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MINUTES

Thirty-seventh Meeting of the General Advisory Committee
to the U. S. Atomic Energy Commission

November 4, 5, and 6, 1953
Washington, D. C.

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FIRST SESSION
(November 4, 1953)

The meeting began in executive session at 10:00 a.m. All members, the Secretary, and Mr. Tomei were present.

The Chairman began by mentioning the full documentation which had been supplied for the meeting, and said that Dr. McDaniel had been very cooperative and helpful in his capacity as the Commission's GAC Liaison Officer. He next directed attention to the agenda for the meeting, particularly to a series of items (a to l) listed in the letter of October 28 from Mr. Strauss. There was preliminary discussion of some of these items.

New Chair-
man of
Reactor
Subcom-
mittee

Next, acceding to Mr. Murphree's earlier request, the Chairman relieved him of his duties as Chairman of the Subcommittee on Reactors, Materials and Production. Mr. Whitman was appointed to this post.

Agenda,
Next
Meeting

Referring to the agenda before the Committee, Dr. Libby said that the GAC should have a discussion of the industrial and medical uses of isotopes. It was suggested that the subject be discussed, within the GAC, at the next meeting.

Attribu-
tions of
State-
ments in
the
Minutes

The Minutes of the 36th Meeting were considered. Dr. Buckley raised a point of principle with respect to the practice of including near-quotations of persons other than GAC members, e.g. Commissioners, in the Minutes. He felt that this should be avoided, as a courtesy to those who were not in a position to check the text before the Minutes were adopted. The Committee discussed this question briefly. Dr. Rabi observed that if the Minutes had wide circulation he would share Dr. Buckley's point of view. However, since their circulation was stringently

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limited, since the Commissioners could call for corrections, and since the discussions could not be well understood without attribution of statements, Dr. Rabi felt that the present rather detailed and specific reporting should be continued, at least until it became apparent that it led to difficulties.

Minutes
Approval,
36th
Meeting

Two minor corrections were noted. Then, on Dr. Warner's motion and Dr. Buckley's second, the Minutes of the 36th Meeting were unanimously approved.

Dr. Rabi asked whether there were any statements from the Subcommittee on Weapons. Dr. von Neumann said there were none which called for present action. Commenting on the oscillations in plans for the Castle tests, he expressed the feeling that in general a greater consistency in Commission policy was to be desired.

Meeting
with the
Commis-
sioners
and
General
Manager

At 11:00 a.m. the Committee was joined by Mr. Strauss, Mr. Campbell, Mr. Murray, Dr. Smyth, Mr. K. D. Nichols, and Mr. Walter Williams.

Agenda,
This
Meeting

After introductions, Mr. Strauss commented on some of the agenda items. (1) An amendment to sections 5 and 10, and other relevant sections of the Act was in preparation. The General Counsel had not yet prepared the alterations for fusion as contrasted to fission. The GAC should think about what, if anything, could be done, especially on control of information. (2) The Commission would like the Committee to consider the size and type of the strong focussing accelerator proposed by Brookhaven National Laboratory, and to express its views on the proposal in the light of its earlier recommendations. (3) The Commission's patent proposals had not yet been discussed with all interested groups, and should be held, for the present in strictest confidence.

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Mr. Strauss then responded to questions on several of the other points in his pre-meeting letter.

On item e (possibilities of further fusion weapon development): Gen. Fields had suggested this item and might discuss it in a later session.

Information
Exchange



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However it is still less than the British want, because of the statutory restriction on exchanging information which could be extrapolated to weapon information. The British also desired cooperation on weapons effects. The Commission is considering a new section to Area 2 (Health and Safety) of the "Modus Vivendi", to provide exchanges on the effects of heat, blast, and radiation on human beings and their environment, excluding information bearing directly on weapons.

On item f (exchange of information with the Canadians): It was hoped that something might evolve from GAC discussions which would aid in easing future relations with the Canadians. Knowledge of how we have cooperated in the past would be helpful in dealing with the new top man (Bennett, replacing Mackenzie). The personal experiences of GAC members, in cooperating with the Canadians, would be appreciated.

FWR
Cost

Dr. Rabi next called on Dr. Wigner for comments on the AEC action of August 27 on the CVR. Dr. Wigner referred to the reappearance of the \$100 million figure as the ceiling cost of the PWR and to the previous assurances made to the GAC that the cost would not exceed \$50 million. If \$100 million were set as the ceiling it could be argued that the actual

cost would turn out to be \$100-150 million. Moreover there were grounds for apprehension that this project would consume all funds which might be available for building a power reactor, so that other developments would be stifled, even in the National Laboratories. There was discouragement and concern among the reactor groups of the country (Dr. Wigner emphasized this last point).

[At 11:40 a.m. Mr. Campbell left the meeting.]

These remarks led to considerable discussion. Mr. Strauss reviewed the historical background of the power reactor situation; and also assured the Committee that the AEC had no intention of spending the entire \$100 million. The cost would be well below this figure.

Dr. Rabi asked if any information was available on the recent British test shots. None was. The British had been very cooperative in letting the U. S. base small planes nearby and in giving their shot schedule.

Dr. Libby raised the question of what would happen to the CR&D chemical engineering target program at Livermore. There was disaffection in the group; he felt it should be held together. Mr. Strauss indicated that some of the talent was being absorbed by Whitney; others were not because their salaries were too high.

The visitors left at 11:55 a.m., and the meeting continued in executive session.

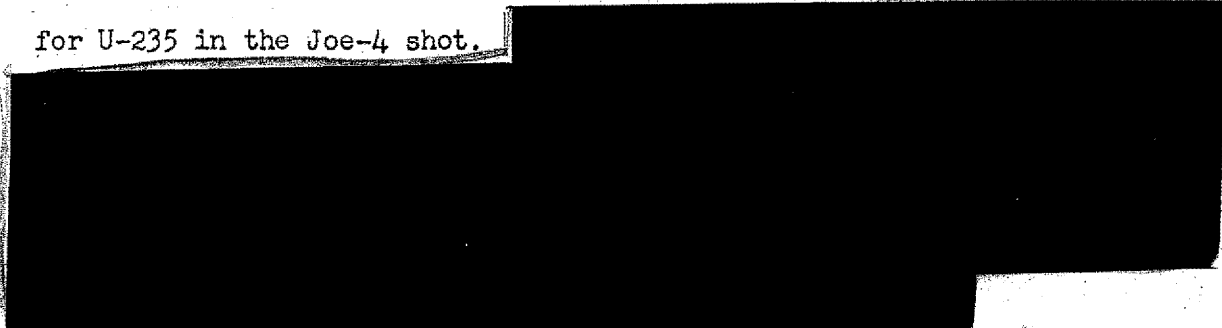
The subjects of information exchange and intelligence were discussed.

Information Exchange Mr. Whitman mentioned Gen. Eisenhower's favorable attitude (during SHAPE) to making weapon effects information available to foreign nationals in

NATO. Dr. Wigner felt the proposed extension of exchange with the British, in this field, would still lead to only a diluted cooperation, and asked about exchange of intelligence information on the Russian shots. It was pointed out that the intelligence teams have cooperated very closely.

Russian
U-235 ?

Dr. Libby returned to a point he had raised in previous meetings of the Committee, namely his grave doubt that the Russians have U-235 and production facilities for it (since their diffusion plant has not been seen). Dr. Fisk argued that information not available to the GAC gives evidence of a Russian diffusion plant; and Dr. Rabi reviewed the evidence for U-235 in the Joe-4 shot.



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At 12:30 p.m. this session was adjourned.

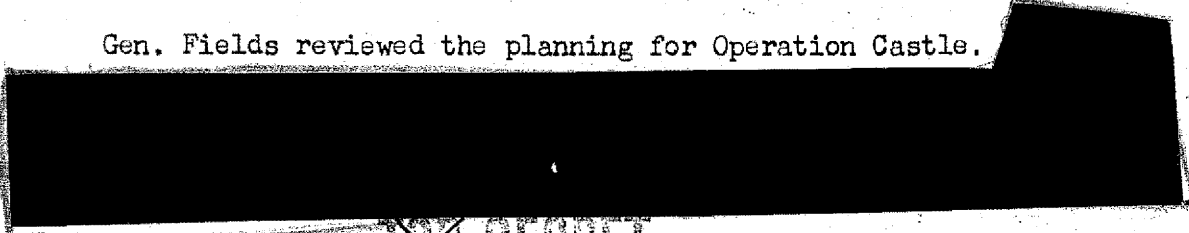
SECOND SESSION
(November 4, 1953)

Weapon
Matters

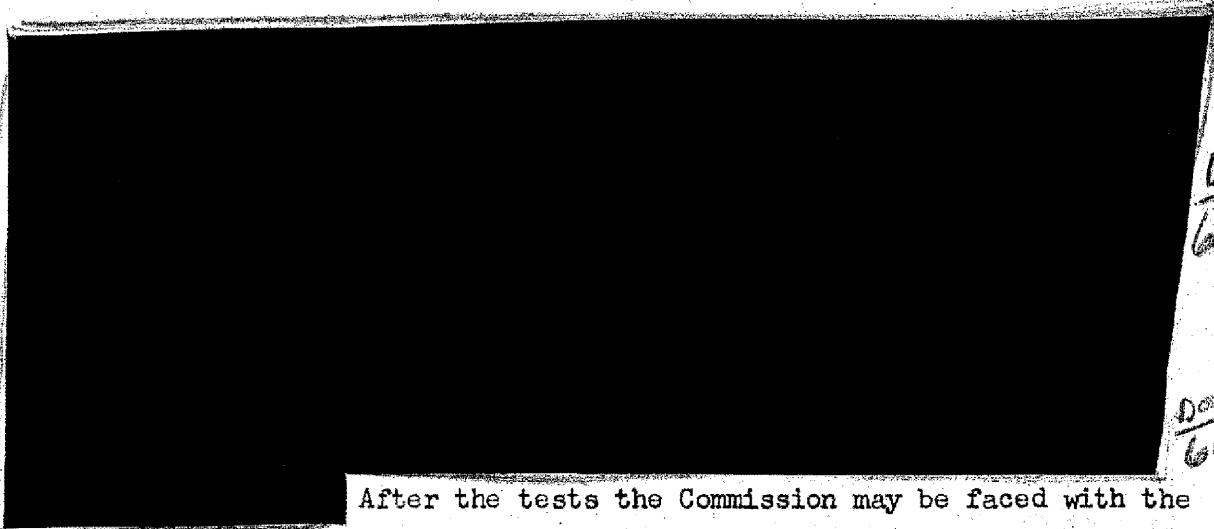
At 1:30 p.m. the Committee met with Gen. Fields, Col. V. G. Huston, Dr. N. E. Bradbury, Dr. H. F. York, and Dr. Smyth. Mr. Murray and Mr. Campbell entered a few minutes later. All members of the GAC were present. The Secretary and Mr. Tomei were also present.

Gen. Fields reviewed the planning for Operation Castle.

