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U. S. ATOMIC ENERGY COMMISSION  
BY: R. H. Anderson, Ch. Jones  
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MINUTES

Forty-first Meeting of the General Advisory Committee  
to the U. S. Atomic Energy Commission.

July 12, 13, 14, and 15, 1954  
Albuquerque, New Mexico  
and  
Los Alamos, New Mexico

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(Secretary's Note: The Committee met at the Sandia Laboratory in Albuquerque on July 12, and at Los Alamos on the three succeeding days. Except for an executive session of the Committee on the night of July 14, the first three days were devoted to program briefings by the Sandia, Los Alamos, and Livermore laboratories. These briefings were also attended by members of the Military Liaison Committee, the Coordinating Committee on Atomic Energy and its Technical Advisory Panel. A list of the expected attendance at the briefings, furnished at Sandia, is attached as Appendix C.

Dr. Wigner was unable to attend this Meeting.)

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FIRST SESSION  
(July 12, 1954)

Sandia Briefings The Committee met (at the Sandia Laboratory) at 8:10 a.m. All members except Dr. Wigner were present. The Secretary and Mr. Tomel were present. In addition, other groups as noted in Appendix C, and members of the Sandia staff attended.

Sandia Laboratory The session was opened by Mr. James W. McRae, who welcomed the visitors and remarked briefly on the Sandia Laboratory and its status. He mentioned that the past year had been marked by the consolidation of the staff into groups and that the staff size had levelled off at 5300-5400 people. About 45% of the laboratory's effort is devoted to production activities, 55% to research and development. He classified the latter as follows: specific weapons development and design, 53%; field testing, 18%; quality assurance, 13%; research, 11%; and information services, 5%. The first two presentations were to be on weapons development and design.

Missile Applications Possible Thermo-nuclear Missiles Mr. L. A. Hopkins discussed missile applications. He emphasized at the start the severity of the logistics problems involved in the use of missile-borne atomic warheads, and said it was time to reconsider the stockpiling of complete warheads. Mr. Hopkins showed slides picturing various missiles, and discussed each in turn. After commenting on the Honest John rocket (Army) and the Navy depth bomb, he mentioned the following as possible carriers for thermonuclear weapons: Rascal; Regulus-2 (500 mile range); Snark (one mile accuracy at 5000 miles); Redstone; Navaho II; and Atlas. [REDACTED]

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Air  
Defense  
Weapons

Mr. Hopkins turned next to the subject of air defense weapons, mentioning: the Navy Talos, eventually to carry an optimized 2 KT warhead; the Army Nike-B, to carry a 30" warhead; the Air Force F99 Bomarc; and, in the conceptual stage, air-to-air rockets. The Talos and Nike-B are to be operational by early '57.

Air-to-  
Air  
Rocket  
Systems  
Studies

The new air-to-air rocket program was considered in some detail. The tightest kind of systems study on this application is necessary. The results of analyses relating time of flight, yield, and aircraft kill and safety were presented. It appears not possible to kill the enemy plane and avoid killing the friendly plane with yields less than about one kiloton. With yields larger than 1 KT there is a region, defined by yield and time of flight, in which the attacking plane can kill the enemy and escape. A special systems study group, involving Sandia, Los Alamos, and the Special Weapons Command, has been set up to consider the interrelated problems of the aircraft, rocket, warhead, fuze, and fire-control, and to optimize this weapon system. It will have a very tight program for the next two years.

Aspects  
of Anti-  
Aircraft  
Warheads

Some other general aspects of air defense warheads were next discussed: (a) safety (requirement high, X-unit important, in-flight-insertion and in-flight-retraction problems); (b) high altitude effects (on high voltage sources); (c) readiness (corrosion problems); large numbers needed. These considerations all point to the desirability of a "canned warhead". Some ideas as to what this might look like externally were presented.

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After questions and discussion there was a 15-minute break. The meeting was resumed at 9:45 a.m.

Fuzing The next presentation, on fuzing questions, bomb release methods, and the thermonuclear weapon program was made by Mr. R. W. Henderson. He reviewed the developments in fuzing strategic and tactical bombs. In order to simplify field logistics, barometric fuzing (fuze A) was substituted for the earlier radar fuzing in strategic weapons. A contact fuze is also used. Fuze B, developed for tactical applications of the MK-7 bomb has radar air burst, timer, and contact fuzes. With respect to the number of options (burst altitude, separation times, etc.) which the tactical fuze should present to the pilot, operating experience and systems studies have indicated that the present seven options should be reduced. When agreement on details has been reached, the simplification will be applied across the board.

