an independent agency or a board within the AEC is created, that it be vested with final responsibility for licensing and rulemaking. In addition, and as spelled out in detail in our study, we also urge that such a board be vested with general responsibility for establishing basic guides, for reviewing and making recommendations on Federal research programs relating to radiation protection, and for serving as the initial and primary point of focus for relations with State officials in the field of radiation safety. Assurance that the views of the agency retaining responsibility for promotion and operation are taken into account can be provided either by requiring that that agency be given an opportunity to comment before any general rule is issued or that it be given representation on the Board in connection with the formulation of any rule of general applicability. A somewhat less desirable alternative, but one that is better in our judgment than the committee staff's suggestion, would be to place definite responsibility in the Board for initiating all rules, leaving the Commission with final authority to issue or not to issue such rules. This division of responsibilty would at least assure that any failure to develop and promulgate rules would not be the result of default.

With respect to the comments in the staff study on the creation of a separate agency, we feel that our recommendations have been misunderstood or not fully considered in several respects:

(1) In the fourth full paragraph on page 65, entitled "Disadvantages," the staff study indicates that we have suggested a reassignment of the existing responsibilities of other Federal agencies. Actually, we have not suggested that the operating responsibilities of any existing agency, aside from the Federal Radiation Council, would be affected by the centralization in the Board of supervisory responsibility in the field of radiation protection. Rather, we have recommended that the Board be given added responsibilities only in the sense of coordinating Federal relationships with the States, evaluating and making recommendations on Federal research programs, and developing basic guides on policies on radiation safety in conjunction with other Federal agencies. In fact, we argue that a number of agencies should and, as a practical matter, must continue to perform their present activities in the field of radiation protection because many aspects of radiation safety are so closely allied to their existing functions of a conventional nature. However, providing an initial point of contact in the Federal Government for the States, affording overall guidance on basic standards, and coordinating research efforts, all are desirable and necessary if an effective system for protecting public health and safety is to exist.

(2) We cannot agree with the notion, set forth in the fourth full paragraph on page 66 of the staff study, that a separate regulatory body would become overly safety conscious and thereby unduly restrict industrial activity. Experience with other regulatory agencies should have taught us, if anything, that agencies tend to become too lenient because of continuing contact with the industry being regulated. Certainly your committee could, and undoubtedly would, utilize its influence to prevent safety considerations assuming undue weight. Moreover, the assertion in the staff study of this potential disadvantage completely ignores the ameliorating effect of our recommended proposal giving

the agency responsible for promoting industrial development a voice in the formulation of rules of general applicability.

(3) The argument that it would be difficult to staff a new agency seems to us to be without any real merit. The staff that would be needed by a new agency already exists within the AEC and could readily be transferred to the new regulatory body. Moreover, a separate agency is likely to have more prestige and be more attractive as a place to work than a separate licensing board established within the present AEC. Certainly an independent board with the broader functions we have recommended would assume greater importance and acquire more prestige than a board with exclusively licensing functions.

(4) We recognize that there is a potentially serious problem of lack of communication between those evaluating the safety of reactors and those at the national laboratories with research information and operating experience; our proposals, however, incorporate several means for minimizing the risk of such a failure in communication. The staff study fails to take these detailed recommendations into account.

Again, let us emphasize that the crucial aspect of our proposal is not the creation of a separate agency, but the establishment of a separate policymaking board, be it within or without the AEC, with primary responsibility for all of the present regulatory functions of the AEC, and the other functions set forth above. It is the unification of these functions, not the location of the board, that is important. Whether such a board is located within or without the AEC depends, in our judgment, on a weighing of the advantages of the enhanced prestige of a separate body, in terms both of acquiring the best possible personnel and of attaining a high degree of public confidence in the regulatory program, against the disadvantage of a possible lack of communication between the scientific and technical personnel serving the regulatory and nonregulatory programs. Regardless of the choice, it is clear that a close working relationship between the two programs must be attained and maintained.

In regard to other facets of the staff study, we have the following comments:

(1) We believe that the regulatory board should not only review the safety research program of the AEC's Division of Reactor Development, but all programs of research on radiation safety conducted or supported by the Federal Government.

(2) We agree that the ACRS should be used on a more selective basis, principally on new and important questions of safety, and that its present statutory responsibilities should be modified to this end. However, we believe that the decision to obtain the Advisory Committee's views should be exclusively in the regulatory board, not in the Committee itself, and that the Committee should be used increasingly to advise generally on matters of reactor safety and decreasingly on particular cases.

(3) The use of hearing examiners should be eliminated in all but contested cases or where the regulatory board cannot devote sufficient time to hear a case.

(4) We agree that testimony normally should be presented in written form, that a "roundtable" exchange is more appropriate for an uncontested reactor hearing than the more formalized procedure followed at present, and that separation of the staff should only be enforced in those instances in which the staff is cast in an accusatory role, such as in connection with suspension or revocation proceedings, as provided by the Administrative Procedure Act. Likewise, we agree that a hearing should only be mandatory at the time of issuance of a construction permit. In addition, a statutory requirement of hearings at the construction permits stage in the licensing process should be limited to a period of 3 to 5 years, the issue of whether any mandatory hearings are necessary to be reviewed again at the end of that period.

(5) In every case of a licensing action of any consequence involving a power or test reactor, irrespective of the holding of a hearing, the action should be preceded by the publication of a staff document summarizing the facts in the case, the judgment of the staff, and the reasons for that judgment, and by ample opportunity for interested persons to request a hearing. This will assure that the public is informed of the issues in an orderly and comprehensible fashion and will protect the right of interested persons to be heard before final decisions are made.

(6) We urge that decisions of the board constitute the final agency action even if the board is lodged within the AEC. To do otherwise would only add

an additional step, of a not particularly meaningful character from the standpoint of safety, to the licensing process.

In conclusion, we should like to restate our views as to the appropriate time for instituting the changes we have recommended with respect to the licensing procedures and the organizational structure of the AEC. We feel that it may now be too late in this session of Congress to attempt to digest thoroughly the import of these hearings and draft appropriate legislation. Clearly, these are matters of extreme importance which merit careful study and detailed consideration. However, we do not feel that action by Congress, and fairly comprehensive action at that, should be long delayed. Consequently, we would urge the Joint Committee to begin drafting detailed legislation in the coming months, looking toward hearings on a proposed bill and enactment early during the next session of Congress.

Respectfully submitted.

LEE M. HYDEMAN.
WILLIAM H. BERMAN.

APPENDIX 2

INTERNATIONAL ASSOCIATION OF FIRE FIGHTERS,
Washington, D.C., June 14, 1961.

Re improvement of the Atomic Energy Commission's regulatory process.

Hon. CHET HOLIFIELD,
Chairman, Joint Committee on Atomic Energy,
Senate Office Building, Washington, D.C.

DEAR CHAIRMAN HOLIFIELD: The International Association of Fire Fighters, AFL–CIO, would like to urge the Joint Committee on Atomic Energy to retain the provisions of the Atomic Energy Act which require a public hearing on applications to construct major facilities such as power and test reactors. It is only by the holding of public hearings that all the parties interested and responsible for the well-being of the community are able to present their positions for the consideration of the Atomic Energy Commission. In each community the firefighters, who are responsible for the life and property of the citizens, are eager to present to the Commission and to the citizens the safety problems involved in any proposed atomic reactor to be built within their proper jurisdiction.

The Advisory Committee on Reactor Safety is a necessary adjunct in a highly complex field. The rapid changes and new advances in the industry must be evaluated by more than just the proponents of a new plan. The plans for a proposed reactor should be properly reviewed and subject to the voice of the public hearing.

A change from the present requirements in these areas would constitute a disastrous blow to sound safety regulations in atomic power development. There would be no objective review of the safety of the reactor design and no opportunity for public proceedings whereby interested parties would have an opportunity to intervene.

Our organization representing 100,000 firefighters throughout the North American Continent urges you maintain the present safeguards of the Atomic Energy Act.

Sincerely yours,

JOHN C. KABACHUS, *Secretary-Treasurer.*

APPENDIX 3

STATEMENT OF PETER T. SCHOEMANN, GENERAL PRESIDENT, UNITED ASSOCIATION OF JOURNEYMEN & APPRENTICES OF THE PLUMBING & PIPE FITTING INDUSTRY DEALING WITH IMPROVEMENT OF THE ATOMIC ENERGY COMMISSION'S REGULATORY PROCESS

Mr. Chairman, my name is Peter T. Schoemann. I am general president of the United Association of Journeymen & Apprentices of the Plumbing & Pipe Fitting Industry, an international labor organization having in excess of 270,000 members in more than 760 local unions throughout the United States and Canada. I am also a member of the American Federation of Labor-Congress of Industrial Organizations Committee on Atomic Energy and Natural Resources.

I wish to very briefly, outline the position of the united association on certain matters now before your committee pertaining to the Atomic Energy Commission's regulatory process.

First I would like to take a moment to commend the Joint Committee for conducting hearings of this nature. In our opinion, an evaluation of the Atomic Enery Commission's regulatory process is necessary at this time, and as the atomic industry continues to grow, periodic hearings must be held in the interest of the general public. Specifically, we wish to remind the Joint Committee that these hearings cover only one part of the Atomic Energy Commission's regulatory process and that there should be additional hearings covering the remainder of the field in the near future.

It has been brought to our attention, that the Atomic Energy Commission and the Joint Committee on Atomic Energy may be urged at these current hearings by the power reactor industries to rescind the 1957 amendments to the 1954 Atomic Energy Act which—

(1) Requires a public hearing on applications to construct major facilities such as power and test reactors; and

(2) Established the Advisory Committee on Reactor Safety as a statutory body required to make a public report on all reactors subject to the public hearing requirement.

We are vigorously opposed to any such proposal should it be made.

The 1957 amendments created a sound regulation, and at the same time provides protection for the general public.

The present atomic picture fails by goodly measure our anticipations at the passage of the 1954 act, and the question is mooted as to whether we have a satisfactory balance between hope and actuality; however, if the 1957 amendments were rescinded, it would be tragic, for then the evaluation of our years of atomic progress would sum up to oppressive disillusionment.

APPENDIX 4

INDUSTRIAL UNION DEPARTMENT,
ATOMIC ENERGY TECHNICAL COMMITTEE,
Washington, D.C., August 14, 1961.

Congressman CHET HOLIFIELD,
Chairman, Joint Committee on Atomic Energy,
Washington, D.C.

DEAR CHAIRMAN HOLIFIELD: In connection with the hearings on "Radiation Safety and Regulation," held during the month of June, I had hoped to have an opportunity to appear before your committee and present a study which I have prepared entitled "Some Atomic Reactor Accidents." This study, prepared from the available public literature, reveals the serious nature of the regulatory problem which your committee is reviewing.

Contrary to the conclusions of the Brookhaven report, "Theoretical Possibilities and Consequences of Major Accidents in Large Nuclear Power Plants," this study reveals that there are much more frequent releases of fission products than that report deemed likely.

I have included one-page summaries of the accidents from the public literature or, where available, from official sources describing each of the accidents listed.

In view of my inability to present this study to you orally before the committee in session, I would appreciate your including it in the printed record of the hearing.

Sincerely yours,

LEO GOODMAN, *Secretary.*

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SOME ATOMIC REACTOR ACCIDENTS

DATE	REACTOR	TYPE OF ACCIDENT	PLACE	REFERENCE *
1961				
Jan. 3	SL-1	Explosion	Idaho Falls,Id.	NW 1/26/61:1,2
1960				
Nov. 15	DRESDEN	Control rod failure	Dresden,Ill.	Tel.to AEC 11/16/60
Jul. 6	G-2	Fuel canal rupture	Marcoule,France	NW 7/14/60
Apr. 3	WTR	Fuel element failure	Waltz Mill,Pa.	NW 4/14/60:3
Mar.	Teakettle	Research reac.breakdown	W.Berlin,Germany	NW 4/14/60:5
Mar. 10	GETR	Fuel element rel.of I^{131}	Pleasanton, Cal.	Hayes 12/6/60:9
Feb.	HRE-2	Corros.hole in core tank	Oak Ridge,Tenn.	NW 2/18/60:3
1959				
Dec. 19	JRR-1	Release to containment	Tokai Mura,Jap.	Nucl.2/60:26
Nov. 10	AGN-211	Scram malfunction	Basel, Switz.	Docket 50-88,103
Jul. 24	SRE	Fuel element failure	Santa Sus.,Cal.	NS 3/60:73
Feb. 16	EL-2	Fuel element rupture	Saclay, France	Nucl.3/60:85
1958				
Dec. 27	EL-2	Fuel element failure	Saclay, France	Nucl. 3/60:85
Nov. 18	ANP	Release	Idaho Falls,Id.	OR 12/1/58
Oct. 15	ZER*	Power surge	Vinca, Yugo.	Int.Bul.4/60/85
Jun. 28	Calder Hall	Elec.gen.turbine failure	Calder Hall,Eng.	ATOM 8/58:8
May 23	NRU	Power burst in NRU	Chalk Riv.,Can.	NS 3/60:82ff
Apr. 13	EL-3	Fuel element failure	Saclay, France	Nucl.3/60:82ff
Apr. 4	HRE-2	Leak in core tank	Oak Ridge,Tenn.	NS 9/59:15
Aug. 26	GR	Radiation in atmosphere	Oak Ridge,Tenn.	ORNL 2777:55
1957				
Dec.	Saphir	Air pollution	Wurenlingen,Switz.	2nd UNC-P/260
Nov. 26	EL-2	Converter meltdown	Saclay, France	Nucl. 3/60:82ff
Oct. 10	Windscale #1	Burning fuel elements	Windscale,Eng.	NS 12/59:55
Feb. 12	Godiva	Godiva explosion	Los Alamos, N.M.	L.A.Pr.Rel.
Jan. 4	KEWB	Pump failure	Santa Sus.,Cal.	JCP-JCAE:314
1956				
Nov.	HRE-2	HRE-2 corrosion	Oak Ridge,Tenn.	OR 12/21/56
Oct. 26	G-1	Fuel ele.partiel burn.	Marcoule, France	2nd UNC-P/1180
Sep. 6	Seawolf	Seawolf-Na corrosion	Groton, Conn.	NYT 11/17/56
Jul. 23	MTR	Refueling exposures	Idaho Falls, Id.	JCP-JCAE:96

* See Reverse Side of Page 2 For Full Listings

(more)

PREPARED BY:

Leo Goodman, Secretary
Atomic Energy Technical Committee, IUD-AFL-CIO
1126 Sixteenth Street, N. W., Washington 6, D. C.