Castle
Plans



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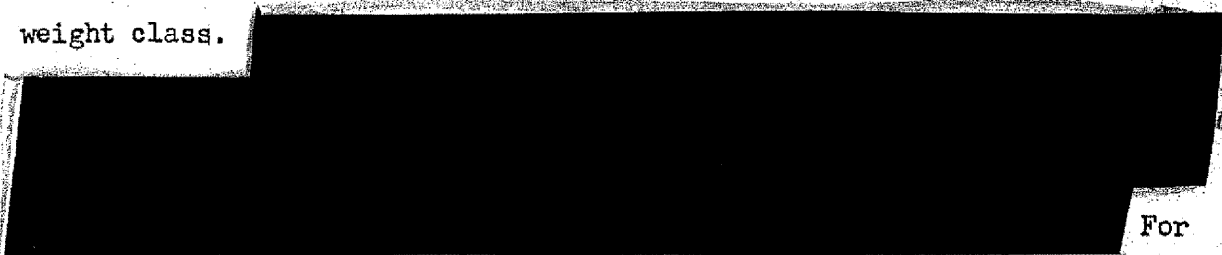


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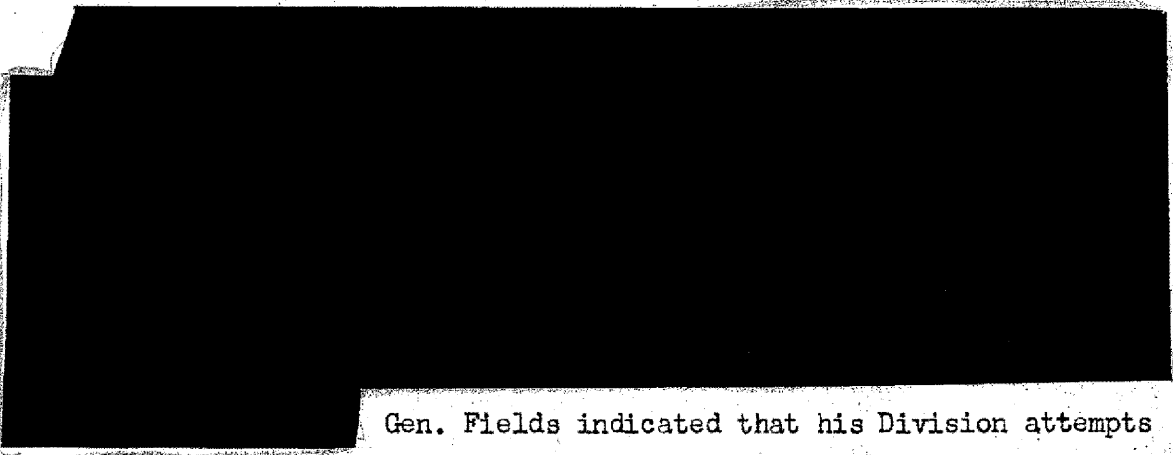
Thermo-
nuclear
Capabil-
ities

After the tests the Commission may be faced with the problem of redesigning for greater efficiency in this heavy (40,000 lb) weight class.



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For the immediate future, Air Force interest seems to lie in the very heavy weapons. In 5-7 years more emphasis on the intermediate and lighter weights is anticipated. Dr. Bradbury suggested that the following weights, in pounds, might characterize the weight classes of interest in the next 5-7 years: 40,000, 20,000, 10,000, less than 10,000.



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Gen. Fields indicated that his Division attempts

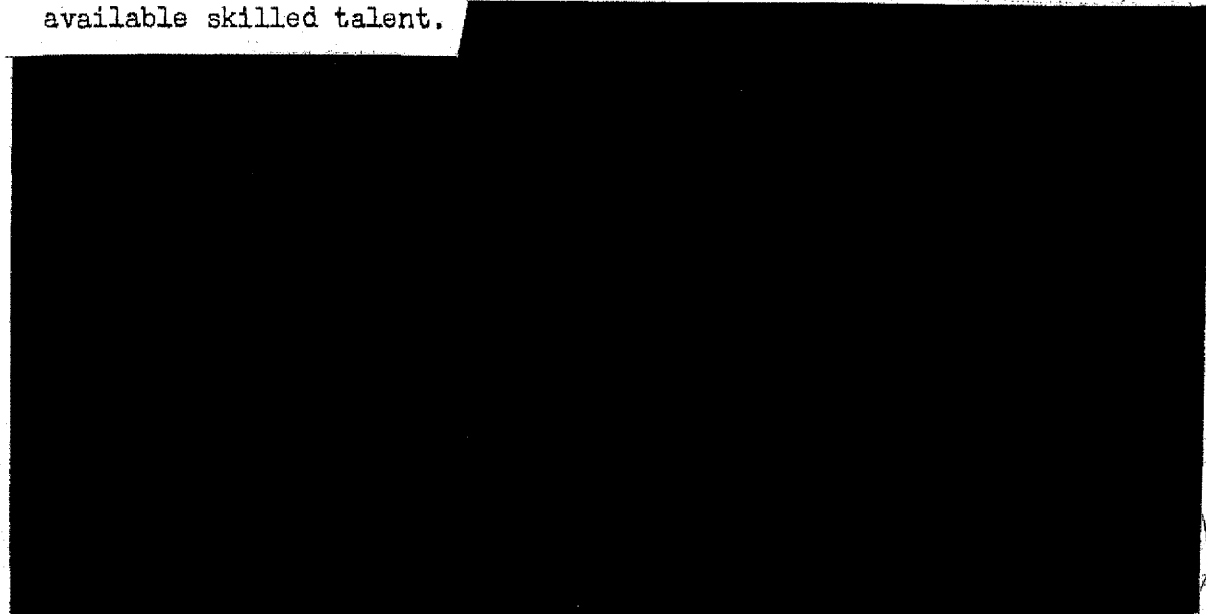
to follow the various studies and developments (e.g. on the 8" projectile), and to raise red flags if necessary. It has access to but not a great impact on much of the weapon systems work in the DOD. One limitation is the smallness of the DMA staff.

Gen. Fields reviewed the promising developments in the Li-6 production program. He also said that the capital facility costs for the thermonuclear program will be \$227 million. Operating costs this year will be \$36 million and will rise to more than \$100 million per year.



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Dr. York next commented on the work at Livermore. He did not anticipate that the new directive for small fission weapon development at Livermore would seriously interfere with the thermonuclear program, provided finances were adequate, although it would divert some of the available skilled talent.



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Mr. Nichols entered during the above presentation.

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At 2:35 p.m. the Committee met with a large group of visitors to consider information available on the recent Russian shots. All members of the Committee, the Secretary, and Mr. Tomei were present. The visitors were: Dr. H. A. Bethe, Dr. N. E. Bradbury, Dr. Carson Mark, Mr. R. W. Spence, Dr. H. F. York, Gen. K. E. Fields, Gen. W. M. Canterbury, Mr. D. L. Northrup, Dr. D. H. Rock, Dr. W. D. Urry, Mr. H. I. Miller, Dr. S. G. English, Mr. G. M. Kavanagh, Dr. C. H. Reichardt, Mr. G. B. Olmsted, Col. J. A. Gibbs, Dr. P. O. Fine, Mr. W. J. Williams, Mr. K. D. Nichols, Dr. H. D. Smyth, Mr. T. E. Murray, Mr. L. L. Strauss, Mr. Joseph Campbell.

Presentations were made by Gen. Canterbury and Mr. Northrup, on behalf of AFOAT-1, and by Dr. Bethe.

Gen. Canterbury reviewed the mission and techniques of AFOAT-1. Their mission is to detect at long range, and obtain and analyze data on all foreign nuclear explosions. They maintain an operational net of acoustic and seismic stations, with which they believe a 20-KT shot in the present Soviet proving grounds can be detected.

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AFOAT-1
Mission
and
Tech-
niques

There is considerable optimism (both by the U.S. and by the British) for electromagnetic long range detection, for which there exist two stations, one in Maine and one in Washington.

A world-wide collection of bomb debris is maintained; daily flights are made from Guam to within 200 miles of the North Pole.

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The system is not geared to detection in the Southern hemisphere; and it would probably miss, for example, a Russian shot on a whaler in the South Seas. Small subsurface shots in the Northern hemisphere would probably also be missed!

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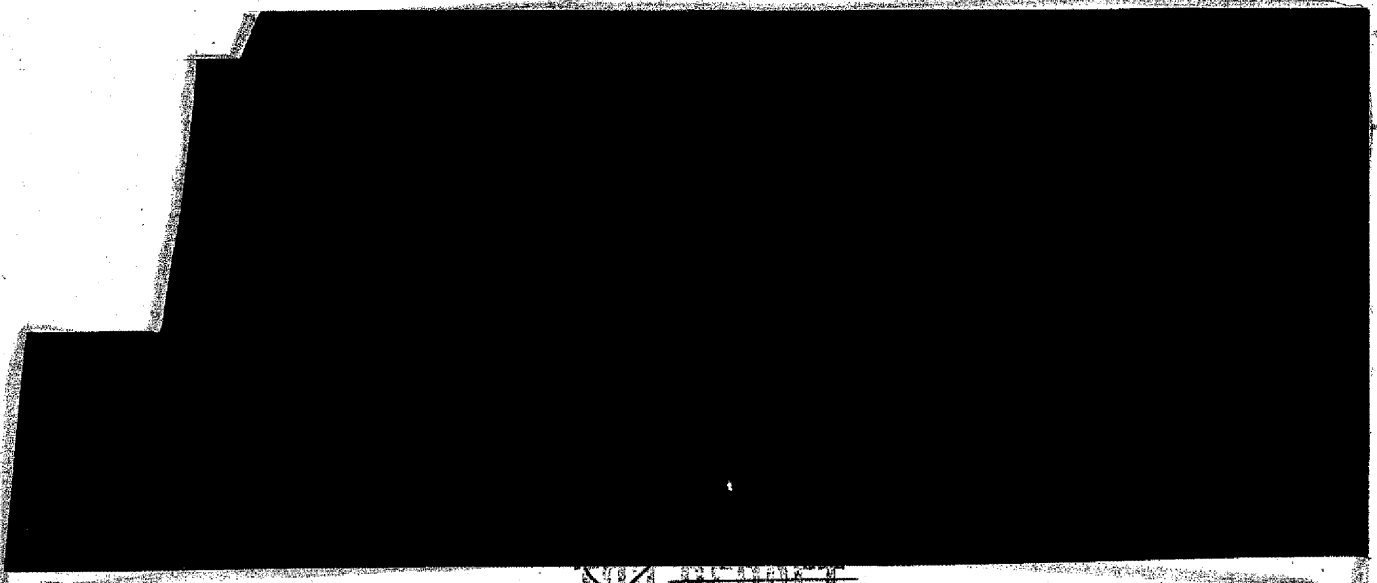


AFOAT-1
Debris
Program

Next, Mr. Northrup described the organization for the radiochemical debris analysis program, and listed the many organizations which collaborate with AFOAT-1. He mentioned plans to establish a permanent Evaluation Committee, which would include Drs. Bethe, Fermi, Spence, and Teller in its membership.

Joe-4
Energy

Mr. Northrup said that the estimates of the energy release of Joe-4 were based on geophysical data, since the radiochemical methods are not applicable in the presence of high energy neutrons. The spread of estimates was: acoustic, 75-310-1700 KT; seismic, 250-1500-3600 KT; mean, with the acoustic data weighted 5:1, 100-500-2000 KT. (The extreme figures are lower and upper limits, the central figure the most probable value.)

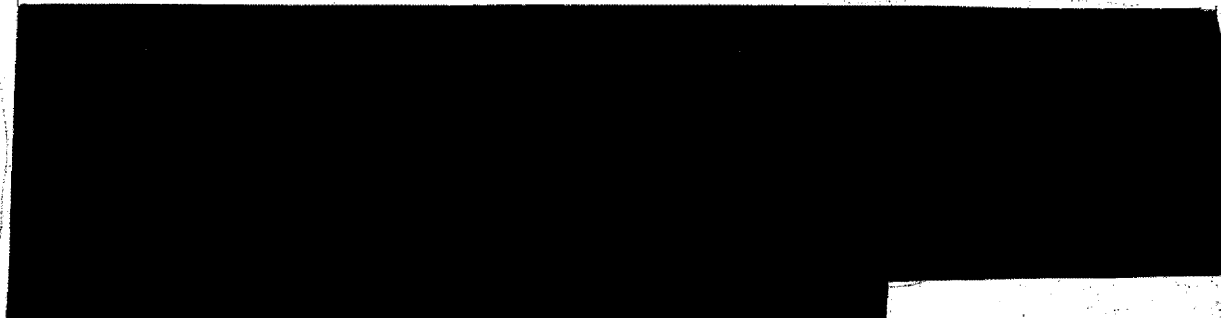


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The evaluation of the data is given in the following table (page 11), which represents the conclusions as of November 3, 1953.