Retarded Trajectories The problem of retarding trajectories in order to give the plane time to get away was discussed. An air brake, called the Rotochute and working on the autogyro principle, is being tested. On the MK-7 it reduces the terminal velocity in drop tests from 1000 ft/sec to 270 ft/sec.

Mr. Henderson next discussed various carrying arrangements for the MK-7 bomb (external versus bomb bay for supersonic delivery). Nuclear safeing by a liquid is being considered as replacement for the present chain safeing method.

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The last subject discussed by Mr. Henderson was the thermonuclear weapon program.

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[redacted] Contact fuzing, desired for surface burst applications is being worked on, but presents difficult problems. It will not be available for at least two years:

TX-15

[redacted] Sandia has assumed responsibility for the detailed internal engineering of this weapon, and has thus become, for the first time, involved in nuclear design. The particular program is subject to control by Los Alamos. The first delivery to the stockpile is scheduled for April 30, 1955. The bomb is engineered for storage as a completely assembled unit, except for the tail fins. It is equipped with barometric and proximity fuzes; some consider contact fuzing a "must".

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The 17,400 lb TX-21 is in its infancy.

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[redacted] The TX-21 appears to be compatible with the B-58 aircraft (Hustler).

An effort will be made to standardize the fuzing in the different thermonuclear weapons.

Contact  
Fuze  
Diffi-  
culties

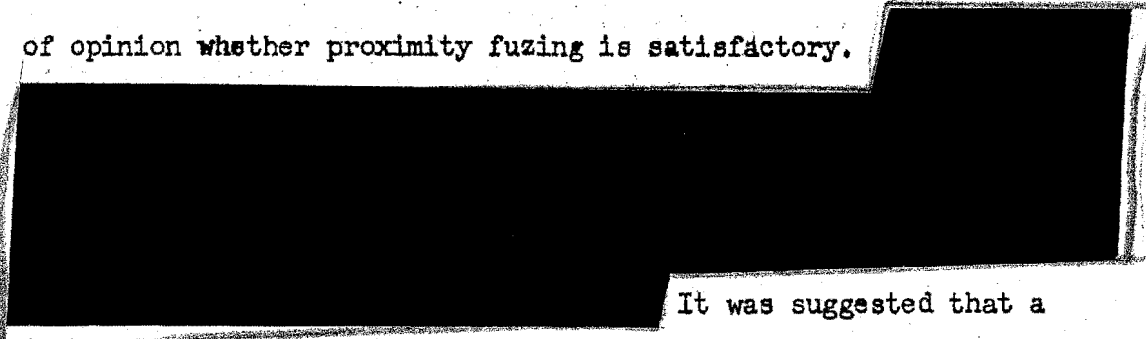
There were some questions and discussions by the group, mainly on fuzing for surface burst applications. There seems to be a divergence

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of opinion whether proximity fuzing is satisfactory.



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It was suggested that a

"walking stick" arrangement might be resorted to.

This discussion concluded the morning meeting, and the session was adjourned at 11:00 a.m. Between this time and noon the groups visited a mock-up room in which various warheads and missile mountings were shown. The exhibits included a full TX-15 assembly.

SECOND SESSION  
(July 12, 1954)

This session began at 12:45 p.m. Attendance was the same as at the first session.

Weapon  
Effects

After introductory remarks by Mr. McRae, the subject of weapon effects, as they come into systems studies, was discussed by Mr. S. C. Hight. The Sandia Laboratory's primary interest in this subject is in learning how best to fuze. Tactical and air defense uses are receiving particular attention at present.

Mr. Hight gave a list of the phenomena of interest, their approximate scaling laws in terms of yield, W, and in some cases D, distance. He also listed kill and safe criteria.