January 16, 1961 - List # 5

1955

Nov. 29	EBR-1	Meltdown at Idaho Falls	Idaho Falls,Id.	ANL 5731:11/57
Nov. 1	PR*	Fire in reactor slug	Hanford, Wash.	TID 5360:8/56:4[illegible]
May	RRR*	N.C. State Col.cor.leak	Raleigh, N.C.	TID 5360:28
Feb.	JEEP	Uranium oxidized	Kjeller, Norway	1st UNC.V.11:262

1954

Jul.	Windscale #1	Spontaneous energy rel.	Windscale, Eng.	A/CONF P/1518:4,[illegible]
Jun.	MTR	MTR fuel plate melting	Arco, Idaho	1st UNC.V.11:276
Feb. 3	Godiva	Burst causes disassembly	Los Alamos, N.M.	TID 5360:9

1953

	HWRR*	Uran.rod covering failure	Soviet Union	1st UNC.V.11:428

1952

	HWRR	Ruptured coil	Soviet Union	P.N.E.:136
Dec. 12	NRX	Power surge	Chalk River,Can.	Eng.Jour.10/53
Sep.	Windscale #1	Accidental release	Windscale, Eng.	Cmnd.471,7/58:[illegible]
Jun. 2	CP	Loss of moderator	Lemont, Ill.	1st UNC.V.11:25
Dec.	Clementine	Ruptured fuel element	Los Alamos, N.M.	PRDC F-16:15

1949

Dec.	HYPO	Super-criticality	Los Alamos, N.M.	JCP-JCAE:96

1947-1948

	Ornl GR*	Fuel element failure	Oak Ridge, Tenn.	1st UNC.V.11:286

# # #

FULL LISTINGS FOR ABBREVIATIONS

A/CONF P/	Second United Nations Conference on the Peaceful Uses of Atomic Energy - paper number
ANL 5731	Report from Argonne National Laboratory, "The EBR-1 Meltdown--Physical and Metallurgical Changes in the Core," available from Office of Technical Services, Department of Commerce, Washington,D.C.
ATOM	Monthly Information Bulletin of the United Kingdom, Atomic Energy Authority
Cmnd. 471	Atomic Energy Office Report, July, 1958
Docket 50-88, 50-103	Correspondence dated 5/6/60, 8/18/60, 8/25/60, Public Document Room, Atomic Energy Commission
Eng. Jour.	The Engineering Journal, Journal of Engineering Institute of Canada,
Hayes 12/6/60	Report by Daniel F. Hayes, Atomic Energy Commission, entitled "Case Histories of Accidents in Nuclear Energy Operations"
HWRR	Heavy-Water Research Reactor
Int. Bul.	International Atomic Energy Agency Bulletin; Vienna, Austria
JCP-JCAE	Joint Committee Print - Joint Committee on Atomic Energy, Feb.,1959
L.A.Pr. Rel.	Los Alamos Press Release
NS	Nuclear Safety, published by Atomic Energy Commission and Government Printing Office quarterly
Nucl.	Nucleonics Magazine, published by McGraw-Hill, Inc.
NW	Nucleonics Week, published by McGraw-Hill, Inc.
NYT	New York Times - daily newspaper, New York, New York
OR	Oak Ridger - daily newspaper, Oak Ridge, Tennessee
Ornl GR	Oak Ridge National Laboratory Graphite Reactor
P.N.E.	Progress in Nuclear Energy, Reactor Series II, Pergamon Press, 1956.
PR	Production Reactor
PRDC F-16	Testimony of W. Kenneth Davis
RRR	Raleigh Research Reactor
TID 5360	Report from Atomic Energy Commission, "A Summary of Accidents and Incidents Involving Radiation in Atomic Energy Activities, June 1945 through December 1955," available from Office of Technical Services, Department of Commerce, Washington, D. C.
1st UNC.V.	1st United Nations Conference on Peaceful Uses of Atomic Energy, volume and page number
2nd UNC.V.	2nd United Nations Conference on Peaceful Uses of Atomic Energy, volume and page number
2nd UNC.-P/	2nd United Nations Conference on Peaceful Uses of Atomic Energy, number of paper
ZER	Zero-Energy Reactor

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APPENDIX - 1961

January 3, 1961 SL-1 EXPLOSION, N.R.T.S, IDAHO FALLS, IDAHO

Source: Excerpt from Nuclear Engineering, March 1961, Vol. 6, No. 58, Page 94

Confronted last month with only the bare account of the immediately obvious aspects of the SL-1 accident, in which three men working inside the containment building of the former ALPR at Idaho Falls were killed, we hesitated to make comment. It is still perhaps a little premature to express definite opinions on the subject but one cannot ignore the implications of the interim report on the accident, prepared by the Board of Investigation of the AEC and published on February 2. This makes sorry reading.

It is clear that the reactor rapidly diverged and built up a pressure of explosion intensity, the blast from which killed two men immediately; the third man died within about two hours as a result of an injury to the head. Preliminary calculations suggest the reactor generated about 50 MW's of energy, producing a pressure within the unsealed reactor vessel of several hundred psi. Exactly why the reactor diverged is not known yet and a complete reconstruction is probably not possible. There is, however, sufficient history of operational problems resulting either from fundamental aspects of the design or features which had developed during running at power, which lead to the conclusion that any running of the reactor was hazardous. For example, in order to reconnect a control rod to its drive (the operation that is believed to have been taking place when the accident occurred) it was necessary to lift, manually, the control rod by a limited amount; exceeding the limit would result in reactivity being added and in the case of the central rod could result in criticality even when the core was fully poisoned; control rods had been sticking so that even under scram operation they had to be motored in and required manual assistance when they were withdrawn. The boron strip poisons attached to the fuel elements had been distorting, and removal of elements from the central region was difficult; furthermore, boron was being lost from the core and the reactivity of the reactor was greater than it should have been. When further cadmium strips were added to the core to increase the shutdown margin these were encased in 2S aluminium rather than the high temperature corrosion resistant nickel-alloy, and they were less effective than expected. The reactor had been shut down to allow the insertion of 40 cobalt flux measuring assemblies into the channels and for certain minor modifications to the reactor auxiliaries and it was following this that the crew of three was reassembling the control rods prior to start-up.

A possible sequence of events is that during the shut-down boron held in suspension or attached to the core settled out into the bottom of the vessel thus increasing the reactivity of the core, and then in attempting to raise the control rod the necessary few inches for attachment to the drive excessive force was applied to overcome the stickiness; the rod jumped up, the reactor diverged, steam pressure ejected the rod and the explosion occurred.

Whether the above explanation is correct or not is really beside the point. The tragedy is that the reactor was being used even when it was known that a number of things were working improperly. The AEC has instituted an immediate inquiry into the method of assessing the safety of reactors and administering their operation. This is clearly a matter of urgency. The Windscale accident resulted primarily from an imperfect understanding of fundamental physical phenomena but this is not the case with the SL-1 which on present evidence is a real blot on the escutcheon of nuclear energy.

APPENDIX - 1960

April 3, 1960 WTR FUEL ELEMENT FAILURE, WALTZ MILL, PA.

Source: Excerpts from Nucleonics, September 1960, Page 104

In the course of a calibration run on April 3, one of the uranium-aluminum tubular fuel elements in the Westinghouse Testing Reactor failed and spread fission products through the reactor cooling system.............No radioactivity spread outside the reactor site. When decontamination of the reactor permitted, most of the fuel elements were lifted out of the core.

. . . .

After all fuel elements except the ruptured one (which had just been loaded in the reactor before this calibration) had been removed, a 500-lb force was needed to pull out the upper third of the failed element..........The remains of the lower two-thirds stuck tight in the core and had to be sawed out.

Disassembly revealed that the two inner tubes had melted away to within about 6 in. of their tops, while the outer tube had about 11 in. fairly intact.

. . . .

Many small defects and faulty dimensions, as well as blisters, were found in the mechanical inspection. When the elements were fabricated, the bond was verified only by a blister test. In this reinspection, ultrasonic tests spotted many poor bonds and cracks, foreign inclusions and voids in the fuel. Defects ranged from 0.015 in. to greater than 1 in. in diameter...........................

From this evidence Westinghouse concludes that fuel specifications were too loose and inspection was lax.

APPENDIX - 1959

July 24, 1959 SRE FUEL ELEMENT FAILURE, SANTA SUSANA, CALIFORNIA

Source: Excerpt from Nuclear Safety, March 1960, Vol. 1 - No. 3, Page 73-75

"SODIUM REACTOR EXPERIMENT INCIDENT"

"On July 24, 1959, the Sodium Reactor Experiment (SRE) was shut down to investigate abnormalities which prevailed in the operations during power run 14. A subsequent preliminary examination revealed that extensive damage had been sustained by several fuel-element clusters during this power run." . . . .
. . . .

"On July 13, 1959, a series of negative and positive reactivity excursions was observed; one of these excursions resulted in a 7.5-sec period. The reactor was scrammed manually. It is estimated that the reactor reached a peak power of 24 Mw (t). The cause of the reactivity changes is not known, but investigations are being made in an attempt to explain them.

"The fuel-element failures resulted indirectly from leakage of Tetralin into the primary sodium circuit. The mechanism of failure is thought to have been either the blockage of coolant passages or the fouling of fuel elements by the products of Tetralin decomposition, which caused subsequent overheating of some fuel elements.

"The fuel-element temperatures rose sufficiently to induce eutectic melting between the uranium and the iron in the type 304 stainless-steel fuel cladding.

"Complete melting of the cladding around 10 of the 43 fuel assemblies in the reactor is now known to have occurred. The resultant loss of cladding support led to a complete separation of the top and bottom halves of these 10 assemblies. In every case the zone of fracture was between one-third and two-thirds of the length measured from the top of the elements." . . . .
. . . .

"In run 13, which was a high-temperature run with a 1000° F sodium outlet temperature, after an initial scram as a result of an abnormal sodium flow rate, the reactor was returned to normal operating conditions. Several unusual situations then arose: the reactor inlet temperature started a slow rise; the log mean temperature difference across the intermediate heat exchanger started to increase, indicating changes in the heat-transfer characteristics; a thermo-couple in a fuel slug in channel 67 showed an increase from 860 to 945°F; some of the fuel-channel exit temperatures showed slight increases; and the temperature difference across the moderator abruptly jumped 30° F. Later examination indicated that a reactivity increase of about 0.3 per cent occurred over a period of about 6 hr and then increased about 0.1 per cent over the next three days of operation."

APPENDIX - 1958

October 15, 1958 INSTITUTE OF NUCLEAR SCIENCES; VINCA, YUGOSLAVIA, ZER POWER SURGE

Source: International Atomic Energy Agency Bulletin, April, 1960
"Experiment At Vinca" - Page 4

The reactor in which the incident occurred is an unshielded critical assembly fuelled by natural uranium and moderated and cooled by heavy water. Control of the reaction rate was achieved by adjusting the level of the moderator. The accident occurred during an experiment to measure the spontaneous fission rate in the natural uranium fuel at different subcritical moderator levels. Due to a combination of circumstances, the water level reached and exceeded the critical level for a few minutes, resulting in intense emission of neutrons and gamma rays.

Six persons in the immediate vicinity of the unshielded reactor received very large doses of neutron and gamma radiation. Two other persons, who were further away, also received radiation doses above the permissible level.

* * * *

Source: Nuclear Safety, (A Quarterly Technical Progress Review,) September 1959: Volume 1, No. 1, Pages 38, 39

Kidrich Institute Accident

The natural-uranium-fueled, D_2O-moderated, unreflected, critical assembly at the Boris Kidrich Institute of Nuclear Science, Yugoslavia, became critical inadvertently on October 15, 1958, and caused significant radiation exposure to eight members of the technical staff. One fatality resulted. The incident has been recently described by Savic; an earlier report appeared in Nucleonics.

. . . .

At the time of the accident the personnel are reported to have been engaged in a "subcritical experiment" at distances of 3 to 8 meters from the tank. No monitor, safety, or control instrumentation was operating. By a means which is not mentioned, D_2O was transferred (possibly pumped) from the storage tank into the assembly tank, through a vertical distance of at least 4 meters, without cognizance by any of the persons present. The resulting super-critical assembly was first detected by an odor of ozone. The immediate actions, which no doubt stopped the reaction, are not described. The time of the energy release is indicated to be the order of 10 min. from a record by an air monitor some 540 meters distant, and the magnitude was evaluated as 8×10^7 watt-sec (2.4×10^{18} fissions). The power versus time pattern is not reported and, presumably, not determinable.

APPENDIX - 1958

May 23, 1958 NRU FUEL ELEMENT FIRE, CHALK RIVER, CANADA

Source: Excerpts from CRR-836 ("Contamination of the NRU Reactor in May, 1958"), Atomic Energy of Canada Limited Pages 3 and 4

Chalk River's NRU reactor is a 200-Mw reactor, moderated and cooled with heavy water and fuelled with aluminum-clad natural uranium. It first operated in November 1957, and in the ensuing six months it had been carried through its commissioning period and had successfully operated at or near full power for several weeks. One of the notable design features, which had already operated satisfactorily, was the provision for changing fuel rods during full-pow operation.

On May 23, 1958, after a week of steady operation, the reactor suffered an automatic shut-down as a result of excessive power rate-of-rise, but the staff could find no evidence to account for the occurrence. Therefore, they started the reactor again, only to be met with another automatic shut-down almost immediately. This time the excessive power rate-of-rise was accompanied by alarm signals indicating a number of unusual conditions in the reactor, the most significant of which was very high radioactivity in the coolant circuit. Some of the other signals were later shown to have resulted from a pressure transient inside the reactor vessel arising from violent failure of one of the fuel rods.

Three fuel rods displayed high levels of radioactivity; one of these was successfully removed several hours later. Attempts to remove the second one by normal procedures failed because of the damage it had apparently suffered, and it was necessary to spend the next day replacing the entrance snout of the fuel-removing flask with a larger one of sufficient diameter to accommodate the damaged rod. The non-standard procedure that was demanded by these circumstances also necessitated removing not only the fuel but also the entire plug from the top of the fuel hole. One unforeseen result of this operation was that the heavy-water coolant drained out of the removal flask into the reactor. If more time had been available there would probably not have been any serious consequences, but unfortunately the damaged fuel rod jammed after being raised part way into the flask and was without cooling for about ten minutes.

. . . .

Over the next two months some 600 men took part in the clean-up, including not only AECL staff but also men of the armed forces and outside contractors. Average radiation doses dropped gradually from 1000 or 2000 milliroentgen for those employed in the early weeks to negligible amounts later. By the end of July both surface and airborne contamination throughout the reactor building had been reduced to negligible levels as a result of intensive vacuum cleaning, mopping and wiping. Fragments of fuel had been removed from the bottom of the reactor vessel by means of several ingenious tools developed for the purpose, and by the end of August the reactor was operating again.

APPENDIX - 1958

April 4, 1958 HRE-2 LEAK IN CORE TANK, ORNL, OAK RIDGE, TENNESSEE

Source: Excerpt from Atomic Industrial Progress and Second World Conference, July-December 1958 - Page 32 (U. S. Atomic Energy Com.)

Homogeneous Reactor Experiment No. 2 went critical in December 1957. After critical and low power-level experiments, the reactor was gradually brought up to its full design power of 5 thermal megawatts in April 1958. Shortly thereafter, instruments indicated that fuel from the main core region was transferring to the heavy water reflector region and that a failure had occurred in the core tank. The plant, which had produced about 326 megawatt-hours of nuclear heat and had operated stably at design conditions, was shut down for examination.

While specialized examining equipment was being developed, the reactor was operated until September 12 with fuel solution in both the core and blanket regions, the concentration in the blanket being kept at low level by continuous purge. During this period 2.5 megawatt hours of heat were generated in 1,074 hours of operation which was trouble free mechanically, but was characterized by occasional brief fluctuations in power level.

A complete inspection of HRE-2 in September disclosed an oval hole measuring about 1½ by 1 inch in the core tank, a general thinning down of the core liner, and extensive corrosion attack in the region of the diffuser screens which distribute the flow of fuel solution at the reactor inlet. Metallurgical examination of samples from the diffuser screens indicated that very high temperatures had been developed in the metal. The evidence is that the observed power fluctuations, the high temperatures, and corrosion are caused by an instability of the fuel solution which results in concentrations of fuel in certain localized areas. HRE-2 operation has been resumed at reduced power and major attention is being given to correcting difficulties

APPENDIX - 1957

October 10, 1957 BURNING FUEL ELEMENTS, WINDSCALE, ENGLAND

Source: Excerpt from Second United Nations International Conference on the Peaceful Uses of Atomic Energy, "District Surveys Following The Windscale Incident" - Pages 2, 3, and 9

"SEQUENCE OF EVENTS"

"The accident in October 1957 occurred during a deliberate release of stored Wigner energy from the graphite core of one of the reactors.