Next, Dr. Bethe described the lines of reasoning which led to the Bethe's inferences on Joe-4. (Secretary's Note: The sequence of arguments is Discussion of Joe-4 rather involved, and is not given here. The reasoning is set forth in detail in Dr. Bethe's report "Analysis of Joe-4", T-527, September 11, 1953, 49 pp.)

Some of the salient conclusions were the following.

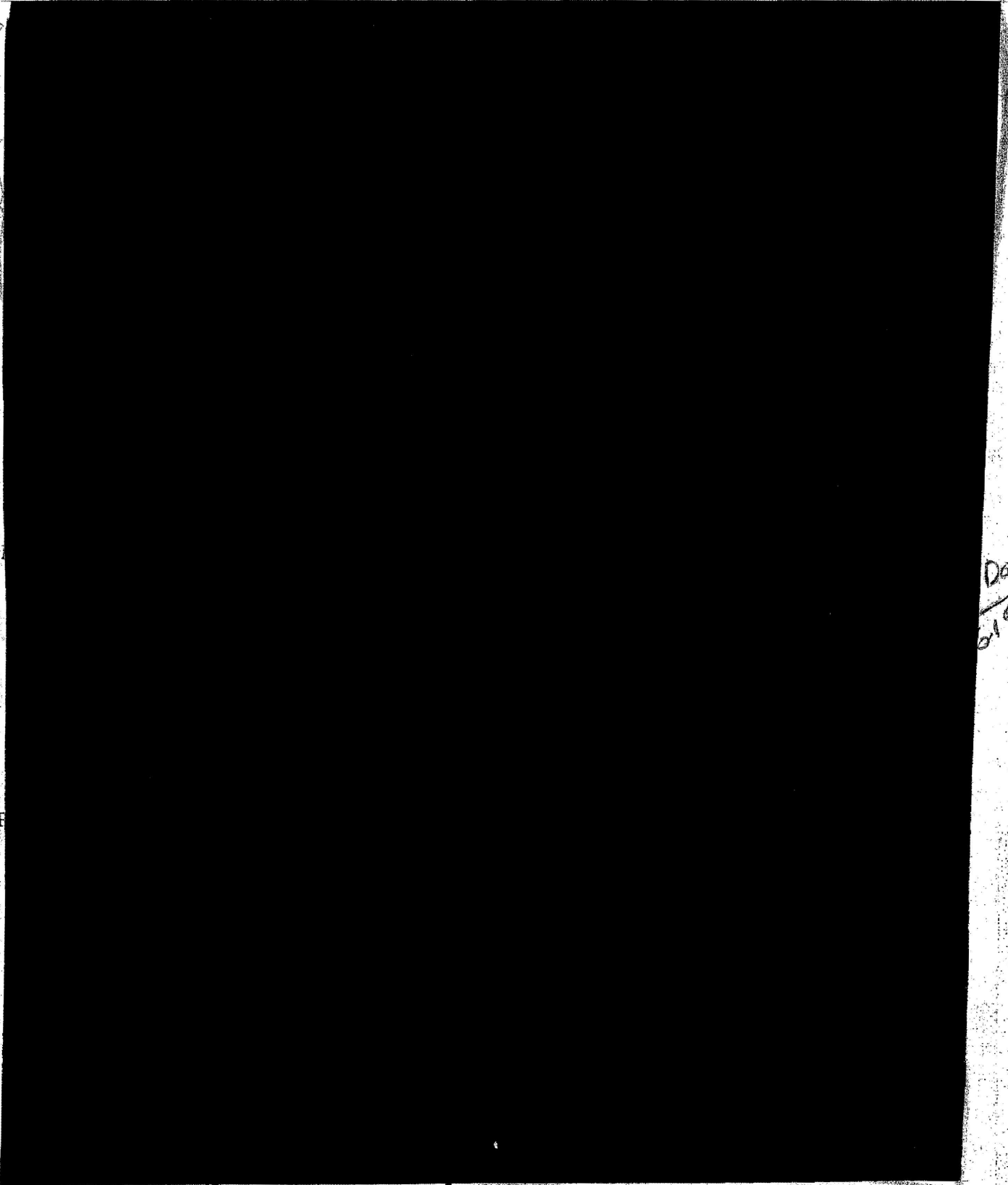


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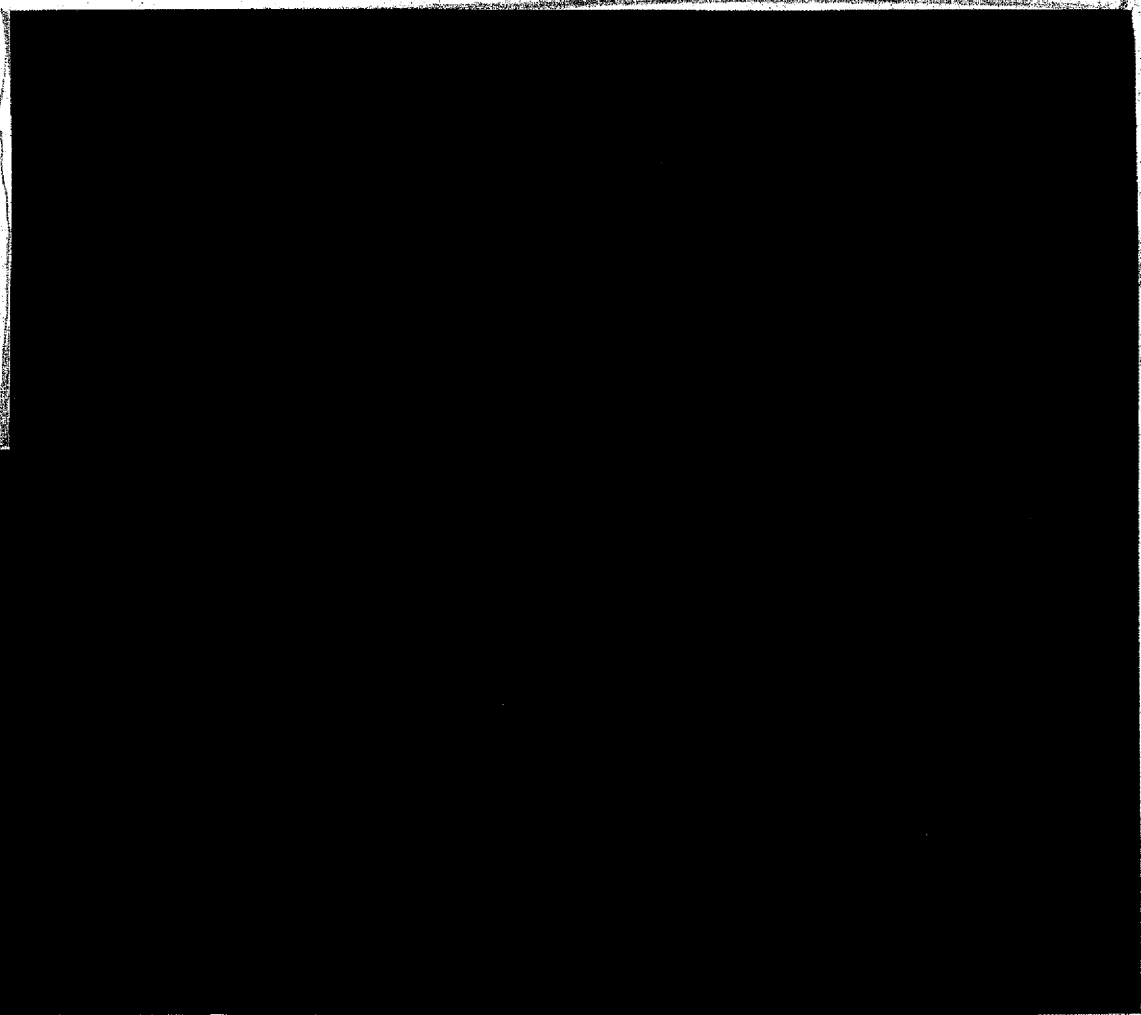


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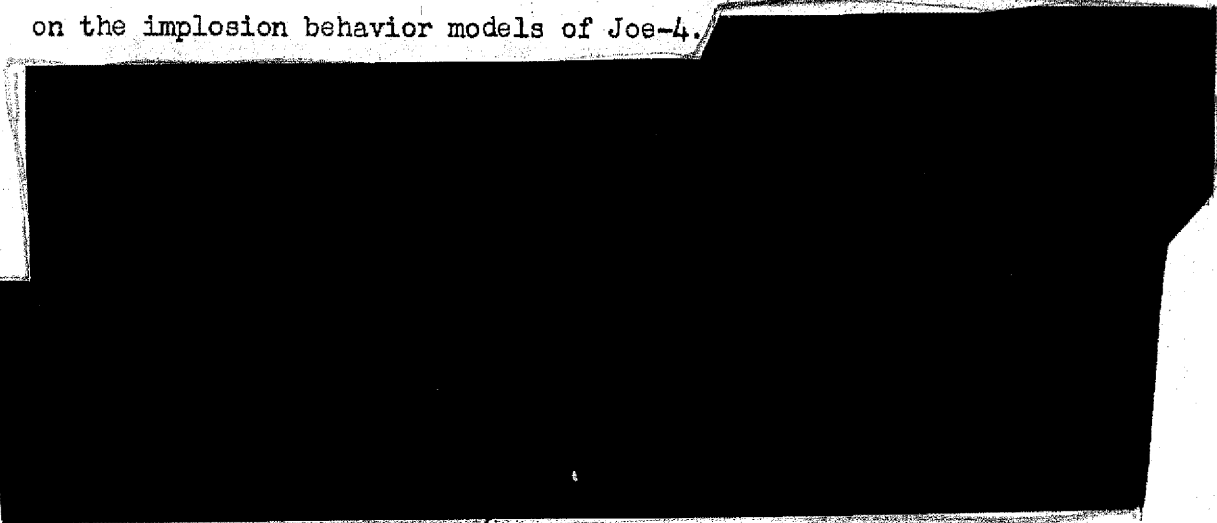
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These questions are being explored at Los Alamos through calculations on the implosion behavior models of Joe-4.