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<u>Phenomenon</u>	<u>Kill</u>	<u>Safe</u>	<u>Approximate Scaling Factors</u>
crushing overpressure	6 psi	1 psi	$W^{1/3}$
dynamic pressure (wind force)	1 psi	0.1 psi	$W^{1/3}$
thermal	10 cal/cm <sup>2</sup>	2 cal/cm <sup>2</sup>	$W, D^2$
penetrating radiation	5000 r (immediate) 700 r (delayed)	25-50 r	$W, D^2$
induced contamination	"	0.1 r/day	$W^{1.5}$
fallout	"	"	$W^{1/3}$
craters	less than 1.5 crater radii		$W^{1/3}$
fireball			$W^{1/3}$

The presentation was aided by a large number of "height of burst charts" for the various weapons effects. Some of the points brought out were the following: There is a "bonus factor" in the scaled effects (on a light steel frame structure, for example) of 1 MT versus those of 1 KT, due to the longer wind duration with the higher yield explosion. Against aircraft, dynamic pressure and penetrating radiation effects seem the most important. (For a 2 KT shot against a B-29 at 10,000 ft the 5000 r radiation envelope reaches out farther than the thermal and wind effects, except in certain directions in which the last have a greater lethal range. At 40,000 ft radiation has a larger lethal radius than any other effect.) With respect to surface contamination, induced activity predominates over fallout for high altitude bursts.

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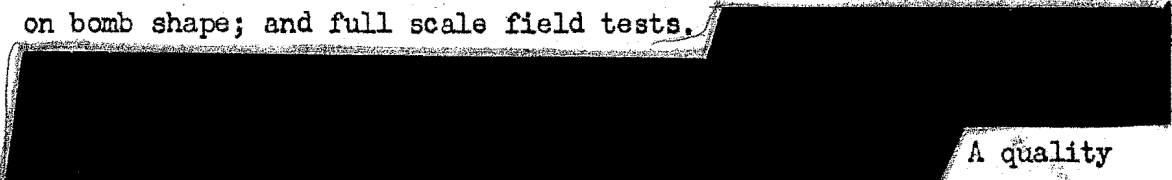
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Next, after a few questions, Dr. Walter MacNair discussed two subjects, product testing and the external initiator program.

Product  
Testing

Dr. MacNair contrasted product testing in the manufacture of nuclear weapons with the usual manufacturing situation in which items are produced for public use in large quantities. In the latter case large scale customer use supplies an overall statistical quality test on the item, a method not applicable to nuclear weapons. The Sandia Laboratory attempts to invent and develop substitutes for customer use testing; this effort accounts for about one third of the laboratory's total budget. The tests include laboratory determinations of the reactions of components to environmental conditions (impact, vibration, acceleration, climatic exposure); wind tunnel experiments on bomb shape; and full scale field tests.

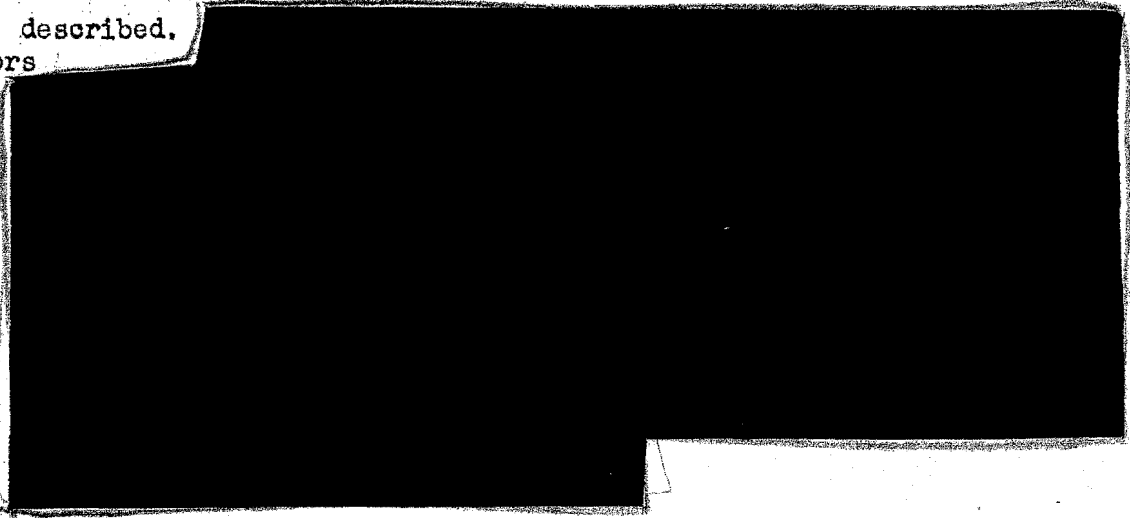
 A quality assurance program is carried out in the fashion of industrial spot-check inspections. Finally, each completed stockpile item is subjected to a continuing surveillance. The surveillance program begins with a complete non-destructive test when the item arrives in the stockpile. It is tested subsequently at intervals of not less than eighteen months. The present stockpile items are tested every five months, on the average. In answer to questions, Dr. MacNair said that components in the stockpile occasionally fail to meet specifications, but there is practically never a bomb that wouldn't work.