"The first indication of an abnormal situation was provided by a routine measurement of air activity. On Thursday, 10th October, 1957, an air sampling instrument was operated between 11.00 hours and 14.00 hours in the open outside a building about 1/2 mile (0.8 km) from the stack of the reactor. The dust collected during this period indicated an air contamination level of 3,000 beta disintegrations per minute per cubic metre (d.p.m./m^3). This level was approximately ten times that normally resulting from the decay products of radon and thoron. This high level initiated further investigation into the cause of the activity. Air sampling was organized at some ten to fifteen locations on the site and the measurements made confirmed the fact that there was a release of activity to the atmosphere.

"It was first thought by the operating staff of the reactor that there was a severe rupture of a fuel cartridge. At 16.30 hours, however, visual inspection through a plug hole on the charge face of the reactor revealed glowing fuel cartridges. Subsequently, it was found that there were about 150 channels containing uranium cartridges glowing at red heat. . . . .
. . . ."

"NATURE OF THE RELEASE"

"The principal fission product released was iodine 131. Smaller quantities of other fission products such as caesium 137, strontium 89 and 90, ruthenium 103 and 106, zirconium 95, niobium 95 and cerium 144 together with polonium 210 were also released. "

"ESTIMATED MAGNITUDE OF THE RELEASE"

"The estimated magnitude of the release is: "

Iodine 131 - 20,000 curies	-	Caesium 137 - 600 curies
Strontium 89 - 80 curies	-	Strontium 90 - 9 curies

Source: Excerpt from the Manchester Guardian Newspaper, Manchester, Massachusetts, March 19, 1958 issue - Article "More Than Hiroshima - Radioactivity at Windscale"

"The quantity of radioactivity released in the Windscale No. 1 reactor during the accident in October was probably considerably more than that released during the explosion of an atomic bomb of the Hiroshima type. This is clear from a statement made by Sir John Cockcroft in his delivery of the James Forrest lecture to the Institution of Civil Engineers last night."

APPENDIX - 1957

February 12, 1957 "GODIVA" ACCIDENT, LOS ALAMOS, NEW MEXICO

Source: Excerpt from Press Release from Los Alamos Scientific Laboratory, Los Alamos, New Mexico to US AEC, Washington, D. C. TWX NR 06 0419522 March 1957

(Official Use Only)

The following information on the accidental "Godiva" burst is taken from the "N" Division monthly progress report now in preparation:

In the course of preliminary irradiations of uranium-loaded graphite samples for fission fragment boil-off experiments conducted by J-11, an unexpected "Godiva" burst of 1.2×10^{17} fissions was produced on February 12, 1957. (This is twice the yield of the accidental "Godiva" burst of February 3, 1954.) There was no detectable personnel exposure from the burst nor damage to the kiva but the "Godiva" assembly suffered mechanical damage. The active material was slightly distorted, the surfaces oxidized and the lighter control and support members were bent or broken. The amount of contamination in the vicinity of the assembly indicated the dispersion of no more than ten grams of uranium oxide, most of which was lost in the cleanup operation. The kiva was decontaminated by standard procedures, thoroughly monitored and restored to normal operation in about one week. This included a cooling-off period of two and a half days before an attempt was made to handle the oralloy parts of "Godiva." These parts have been stored in the TA-18 vault and will be allowed to cool for several weeks before recovery operations are started.

The accidental burst occurred while running cold sample tests in preparation for an experiment in which a sample of uranium-loaded graphite was to be heated by an induction furnace to high temperature, irradiated with a "Godiva" burst and transferred to a counting geometry. The furnace and a neutron moderating geometry were located near the surface of "Godiva." The work had been started a week earlier at which time the effect of this tamping had been measured as a function of separation. The furnace was then removed to permit a scheduled service irradiation for White Sands. On the day of the accidental burst, positive period measurements had been made with the furnace mounted with a somewhat increased spacing and two scheduled bursts of 10^{16} fissions each had been produced. The activation of the samples was rather low and the furnace assembly was therefore moved to a position estimated to be slightly over one inch from the "Godiva" surface. Precise measurements were not attempted because of the uneven surfaces and the high radiation level near "Godiva." Since the effect of this change in geometry was believed to be known with reasonable accuracy, "Godiva" was reassembled and the control rods set for a standard positive period check. The accidental burst occurred during this assembly.

APPENDIX - 1956

November 1956 HRE-2 CORROSION, OAK RIDGE, TENNESSEE

Source: Excerpt from The Oak Ridger Newspaper, Oak Ridge, Tennessee, December 21, 1956 issue

"LEAK DELAYS START OF POWER REACTOR"

. . . .

"In the official news release about the delay, the trouble with HRE-2 is described as 'microscopic cracking in the leak detector system.' S. R. Sapirie, manager of Oak Ridge Operations for the AEC announced the delay.

"The trouble has come to light during the testing stage that has been underway for the past several months. Officials emphasize, however, that all of these tests have been "non-nuclear" tests, not involving any radioactive material. Therefore, there has been no possibility of hazard as a result of the leak trouble.

"In addition to the leak, the report says, 'there is (also) some evidence of similar damage to flanges in the high pressure system to which the leak detector system is connected."

. . . .

"The microscopic crackings is ascribed to stress corrosion and is believed to be the result of chlorination contamination of stainless steel tubing in the leak detector system.

"This sort of trouble is common to chemical industrial work, an AEC spokesman explained. Whenever stainless steel is so used the possibility of the chloride ion is always possible. The HRE-2 builders and testers were aware of this from the start of the tests and had been checking for this specific trouble when, unfortunately, but not too much to their surprise, they found it.

"As to when the trouble with the reactor occurred, AEC would define the time only as "late November." Earlier this month, when asked about the reactor's progress, AEC said only that the tests were continuing."

APPENDIX - 1956

October 26, 1956 FUEL ELEMENT'S PARTIEL BURNING WITHIN G-1
SACLAY, FRANCE

Source: Excerpt from Second United Nations International Conference on the Peaceful Uses of Atomic Energy - P/1180
Abstract, March 12, 1958

Summary

On the 26th of October 1956, after having stopped a few days, the G 1 reactor was started up again. The burst slug system gave a first warning at 19 h. 07 on loading side, a second one at 19 h. 13 on unloading side, and so on others. At 19 h. 15 the Control Engineer ordered a quick decrease of power and then, made it rise again from 2 to 5 MW., to find out, with accuracy, the failing channel.

Soon after, in order to avoid any exterior contamination, scanning had to be stopped and a "o" ray detecting system outside the burst slug piping system, found out the damaged element in the channel 19-13.

The health stations recording showed that the highest experienced measures were still notably lower than the maxima permissible levels.

. . . .

On the 7th of December 1956, the reactor had a divergence at 2 MW., the first since the fault.

A hundred or so channels were still giving a background, therefore making the burst slug system inefficient for those channels. Systematical brushing and sucking up were not able to reduce it beyond a certain level. It forced the reactor to operate during several months with 56 unloaded semi-channels.

At last, in June 1957, two handlings allowed the reactor to operate in a satisfactory way:

Removal of 1 mm-thickness of graphite by re-reaming 54 semi-channels and setting on the burst slug detection-devices, some null regulating tension systems, annealing the background due to continuous pollution.

This event has been fruitful. A grid trap has been set right ahead the reactor Stricter instructions have been given for rising power operations and automatic burst slug system (already improved as said above) has been duplicated by a human control.

At last, the fault has pointed out that the reactors with gap had the disadvantage of facilitating the contamination of channels from one to another.

On the other hand, graphite stores the radioactive dusts and hinders an easy decontamination.

APPENDIX - 1955

November 29, 1955 EBR-1 FUEL ELEMENT MELTDOWN, ARCO, IDAHO

Source: Excerpt from The Oak Ridger, April 10, 1956 - "Was Arco Reactor Occurrence An 'Accident', 'Incident' Or 'Experiment'?"

. . . .

Some accounts of the "accident," "incident," or "experiment" said the trouble occurred when an operator pressed a wrong button, or when a "verbal instruction to shut off the reactor instantly was misunderstood." The latter reason is quoted directly from the official AEC news release issued on Thursday from the AEC's Chicago Operations Office. The Argonne spokesman feels neither description is precisely accurate.

Rather than a wrong button or a misunderstanding, he describes what happened as "split-second indecision" or "underestimation of the necessary shut-down time."

# # #

Source: Excerpts from ANL-5577 ("Some Problems in the Safety of Fast Reactors") Pages 4 and 18

. . . .

Fast reactors differ from less energetic systems in two principal respects. The short lifetime of prompt neutrons represents one, the nature of the reactivity coefficients the other. The lifetime of prompt neutrons in a fast system differs from other characteristic time constants, such as those of delayed neutron emitters, of mechanical motion, and of thermal transport, by several orders of magnitude. The inherent reactivity coefficients are of considerably different character, with competition between positive and negative components resulting in net coefficients which are small and vary in sign with the rate of the changes. The net coefficients are strongly dependent on detail of core design and fabrication.

. . . .

The reactor was placed above critical on a period of ~ 60 seconds (kex ~0.001) at 20 watts. Sometime after the power level had risen to the point where sensible heating began, the value of P/P began to decrease. It was planned to shut the reactor off when the period got to about one second or when the power approached 1500 kw. Both circumstances occurred nearly simultaneously, so that the scram order occurred just below 1500 kw. The rods were scrammed but their worth was insufficient to reduce the reactivity adequately; and before the slow-moving blanket control could come into play, the power had risen above 1500 kw and the period was about one-half second. The power trace was not recorded above 2000 kw but came back on scale two seconds later. Apparently, the thermocouple on the low-time constant recorder had failed and was recording NaK temperature rather

(more)

APPENDIX 1955 CONTINUED

than slug temperature. The slower recorders were unable to follow the fuel temperature excursion. The heat generation had proceeded to the point where the fuel element temperature was at the melting point of either the uranium or the eutectic formed with the stainless steel jacket. Normal coolant supply was restored, but a flow restriction became evident after a short time. This indicated the possibility that the jackets took some time to melt through. The core is presently being removed.

# # #

Source: Excerpt from ANL-5731 ("The EBR-1 Meltdown-Physical and Metallurgical Changes in the Core"), Page 11

As a result of the partial meltdown which occurred in EBR-1 on November 29, 1955, it was necessary to remove the core assembly from the reactor and to separate the enriched fuel section from upper and lower unenriched blanket sections. A temporary cave was constructed on top of the reactor in order to remove the core assembly, and at this time about one-fourth of the fuel elements were removed. In order to perform further disassembly operations under less hazardous conditions, the core assembly was shipped from the Idaho Division of Argonne National Laboratory, at the National Reactor Testing Station, to the Lemont, Illinois, site of the Laboratory, where disassembly was completed in a protective atmosphere. It was found that approximately 40 to 50% of the core had melted and reached temperatures ranging between approximately 850°C and 1400°C, and that the molten portion had separated into three clearly defined zones characterized by different porosities. Densities of the zones ranged from 2.5 to 15.4 gm/cm^3, depending upon the degree of porosity. It was also found that molten fuel alloy had traveled upward 5 inches and downward 3 inches between the blanket rods. Chemical and mass spectrographic analyses indicated that relatively little mixing occurred in the core during the period in which it was molten, that the fuel alloy which penetrated the blanket sections originated primarily from the outer part of the molten zone, and that the blanket did not enter the molten phase. Observations during disassembly of the core and subsequent simulated meltdown experiments indicated that the porous structure which formed in the molten core could have resulted from the vaporization of entrained NaK.

November 29, 1955
Arco, Idaho accident

APPENDIX - 1955

February 1955 JEEP REACTOR-URANIUM OXIDIZED, KJELLER, NORWAY

Source: Excerpt from First United Nations Conference on the Peaceful Uses of Atomic Energy, Vol. II : Page 262

"One serious case of heavy contamination has occurred. About three kilos of uranium canned in aluminum had been inserted in an irradiation channel for three weeks, after which the experiment for which it was intended was completed. It had been checked after two weeks and found in good order, but when the uranium was to be removed from the channel, the canning had burst. Due to a rather high temperature in the uranium, it had oxidized strongly in the air, and quite a large amount was sprayed around, in the form of dust, when the channel was opened. All personnel were immediately evacuated from the building, and before men in protection clothing and masks were allowed to re-enter the building air samples were taken. Primarily the burst slug had to be removed. It was transferred to a container by means of long tongs, where it was soaked in oil to prevent more dust from escaping. Vacuum cleaners were then used for removing the major part of active dust which was located in the channel, and on the floor in front of the channel. The vacuum cleaners were so highly active that they were disposed of in concrete drums. The cleaning job was then commenced upon with brushes and water, the washing being continued day and night over the entire building, for four consecutive days. Most of the activity was then removed, but some was left in cracks in the concrete floor; after monitoring however, it was decided that the remaining activity was not dangerous. Liquid floor polish was then used for binding the dust in the cracks, the waxing of the floor being repeated several times."

APPENDIX - 1954

MTR FUEL PLATE MELTING, ARCO, IDAHO

Excerpt from:
Source: Peaceful Uses Of Atomic Energy, Proceedings of the International Conference in Geneva, August 1955 - Vol. 2, Page 276

"In the summer of 1954 the gross beta and gamma activity of the process water increased considerably and during the fall of 1954 suddenly increased to 40,000 dps/ml. Closer examination of the outside fuel plates showed a higher percentage of blemishes and disclosed some breaks through the aluminum cladding, thus permitting fission product escape into the water. These breaks and blemishes were discovered to be due to the bulging outward of the concave plates to the extent that they touched the surfaces of the fuel plates on the adjacent fuel assemblies. Thus higher temperatures existed on the aluminum surface, and possibly even melting, so that the cladding was destroyed. Pressure measurements were made to determine the differential pressures acting on the plates and it was discovered that forces existed which would cause the outer plates to bulge. Bench tests confirmed this fact. By slight adjustments in the dimensions of the lower end boxes on the fuel assemblies so that safe differential pressures were obtained, this difficulty has been eliminated. To provide a greater safety factor, the fuel plate and side plate thicknesses were also increased slightly.

"The main consequence of this difficulty has been a greatly increased activity on the pipe walls of the process water system and in the MTR tank. Activities as high as three roentgens per hour were obtained at contact on the outside of tanks and pipes in the process water system, compared to 50-100 milliroentgens per hour. Activities as high as five to seven roentgens per hour were obtained inside the MTR tank where it is necessary to work in order to change a number of experiments. This activity of course died off to a great extent after the source of activity was removed from the system and normal operation was resumed; however, on a short-term basis it did create operating problems by limiting the working time in the MTR tank and the available time for maintenance of the process water system."