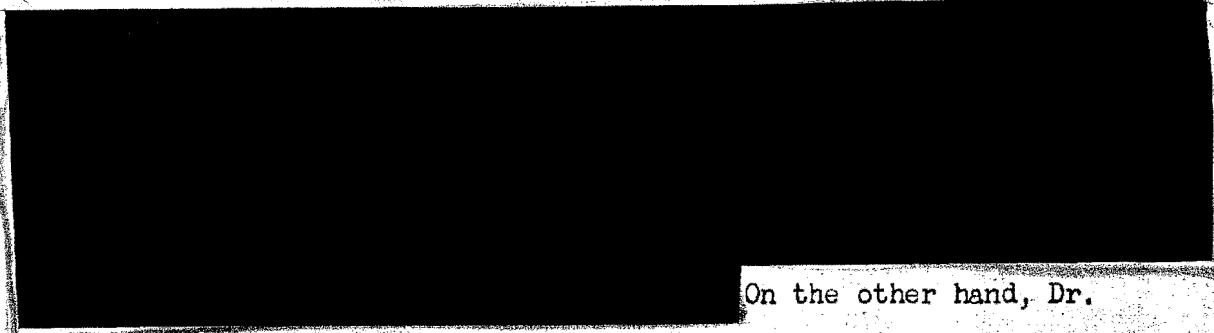


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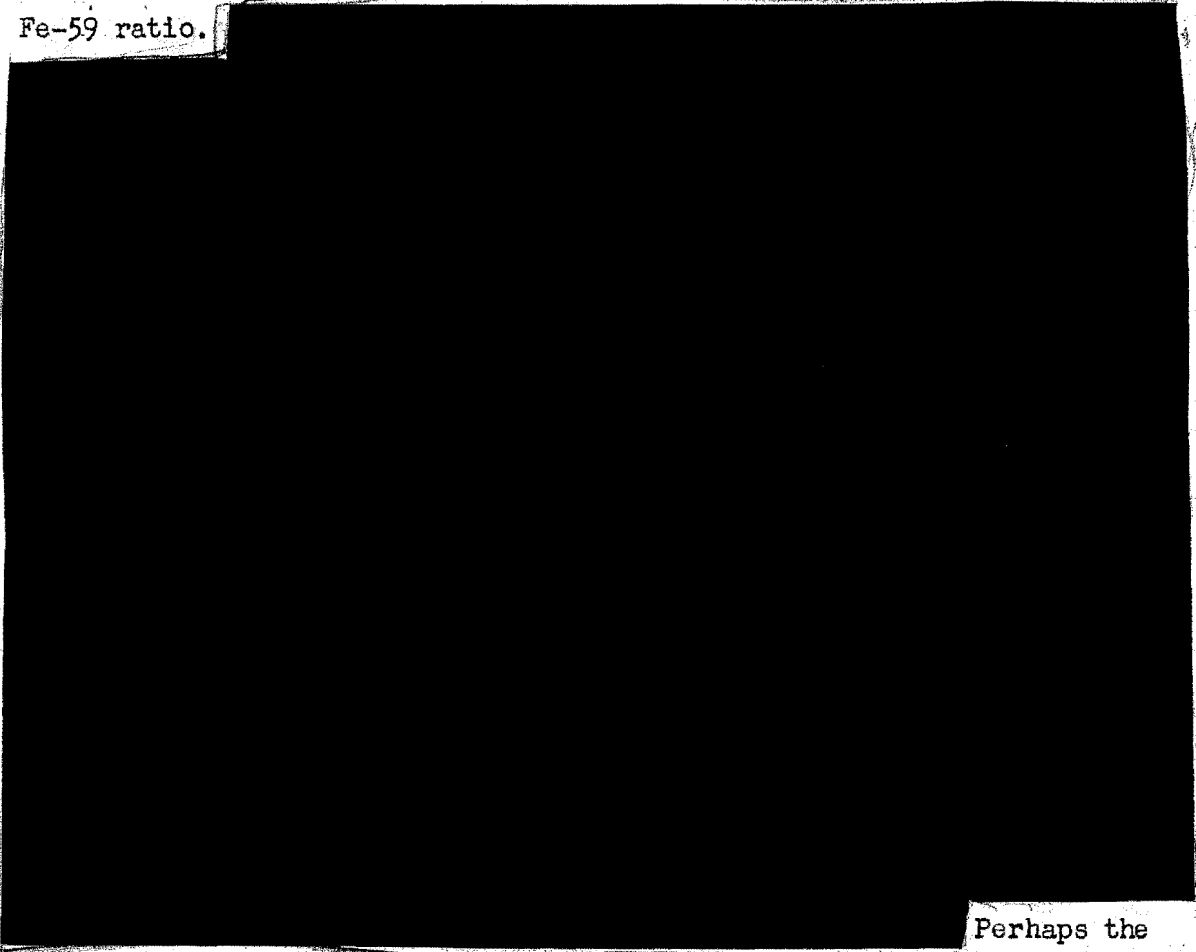


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On the other hand, Dr.

Spence suggested, n, alpha on nickel might account for the high Fe-55/

Fe-59 ratio.



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Perhaps the

shot was a test of a design that looked like a good idea but didn't work very well. Dr. Spence mentioned an interesting fact, that, from the Am-241 content it be concluded that the plutonium dated back to 1949, certainly not later than middle 1950.

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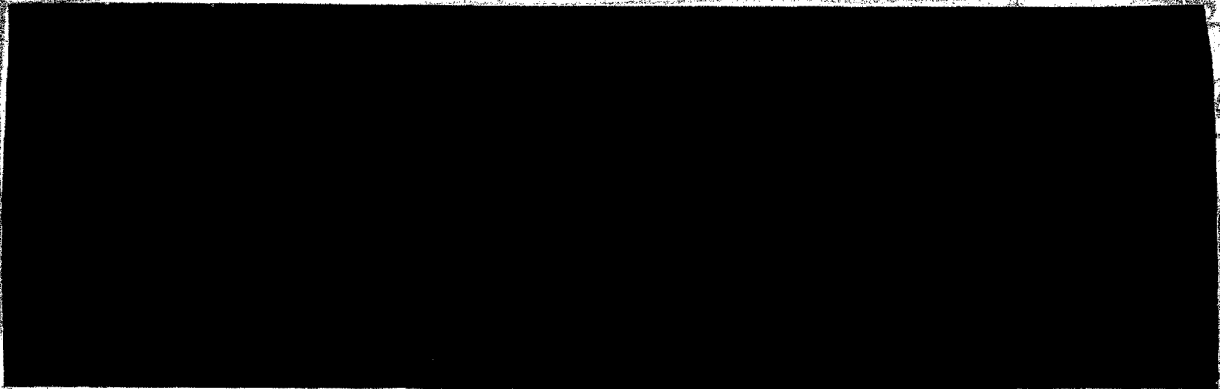
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It was suggested that the data might be compatible with a small diameter HE. Perhaps the designs were for the conversion of some of their large bombs to a large number of air defense missiles.



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At 5:30 p.m. this session was adjourned.

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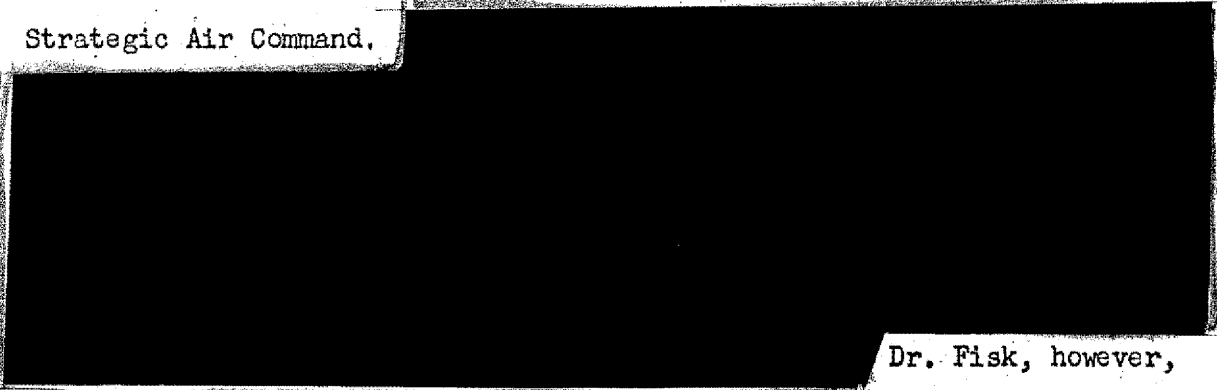
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THIRD SESSION
(November 5, 1953)

The Committee met in executive session at 9:30 a.m. All members, the Secretary, and Mr. Tomei were present.

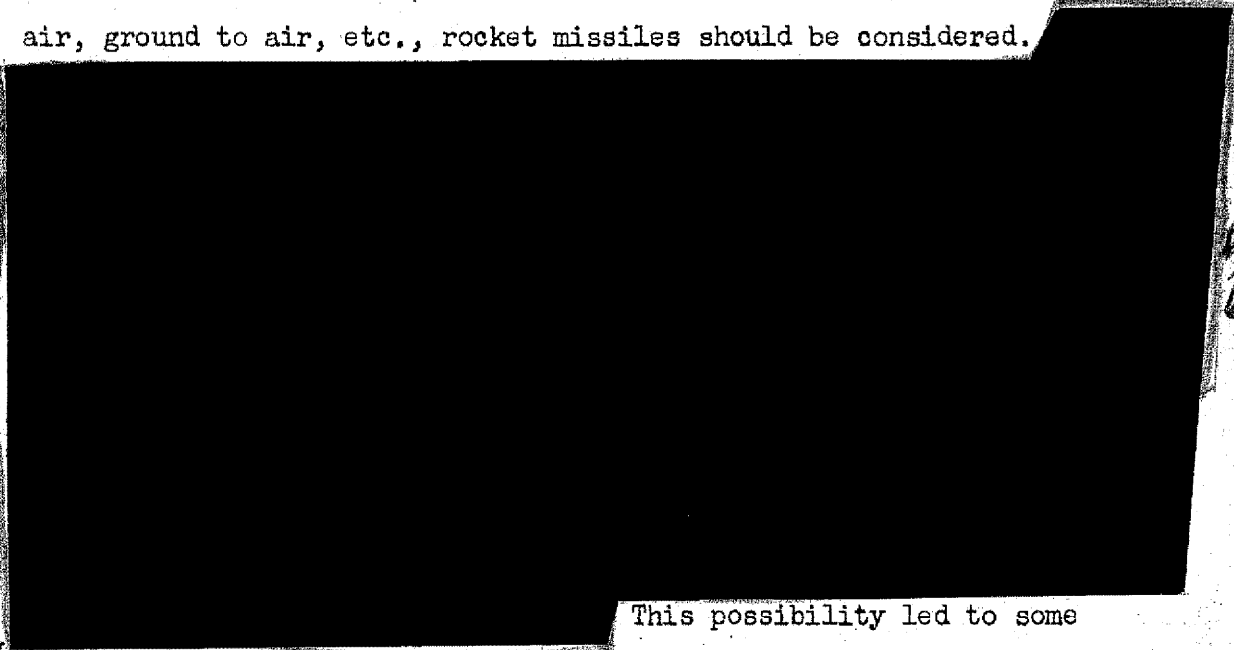
Referring to the Russian shots, Mr. Whitman suggested the following propositions. Russia's first concern is air defense against our Strategic Air Command.

Russian
Shots



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Dr. Fisk, however, tended to find the suggestion plausible. The possibilities of air to air, ground to air, etc., rocket missiles should be considered.



Doc
6.16

Possi-
bilities
for
Improving
Chemical
HE

This possibility led to some discussion. Dr. von Neumann cited a feeling, which had been expressed by Dr. Kistiakowsky, to the effect that 30-40% more powerful HE could be achieved. This might permit reduction of the mass of HE by as much as

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twofold.

[REDACTED] Dr. Rabi viewed these possible gains as enormously important, and suggested a GAC recommendation to the Commission that increased attention be given to the improvement of chemical high explosives. (Appendix B, item 1)

At 10:00 a.m. there was a practice air raid alarm. The Committee reconvened at 10:20 a.m.

The Chairman called on Dr. Libby for a report from the Research Research Subcommittee, which had met the previous evening. Dr. Libby presented the Subcommittee Recommendations following suggestions for increasing the longevity of the Commissions' laboratories and improving them as research organizations.

on AEC Lab Policy

- (1) The AEC can afford and should provide more facilities for transient housing at its laboratories. This would catalyze participation by university people. The lack of such housing is sorely felt at Argonne.
- (2) The AEC should clearly state that it favors and intends to support basic research in the National Laboratories.
- (3) The BNL practice of having visiting committees visit the Laboratory and report on the research being done is a practice that should be encouraged in all of the Laboratories.
- (4) Ties with the universities should be strengthened, e.g. through joint appointments held by the senior staff. There is little of this at ANL or BNL, although quite a bit at Berkeley.

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(5) During the first few years of employment staff members should be on trial. Persons who turn out to be incompetent for technical positions should be considered for administrative positions. (There was vigorous dissent on this point.)

(6) The barriers to employment transfer from one site to another should be removed. The transient period is over and the normal courtesies would be sufficient.

(7) The performance of every employee, including the director, should be reviewed annually.

(8) All professional employees should be given adequate vacations.