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The engineering status of the external initiator was next

External described.  
Initiators



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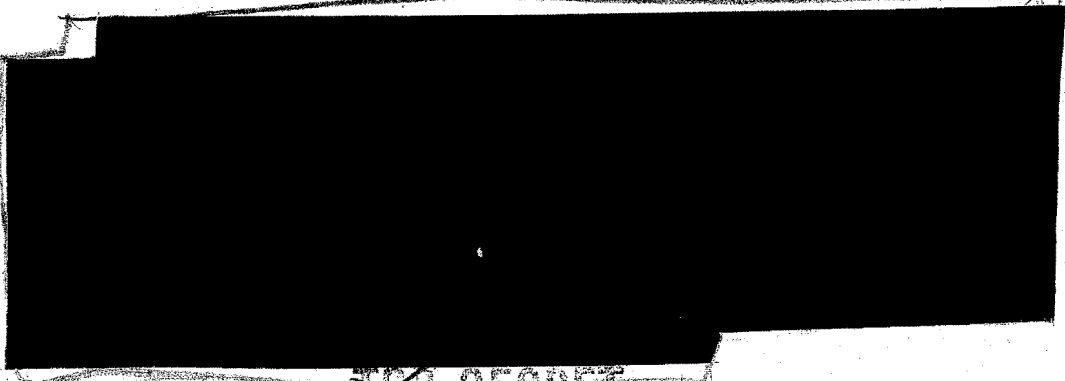
Dr. MacNair said that the present units have one chance in 170 of not performing properly. This can probably be improved by selection of components and by potting procedures. The interim solution is to use two units in parallel.

The present external initiators would require testing every 90 days. It is hoped that improvements will allow the tests to be put on a six month basis. The timing condensers require particular attention.



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In the question period the following points were brought out:



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A program is coming along on nuclear safeing of high yield weapons; however the military requirement has not yet been formulated.

Considerable interest was shown in proximity and contact fuzes. The proximity fuze program is being pushed; it is hoped that 400 will be available for experimental purposes by the end of the year.



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This session was adjourned at 3:10 p.m.

THIRD SESSION  
(July 13, 1954)

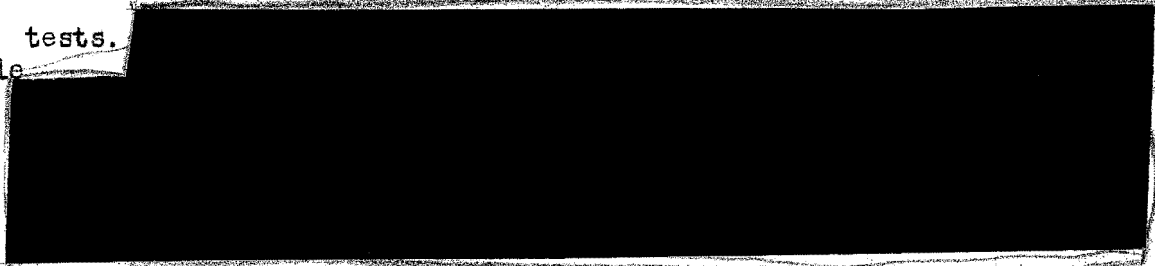
Los Alamos Briefings

The briefings were resumed at 9:05 a.m. in the S conference room at Los Alamos. Those present were: all members of the Committee except Dr. Wigner; the Secretary and Mr. Tomei; the other visiting groups (Appendix C); and members of the Los Alamos staff.

Dr. Bradbury opened the meeting by welcoming the visitors and introducing the LASL presentations.

Review of Castle tests.