APPENDIX - 1953

HEAVY-WATER RESEARCH REACTOR, USSR

Source: Excerpt from Peaceful Uses Of Atomic Energy, Proceedings of the International Conference in Geneva, August 1955 Vol. 2, Page 428

"In 1953 we noted an increase in the activity of the gas. Analysis showed the presence of fission products in the helium, which indicated failure of the uranium rod covering. We decided to replace the uranium rods. After the reactor had cooled, all the uranium rods were withdrawn and two of them proved to have damaged canning. One of the rods had expanded somewhat and would not come through the top plate. During attempts to pull it out, it broke and damaged the bottom of the reactor tank. The rod was finally removed through the central experimental tube, the diameter of which was large enough to permit withdrawal of the rod. After this incident, the top cover (shield) of the reactor was demounted and the aluminum tank was replaced. In fabricating the reactor, we prepared two new replacement tanks. Some difficulty was encountered in disconnecting the bottom packing under the reactor, where the gamma activity reached 700 micro-roentgen per second. Appropriate protective measures were taken and the work was quickly accomplished."

APPENDIX - 1952

December 12, 1952 NRX POWER SURGE, CHALK RIVER, CANADA

Source: Excerpt from The Engineering Journal, October, 1953
The Journal of the Engineering Institute of Canada

A skilled workman might receive his weekly allowance of radiation within an hour, and thus a much larger crew of workers was needed than would be required in the repair of any other equally complicated industrial machine.

In a few instances a workman could remain within the radiation field for only a very few minutes. Careful planning was required to avoid the necessity of using a prohibitively large number of men. In some instances it was necessary to allow individuals to take a thirteen weeks' dosage in a matter of a day or two. This, of course, meant that they were barred from the radioactive area for a period of 13 weeks.

Skilled tradesmen were conserved, wherever possible, by using other men for such operations that did not definitely require trade qualifications... It is interesting to note that, in some operations, use was made of volunteers from various branches of the project who are rarely exposed to radiation. Carpenters, clerks, accountants, janitors, and others donned gas masks and protective clothing, and carried out various tasks under the direction of the supervisory staff of Industrial Operations... The U.S.A.E.C., in cooperation with the U.S. Navy, and particularly the U.S. Naval Radiological Defense Laboratory, were extremely helpful in the early months of dismantling and decontamination. This work provided an opportunity to train personnel in the problems of handling highly contaminated material and equipment.

Source: Excerpt from Mechanical Engineering, February, 1955
"A Reactor Emergency with Resulting Improvements," p. 125

Radiation measurements on this tank indicated 20 roentgens per hour in contact with the top tube sheet, 100 roentgens per hour in contact with the side of the tank, and 300 roentgens per hour in contact with the bottom tube sheet.

In order to appreciate the magnitude of this radiation measured in terms of roentgens per hour, if one hundred people were to receive a total body irradiation of 400 roentgens, at least fifty of these people would definitely have received a lethal dose. For this reason the normal health tolerance has been limited to 300 milliroentgens per week which is applied as a very rigid control on all employees working with radioactivity. However, had we attempted to apply this rigid tolerance when working with the activities involved due to this accident, we would have very quickly run out of manpower to handle the job.

APPENDIX - 1952

June 2, 1952 CP REACTOR, LOSS OF MODERATOR, LEMONT, ILLINOIS

Source: Excerpts from TID-5360 ("A Summary of Accidents and Incidents Involving Radiation in Atomic Energy Activities, June 1945 through December 1955"), Pages 23 and 25

Manual withdrawal of a control rod from a reactor caused an accidental super-criticality. Four persons were over-exposed but apparently were not injured.

. . . .

The reactor became super-critical because the test rod being removed by the leader was highly effective in suppressing the chain reaction when fully inserted. But, as it was being removed, a point was reached when the reactor was critical even with the standard type rods fully inserted. In removing this rod, the reactor passed through the critical into the prompt critical stage. This would not have occurred if water had not been in the reactor assembly, since this thermal reactor was dependent upon water to moderate the neutrons from the fast energy level to the thermal energy level and the fission process can only be supported by thermal energy neutrons.

After this super-criticality was reached, several reactions took place, any one of which could have contributed to immediately shutting the reactor down:

1. Part of the uranium polystyrene fuel mixture expanded, displacing the water.
2. A bubble formed causing a change in density in the reactor, reducing the effectiveness of the moderator.
3. The group leader immediately dropped the rod back into place.
4. The instrument circuits detected a level of neutron intensity and opened the water dump valve.

Damage caused by this incident appears comparatively slight and falls into three areas:

1. The radiological effect upon the victims is discussed in separate reports.
2. The fuel assemblies were damaged to the extent that the uranium polystyrene mixture on the zirconium strips was no longer in usable condition and had to be reclaimed immediately rather than after the experiments planned for the reactor. Seventy-five percent of the fuel on hand was not involved in the incident. The reactor tank and fixtures were undamaged.
3. The program was delayed due to the loss of personnel available for this operation as a result of the incident, and by the time required to revise operating procedures to insure complete safety in the future.

The direct cause of the nuclear reaction comprising the incident was the rapid withdrawal by hand of the control rod being tested from the water-filled assembly. This effected a large increase in reactivity and the reactor achieved super-criticality in a very short time.

APPENDIX - 1947-1948

ORNL GRAPHITE REACTOR, OAK RIDGE, TENNESSEE

Excerpt from:
Source: Peaceful Uses Of Atomic Energy, Proceedings of the International Conference in Geneva, August 1955 - Vol. 2, Page 286

"The failure rate of these elements was approximately one per month. Although this rate was not excessive enough to curtail operation, it did require constant vigilance to prevent damage to the reactor. The causes of failure were probably several, but the end result was always the same--bursting of the aluminum jacket allowing the rapid formation of uranium oxide which was carried away to some degree by the air stream causing contamination of the air exhaust system with fission products. The more serious result of failure is the possible sealing off of the channel by the swelling element jacket as the oxide volume increases. When the air flow ceases, other elements in the channel fail due to high temperature. This has occurred twice, once in 1947 and again in 1948. The first instance involved 13 elements and the second 5 elements."

APPENDIX 5

UNIVERSITY OF MINNESOTA,
THE LAW SCHOOL,
Minneapolis, June 27, 1961.

Mr. JAMES T. RAMEY,
Joint Committee on Atomic Energy,
Congress of the United States,
Washington, D.C.

DEAR MR. RAMEY: At the end of our panel discussion, the presiding officer invited any participant to make a further submission in writing. After listening to Commissioner Olson's surprising presentation to the effect that the 1957 amendment requires a trial-type hearing, I am inclined to think that a further word from me may be desirable. The Olson position, so far as I can discover, is totally unsupported either by the statute or by the legislative history, and, therefore, I think it important to pinpoint the misunderstanding, if that can be accomplished.

The 1957 amendment, of course, says nothing of (1) a trial-type hearing, or of (2) a hearing with a determination on the record. These two concepts are exact equivalents, as I understand the usage. The Administrative Procedure Act uses the term of "required * * * to be determined on the record," and this is uniformly interpreted to mean a trial.

Not only does the statute fail to specify either a trial-type hearing or a requirement of a determination on the record, but the legislative history likewise fails to specify either. Since a trial, in absence of issues and in absence of opposing parties, is obviously a misfit, the lack of requirement either in the statute or in the legislative history of a trial or of a determination on the record is more than an ample basis for drawing the conclusion that neither a trial nor a determination on the record was intended.

But we also have an affirmative indication from the Joint Committee that what was intended was "discussion in public," and not a trial. In the 1957 United States Code Congressional and Administrative News, at page 1814, is a statement by the Joint Committee explaining the 1957 amendment. With reference to the Advisory Committee on Reactor Safeguards, the Joint Committee says: "Having established the committee under the bill, it was thought that its functions would be best served if its reports should be made public, and if the facilities of the type on which its report were required should be licensed only after a public hearing. The Joint Committee concluded that full, free, and frank discussion in public of the hazards involved in any particular reactor would seem to be the most certain way of assuring that the reactors will indeed be safe and that the public will be fully apprised of this fact. The Joint Committee, therefore added * * * provisions * * * to establish the committee, to require that its reports be made public and that hearings be held on certain reactor applications."

The Joint Committee thus made clear that what it meant by the statutory requirement of hearing in uncontested cases was "full, free, and frank discussion in public." This language, in my opinion, is utterly inconsistent with a trial procedure.

When a trial is conducted, what goes on is primarily the direct examination and the cross-examination of witnesses. A trial cannot be described as "full, free, and frank discussion in public."

I think a discussion in public is entirely appropriate in an uncontested case, but I think that a trial of an uncontested case, with no disputed issues, with no opposing parties, and with a trial examiner who is forbidden to consult the technical staff about technical questions, is perfectly preposterous. The language I am using is strong language, but I am convinced, after careful study, that it is not too strong. I repeat: I think a trial of an uncontested case is perfectly preposterous.

Just where the misunderstanding has developed that has brought about trial procedure in uncontested cases is not entirely clear. But I think it is probably in the failure to comprehend that a "hearing" can be appropriate and useful even if the hearing is not a trial. Let me spell this out in rather elementary terms:

A hearing is any oral proceeding before any authority. Hearing are of two principal kinds—trials and arguments. A trial is a process by which parties present evidence, subject to cross-examination and rebuttal, and the tribunal makes a determination on the record. The key to a trial is opportunity of each party to know and to meet the evidence and the argument on the other side; this is what is meant by the determination "on the record." The term "hearing" is often used by legislatures, courts, and agencies to designate what might more precisely be called argument. A typical hearing before an appellate court is an argument, not a trial. A hearing before an administrative agency may be either a trial or an argument. Or a hearing may be a mixture of trial and argument. The method of trial is designed for resolving issues of fact; the method of argument is designed for resolving issues of law and policy and discretion. It is because appellate courts are typically concerned with issues of law and policy, not with issues of fact, that the typical procedure before appellate courts is that of argument, not that of trial. Even a trial court, which is especially equipped to hold a trial, does not use the method of trial except when parties oppose each other on disputed issues of fact. In absence of disputes of fact, trial courts allow opposing parties to present argument, but they do not take testimony of witnesses. Even a trial court would never use the method of trial in an uncontested case. This is why I use such strong language in saying that the Atomic Energy Commission's use of trial procedure in an uncontested case, without issues of fact, without opposing parties, and with a trial examiner forbidden to consult technical staff on technical questions, seems to me perfectly preposterous.

Sincerely yours,

KENNETH CULP DAVIS.

APPENDIX 6

DUEPROCESSITIS IN THE ATOMIC ENERGY COMMISSION

[From August 1961 American Bar Association Journal]

(By Kenneth Culp Davis, professor of law at the University of Chicago)

Administrative agencies, like men, are sometimes afflicted with disease. More than a decade ago I suggested that "administrative arteriosclerosis is a common disease among the older agencies." [1]

Now a young agency, the Atomic Energy Commission, has come down with a bad case of dueprocessitis.

The symptoms of dueprocessitis are easy to recognize, and both the cause and the cure are well known. The first symptom to appear is a slight paralysis, which gradually grows into a more general paralysis if the disease is not checked. The cause of dueprocessitis is legal advice which exaggerates the requirements of due process and gives inadequate weight to considerations of commonsense that are plain to anyone who is not afflicted with dueprocessitis. The disease is a contagious one, although some agencies so far have seemed immune.

The cure for dueprocessitis is simple surgery to remove the harmful procedure, so that a commonsense balance will be restored.

Diagnosticians of government ills have much to learn by studying carefully the current case of dueprocessitis in the Atomic Energy Commission. The reason for this article is not merely to recommend a cure in the one agency; the reason is that the case is especially instructive for all who are concerned with the administrative process.

THE REGULATORY FUNCTIONS OF THE AEC

The Atomic Energy Commission is primarily engaged in operation and promotion, not in regulation, and so far as I know the disease of dueprocessitis affects only the regulatory function. Commissioners spend from one-sixth to one-third of their time on regulatory matters.[2] Government expenditures on AEC regulation are more than half such expenditures for regulation by either the Federal Trade Commission or the Civil Aeronautics Board. The AEC is already one of our important independent regulatory agencies, and its regulatory functions are growing fast.

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[1] Davis, Administrative Law 183 (1951). See also 1 Administrative Law Treatise 284 (1958).

[2] Joint Committee on Atomic Energy, Improving the AEC Regulatory Process, 87th Cong., 1st Sess. (1961), Volume 1, page 15. (This document is a study by the Joint Committee's staff.)

The heart of AEC regulation is licensing of reactors and other facilities and licensing of nuclear materials. Our discussion of procedure will focus upon the example of applications for reactor construction permits. At the present stage of development the sole regulatory purpose in requiring such permits is protection of public safety.[3]

THE PROCEDURE PATTERN

An applicant for a construction permit is encouraged to discuss his application informally with the technical staff of the AEC before making a formal application. Upon receipt of the application, the AEC's Division of Licensing and Regulation evaluates safety, postulates a "maximum credible accident," and prepares a "hazards analysis" memorandum.

Simultaneous with the AEC staff review is an independent review by the Advisory Committee on Reactor Safeguards (ACRS), which consists of a maximum of fifteen part-time members, recognized authorities on reactor safety. A subcommittee of the ACRS may meet informally several times with the applicant and the AEC staff to discuss hazards questions, and after getting the report of its subcommittee the full ACRS meets first with the AEC staff and then with the applicant.

So far the procedure seems entirely sound and healthy. And it is quite successful as well, for, in every case but one, the applicant, the AEC staff and the ACRS have worked out an agreement. "There has been only one instance * * * in which there has been an intervention and an active contest of the staff's decision in a reactor licensing case [and] except on procedural issues, the applicants have not attempted to contest an adverse position taken by the staff."[4]

One would suppose that as soon as the applicant, the AEC staff and the ACRS reach complete agreement, the agreed position would be publicized and that in the absence of objection from anyone the only remaining step would be for the Commission itself, that is, the five Commissioners, to assure themselves that the agreed position should be approved. Since the Commissioners are not necessarily trained on problems of reactor safety, one would expect them freely to consult the technical staff in order to make up their minds. Careful Commissioners, despite the complete agreement, would probably ask questions and think independently, especially since risks to the public safety may be considerable.

But that is what would happen in an agency unafflicted with dueprocessitis. Here are the steps now taken:

1. A trial-type hearing is held whether or not there are any issues, whether or not any intervener comes in, whether or not anyone is in disagreement with anyone else. "The hearing examiners have required extensive oral testimony, despite the fact that the cases are not contested."[5]
2. Even though the examiner at this trial has no technical training on problems of reactor safety, he is forbidden to consult the technical staff when he is preparing his report.
3. The five Commissioners who have the responsibility for the final decision are not necessarily technically trained on problems of reactor safety, but they are forbidden to consult the technical staff in making their decision.

DIAGNOSIS

My opinion is that each of the three procedural facts just stated is a symptom of the administrative disease of dueprocessitis. I shall state my reasons:

1. The purpose of trial procedure, as all lawyers should know, is to resolve issues of fact between parties who oppose each other. The Commission is using trial procedure even in the absence of issues and even in the absence of opponents. Adversary procedure is followed in the absence of adversaries. The proponents have to prove, over the nonexistent opposition of the nonexistent opponents, that the license should be granted.

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[3] *Id.* at pages 1–2: "The Commission, in the typical case involving the licensing of a power or test reactor, is not called upon to adjudicate between competing interests, public or private, but rather to reach a judgment as to the safety of a proposed activity."
[4] Id. at page 22.
[5] *Ibid.*

COMMISSION'S RULES OF PROCEDURE NOT FOLLOWED

The Commission purports to follow its rules for "formal hearings", but it is unable to follow them because the rules are designed, as they should be, for cases in which parties are opposing each other. For instance, one rule provides for default for failure to file an answer.[6] The rule does not say whether a nonexistent opponent may default. Presumably nonexistent opponents fail to file answers. Another rule provides for a prehearing conference "for the settlement * * * of the issues" and provides for "a written stipulation * * * reciting the matters upon which there has been agreement."[7] The Commission conducts its trials in uncontested cases without following its prehearing rule, for I assume that no one has discovered a way to settle nonexistent issues or to negotiate a settlement with nonexistent opponents.