(9) Liaison between the Laboratories should be fostered, e.g. by annual meetings of the directors with the AEC or GAC, but without staff.

(10) Extended leaves, analogous to sabbatical leaves, should be encouraged, as they are in universities.

Time did not permit detailed discussion of these proposals. Among the comments were the following.

BNL, with its corporate contractor, is a special case; and its visiting committee system may not be applicable to the other laboratories (Dr. Rabi).

One can question whether basic research should be done in the Laboratories--somewhere you run out of funds (Mr. Murphree). However, the conduct of basic research has a very important favorable effect on employment, in making the laboratory more attractive (Dr. Fisk, Dr. Buckley). Dr. Rabi said that the availability of only a finite

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amount of money is a very important point. As a BNL trustee he had taken the view that the Laboratory should avoid research which could be done at universities. Several members felt that an affirmation by the AEC of its support of basic research in the National Laboratories was needed, and that an affirmation would suffice.

With regard to joint appointments, there are limitations imposed by university standards in precisely the areas in which those standards are inferior, namely pay scales (Dr. von Neumann). This, however, was not the point of the suggestion. The aim was largely to provide recognition and prestige (Dr. Fisk). There are many difficulties and delicate questions involved in the proposal (Dr. Wigner). Dr. Fisk and Dr. Buckley favored a liberal policy on the part of the AEC with respect to university participation, but did not wish to make a specific proposal for joint appointments. This discussion was terminated at 11:00 a.m., when Dr. L. R. Hafstad,

Reactor
Matters

Col. N. L. Krisberg, Mr. J. C. Robinson, and Dr. H. C. Ott entered to discuss the reactor program.

Dr. Hafstad first commented on mobile reactors.

Aircraft
Reactors

There is a new line of thought with respect to aircraft reactors, which emphasizes an application that is not feasible with only chemical power. High speed is needed only for short distances over the target zone; lower speeds are allowable for most of the cruising radius. It is proposed that a plane be designed which can cruise with nuclear propulsion at low speed, e.g. mach 0.7, then switch to combined nuclear and chemical propulsion for a high speed sprint, e.g. at mach 2, for the last few

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hundred miles to and from the target. With such a system the reactor power requirement is less; and the system looks promising.

Naval
Reactors

With regard to naval reactors, Dr. Hafstad mentioned that the STR cores and fuel elements have been improved, with great increases in their expected lives. The fabrication of SIR parts was coming along on schedule.

Dr. Hafstad next turned to civilian power reactors and the "Five Year Program". He indicated that policy had emerged as a result of discussions by the Commissioners at their Topnotch Meeting, and that actions had been taken to set policy. Industrial participation is to be encouraged. The AEC expects to use government money to support research and development projects in the National Laboratories. The favored method of subsidizing power reactors would be to construct plants with government money; by-product plutonium might be purchased, although not at premium prices. Dr. Hafstad quoted at length from a Commission action paper, which was not at the moment in the hands of the Committee. Industrial study group contracts are being revised in the light of the decisions taken.

At 11:50 a.m. Dr. Smyth entered.

Employing numerous charts as "visual aids", Dr. Hafstad next discussed the Five Year Program. It was planned to spend large sums on the Civil Power Program fast breeder approach. The distribution of cumulative costs by 1958 was given as follows: fast breeder, \$80 million; homogeneous reactor, \$40 million; water reactors (excluding PWR), \$20 million; sodium-graphite reactor, \$15 million. These include pilot plants for the fast

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breeder and homogeneous reactors. The dollar figures are based on Laboratory recommendations and are not yet Reactor Division recommendations.

Questions on Homogeneous Reactor
There was some discussion on the intent to go ahead with the homogeneous reactor. Dr. Hafstad indicated that its support would continue on a plateau until a solution of the corrosion problem looked promising. Dr. Rabi inquired whether the HR approach has any real advantage over more easily engineered designs, and whether one could say at present that this was a wise path to pursue. Dr. Wigner commented that the answers were not yet known. The homogeneous reactor is a breeder, whereas the PWR is a consumer. The homogeneous reactor has the advantage of higher specific power (thus higher power per unit fuel investment), but its breeding is not as sure as with the fast breeder. Also, the corrosion may not be licked.

Dr. Wigner asked about coordination of the Argonne fast breeder work with Dow-Detroit Edison, and about plans for the Brookhaven liquid metal fuel reactor. Dr. Hafstad indicated that the ANL and DDE groups are interacting more and their thinking is converging. The present did not seem an opportune time to push the BNL reactor, relative to ANL and ORNL, but greater support would be appropriate when it began to look good. Interest in it was increasing.

Questions on Homogeneous Reactor
Mr. Murphree also inquired about the real advantages of the homogeneous reactor. It was said that chemical processing might be easier and need to be less frequent, that significant savings in the chemical costs might be attained. If everything worked out according to the ORNL paper studies, 5 mill power might be achieved. An independent group will look at the paper studies.

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Sodium-
Graphite
Reactor

The sodium-graphite reactor would use known technology, and an SGR experiment would be appropriate. The AEC was still negotiating with North American Aviation. Perhaps the AEC would finance an experiment, and NAA the pilot plant.

Water-
cooled
Reactors

The next subject was water-cooled reactors. Continued support will be given to ANL for research on principles. An experimental boiling water reactor may be built to obtain more experimental data on this type of operation than could be got from the recent boiling experiment carried out with limited experimental facilities at Arco.

Arco
Boiling
Water
Experiment

Col. Krisberg next described the Arco boiling water experiment. The experiment was carried out to study the feasibility of extracting power by direct boiling of primary water coolant, and to learn how safe water-cooled reactors might be when suddenly made supercritical. The core of the assembly was composed of MTR fuel elements. The reactivity was increased suddenly by known increments, and the behavior of the system studied. Neutron flux, pressure in the water, and temperature of the fuel and of the aluminum can were recorded oscillographically. The behavior was very satisfactory. At moderate power, the operation was steady; with large excess k the water was expelled in geyser fashion and the reactor turned itself off. The water boiled with small fluctuations at 24-28 kw/liter at one atmosphere. With the system closed and operating at 100 psi the operation was somewhat more stable. It became quite unstable at 4% excess k. It was concluded that the system was safe and very promising. Further study of the steadiness of such a system, particularly how it is affected by pressure and geometry, needs to be done.

At 12:35 p.m. this session was adjourned.

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FOURTH SESSION
(November 5, 1953)

Research
Matters

At 1:35 p.m. the Committee considered Research Matters. All members of the Committee, the Secretary, and Mr. Tomei were present. Also present were Dr. T. H. Johnson, Dr. J. C. Bugher, Comdr. James Dunford, and Dr. Smyth.

Sunshine
Program

Dr. Bugher reviewed progress in Project Sunshine. Soil samples have been obtained from many places on the globe, including Turkey, England, New Zealand, and Japan. Also, forage crops, milk, and cadavers have been obtained. The Department of Agriculture is undertaking a program of soil analysis for non-radioactive constituents. A program of study of the metabolism of strontium in man is in progress.

Dr. Bugher also mentioned some results of recent cosmic ray studies with high altitude rockets in northern regions. Exceptionally high counting rates were observed at altitudes of 75,000-300,000 feet. He said this raised a question whether there was an accumulation of radioactive debris from the Mike shot above the north magnetic pole. Electrostatic collection of particles at high altitudes will be attempted to see if this can be verified. This matter was discussed and the view expressed that the high counts probably had nothing to do with Mike debris, but rather were caused by the auroral zone.

Mr. Murray joined the meeting at 1:55 p.m.

Sunshine
Sample
Assays

More information on Sunshine developments was given by Dr. Libby. About twenty Chicago babies, mostly stillborn, have been analyzed for strontium 90. The results averaged about 10^{-4} of the tolerance figure. Cheese samples from various locations ranged from 10^{-4} to 10^{-3} times

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tolerance for the Sr-90/Ca ratio. ("Tolerance" in this case means the allowable magnitude of the Sr-90/Ca ratio in the human body, 2.2 dpm/gram Ca.) Dr. Libby also presented some figures for the tritium content of rain water from the Philippine Islands and from Chicago. The values ranged from 2 to 13 disintegrations per minute per gallon. In the latter part of September, after the Russian shots, Chicago rain water rose to 39 dpm/gal. Chicago tap water, Mississippi River water, and Pacific Ocean water were 1 dpm/gal or less. Dr. Libby said that the various indications were not much worse than expected but deserved consideration.

Dr. Smyth asked who was worrying about the missing Mike debris? Dr. Bugher indicated that all concerned with the Sunshine problem were. He said that conceivably most of it had fallen out in the Pacific, or that it might be still stored in the atmosphere. During the Castle tests fall-out stations will be maintained on Navy vessels to test the fall-out question further.

At this point, Dr. von Neumann, Mr. Murray, Dr. Smyth, and Comdr. Dunford left the meeting.

Next, Dr. Johnson reported on accelerators and on controlled thermonuclear reactions.

Heavy Particle Accelerators
Three proposals were before the GAC for the construction of heavy particle accelerators. The aim was to accelerate heavy ions (beryllium to neon) to energies of about 10 Mev per nucleon so that they could penetrate the potential barriers of even the heaviest nuclei, and to study the reactions and reaction products. UCRL and Yale proposed linear accelerators, each costing \$1.2 million, ORNL a 114" cyclotron costing \$2 million. Dr. Johnson reviewed the proposals of the three institutions

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as set forth in a written report which he had forwarded to the Committee. At Berkeley the interest came mainly from Seaborg's group which wished to make and study transplutonic elements of Z 99 to perhaps as high as 102. Yale wished the facility for staff and graduate student research. The Oak Ridge interests also were general; their proposal was pushed mainly by Dr. Livingston of the cyclotron group. Dr. Bugher mentioned that there was medical interest in the use of high energy heavy particles for delivering radiation dosage in depth.

In the discussion of these proposals, the following points were mentioned.

Some additional personnel would be required for the ORNL project (Dr. Johnson). Is it sensible to build another cyclotron when so many already exist (Dr. Fisk)? Perhaps one of the existing large cyclotrons which can't make mesons should be converted (Dr. Libby). The art of making ion sources deliver large currents is well developed at Oak Ridge. The project would naturally fall in line with their interest and experience with the 86" cyclotron and the acceleration of N 14, but it would not be crippling to the Laboratory if they do not get it (Dr. Wigner).

Yale and California would pool engineering facilities for the design and development of their machines. Yale is very keenly interested and would construct the building with university funds. It needs a machine since it now has no major nuclear facilities (Dr. Johnson). It would be very desirable to get Yale back into nuclear physics (Dr. Rabi).

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The money would come from FY 54 equipment funds (Dr. Johnson). The continued burden of operating costs must also be considered (Dr. Buckley).

Con-
trolled
Thermo-
nuclear
Reactions

Dr. Johnson next discussed the controlled thermonuclear reactions program, known as "Project Sherwood". He indicated that the Commissioners and also the JCAE were taking a great interest in the subject. He reviewed the various technical ideas, and mentioned that G. P. Thompson (England) had filed a secret patent on a device very much like that of Tuck. He also said that Christophilus at Brookhaven has some ideas but is not allowed to work on them (Secretary's Note: for security clearance reasons).

At 3:10 p.m. Dr. von Neumann returned.

Dr. Johnson proposed to organize the effort so as to leave it decentralized, and support people on what they wanted to do. He planned to set up a steering committee, consisting of Teller, Spitzer, Tuck, a good engineer, and a "down-to-earth" physicist to advise the Division of Research.