In the first talk, Dr. Graves reviewed the results of the Castle



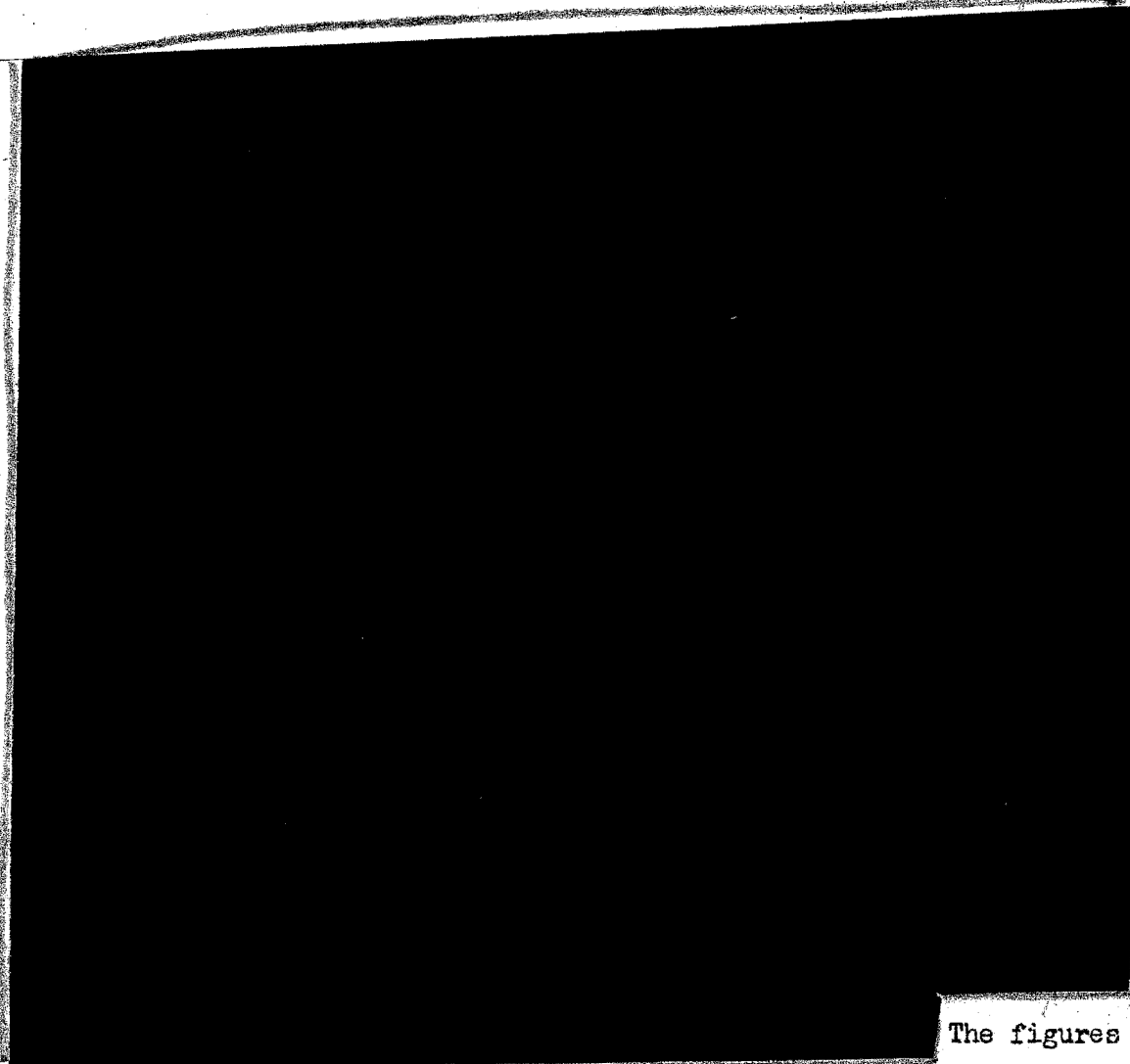
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The following tabulation gives essentially final results as to yield and alpha of the various shots.

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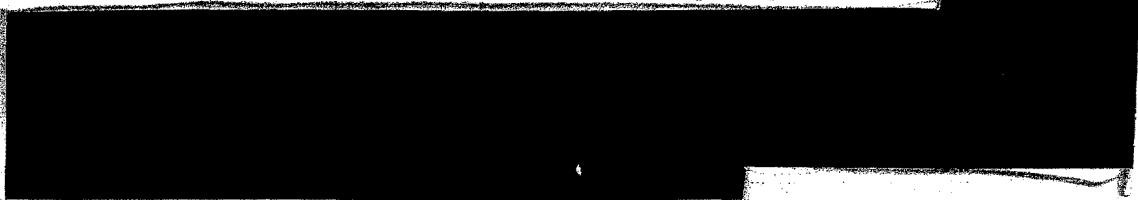
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The figures in parentheses are those which were predicted before the shots.