Another rule is even more intriguing: "The parties shall be encouraged to present evidence in written form."[8] The best portions of a case for written presentation are those portions on which the parties are agreed. But if the parties are agreed on everything, why not present everything in writing? The answer must be that that would mean no trial and the Commission wants a trial. Then may the long technical reports be submitted in writing, or do they have to be read orally? May a busy member of the technical staff have his secretary do the oral reading for him? If so, if nobody is listening, may six secretaries read six documents simultaneously to speed up the proceeding, after the manner of six Buddhist priests sitting together and simultaneously reading aloud six separate prayers?

Because trial procedure seems so obviously unsuitable for uncontested cases, the reasons impelling the Commission to use trial procedure in the absence of issues and in the absence of opponents are hard to understand. In discussing "excessive formality in reactor licensing proceedings," the Commission says that "the conduct of proceedings through oral testimony is an affirmative contribution to due process, as well as to greater public confidence."[9] Apparently the requirement of trial procedure goes back to a 1956 University of Michigan Law School Summer Institute on Legal Problems of Atomic Energy, which recommended "formal hearings * * * on all applications for the licensing of facilities."

Under the Commission's rules of practice, "formal hearings" mean trial procedure. The Michigan Workshop stated two reasons in support of its recommendation of "formal hearings": "First, that in view of the various interests that could be affected, a formal hearing would make available a procedure appropriate to the protection, at the earliest possible stage, of all affected legal interests; and second, that the public information provided by such a hearing would serve to foster and maintain the confidence of the general public and state and local authorities in the proposed project."[10] This statement seems all right for a case in which facts are in dispute. But the Workshop added: "In the event that the application is not opposed, the hearing could be conducted expeditiously along the lines of similar proceedings before other federal regulatory agencies." The Workshop did not say what other agencies hold "formal hearings" on nonexistent issues between proponents and nonexistent opponents, and I know of none.[11] Nor did it explain how such "formal hearings" on nonexistent issues can be "conducted expeditiously." I wish it had explained this, for I know of no other authority on the subject of trials without issues, and I don't see how a trial without issues can be "conducted expeditiously." The first step I would take to make such a trial expeditious would be to do it all in writing. The second step would be not to do it at all. Would it be expeditious to give nonexistent opponents the same procedural rights as ordinary parties? Or would it be both expeditious and poetic justice for nonexistent opponents to have nonexistent rights?

I readily agree with the Workshop that procedure should protect "all affected legal interests" and that "public information" will "foster and maintain the

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[6] 10 CFR § 2.738.
[7] 10 CFR § 2.740.
[8] 10 CFR § 2.747(a).
[9] Joint Committee on Atomic Energy. Improving the AEC Regulatory Process, 87th Cong., 1st Sess. (1961), Volume 2, page 410.
[10] University of Michigan Workshops on Legal Problems of Atomic Energy (1956) page 59.
[11] Two statutes requiring hearings in uncontested cases are the Natural Gas Act, 52 Stat. 825 (1938), 15 U.S.C. § 717f(c), and the Federal Aviation Act, 72 Stat. 754 (1958), 49 U.S.C. § 1371(c). But in neither instance are "formal hearings" held that involve oral testimony subjected to cross-examination, in the absence of a contest.

confidence of the general public." But I most emphatically disagree with the Workshop that trial procedure is a good way to provide "public information."

The way to inform the public, in my opinion, is by four kinds of releases: (1) The report of the ACRS should be published, as now. (2) The report of the AEC staff should be full and detailed, giving a full statement of pros and cons with respect to each facet of safety, and the report should be published in full, in whatever technical language the AEC staff chooses to use. (3) A translation should be prepared by the AEC staff in layman's language, going as far into technical questions as is feasible in such language, but presenting fully to the final practical judgment on the question of how much risk is too much in the circumstances of the particular case. (4) As a part of the notice to the public, a conference somewhat in the nature of a press conference should be held, where reporters and anyone else having a legitimate interest should have an opportunity to question the technical people.[12]

After these four methods are used to inform the public, if no one opposes the application I can see no purpose in any further oral process.[13] Of course, I would grant hearings to people who want to be heard. On issues of fact, I would use trial procedure, and on non-factual issues of policy or discretion I would use argument procedure like that before an appellate court.

The harm done by using the forms of adjudication to resolve nonexistent issues goes well beyond waste of time and money—both that of the government and that of the applicant. The greatest affirmative harm lies in forcing officers without technical training to make decisions without the assistance of technical staffs, as we shall now see.

2. Uncontested cases are tried before a hearing examiner. I see no reason to have any examiner at all in an uncontested case; I would dispense with the examiner and send an uncontested case directly from the AEC's Division of Licensing and Regulation to the five Commissioners. The examiner now used has no technical training. Not only that, but he is forbidden to consult the technical staff when he has difficulties in the preparation of his initial decision. This system seems to me to reveal one of the most spectacular symptoms of dueprocessitis. I think that not even an initial decision on technical questions so importantly affecting the public safety should be made by an officer who is both without technical training and without technical assistance. Neither due process nor any other law requires any such result. True, the Administrative Procedure Act forbids a presiding officer to "consult any person or party on any fact in issue unless upon notice and opportunity for all parties to participate."[14] But that provision has no application to an uncontested case for many reasons, three conclusive ones being: (1) The provision is by its terms limited to adjudication, and a case without issues and without opponents is not an adjudication. (2) The provision is limited to "adjudication required by statute to be determined on the records"[15] and no statute concerning the licensing of reactors requires a hearing on the record. (3) A presiding officer can hardly consult "on any fact in issue" when no fact is in issue.

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[12] In response to an invitation from the Joint Committee on Atomic Energy to criticize existing and proposed organization and procedure of the AEC in licensing cases, I suggested by letter last April that the Commission use a press conference type of hearing. Before the Joint Committee in June, Commissioner L. K. Olson announced that the Commission had adopted this idea and would shortly hold a hearing in the nature of a press conference in California. But he added that "of course" the press conference hearing would not take the place of a trial-type hearing. I think it should in absence of contest.

[13] The statute as amended in 1957 requires a hearing even in an uncontested case, but the committee explained that what was intended was "discussion in public." Neither the statute nor the history indicates a trial. The conference I recommend should satisfy the requirement of "discussion in public" for uncontested cases. My view is apparently opposed to that of the staff of the Joint Committee on Atomic Energy, which says in its 1961 study: "A hearing * * * should be mandatory in all major facility licensing cases. * * * The hearing should be held in public and oral testimony taken, although in uncontested cases not to the extent evident in present practice." The staff says it is "important to provide an opportunity for interested members of the public to attend" and that "in doing 'the homework' for such a hearing, the applicant or the staff may view the problems they have been considering in a new perspective and may become aware of the need to rethink or reexamine some facet of a problem." Joint Committee on Atomic Energy, Improving the AEC Regulatory Process, 87th Cong., 1st Sess. (1961), Volume 1, pages 49, 72. I agree that members of the public should be given opportunity for hearing, and that the staff should do the homework. The translation to layman's language and the conference in the nature of a press conference will serve these ends, without trial procedure in absence of contest.

[14] APA § 5(c).

[15] APA § 5, introductory clause.

3. The five Commissioners who make the final decision are forbidden to consult their technical.[16] This is even worse than forbidding the examiner to consult, for the Commissioners have the basic responsibility for protecting the public safety, and officers who have such an important responsibility should not be required to act without full understanding of what they are doing.

Compelling a Commissioner to decide an uncontested case concerning public safety without consulting the technical staff on technical questions even if the Commissioner is sure he needs technical assistance seems to me contrary to common sense. Neither due process nor any other law requires it.[17]

What an outrageous predicament for a conscientious Commissioner who happens to be without technical training on problems of reactor safety: he feels strongly his responsibility for public safety, he is convinced that he needs help from his technical staff, and yet his lawyers insist he must decide without consulting the technical staff!

Lawyers who give such advice are allowing their misunderstanding of due process to override their common sense. They and the agency which acts on their advice are afflicted with the disease of dueprocessitis.

I hope that other agencies will be alert to the symptoms of dueprocessitis and take precautions against this debilitating disease.

U.S. ATOMIC ENERGY COMMISSION,
Washington, D.C., September 6, 1961.

MR. JAMES T. RAMEY,
Executive Director,
Joint Committee on Atomic Energy, Congress of the United States.

DEAR MR. RAMEY: Reference is made to your letter dated August 24, 1961, in which you request Commission comments concerning an article by Prof. Kenneth Culp Davis, entitled "Dueprocessitis in the Atomic Energy Commission," appearing in the August issue of the American Bar Association Journal.

Professor Davis states, in his discussion of the role of hearing examiners, that "no statute concerning the licensing of reactors requires a hearing on the record." He implies that the Atomic Energy Act, as amended in 1957 by the addition of the mandatory hearing requirement of section 189(a), requires only discussion in public. See footnote 13, page 784, of the ABA Journal containing his article. His argument seems to be that (1) a formal hearing is really just an adjudication; (2) an adjudication is only required when there is an issue to adjudicate; (3) in the absence of intervenors, or contested issues, there is nothing to adjudicate in reactor cases; (4) thus reactor cases are not adjudications; and (5) consequently the law does not require a hearing. The Commission does not agree with him if that is his view. Section 189(a) of the Atomic Energy Act explicitly requires a hearing on the record conducted in accordance with the APA. For the Commission to have made any other interpretation would have been inconsistent with what we believe to have been the intent of Congress in adopting the mandatory hearing requirement.

Professor Davis makes too much of his conclusion that reactor cases are "noncontested." Professor Davis' conclusion is, at best, correct only to the extent the meaning of the word "contest" is considered in its narrowest adversary sense. Certainly, within the usual meaning of the word, there is a contest of competing interests in a reactor licensing case. The contest is between the motivation of builders to reduce cost and the need of the public that the reactors be safe. Safety, as Commissioner Olson has pointed out, is expensive.

I enclose a copy of a letter from Commissioner Olson, dated September 1, 1961, to the editor of the American Bar Association Journal.

Sincerely yours,

NEIL D. NAIDEN, *General Counsel.*

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[16] When the Commission reviews a licensing case, "none of the available staff assistants have had training or experience in reactor safety matters * * * [T]he Commission is precluded from consulting its experts on reactor safety in the Division of Licensing and Regulation * * *" Joint Committee on Atomic Energy. Improving the AEC Regulatory Process, 87th Cong., 1st Sess. (1961), Volume 1, page 22. "The Commissioners in carrying out their adjudicatory functions are presently assisted only by legal counsel and personal office assistants, none of whom are technically qualified on matters of reactor safety. As a result, the Commissioners are isolated from agency expertise * * *" Id. at 51.

[17] For a comprehensive discussion of the law of separation of functions, see 2 Davis, Administrative Law Treatise 171–240 (1958).

U.S. ATOMIC ENERGY COMMISSION,
Washington, D.C., September 1, 1961.

EDITOR,
American Bar Association Journal,
Chicago, Ill.

DEAR SIR: The article by Prof. Kenneth Culp Davis in the August 1961 issue of the Journal, entitled "Due Processitis in the Atomic Energy Commission" (47 A.B.A.J. 783) has just come to my attention. Professor Davis demonstrates in this article the same lack of objectivity which has previously drawn the attention of a number of legal scholars. (See, e.g., Jaffe, book review, 73 Harv. L. Rev. 1638 (1960); Newman, book review, 43 Minn. L. Rev. 637 (1959); Brett, book review, 38 Texas L. Rev. 349 (1960); Westwood, book review, 43 Minn. L. Rev. 607 (1959).)

On June 15, 1961, Professor Davis, when he made a similar statement at a hearing before the Joint Committee on Atomic Energy, frankly stated, "I am not competent in the area of atomic energy except to the extent that the problems involve administrative law."

Professor Davis is admittedly and obviously unfamiliar with the Commission's regulatory processes and methods, with the provisions and legislative history of the Atomic Energy Act, and with the principal issues of policy which have over a period of years influenced the development of statutory and administrative policy concerning atomic energy. He apparently is unfamiliar, for example, with the legislative history of the 1957 amendment of the act which imposed on the Commission the requirement of at least two successive mandatory hearings in the licensing of each power or test reactor.

Professor Davis criticizes the Commission's concern with the hearing process. Those who have been entrusted with the responsibility of protecting the health and safety of the public are more conscious than is Professor Davis of the importance of what the Supreme Court properly described as the "full public hearing at each step," on which the Court relied heavily in its recent decision sustaining the lawfulness of the Commission's procedures (*Power Reactor Development Co. v. International Union*, 367 U.S. 396 (1961)).

Professor Davis' position is that a reactor licensing case in which there is no intervention by a member of the public, but in which the Commission's regulatory staff which has evaluated the application appears before the hearing examiner and testifies as to its expert opinion, is one without "issues" or "parties." The regulatory staff does in fact appear before the hearing examiner as a party, as does the applicant for a construction permit or operating license. The mission of the regulatory staff is to protect the public health and safety and other public interests whether or not there are any intervenors, and to assert those interests against the interest of the applicant in economical construction and operation. The safety of reactors is expensive.

Our experience has shown that the applicant and the staff are by no means always in agreement about what ought to be permitted, even in what Professor Davis would call an "uncontested case." These differences must be and are resolved by the hearing examiner in the light of the applicable statutes and regulations. They are "issues."

Professor Davis mentions in a footnote section 189 a. of the Atomic Energy Act, which in 1957 imposed on the Commission the requirement that it hold public hearings before the issuance of a construction permit and an operating license for power and test reactors. Notwithstanding this, he proceeds to assert that "no statute concerning the licensing of reactors requires a hearing on the record." This is a basic error of law which vitiates the basic premise of Davis' article.

Section 181 of the Atomic Energy Act applies the provisions of the Administrative Procedure Act to all "agency action" as defined in the Administrative Procedure Act. Sections 2 (d), (e) and (f) of the A.P.A. define "adjudication" as including licensing. Section 5 of the A.P.A. imposes the requirement of formal adjudication, including the opportunity for a hearing, in every case of adjudication required by statute to be determined on the record after opportunity for a hearing. Section 189 a. of the Atomic Energy Act undoubtedly has that purpose and effect. Licensing is formal adjudication within the A.P.A. whether or not a contest is involved, so long as the requirement of an opportunity for a hearing exists under a liberal interpretation of the statute. Cf. *Wong Yong Sung* v. *McGrath* (339 U.S. 33, 41, 45, 50 (1950)). The legislative history of the Atomic Energy Act clearly establishes that the mandatory hearing provision of section 189 a. requires a formal hearing on the record. 2 Legis. Hist. of Atomic Energy Act, 2427–2428; "A Study of Atomic Energy Commission Procedures and Organization in the Licensing of Reactor Facilities," 85th Cong., 1st Sess., 71–74 (Joint Committee on Atomic Energy Print 1957). If there were any possible doubt on that score, it would be removed by the observations of Senator Anderson as sponsor of the bill which embodied the 1957 amendment of section 189 a., 103 Congressional Record 4094 (March 21, 1957).