Classi-
fication
of Con-
trolled
Thermo-
nuclear
Reaction
Program

The question of classification was troublesome. Initially the work was Top Secret, then it was made Secret and highly compartmentalized. As a result of the compartmentalization classified seminars on the subject had been stopped, and some embarrassment had resulted. There was a lengthy discussion of the problem of classification; the Committee reached no consensus. Dr. Rabi, reversing his earlier opinion favored a high classification. His argument was that large sums are being spent with practical ends in view. Support on this scale implies a considered

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technical judgment that something practical is likely to emerge. Such a development, e.g. the abundant production of neutrons and of tritium as well as power, would certainly fall under high classification. Hence it is illogical not to classify the project. He mentioned that a group at Cambridge would like to work in the field if it were declassified. Dr. Fisk proposed, for discussion, that there was much to gain by having the subject unclassified until something emerged which promised to pay off. Dr. Buckley expressed a similar view. (To classify it at present would be like classifying space ships.) Dr. Wigner observed that it is easy to keep the cat from coming out of the bag if there is no cat. Dr. von Neumann suggested that the subject could be kept under wraps to about the same extent that reactor technology is. Dr. Libby suggested that an opinion be obtained from the Senior Responsible Reviewers. Dr. Johnson indicated that he intended to recommend Secret classification, without compartmentalization. Dr. Fisk suggested that basic research in the field be declassified liberally as it appears.

Ultra
High
Energy
Accele-
rator

Dr. Rabi inquired as to the meaning of item k (proposed accelerator program) in Mr. Strauss's pre-meeting letter. Dr. Johnson indicated that it referred to the proposed action to construct an ultra high energy strong focussing machine at Brookhaven, and that the intent was to check on whether the recommendations of the staff paper on this subject were in accord with the GAC's thinking. The staff paper stated that need exists for the construction of a 25 bev accelerator at BNL, and proposed that \$2.5 million be provided for this purpose in FY 54, the balance in FY 55. The BNL schedule provided for completion of the machine in 1959. Dr. Libby

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observed that this was a disappointingly late completion date. Dr. Rabi said that both the design and schedule were conservative, and explained the magnitude of the development problem. He mentioned that although the nominal design performance was for 25 bev at 10,000 gauss, it was hoped ultimately to achieve 35 bev, at 15,000 gauss.

Mr. Whitman remarked that the proposal seemed to fit the previous position of the Committee. Dr. Johnson said that it was intended to do so.

As an item of information, Dr. Johnson mentioned that the Berkeley group hopes to get a beam in the bevatron by Christmas '53.

The matter of another ultra high energy accelerator at a second site was briefly considered. Dr. Johnson indicated that the way the cooperation in the midwest group was working out had been unsatisfactory, and that their proposal had been rejected. One of the principal difficulties was in the selection of a site; for many reasons, the machine should be at ANL. However the interested universities had failed to agree on this. Dr. Libby said that ANL had not been receptive to this idea, either. It was unfortunate that ANL and the universities had not yet been able to get together.

Univer-
sity
Contract
Policy

Dr. Rabi asked Dr. Johnson about university contract policy. Dr. Johnson said that a new policy was in effect, established by Commission action early in September. The policy gets away from the 8% overhead figure, recognizes the full costs of research, and provides for payment of a lump sum toward the total cost.

At 3:50 p.m. this part of the session was concluded.

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Session with Mr. LeBaron

At 4:00 p.m. the Committee met with Mr. Robert LeBaron. All members of the Committee and the Secretary were present. Mr. LeBaron gave an off-the-record discussion of the situation of the Defense establishment with regard to atomic energy matters, emphasizing the effects on planning of available devices, and the developing stabilization of policy.

Patent Briefing

At 5:00 p.m., Mr. LeBaron left the meeting, and the Committee met with Mr. Max Isenbergh and Mr. R. A. Anderson for a briefing on patent policy. All members of the Committee except Dr. von Neumann were present. The Secretary and Mr. Tomei were present.

(Secretary's Note: According to the suggestion of the Chairman, made on this occasion, no attempt is made to report here the details of the presentation and discussion of patent policy. However, the main themes are indicated.)

The two fields in which patents are prohibited are (1) the production of fissionable material, and (2) the utilization of fissionable material for a military weapon. Since the proposed legislation would permit ownership of fissionable material, it is also proposed to allow patents on the production of fissionable material. The prohibition on weapon patents would be maintained. In the field of production of fissionable materials the Commission would have the power to compel licensing of a patent, if it found this to be essential and necessary to the public interest. Information could be turned over by the Commission from one licensee to another. Since compulsory licensing is not well liked, it would be established on an interim basis. Five years after the date of

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the new legislation the compulsory licensing provision would expire unless extended by Congress.

The discussion was mainly on the compulsory licensing point. Mr. Murphree, in particular, was concerned about it. It could essentially compel a company to turn over an invention it had made to competitors without compensation, no matter how much money it had spent in making the invention. Dr. Buckley also felt this provision was undesirable; however, he did not think it very serious.

At 5:40 p.m., Mr. Isenbergh and Mr. Anderson left the meeting, and Dr. von Neumann returned.

There followed an executive session, in which Mr. LeBaron's remarks and the patent questions were briefly considered.

This session was adjourned at 6:00 p.m.

FIFTH SESSION
(November 6, 1953)

Production
Matters At 9:30 a.m. the Committee met with Mr. N. J. Carothers and Dr. F. K. Pittman of the Division of Production. All members of the Committee, the Secretary, and Mr. Tomei were present.

Dr. Pittman reviewed the several papers which his Division had forwarded to the Committee. Mr. Carothers also contributed to the presentation.

The ADP program (Li-6) was in full swing, with substantially Lithium 6 greater production from Elex than anticipated. No difficulty was anticipated in meeting the Li-6 requirements for the Castle test operation.

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At a September meeting at Los Alamos the future requirements for Li-6 had been raised, and a new plant would be constructed to meet the increased needs. The Colex process had been chosen as the one most likely to meet schedules. This process involves $\text{Li}^+(\text{aq}) - \text{Li}$ (amalgam) exchange in pulsed columns. Hydrolysis of the amalgam is reduced by operation at low temperature ($5^\circ - 10^\circ\text{C}$). The feeds will be cooled; it will probably be unnecessary to cool the columns. Contractors have been selected; Carbide will operate the plant.

[REDACTED] The schedule for the new plant is: first operational phase, April 1955; final, October 1955. The new plant will cost about \$70 million, including \$13 million for mercury; the Elex cost was \$45 million. The operating cost of the new plant will amount to about \$3/gram.

[REDACTED] This question will be considered after the Castle tests. Orex may be of some promise for the third ADP plant, but Colex looks better at present.

A new boron-10 plant is being built at the Lake Ontario Storage Boron-10 works. It will cost \$1.5 million and produce 250 kg B-10/year. Operation is expected in the first part of 1955.

Reactor Power Levels Current thinking about power levels at the reactor sites is optimistic. The optimistic expectations are now for 8000 MW at Savannah River and 12,500 MW at Hanford. These are not yet assured.

The Savannah River figure assumes success with the flat plate fuel element development. Encouraging results have been obtained on the

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fabrication problem. The first charging will have to be made by rolling techniques (nickel clad uranium in aluminum can); powder metallurgy techniques are being developed. It is hoped to charge the fifth reactor with flat plates when it comes in, in January 1955.

At Hanford the utilization of the available cooling water has been improved. In addition, the water plant capacity will be increased, and more water will be pumped through the reactors.

Pu and U-235 Production

Dr. Pittman reviewed the estimated production figures for Pu and U-235. These are substantially above the minimum requirements of the expansion program. The expected production will be about 15 months ahead of that prescribed in the expansion program.

Higher g/T Program

The field offices and contractors have been asked to study the effects of 25% and 50% increases in irradiation time. Advantages would be: reduced capital costs, savings in the costs of chemical processing, side stream withdrawal from Oak Ridge would not be necessary. Disadvantages would be: decreased amount of available plutonium (offset by increase in available U-235), plutonium burn-out (6-7%), effect on weapon quality, possible increase in slug ruptures. The last two points have not yet been evaluated.

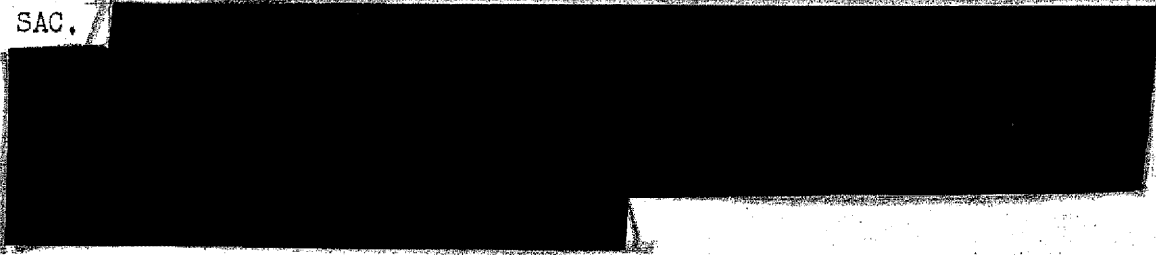
Dr. Fisk asked about waste storage and uranium recovery at Hanford. Dr. Pittman said that TBP is working, and about half the uranium has been recovered. The amount still stored is about 25,000 tons. The volume of fission product wastes is still a problem. This may be ameliorated by the development of ferrocyanide scavenging. At present about \$4 million (10 million gallons) of additional tankage is being built per year.

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At 10:40 a.m. the visitors left and there was a brief break. The Committee reconvened in executive session at 10:45 a.m.

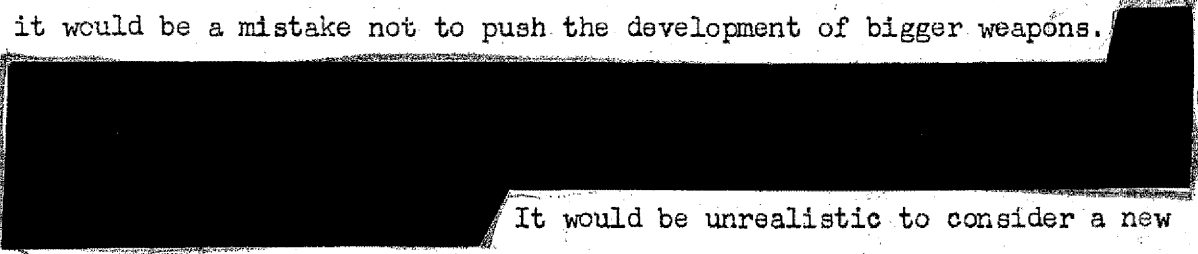
Dates of Next Meeting It was agreed to hold the next meeting in Washington on January 6, 7, and 8, 1954. (Appendix B, item 5)

Larger Thermo-nuclear Weapons ? The next matter considered, larger thermonuclear weapons, was brought up by Dr. von Neumann. He argued that the Strategic Air Command is confident it can make deliveries with its large planes and wants the largest possible bang. Hence, he supported the view that the explosion yield of the heaviest weight class of bombs should be maximized. The weapons which look good right now are in the 20,000 lb and less ranges; nothing really satisfactory is available in the preferred weight range of SAC.



DoE
G.1(a)

There was an extended discussion, pro and con. Dr. Libby agreed that it would be a mistake not to push the development of bigger weapons.



DoE
G.1(a)

It would be unrealistic to consider a new development leading to production of an item for stockpile use before it could be tested.



DoE
G.1(a)

Mr. Whitman observed that if there were real need for bigger weapons the Commission would be under strong pressure from the DOD to make them,

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He felt such a question was hardly a proper subject for a GAC recommendation. Dr. Buckley shared this view. Dr. Rabi expressed grave doubts that the Committee should make a recommendation on the subject without far more study, especially in view of the imminence of Castle. Dr. von Neumann agreed that it would be better to withhold a recommendation until after Castle.


Agenda,
Next
Meeting

The Committee agreed that a discussion of larger thermonuclear weapons should be an item on the agenda for the next meeting. (Appendix B, item 1)

Small
Weapons

The Committee did not have an opportunity at this meeting to study the paper on small weapons (VGHuston-to-IIRabi memorandum of October 2nd with five attachments). With regard to this subject, Dr. Wigner urged that more attention should be given to defense measures, and that the use of small atomic bombs as antiaircraft weapons should be thoroughly considered. This feeling was shared by several members of the Committee. The fact that Los Alamos and Livermore are pursuing the small weapons question was viewed with favor.

Improve-
ments in
Chemical
HE

It was brought up again that great advantages, particularly in small weapons but actually in all size ranges, would accrue from improvements in chemical high explosives. 

Dr. von

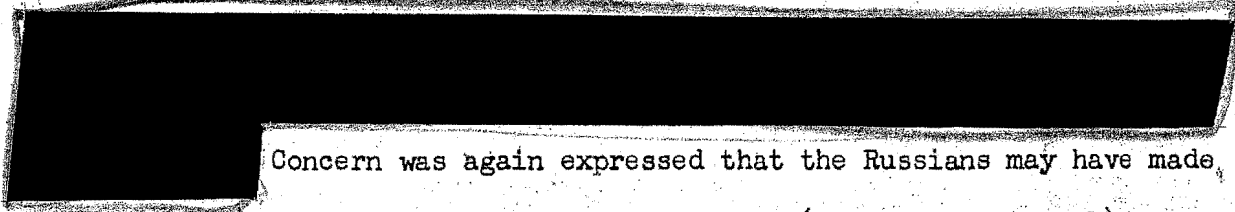
Neumann again referred to expert opinion (Kistiakowsky) that 30-40% improvement in HE performance might be achieved. The usual severe requirements on stability and surveillance behavior might be relaxed somewhat

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for applications in atomic weapons. Dr. von Neumann felt that the Los Alamos approach was on the conservative side. It was proposed that the Committee suggest to the Commission that an independent survey of possible improvements in chemical HE be made. All agreed. (Appendix B, item 1)



Don
to/le

Concern was again expressed that the Russians may have made technical advances of a sort not known to us. (Appendix B, item 1)

Five Year Plan for Reactor Program
Mr. Whitman had drafted a statement on the reactor program, calling particularly for an appraisal of the significant technical features of the several reactor projects involved in the five-year plan. The statement was adopted by the Committee, and constitutes the first paragraph of item 2, Appendix B. It was agreed that the Committee would request a paper giving such an appraisal, and that the Reactor Subcommittee would meet and study it. (Appendix B, item 2)

GAC Support of BNL Accelerator Proposal

The Committee affirmed its backing of the plans for the 25 bev accelerator at BNL as described in the AEC staff paper and BNL proposal. (Appendix B, item 3)

Heavy Particle Accelerators

Next, the three proposals for heavy particle accelerators were considered. In view of the scientific interest in the fields of nuclear physics, chemistry, and the biological sciences, it was agreed that a machine of this type should be built. There was some doubt about the wisdom of building the Oak Ridge and Berkeley machines, but unanimous agreement that the Yale request should be supported. The conclusion as to Yale was based on the belief that a machine there would serve the needs

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of the scientific community and, moreover, that it would be of long range value in greatly strengthening nuclear physics research at that institution. The doubt about ORNL and UCRL was based on the facts that these laboratories already have a great abundance of nuclear machines and highly developed nuclear programs, and on the feeling that three heavy particle accelerators might be unwarranted duplication in this field. No final conclusion was reached as to the ORNL and UCRL requests, however, Opinion was divided as to which laboratory should be the site of a second machine if it were built. (Appendix B, item 3)

At 12:40 p.m. this session was adjourned.

SIXTH SESSION
(November 6, 1953)

The Committee reconvened in executive session at 1:25 p.m. All members, the Secretary, and Mr. Tomei were present.

Con-
trolled
Thermo-
nuclear
Reactions

The controlled thermonuclear program was briefly discussed, Dr. Rabi said he felt that on political grounds it would be very hard not to go along with this program; the basis for support on technical grounds was not so well established. He felt the program would go along better if coalesced in about a year, but mentioned that E. O. Lawrence favored keeping it decentralized. The Committee did not feel that the presentation on this subject called for any action by the GAC, other than to note the program with interest. Dr. Buckley observed that experience with large scale technical projects indicates that many fruitful results are likely to come from the effort even if the initial goal is not reached. (Appendix B, item 3)

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On Project Sunshine, it was felt that comment based on the limited Sunshine amount of data in hand would be unwise, except to note the large variations in Sr-90 content found in different samples. It was felt that the GAC should go on record as continuing to attach great importance to the work. (Appendix B, item 3)

Information Exchange with the Canadians
On the subject of information exchange with the Canadians, Dr. Rabi asked Dr. Libby, Mr. Whitman, and Dr. Wigner to prepare statements of past experience in this field for transmittal to Mr. Strauss.

It was agreed that members who wished to comment on the patent presentation should address their remarks individually to the Commissioners in the next part of this session.

Research in the National Laboratories
With regard to the Research Subcommittee's recommendations about the National Laboratories, it was felt that the Committee could not reach a position at this time, but that the Minutes would inform the Commission as to the Subcommittee's thinking. The opinion was expressed that the Laboratories are for the most part already in excellent condition. Brookhaven is developing notably. Argonne may be the main problem.

Agenda, Next Meeting
The Chairman requested Dr. Libby to prepare a paper on the Subcommittee's study of the Laboratories and its recommendations, for full dress review by the GAC at its next meeting. Dr. Libby agreed to prepare and circulate such a paper. The Chairman also asked Dr. Fisk and Mr. Murphree if they could furnish information based on industrial experience about salaries of technical personnel, particularly those of top management. They agreed to do so. It was agreed to inform the Commission that the Committee was continuing to study the problem of how most

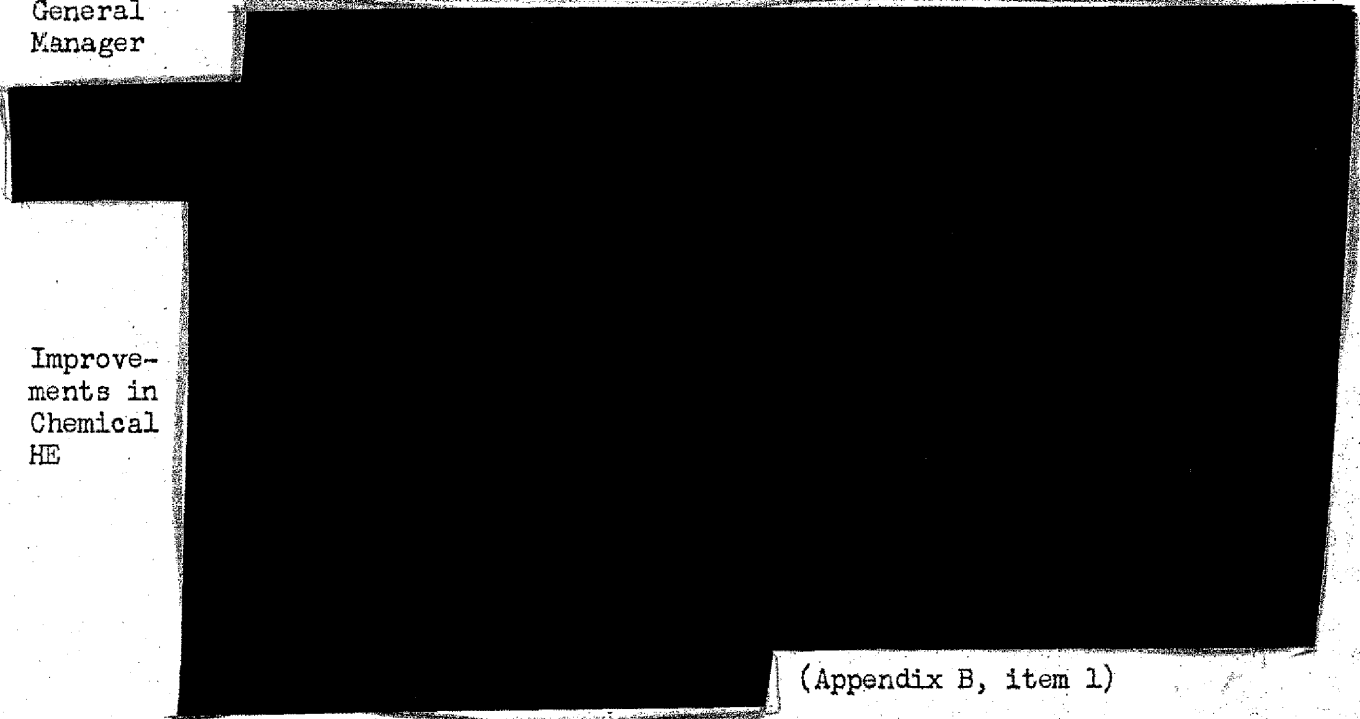
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effectively to manage and evaluate the programs of research carried out in the National Laboratories. (Appendix B, item 3)

At 2:00 p.m. the Committee met with Mr. Strauss, Mr. Murray, Mr.

Meeting with the Commissioners and General Manager

Campbell, Dr. Smyth, Mr. Zuckert, Mr. Nichols, Mr. Walter Williams, and Mr. John Mackenzie. All members of the Committee and the Secretary were present.



DOE
6/1/68

Improvements in Chemical HE

(Appendix B, item 1)

Dr. Rabi next mentioned that the GAC intended to study the problem of maximizing the yield of the weapon which can be carried by existing airplanes (up to 50,000 lb).

Larger Thermo-nuclear Weapons

Next, he mentioned the briefing from Dr. Hafstad on the five-year Five-Year plan. He indicated that Mr. Whitman was the new Chairman of the Reactor Plan Subcommittee, replacing Mr. Murphree, and called on Mr. Whitman to comment on the briefing. Mr. Whitman read the statement which he had prepared. (Appendix B, item 2)

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The dates of the next GAC meeting were mentioned to the Commissioners.

Dr. Rabi then presented the Committee's views, as previously agreed on, with respect to: the BNL strong focussing accelerator proposal; the three proposed heavy particle accelerators; the controlled thermonuclear reaction program (interesting, worth backing, no view on its ultimate outcome); the world-wide Sr-90 sampling program. Referring to the production presentation, he said that the Committee was extremely pleased at the prospects and at the very good report (App. B, item 4).

External
Circulation of
GAC
Recom-
mendations

Mr. Strauss asked whether the GAC would object to having its recommendations shown to individuals whom the Commission might wish to inform. (The case in point was the recommendation on the BNL strong focussing accelerator.) The Committee expressed itself as having no objection, except in cases of a division of opinion within the Committee.

Patent
Policy

Dr. Rabi asked Mr. Murphree to comment on the patent policy presentation made by Mr. Anderson and Mr. Isenbergh. Mr. Murphree said it was a very good job and very constructive. He had questioned only the provision about passing information from one licensee to another. Mr. Strauss asked Mr. Murphree to send him a note detailing his views on this subject.

Manage-
ment and
Evalu-
ation of
Research
in the
National
Labora-
tories

Dr. Rabi said that the Research Subcommittee was trying to develop principles, in terms of which the GAC could respond to Mr. Boyer's earlier request for a consideration of how to manage and evaluate research in the National Laboratories. The full Committee was not ready to present its views, but the Commission might find of interest the reports in the Minutes of the last meeting.

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He next asked what sort of response the Commission desired from the Information Committee on the subject of information exchange with the Canadians. Exchange with the Canadians Mr. Strauss, Mr. Murray, and Dr. Smyth remarked on this question. The Commission is anxious to foster cooperation with the Canadians, anticipates some opposition, and would like reinforcement for its arguments. It would help if the GAC would look over past exchanges and could point out their value to the U.S. The Canadians are particularly anxious for more cooperation in the field of power reactors and the associated research and technology. Their security situation is in good shape, although the free exchange between Chalk River and the British is somewhat worrisome. Mr. Strauss said it would be soon enough if he had a memo by the time of the next GAC meeting.