"When the Atomic Energy Act was amended 3 years ago, I made the following statement on the floor of the Senate on July 14, 1954, expressing my opinion as to the advisability of public hearings on reactor license applications:

" 'But because I feel so strongly that nuclear energy is probably the most important thing we are dealing with in our industrial life today, I wish to be sure that the Commission has to do its business out of doors, so to speak, where everyone can see it.

" 'Although I have no doubt about the ability or integrity of the members of the Commission. I simply wish to be sure they have to move where everyone can see every step they take; and if they are to grant a license in this very important field, where monopoly could so easily be possible, I think a hearing should be required and a formal record should be made regarding all aspects, including the public aspects.'

"Almost 3 years have now passed and I believe my words of 1954 are still applicable. * * *"

Professor Davis criticizes what he describes as the isolation of the Commissioners from expert assistance. He fails to understand that the Commission does obtain that expert assistance, and does so on the record, openly. If the Commission wants more information, it can obtain that information on the record, as it did in the *Westinghouse Test Reactor* case. As Professor Davis testified in 1959 before the Special Committee on Legislative Oversight of the House Committee on Interstate and Foreign Commerce (H. Rept. No. 2711, 85th Cong., 2d Sess., 79 (1959)):

"There is danger in consultation by the agency head with the staff specialists behind the scenes, when ideas or information are brought into a case without giving representatives of the parties sufficient opportunity to know what it is and opportunity to meet it."

A final observation: One would hardly think that, in deploring the isolation of the Commissioners and their lack of expert assistance in evaluating technical evidence of record, Professor Davis is speaking of a five-man Commission which includes the Nobel prize winner who discovered plutonium 239 and other new elements (Dr. Seaborg), the former director of the Brookhaven Laboratory (Dr. Haworth), and one of the country's most distinguished chemical engineers (Dr. Wilson). Further, several of the Commissioners have assistants in their own offices who are qualified technically or scientifically. In my own case, for example, one of my assistants is a physician, who, like the other assistants in the Commissioners' offices, is available to my colleagues.

Sincerely yours,

L. K. OLSON, *Commissioner.*

THE UNIVERSITY OF CHICAGO,
THE LAW SCHOOL,
Chicago, Ill., September 13, 1961.

Mr. JAMES T. RAMEY,
Joint Committee on Atomic Energy,
Congress of the United States,
Washington, D.C.

DEAR JIM: In his letter to the Joint Committee, dated September 6, 1961, Mr. Neil D. Naiden, General Counsel of the AEC, makes two glaring mistakes, both in blacks and whites, both involving misstatements of what words appear on the printed page.

After quoting me accurately that "no statute concerning the licensing of reactors requires a hearing on the record," he goes on to say that I have argued that "the law does not require a hearing." I have made no such argument. I would make no such argument, for section 189(a) plainly and on its face requires "a hearing."

Mr. Naiden then says: "Section 189(a) of the Atomic Energy Act explicitly requires a hearing on the record conducted in accordance with the APA." His word "explicitly" makes it possible to contradict his statement by merely looking at the words of section 189(a). That section does not explicitly require "a hearing on the record" and it does not explicitly mention the APA.

Perhaps Mr. Naiden's mistakes are extremely significant, for they may explain the basis for the Commission's continued insistence that the statute requires a trial procedure even in uncontested cases. Commissioner Olson argued before the committee that the statute required a trial; perhaps Commissioner Olson was making the same mistake which is now so clearly revealed in Mr. Naiden's letter.

Possibly it will be of some usefulness if I spell out why I think the distinction between "a hearing" and "a hearing on the record" is such an important one. The distinction has become a cardinal one in administrative law. The procedure a trial court uses on issues of fact is "a hearing on the record"; it involves the taking of evidence, subject to cross-examination, and a determination on the evidence presented, that is "on the record." The procedure is customarily called "trial procedure," but since adoption of the Administrative Procedure Act, it is often called a "hearing on the record." The procedure an appellate court uses on issues of law is not "a hearing on the record." It is not trial procedure. It does not involve the taking of evidence, it does not involve cross-examination, and it does not involve a determination "on the record." It is called argument procedure, or "oral argument" or simply "argument."

Trial procedure and argument procedure differ decidedly. To say the same thing in different terms: A "hearing on the record" and a hearing which is not on the record are altogether different. The two should not be confused.

The letter of Mr. Naiden shows that he confuses the two, and the argument made to the Joint Committee by Commissioner Olson shows the same thing.

In the legislative history of the 1957 amendment of section 189(a), I have found nothing at all to support the position that the Commission is required to use a trial procedure in uncontested cases, that is, nothing that the Commission is required to have a "hearing on the record" in such cases. On the contrary, the Joint Committee said explicitly that what was intended was a "discussion in public." The words "discussion in public" are the words of the Joint Committee.

A hearing in the nature of a "discussion in public" is not a trial procedure, and it is not a "hearing on the record."

The Commission has been using a trial procedure, that is, a "hearing on the record," in uncontested cases involving licensing of reactors. My view is that such trial procedure is inappropriate. The procedure that is appropriate, in my view, is what the Joint Committee called discussion in public.

Sincerely yours,

KENNETH CULP DAVIS.

APPENDIX 7

U.S. ATOMIC ENERGY COMMISSION,
July 24, 1961.

Hon. CHET HOLIFIELD,
Chairman, Joint Committee on Atomic Energy,
Congress of the United States.

DEAR MR. HOLIFIELD: At the recent hearings on the regulatory program of the Atomic Energy Commission there was substantial unanimity of opinion that the mandatory hearing requirement of the act, with respect to power and testing facilities, should be relaxed. As stated in the Commission's testimony such a relaxation would make it possible, without violating the spirit of the act, to reduce the number of hearings without prejudice to the public's right of access to full and timely information; and without prejudice to any interested party's right and opportunity to intervene.

Both the Joint Committee on Atomic Energy staff study and the Commission study recognized the desirability of holding at least one hearing on each power and testing reactor case at the initial construction permit stage when the question of the suitability of the site is being decided. Under such a plan the issuance of amendments to construction permits and the issuance of operating licenses and amendments to operating licenses would be made only after public notice and an offer of a hearing so that any party or interested intervenor could have a hearing at these later stages if he so desired. Of course, the Commission, on its own motion, could order a hearing at any stage.

This flexibility in the act could be achieved simply by replacing the word "license" in the two places where it appears in the last sentence of section 189

a. with the words "initial construction permit." The sentence as modified would then read as follows:

"The Commission shall hold a hearing after thirty days' notice and publication once in the Federal Register on each application under section 103 or 104b. for [a license] *an initial construction permit* for a facility, and on any application under section 104 c. [a license] *an initial construction permit* for a testing facility."

The first sentence of section 189 a. would remain and under it any party or intervenor could demand a hearing on any construction permit or licensing action.

At the regulatory hearings the view was also widely expressed that there should be some flexibility in the scope of the review required to be made by the Advisory Committee on Reactor Safeguards so that the committee will need to consider only safety questions of real significance. In his testimony Dr. Silverman said: "Frequent reviews of numerous amendments submitted by applicants, we believe, has added unnecessary work to the regulatory load, both for ACRS and the staff."

The present provisions of section 182 b. requiring the Advisory Committee on Reactor Safeguards to review each "application" for power and testing facilities have resulted in the requirement that they review and report on *all* amendments to applications, however minor. We believe that the Advisory Committee on Reactor Safeguards should review and report initially on all power and testing reactor projects. We also believe that all documents filed with the Commission by an applicant should be submitted to the Advisory Committee on Reactor Safeguards and this has been the long-standing practice. We further believe, however, that it should be unnecessary to burden the committee with reviews and reports on amendments which do not raise significant safety questions.

These objectives could be achieved by modifying section 182 b. to read as follows:

"b. The Advisory Committee on Reactor Safeguards shall review each application under section 103 or 104 b. for [a license] *an initial construction permit or an initial license* for a facility, any application under section 104 c. *for an initial construction permit or an initial license* for a testing facility, any application under section 104 a. or c. specifically referred to it by the Commission, *and any application for an amendment to a construction permit or license under section 103 or 104 a., b., or c. specifically referred to it by the Commission,* and shall submit a report thereon, which shall be made part of the record of the application and available to the public except to the extent that security classification prevents disclosure."

If an amendment along the lines described above were adopted, it would be the Commission's purpose to seek the advice of the Advisory Committee on Reactor Safeguards as to the areas in which they feel referral for review and report is not necessary.

Sincerely yours,

GLENN T. SEABORG, *Chairman.*

U.S. ATOMIC ENERGY COMMISSION,
July 27, 1961.

HON. CHET HOLIFIELD,
Chairman, Joint Committee on Atomic Energy.

DEAR MR. HOLIFIELD: At the recent Joint Committee hearings on the Commission's regulatory program, Dean Landis stated, and Commissioner Olson agreed, that there was merit in the suggestion of a three-man board to consist of a hearing examiner and one or more technical members to conduct hearings in reactor licensing cases. Both Dean Landis and Commissioner Olson expressed the view that, if such a board were established, it should be within the Commission and its decisions should be subject to review by the Commission.

In discussions between members of the Commission staff and of the Joint Committee staff of our letter of July 24 dealing with the mandatory hearing requirement of the statute and the provisions of the statute relating to the responsibilities of the ACRS, Mr. Ramey asked that we submit language which would authorize the Commission to implement the above suggestion.

We have drafted the following proposed subsection for section 189 of our act which we believe carries out this suggestion:

"In any proceeding under this Act on an application under section 103 or 104b. for a license for a facility or under section 104c. for a license for a testing facility, the Commission may, by regulation or order, designate two or more persons to serve with a duly appointed hearing examiner as a board to conduct hearings and render a decision in accordance with the Administrative Procedure Act (Public Law 404, Seventy-ninth Congress, approved June 11, 1946)."

The above language is designed to bring the proposed licensing board within the meaning of section 7(a) of the Administrative Procedure Act with respect to "the conduct of specified classes of proceedings in whole or in part by or before boards or other officers specially provided for or designated pursuant to statute."

The addition of such a provision to the statute would give the Commission flexibility to use a single hearing examiner or a three-man board. We would not expect that this would be a full-time board. On the contrary, it would be established on an ad hoc basis for individual cases.

The authority of the board would be commensurate with the present authority of a hearing examiner under the Atomic Energy Act and the Administrative Procedure Act.

Sincerely yours,

GLENN T. SEABORG, *Chairman.*

CONGRESS OF THE UNITED STATES,
JOINT COMMITTEE ON ATOMIC ENERGY,
Washington, D.C., August 7, 1961.

Dr. GLENN T. SEABORG,
Chairman, U.S. Atomic Energy Commission,
Washington, D.C.

DEAR DR. SEABORG: This is in response to your letter of July 27, 1961, concerning the conduct of hearings in the AEC regulatory program.

We appreciate the attempt of the Commission to go part way in the direction of the Joint Committee staff study which recommended the establishment of a permanent Licensing Board within AEC to hold hearings and decide cases on reactors and material licenses. Since the undersigned were responsible for the initiation of both the 1956–57 staff study and the recent study, we believe their conclusions and recommendations merit careful attention. We recognize that the Commission has also given serious study to the regulatory program.

The problem of the combination of developmental and adjudicatory functions in the Commission has been of concern since the events which initiated our 1956 staff study. It is very important, it seems to us, that the Commissioners themselves not be put in the position of deciding licensing cases in which AEC has a developmental interest. Under the present AEC system, it is difficult to determine where such decisions are made, although ostensibly they are made by the Director of Regulation or the hearing examiner, subject to Commission review.

We are inclined to agree with the Joint Committee staff study that instead of the initial decision being made by a nontechnically trained hearing examiner, a three-man Board should be established. It is agreeable with us to try it out on an ad hoc case-by-case basis. However, in view of the support given to the permanent Board idea by the Atomic Industrial Forum, the ACRS and most utility and industry witnesses, we believe the Commission should attempt to encourage the Board to evolve into a permanent institution.

There would be no objection to utilizing a hearing examiner on the Board, although we believe you also may wish to try outside people also. The technically qualified members of the Board should be persons of the caliber of the ACRS, such as Dr. Rogers McCullough.

In view of the above considerations, we have had the staff redraft the language submitted with your letter of July 27, as set forth below:

"(a) The Commission is authorized to establish an Atomic Safety and Licensing Board, composed of three members, two of whom shall be technically qualified, and one of whom shall be be qualified in the conduct of administrative proceedings, to conduct such hearings and make such determinations, as may be required for the issuance of any license or authorization under the provisions of this Act or any other provision of law, or any regulation of the Commission issued thereunder. The Commission may delegate to the Board such other functions as the Commission deems appropriate. The Commission may utilize the Board on an ad hoc or a permanent basis.

"(b) Members of the Board may be appointed by the Commission from private life, or designated from the staff of the Commission or other Federal agency. The members of the Board appointed from private life shall receive a per diem compensation for each day spent in meetings or conferences, and all members shall receive their necessary traveling or other expenses while engaged in the work of the Board. The members of the Board may serve as such without regard to the provision of sections 281, 283, or 284 of title 18 of the United States Code, except insofar as such sections may prohibit any such member from receiving compensation in respect of any particular matter which directly involves the Commission or in which the Commission is directly interested."

Although the language proposed in the Commission's letter satisfactorily provides for the conduct of hearings in those situations where a mandatory hearing requirement pertains, we believe that it is desirable for the Commission to have permissive authority to use the Board in connection with a broader range of functions.

You will note that under the terms of this language it will be possible for the Commission to utilize the Board in connection with "parallel procedures" cases, difficult materials licensing cases and in any other hearing situation where the Board could be useful. In addition, under the authority to delegate "such other functions as the Commission deems appropriate," it would be possible for the Commission to utilize the Board, where appropriate, to advise on rulemaking matters.

It is our hope that the statutory language we propose in this letter will receive the careful consideration of the Commission and its staff. It would be desirable to report the regulatory amendments at the same time as our omnibus bill.

Sincerely yours,

CHET HOLIFIELD, *Chairman.*
CLINTON P. ANDERSON.

[H.R. 8708 (S. 2419), 87th Cong., 1st sess.]

A BILL To amend the Atomic Energy Act of 1954, as amended, and for other purposes

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Atomic Energy Act of 1954, as amended, is amended by adding thereto the following new section:

"SEC. 191. ATOMIC SAFETY AND LICENSING BOARD.—

"a. Notwithstanding the provisions of sections 7(a) and 8 of the Administrative Procedure Act, the Commission is authorized to establish an Atomic Safety and Licensing Board composed of three members, two of whom shall be technically qualified and one of whom shall be qualified in the conduct of administrative proceedings, to conduct such hearings and make such intermediate or final decisions as may be required for the granting, suspending, revoking or amending of any license or authorization under the provisions of this Act, any other provision of law, or any regulation of the Commission issued thereunder. The Commission may delegate to the Board such other regulatory functions as the Commission deems appropriate. The Commission may utilize the Board on an ad hoc or permanent basis.

"b. Members of the Board may be appointed by the Commission from private life, or designated from the staff of the Commission or other Federal agency. The members of the Board appointed from private life shall receive a per diem compensation for each day spent in meetings or conferences, and all members shall receive their necessary traveling or other expenses while engaged in the work of the Board. The provisions of section 163 shall be applicable to the Board."

SEC. 2. The second sentence of subsection 189 a. of the Atomic Energy Act of 1954, as amended, is deleted and the following is inserted in lieu thereof: "The Commission shall hold a hearing after thirty days' notice and publication once in the Federal Register, on each application under section 103 or 104 b. for a construction permit for a facility, and on any application under section 104 c. for a construction permit for a testing facility. In cases where such a construction permit has been issued following the holding of such a hearing, the Commission may, in the absence of a request therefor by any person whose interest may be affected, issue an operating license or an amendment to a construction permit or an amendment to an operating license without a hearing, but upon thirty days' notice and publication once in the Federal Register of its intent to do so. The Commission may dispense with such thirty days' notice and publication with respect to any application for an amendment to a construction permit or an amendment to an operating license upon a determination by the Commission that the amendment involves no significant hazards consideration."

SEC. 3. Subsection 182 b. of the Atomic Energy Act of 1954, as amended, is amended to read as follows:

"b. The Advisory Committee on Reactor Safeguards shall review each application under section 103 or section 104 b. for a construction permit or an operating license for a facility, any application under section 104 c. for a construction permit or an operating license for a testing facility, any application under section 104 a. or c. specifically referred to it by the Commission, and any application for an amendment to a construction permit or an amendment to an operating license under section 103 or 104 a., b., or c. specifically referred to it by the Commission, and shall submit a report thereon which shall be made part of the record of the application and available to the public except to the extent that security classification prevents disclosure."

APPENDIX 8

COMBUSTION ENGINEERING, INC.,
NUCLEAR DIVISION,
Windsor, Conn., September 20, 1961.

Hon. CHET HOLIFIELD,
Chairman, Joint Committee on Atomic Energy,
The Capitol Building, Washington, D.C.

DEAR MR. HOLIFIELD: I enclose herewith a memorandum which has been written by Mr. W. B. Allred of our staff concerning the testimony on the SL–1 reactor accident which your committee received in June. Mr. Allred's comments refer mostly to the report by the AEC Investigation Board. Had we had an opportunity to see the report of the investigation board before the hearings, I am sure that the points raised by Mr. Allred's memorandum would have been raised by us at the hearings.

In the memorandum, no attempt has been made to comment on all parts of the AEC report and testimony to which we feel we could contribute in a constructive manner. Since the cause for the accident has not so far been discovered and since, as I indicated at the hearings, we do not find it credible that one of the operators should have accidentally jerked the rod from the reactor, we prefer to reserve our further comments in the hope that the present disassembly and examination of the reactor will reveal what actually happened.

I am taking the liberty of transmitting a copy of Mr. Allred's memorandum to Dr. Glenn T. Seaborg so that the AEC will be aware of the comments which are being sent to you.

Yours truly,

W. H. ZINN, *Vice President.*

COMBUSTION ENGINEERING, INC.,
September 8, 1961.

To: Dr. W. H. Zinn, vice president.
Subject: SL–1 reactor accident.
From: W. B. Allred, nuclear division.

The June hearings on "Radiation Safety and Regulation" have included extensive testimony on the SL–1 reactor accident. Combustion Engineering, Inc., was not asked to testify directly, but as the operating contractor for the reactor was asked by the Atomic Energy Commission to submit to the Joint Committee on Atomic Energy a statement on four specific points, and this was done in my testimony before the committee on June 13, 1961.

Now that we have heard the testimony by various AEC officials and have studied the report of the SL–1 board of investigation, we have prepared the present memoranddum in the hope that the comments therein will be helpful since we believe that in the material so far presented before the hearings certain facts are not given proper perspective. Further, we do not agree with the evaluation of the inferred connection of some of these facts or matters with the so far unknown cause of the accident, and therefore believe that these differing opinions should be recorded.

In the following, the pertinent report statement or testimony statement is quoted in connection with the point we wish to make and to which it is related. The Joint Committee print is used in identifying page and paragraph numbers.

1. Disassembly and assembly of control rod No. 9 drive mechanism on January 3, 1961

The Board, in its transmittal letter (p. vi), makes the statement that "it seems extremely improbable that the required motion of the central control rod (a distance greater than approximately 20 inches, and at rate close to the maximum humanly possible, under the circumstances) could have occurred accidently, unless the rod had been stuck in the shroud and became free while one or more operators were exerting a large upward force on it."

We wish to address ourselves to the part of this statement which implies that the rod may have been firmly stuck in the shroud. While no one knows what in fact took place, it appears to us that it also is extremely improbable that the rod at that time was stuck in the shroud. In making this judgment, these points are pertinent:

(*a*) On the morning of January 3, the operation of lifting rod No. 9 to disassemble the drive mechanism was performed with no difficulty. It was not stuck then, and in all of the experience of disassembling and assembling the drive mechanisms there is no case where merely lowering the rod 4 inches to its resting place caused the rod to bind in the shroud. It would appear almost certain that to get the rod stuck in the shroud by lowering it this short distance would require force to jam the rod into the shroud. No evidence exists for such force having been used by the crew which disassembled the rod in the morning of the same day; on the contrary, when asked, the operators stated that the work went normally and no force was used to push the rod to its resting place.

(*b*) During the day of January 3, no event occurred which can be connected with a subsequent seizure of control rod No. 9. If some event took place during the day which resulted in a firm binding of rod No. 9 when it was moved during reassembly, none of the people involved has been able to suggest what it could have been. It seems improbable, therefore, that binding of rod No. 9 which would require "a large upward force" to free it was brought about by operations during that day.

(*c*) There is no record or evidence to show that rod No. 9 had ever previously been jammed in the shroud. On an overall basis, rod No. 9 had performed better than any other of the rods, taking into account its drive mechanism and its action in the shroud. For instance, in the 6-month period prior to the last shutdown on December 23, rod No. 9 was scrammed successfully 109 times out of 110. The one instance where it failed to scram was a momentary hesitation at the beginning of a scram on November 27, 1960, before falling freely to its down position. (See attached fig. 1.) During this same period, rod No. 9 met the established drop test criterion 16 times out of 16 tests. The drop test is one in which the time of fall is measured and is considered successful if the time is less than 2 seconds for a drop of 20 inches. It is important to understand that the drop test is a measure of the overall friction in the system, both in the drive mechanism and of the rod in the shroud. It is an accepted fact that where friction plays a large part in the phenomenon observed, as it does in the drop test, reproducibility of performance within close limits cannot be expected. The SL–1 control rods, by the nature of their design, could slide into the core under their own weight but always in the presence of a considerable retarding frictional force. Because frictional forces did exist in both the drive and the motion of the rod in its shroud, it is not possible to distinguish by the drop test as to which place is causing the slowdown. It was assumed, and we believe correctly, that a repetition of the test in which the rod met the criterion would be an acceptable reason for assuming that the rod had not been binding in the shroud but rather that the friction forces in the drive had been reduced. For example, it may be noted that the sticking of rod No. 9 on November 27, 1960, which was mentioned above, was followed by 16 successful scrams. This included a scram on the last day of operation, December 23, 1960. It does not seem reasonable in the light of the above facts to indicate that there is evidence for the jamming of control rod No. 9 in its shroud.

2. Reactivity gain from loss of boron

The Board's letter of transmittal, page vii, states the following in paragraph (*a*): "As indicated above, a large increase in reactivity above delayed criticality, in a short time, would have been required to produce the indicated nuclear incident. If there had been a larger shutdown margin of reactivity (less mechanical loss of boron), the total distance through which the central control rod would have had to be moved would be correspondingly greater. It is conceivable that the actual rod displacement would have been inadequate in magnitude or rate to produce the excursion, under these conditions."

We take issue with the conclusion that a condition which had developed in the core, namely, the deterioration of certain boron-aluminum strips, was an important contributory cause of the accident by making it possible to withdraw the center control rod to a point where the accident was possible.

First, the reactivity shutdown margin at the time of the accident was not very different from what it was at the beginning of operation. Thus, in the beginning, withdrawing the center rod 19 inches would start the chain reaction and withdrawal up to 26 inches would lead to an accident similar to that of January 3, 1961. By comparison, on December 23, 1960, the last day the reactor was operated, withdrawal of the center rod 18 inches would start the chain reaction and withdrawal to 23 inches would produce the accident. Data taken routinely by the operating crew showed that there was no unaccounted-for change in control rod positions of any significance during the last 3 months of operation. It is reasonable to assume that no change occurred during the 10-day shutdown prior to the accident. The control rod positions noted on December 23 should then apply on January 3, 1961. The potential of withdrawing the center control rod sufficiently to trigger the accident was always present from the very beginning of operation. Although for a time during operation the reactivity shutdown margin decreased, it was substantially restored on November 15, 1960, when cadmium shims were added to the core. In summary, the difference in the position of the center control rod required for the accident between beginning of operation and the time of the accident is not sufficient to warrant the conclusion which was quoted.

Second, there is no evidence that the entire decrease in reactivity shutdown margin which was experienced from the initial operation of the reactor was brought about by the mechanical loss of boron-aluminum strips, as is implied in the above quotation from the Board's letter. It is further stated in the report proper, page 17, under "Reactivity Changes," "By 500 mwd. (i.e., by May 1960), it appeared that the core was gaining reactivity faster than predicted. In August 1960, routine inspection of selected fuel elements revealed the extensive loss of boron. The large rate of gain of reactivity was ascribed to this boron loss." The examination of representative fuel assemblies in August 1960, revealed that the mechanical loss was more extensive in regions of higher irradiation. Based upon analyses of a residual boron-aluminum strip removed from a center fuel element during the August 1960 core examination, we believe that the boron-aluminum strips which were mechanically lost had largely accomplished their intended purpose in the ractor, i.e., the boron isotope of high neutron cross section was substantially depleted.

Third, estimates of the amount of reactivity increase from the loss of boron-aluminum strips are based on the premise that the reactivity in the core increased at a rate which was greater than predicted by calculation. We should, therefore, reexamine this premise to ascertain the uncertainty of these estimates. The boron was installed in the core as a poison for the purpose that its nuclear burnup would compensate for the loss of reactivity by burnup of fuel and formation of fission product poisons. The Argonne National Laboratory had predicted that the boron would overcompensate to the extent of a reactivity increase of one-half of 1 percent reactivity, corresponding to an inward motion of the control rod bank of about 1 inch. On the other hand, we had predicted an increase of 1 percent reactivity, or an inward motion of the rods of 2 inches. The reactivity controlled by the boron as well as the rate at which it burns up is controlled by the neutron flux level in the boron. It is our contention that the uncertainties in computing these flux levels for the complex arrangement of boron-aluminum strips in the SL–1 core could account for most of the difference between the predicted and actual control rod positions, i.e., the nuclear depletion of the boron overcompensated to a greater degree than was predicted. We have estimated that an increase of neutron flux level in the boron by 10 percent—which is within the uncertainties of the analysis, considering the unusually complex array of boron in the reactor core—would have led to a prediction of the control rods being inserted an additional 1½ inches to 700 mwd. This corresponds to the time the core was examined and the loss of boron-aluminum strips noted. The difference then between the predicted and observed rod positions, which was the basis for estimating the reactivity presumably gained from the loss of boron-aluminum strips, would only be 1 inch instead of 2½ inches. Discrepancies between observed and theoretically predicted control rod positions during the depletion of the core are not unique to this reactor; it is reported in WAPD-MRP-89 (technical progress report—pressurized water reactor (PWR) project for the period October 24 to December 23, 1960) that about halfway through the expected operating life of seed 2 in the Shippingport Reactor, the observed position of control rod group II was 40 inches as compared with a prediction of 60 inches; this corresponds to a discrepancy of nearly 3 percent in reactivity.

Fourth, it is essential in a power reactor, especially in a prototype, to regularly monitor changes in reactivity no matter from what source they may arise; and this was done in the operation of the SL-1. Table 1 on page 19 of the report gives a partial listing of the rod positions taken from the physics data log which were used to monitor reactivity since rod position is the most sensitive and direct measure of core reactivity. Rod positions were also recorded by the SL-1 operating crew once an hour on the hourly log sheets and once a shift in the operating logbook, so that they were continually aware of the reactivity and shutdown margin of the reactor. We are submitting with this brief a plot of rod positions selected from the logbook, corresponding to reasonably steady operation and normalized to a common power level. (See attached fig. 2.) Both table 1 and the figure we are here submitting show, for example, the outward motion of the control rods of 1½ inches after cadmium shims were inserted November 15, 1960 (853 mwd.), to increase the reactivity shutdown margin.

In the report, page 19, following table 1, there is a parenthetical paragraph which reads: "(In the initial critical experiments, with no boron present in the 4 by 4 array of fuel elements and with the side rods fully inserted, criticality was achieved with the central rod 14 to 14.5 inches withdrawn * * *. These numbers serve to emphasize the uncertainty of the critical rod position in the absence of detailed knowledge of the composition of the core.)" Although these statements may, in general, be true, it is not apparent what their connection is with table 1. Certainly, no changes in number and arrangement of fuel elements of the type described in the paragraph took place in the course of reactor operation. It is commonly acknowledged that the reactivity in a power reactor is most directly monitored by the control rod positions and there is no evidence that any reasonably postulated changes in the core could seriously obscure any reactivity changes inferred from rod movement.

Fifth, the report on page 35 states that "additional factors can be considered at this time which involve the possibility that some changes occurred in the properties of the reactor between December 23, 1960, and January 3, 1961, changes which would minimize the capability of the control rod system to maintain the reactor shutdown. There is no direct evidence at present that any such changes took place. If loss of cadmium or loss of boron did occur during the shutdown period in question, the shutdown margin of reactivity would have been reduced. With a reduced shutdown margin of reactivity, substantially less withdrawal of the central control rod would have produced criticality."

We specifically direct our remarks to the statement: "If loss of cadmium or loss of boron did occur during the shutdown period in question, the shutdown margin of reactivity would have been reduced." From an analysis of the reactivity condition of the core on December 23, 1960, we estimate that at least the equivalent of 13 full length boron-aluminum strips must fall out or corrode from the core during the shutdown period to cause the complete loss of the estimated 2.9 percent shutdown margin. If no preferential loss from any one core area is assumed, we estimate that the equivalent of 23 full-length strips must fall out of the core or corrode away to cause the complete loss of the shutdown margin. Finally, the loss of all six cadmium shims which were inserted in the core on November 15, 1960, would have reduced the shutdown margin from 2.9 to 2.1 percent, and therefore could not, by themselves, have removed all or most of the shutdown margin.

Although we cannot discount completely the possibility of such substantial boron or cadmium losses during the shutdown period, we believe them to be very improbable.

3. Sticking of control rods was caused primarily by friction in the mechanism

The Board, on page vii, paragraph (*b*), of its transmittal letter, states: "The emphasis in the testimony of difficulty with rod sticking only because of seal difficulties would seem to argue that rod sticking was unrelated to the hypothesis under discussion. It is not unlikely, however, that if the rods were beginning to stick in the shrouds immediately before the shutdown on December 23, 1960, the fact that sticking because of seal difficulties was an old and familiar problem might have been responsible for failure to recognize this later development or to bring it to the attention of higher supervision."

We wish to reaffirm our testimony to the investigation board which is referred to in paragraph (*b*), page vii, that rod sticking resulted from seal difficulties (and difficulties with other components) of the drive mechanisms. We present the following as support for our conclusion:

(*a*) The drive mechanism contained several components which are known to have contributed to the recurring rod sticking problem, including the shaft seal assembly, the pinion bearings, the rack backup roller graphite bushing, and the magnetic clutch. One instance of sluggish motion of all the rods in February 1959 was resolved by increasing the clearance of the rack backup roller graphite bushings. Since no further difficulty was experienced from the bushings, we shall exclude them as a cause of the recurring sticking.