Several Committee members mentioned points in which U.S.-Canadian cooperation had been helpful to us: experience in operating heavy water reactors at high flux and high power; irradiation of materials at Chalk River; flat plate fuel elements; early work on TBP and Redox; D₂O constants.

Classification of CTN Dr. Smyth asked if the question of the classification of the controlled thermonuclear reaction program had come up. Dr. Rabi replied that it had been discussed at length, but that the GAC had no recommendation to make at present. He asked the individual members to express their views. They did so as follows.

Mr. Whitman: a little inclined to favor declassification.

Dr. Wigner: no strong feelings. If it were declassified and then reclassified in the light of important developments, the cessation of publication would be very obvious.

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Dr. von Neumann: not so concerned about Dr. Wigner's last point. The supporting research in magnetic hydrodynamics should be unclassified.

Dr. Warner: no strong feeling, except that the work should not be compartmentalized within the project.

Dr. Fisk: agreed with Dr. von Neumann,

Mr. Murphree: favored Secret classification but no compartmentalization.

Dr. Libby: it should not be too highly classified in the early stages.

Dr. Buckley: at the start it should be declassified. Since it is supported with public money, the fact that it is being done should be public knowledge. Policy should be determined with reference to what you have once you have it.

Dr. Rabi: struck by a certain logical difficulty. If one did not expect much from the project, it would not be supported on such a large scale. In case the development does work out it will be of the utmost importance--if only as a source of neutrons and tritium. He favored a high classification. He believed with Dr. von Neumann, although somewhat less broadly, that some of the theoretical hydrodynamics aspects should have a much lower classification.

Dr. Rabi asked about the Commission's plans for its Office of

Intelligence Office Plans Intelligence. Mr. Strauss answered that they did not yet have a replacement for Dr. Colby, but that the policy was that there should be such a man, for the benefit of both AEC and CIA. Any suggestions from the GAO would be welcome.

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Dr. Rabi remarked that the Committee had had an interesting session with Mr. LeBaron. He said that he had the feeling, in view of the rapid changes that were occurring, that the AEC would be wise to equip itself in the Division of Military Application with some very knowledgeable military people who can respond critically to the DOD's ideas for weapon requirements. The task of the present DMA staff is different; perhaps they only need more help. Mr. Strauss and Mr. Zuckert indicated that interaction with the DOD has grown a lot and will grow more.

As the meeting closed, Dr. Rabi thanked the Commissioners for supplying the GAC with ample information at this meeting and for making available its staff and outside visitors.

This final session of the 37th Meeting was adjourned at 3:10 p.m.

Richard W. Dodson
Secretary

Attachments (2)

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GENERAL ADVISORY COMMITTEE
to the
U. S. ATOMIC ENERGY COMMISSION
Washington 25, D. C.

November 2, 1953

The following is the tentative Schedule* for the 37th Meeting of the General Advisory Committee, to be held in room 213 on November 4, 5, and 6:

November 4 (Wednesday):

- 10:00 a.m. -- Executive Session
- 11:00 a.m. -- Meeting with the Commissioners and General Manager
- 1:30 p.m. -- Weapon Matters.....Gen. Fields
- 2:30 p.m. -- Weapon Matters.....Gen. Fields, Drs. Bethe, Bradbury, Mark, Spence, Teller, English, Reichardt, and Mr. Northrup

**

November 5 (Thursday):

- 9:30 a.m. -- Executive Session
- 11:00 a.m. -- Reactor Program.....Dr. Hafstad
- 1:30 p.m. -- Research Matters.....Dr. Johnson and Dr. Bugher
- 4:00 p.m. -- Executive Session
- 5:00 p.m. -- Patent Briefing.....Mr. Mitchell and Mr. Anderson
- 5:30 p.m. -- Executive Session

November 6 (Friday):

- 9:30 a.m. -- Production and Special Materials.....Mr. Cook
- 10:30 a.m. -- Executive Session
- 1:30 p.m. -- Meeting with the Commissioners and General Manager
- 2:30 p.m. -- Executive Session

CLASSIFICATION CANCELLED
 BY AUTHORITY OF DOE/OC
 Carl Wilson 4/4/84
 REVIEWED BY: H.R. Schmidt 8/6/85
 DATE
 By: W. Tench
 3/20/86

Richard W. Dodson
Secretary

*Changes in Schedule may be found necessary in advance of or during the Meeting. The offices of the Commissioners, the General Manager, and the Secretary will be kept informed of any changes.

**The Research Subcommittee will meet Wednesday evening.

DISTRIBUTION: Commissioners (5) Secretary, AEC (16)
 General Manager (2) Secretary, GAC (13)

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GENERAL ADVISORY COMMITTEE
to the
U. S. ATOMIC ENERGY COMMISSION
Washington 25, D. C.

November 7, 1953

Mr. Lewis L. Strauss, Chairman
U.S. Atomic Energy Commission
Washington 25, D.C.

Dear Mr. Strauss:

Herewith is the summary report of the Thirty-seventh Meeting of the General Advisory Committee, held in Washington on the 4th, 5th, and 6th of November, 1953.

All members were in attendance.

We wish to thank the Commission and staff for their high degree of cooperation in arranging for this meeting, in supplying complete background information for the subjects to be considered, and in providing for the attendance of staff and consultants, which greatly aided the deliberations of our Committee.

In both our informational and executive sessions we gave particular consideration to: (1) weapon matters, including the study of the recent nuclear explosions in Soviet territory; (2) a review of the reactor program, with particular attention to a possible 5-year plan; (3) research matters, including the proposed large strong-focusing accelerator at Brookhaven, the various heavy particle accelerators proposed for Yale, Berkeley and ORNL, a review of the present status of Project SUNSHINE, and controlled thermonuclear reactions; and, (4) present status of production of fissionable and special materials:

1. The Committee had the benefit of an excellent briefing on the proposal for the CASTLE tests and other weapon matters. [REDACTED]

[REDACTED] We did not have time to consider in detail the interesting suggestions for the small weapons program but propose to return to this subject at a future meeting of the Committee. Another subject which we may study is the question of the development of a weapon which will maximize the total explosion yield within the weight-carrying capacity of our largest bombers.

[REDACTED] We wish to take this opportunity to give our highest

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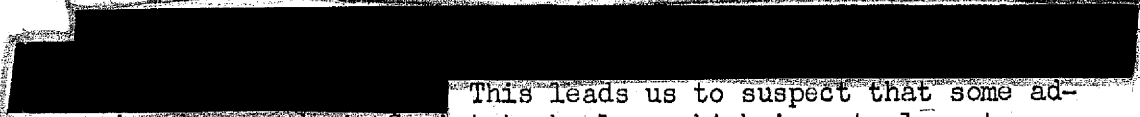
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commendation to AFOAT-1 and their collaborators for their excellent performance of a most difficult mission.

Our discussions, though most enlightening, still leave us with a feeling that much remains to be understood about the design, purpose and operation of the four Soviet devices, a feeling which was shared by all present.

 This leads us to suspect that some advance has been made in Soviet technology which is not clear to us. This worry leads us to a suggestion which we strongly urge on the Commission, namely, to initiate a vigorous program of research in chemical explosives suitable for the implosion of atomic weapons. It has long been felt by some experts in the field of chemical explosives that great improvement in explosion yield per unit volume could be achieved by explosives research and development. The pressure of other programs however, has caused this field to be largely neglected. We feel that we should no longer leave this largely unexplored. The gains to be achieved from success in this direction are enormous both in the reduction in size of large fission weapons and even more importantly in the possibility of making smaller fission weapons of simple design and great economy of fissionable material. It is well known that both the Russians and the British are very expert in the field of chemical explosives. It is conceivable to us that they may have made significant advances in this field.

The explosives in present use in the United States were developed for the more usual military purposes. Many of the requirements which are put on such explosives can perhaps be relaxed for nuclear weapons in order to achieve a greater energy release per unit volume. With this in mind and with regard to the great gains to be achieved for the weapons program from such a development, we recommend that the Commission proceed toward the exploration of these possibilities with all speed.

2. Doctor Hafstad's presentation of the budgetary aspects of a five-year plan for power reactors, which is being developed by the Reactor Division, raised a number of technical questions which seem relevant to the soundness of the plan. The Committee would appreciate a paper for its study before the next meeting which would appraise the significant technical features of the several reactor projects involved in the five-year plan. Such a study should compare and contrast the relative merits and economic promise of the projects, including chemical processing, and the probable time factors. Relevant budgetary estimates might well

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be appended as a supplement to the technical study.

The Subcommittee on Reactors, Materials and Production which is now chaired by Dr. Walter G. Whitman, succeeding Dr. Eger V. Murphree in this position, has offered to meet in about a month to consider such a study by the Reactor Division should it be available.

3. In the report of our Thirty-sixth Meeting we recommended that the Commission support the design and construction of an ultra-high energy particle accelerator in the 15 - 25 BEV range, at the Brookhaven National Laboratory. We have reviewed with the Director of the Division of Research the proposal submitted by Brookhaven for this project. The proposal provides for the design and construction of a proton synchrotron employing the strong focusing principle, designed to accelerate protons to an energy of 25 BEV, and having a potentiality of ultimately achieving 35 BEV. We find this proposal exactly in accord with the intent of our earlier recommendation and endorse the proposal submitted by the Brookhaven National Laboratory.

During this meeting we considered at some length, with the Director of the Division of Research, proposals which have been submitted for the construction of heavy particle accelerators, a linear accelerator at Yale University and at the University of California at Berkeley, and a cyclotron at the Oak Ridge National Laboratory. The aim is to accelerate relatively heavy nuclei, in the range from beryllium to neon, to an energy of about 10 MEV per nucleon so that they can react with even the heaviest known nuclei. It is believed that an abundance of new nuclear species will be formed as a result of the nuclear reactions of such particles, for example, neutron deficient isotopes throughout the periodic table and isotopes of elements of higher atomic number than californium. The effects of the high energy heavy particles on biological and chemical systems also appear to be of interest. In view of these research possibilities, we believe that there is ample reason to undertake the construction of at least one such accelerator at the present time. Because of the relative abundance of nuclear machines at Oak Ridge and at Berkeley, we believe that the interests of the Commission and of the scientific community will best be served if this accelerator is located at Yale University, and we so recommend. We have not reached a conclusion on whether the simultaneous construction of more than one heavy particle accelerator would be justified.

We have noted with interest the continuing activities in the study of methods for producing controlled thermonuclear reactions. It is not possible at this time to be assured that the goal of the work will, in

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fact, be reached; however, there is no doubt but that interesting and valuable results of a scientific and technological nature will emerge. The program is of interest and worthy of support.

As you know, we were requested by the former General Manager to consider the problem of how most effectively to manage and evaluate the programs of research carried out in the National Laboratories. Our Subcommittee on Research has been active in visiting the Laboratories and studying their researches, and is attempting to develop some principles which may be helpful to the Commission in connection with this problem. The full Committee has discussed the subject at length, but is not yet ready to present final conclusions.

We were interested to hear some preliminary results of the strontium-90 sampling program recommended by Project SUNSHINE. The results were interesting for the very large variations which were found for different samples. We feel that the project is off to an excellent start and await with great interest the results of the analysis of the numerous samples which are now on the way. We continue to attach great importance to this project.

4. The Committee was greatly heartened by the excellent progress which has been achieved in the field of production and special materials and the high promise for the future.

5. The next meeting of the General Advisory Committee will be held in Washington on January 6, 7, and 8, 1954. This meeting will be devoted in the first instance to such problems as the Commission wish to put before the GAC. We will also wish to consider certain matters of which the Commission will be notified well before our next meeting.

As always, members of the GAC will be available to the Commission for any problems which may arise between meetings. The Chairmen of the Subcommittees are also available to call special meetings should the Commission have emergency need of their services.

Sincerely yours,

I. I. Rabi
Chairman

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