(*b*) It is well known from mechanical engineering practice that the SL–1 type of control rod drive shaft seal has a sizable inherent frictional resistance to shaft motion. It is also known from visual inspection that an accumulation of debris deposited out of sealing water and in the seal assemblies causes wearing of the shaft. Shaft wear would and did result in increased friction which retarded rotation of the drive shaft and erratic performance of the rod drive mechanisms. Our maintenance experience on SL–1 shaft seals in 23 instances, where the sluggish mechanism was removed and the seal disassembled and cleaned, showed that the reassembled control rod and mechanism passed the prescribed drop tests. In five other cases, the shaft surfaces under the seals were refinished by polishing and chrome plating to remove excessive wear marks. The mechanisms, including the seal assembly, were reassembled and returned to operation. Rod drop tests in these cases were also satisfactory. Our maintenance experience on replacement of 15 sets of bearings showed that the reassembled control rod and mechanism did pass the prescribed rod drop tests and did not show the signs of sticking when initially returned to operation.

(*c*) We believe that the rod sticking observed in the withdrawal direction was most likely caused by slippage in the magnetic clutch assemblies. If the clutch becomes worn or the slide plates do not match, the torque capacity of the clutch is reduced.

The condition was observed on SL–1 drives since several cases of an operator using his hand (or in one case a wrench) to assist in the rod withdrawal operation are recorded. Tests on typical SL–1 clutch assemblies indicated a loss in torque capacity to as little as 56 percent of design rating where the clutch had seen medium service. Other tests indicate that the torque applied in a hand assist by an operator matched the mechanical loss in torque. Had the clutch assemblies delivered the full design torque rating, we believe the sticking instances during rod withdrawal would not have occurred.

(*d*) On page vii, paragraph (*c*), the following statement is made: "It was well known that the boron strips bowed excessively between tack welds along the outside surfaces of the fuel elements. It was also well known that it was extremely difficult to remove, manually, the central fuel elements. It appears not unlikely that the bowing of the strips caused lateral pressure to be exerted on the fuel elements, and consequently especially where full and half strips were both present, there may have been lateral pressure on the shrouds, which decreased the clearance between the control rod and the inner walls of the shroud."

We wish to place in proper perspective the statement that, "* * * there may have been lateral pressure on the shrouds, which decreased the clearance between the control rod and the inner walls of the shroud."

In view of the known bowing of the aluminum-boron strips, we cannot disagree that the shroud width may have been decreased. We do state, however, that there is no evidence that the sticking rod problem was caused by inward distortion of the shrouds. If inward distortion of the shrouds were a prime cause for sticking, we would expect it to occur more frequently in the lower one-half of the core because only in this region are there boron strips on two sides of the centrally located fuel assemblies. In fact, the sticking occurred in the top one-half of the core with significantly greater frequency based upon statistical analysis.

We can also state that the central rod would have been affected more than any other rod, since it was completely surrounded by fuel elements containing two boron strips. However, the performance of the central rod was the best of all the rods. The center rod was successfully scrammed 109 times in the 6-month period prior to December 23, 1960, with only one instance on November 27, 1960, with hesitation momentarily at start of scram when frictional forces in the mechanism are maximum.

Finally, we believe that if the shroud width had decreased sufficiently to bind any of the control rods, the binding of a rod would have occurred in a repeat-
a [illegible] the rod would have been progres-

sively greater with time. In fact, the sticking pattern for all rods was erratic and unpredictable. Further, the sticking rod was freed by subsequent movement without exception.

4. Recurring safety and operational reviews were conducted

(*a*) On page 8 of its report, the Board states, "A complete technical review of the reactor and its proposed operation was made in February 1959, when Combustion Engineering, Inc., became the contractor, by a nuclear safety committee composed of personnel from the Connecticut offices of Combustion Engineering. It appears that no other such review or appraisal of the safety of the reactor operation has been made since that time by the Combustion Engineering, Inc."

The record shows the following list of safety reviews were made by the contractor's nuclear division safety committee and that conclusions of the committee's deliberations were recorded in memorandum form:

1. Nuclear Safety Review of SL–1 Facility, March 5 and 6, 1959.
2. Review of SL–1 Operating Manual, April 24, 1959.
3. Review of SL–1 Operations, August 19, 1959.
4. Review of SL–1 Malfunction Report No. 7 (Low Water Level), December 4, 1959.
5. Review of SL–1 Plant Expansion Hazards Evaluation Report No. IDO–19016, June 20, 1960.
6. Review of SL–1 Operations, Including the Loss of Boron-Aluminum Strips, November 17, 1960.

In addition to the six specific cases where the nuclear division's safety committee reviewed SL–1 operational problems, a special investigation in December 1960 at the instigation of the division director was made by Dr. J. R. Dietrich, vice president of General Nuclear Engineering Corp., and a former senior staff member on the Argonne National Laboratory borax project, of the stability of reactor operation at a power level of 4.7 megawatts (thermal).

(*b*) On page 8 of the report, the Board also states, "Reactor operating procedures, completely satisfactory to the AEC, have never been completed by Combustion Engineering, Inc., although they have been in the process of preparation and revision since mid-1959." The Board further makes the following statement on page 15 of its report: "The Army Reactors Branch at this time stated that the procedures and manuals turned over to CEI by ANL were not satisfactory for use by CEI. CEI was requested to prepare revised material. The material submitted by CEI was accepted as a basis for the start of reactor operations, but CEI was to further develop and modify the operating manuals and procedures after obtaining actual operating experience."

We direct our remarks to the statement that procedures completely satisfactory to the AEC were never completed by Combustion. Combustion, at the time it assumed operational responsibility for the SL–1, adopted the ANL operating procedure as an interim procedure for reactor operation and submitted the procedure to the Commission on February 25, 1959, for approval. It was this procedure that the Commission disapproved for interim operation in a letter dated March 6, 1959. The Commission on March 13, 1959, stated its requirement for a complete operating manual and proposed a manual format to be used as a guide in preparation of the manual. The contractor submitted an operating manual to the Commission on March 20, 1959, for approval. Following discussions with the Commission staff, supplement No. 1 was prepared by the contractor and submitted on March 27, 1959. Based upon the manual and supplement No. 1, the Commission gave approval in its letter of April 8, 1959, to the contractor to operate the SL–1 reactor. By letter of May 15, 1959, the Idaho Operations Office transmitted to the contractor formal comments from the Army Reactors Branch and requested that these comments be incorporated in the manual. Supplement No. 2 to the operating manual was subsequently prepared by the contractor and submitted to the Idaho Operations Office on May 28, 1959. This action was taken to fulfill the Commission's instructions to revise or update the manual from time to time. It was our understanding at this time that the manual was acceptable to the Idaho Operations Office.

In addition to the Idaho Operations Office review of the SL–1 Operating Manual submitted March 1959, the contractor's nuclear safety committee, following its technical review of the reactor facilities, procedures, and personnel qualifications, submitted a report which placed certain limitations upon operation of the reactor until several conditions were satisfied. The committee removed these restrictions following compliance with all committee requirements on August 25, 1959. The Idaho Operations Office was advised of this fact on September 2, 1959. We know of no re- [illegible] on of the reactor at this time by the Commission. In the fall of 1959, the contractor and Idaho Operations Office staff discussed modifying the format of the operating manual to facilitate training, to conform to Army technical requirements, and to make the manual a more readily usable document as well. At no time was a deficiency in content or coverage of the document indicated.

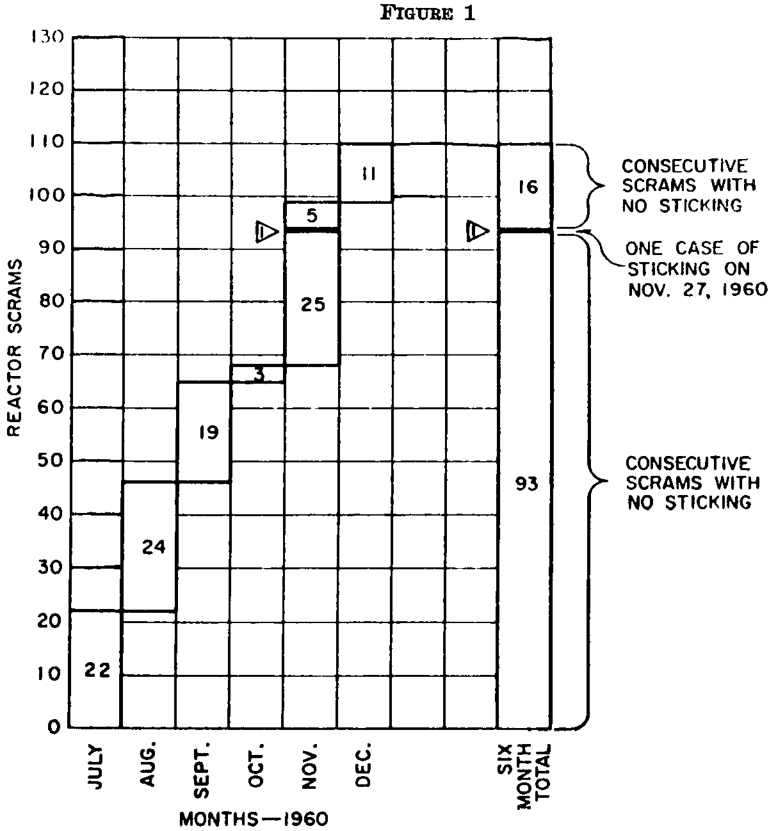
In its letter of October 26, 1959, the Idaho Operations Office forwarded to the contractor the Standard Army Regulations for technical manual format. The Commission also proposed in this letter that the SM–1 Operating Manual serve as a format guide. Further, the Idaho Operations Office stated that it would supply a copy of the SM–1 Manual. Such a manual was never received by the contractor.

A draft SL–1 Operating Manual, volume II, was submitted to the Commission for approval on September 16, 1960. Volume II contained all SL–1 operating procedures. Volume I which covered plant systems descriptions was to have been submitted in draft form in January 1961. The revised manual contained only minor changes in substance. It represented primarily a modification of format to improve its operational use and to satisfy Army training regulations. The procedural changes necessitated by the addition of the PL condenser expansion had been prepared in draft form.

Since the cause of the accident is so far undetermined and there is the possibility of further evidence being found in the disassembly of the reactor, we are limiting our comments at this time to the operational problems discussed above. We believe that there is no justification for the inference that the accident was caused by factors evident in the operating history of the reactor or that observed changes in the reactor indicated that it was unsafe for further operation.

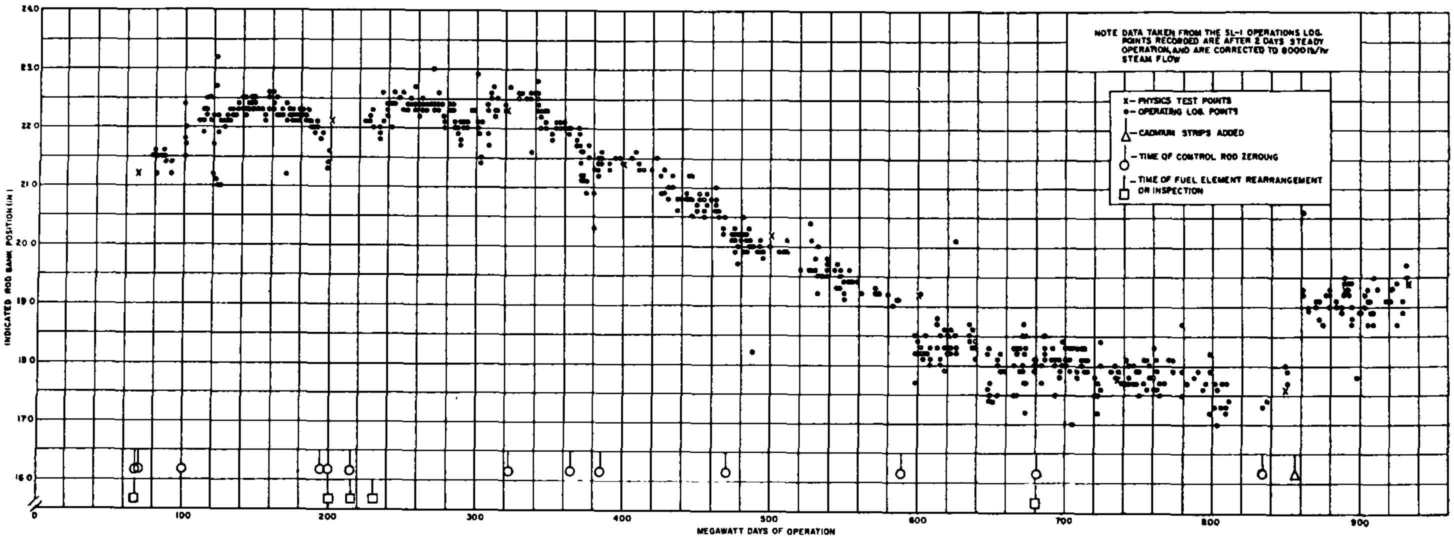
W. B. ALLRED.

FIGURE 1



SL-1 REACTOR CONTROL ROD NO. 9 PERFORMANCE DURING SCRAMS JULY 1, 1960 THROUGH DECEMBER 23, 1960

FIGURE 2



HOT OPERATING (8000 lbs/hr STEAM FLOW AND EQUILIBRIUM XENON) CRITICAL ROD BANK POSITIONS IN SL-1 VS MEGAWATT DAYS OF OPERATION

CONGRESS OF THE UNITED STATES,
JOINT COMMITTEE ON ATOMIC ENERGY,
Washington, D.C., September 21, 1961.

Gen. A. R. LUEDECKE,
General Manager,
U.S. Atomic Energy Commission,
Washington, D.C.

DEAR GENERAL LUEDECKE: On September 20, 1961, the Joint Committee received a letter from Mr. W. H. Zinn, vice president of Combustion Engineering, Inc., forwarding a copy of a memorandum prepared by Mr. W. B. Allred of the company's staff, concerning the SL-1 reactor accident. Mr. Zinn stated that a copy of Mr. Allred's memorandum had been furnished to Chairman Seaborg.

The committee plans to reproduce Mr. Allred's memorandum in an appendix to the hearings on "Radiation Safety and Regulation" which will be published shortly. We would appreciate receiving a copy of any comments that the Commission may wish to make on Mr. Allred's memorandum so that they might also be included in the published hearings.

It is expected that the hearings will be sent to the printer on October 13, and we would therefore appreciate receiving the Commission's comments before that date.

Your cooperation in this matter is appreciated.

Sincerely yours,

JAMES T. RAMEY,
Executive Director.

U.S. ATOMIC ENERGY COMMISSION,
Washington, D.C., October 12, 1961.

Mr. JAMES T. RAMEY,
Executive Director, Joint Committee on Atomic Energy, Congress of the United States.

DEAR MR. RAMEY: We have referred Mr. Allred's memorandum report to the board of investigation for consideration in developing its next report.

As you are aware, our contractor is working on disassembly of the reactor. We hope that this disassembly work will shed more light on the problem of what caused the accident. However, to date, the evidence is still far from being conclusive.

Since Mr. Allred's memorandum deals with various hypotheses as to the cause of the accident we do not consider that it is appropriate to comment on his memorandum at this time. Should the recovery work reveal evidence bearing on his hypotheses, we would plan to use such evidence as a basis for comment on his memorandum.

Sincerely yours,

A. R. LUEDECKE, *General Manager.*

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