Radiochemical fast neutron detectors (by n,2n) placed at various points in the gadgets gave information about efficiency of burning at various points and about the compressions reached. There are some anomalies in these results which are not yet understood.



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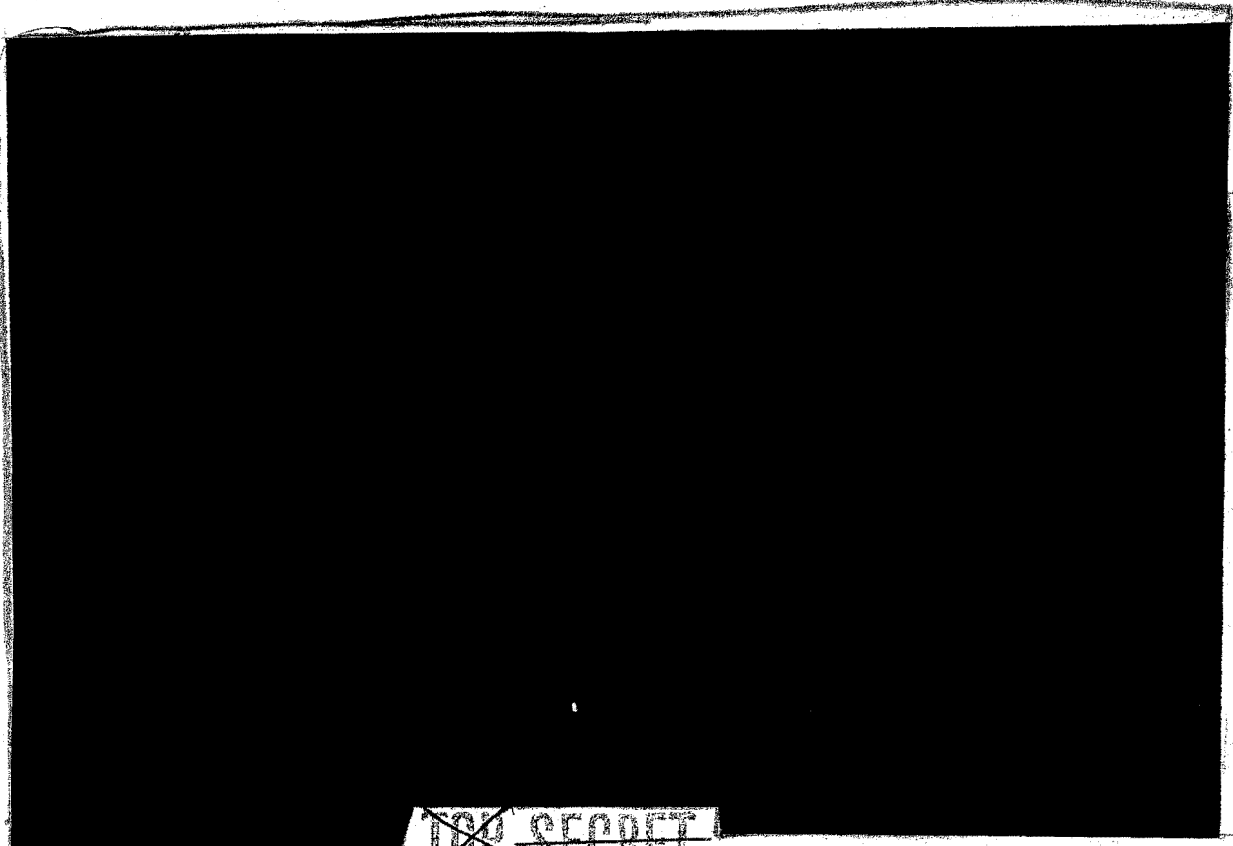
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Commenting on fall-out measurements, Dr. Graves mentioned difficulties in recovering the buoys and barges (after shot cancellations as well as after the actual shots) and said that he believed the best data would come from measurements made on the ocean water. (Mixing occurs in a turbulent surface layer of limited depth.) Fallout was sufficient to give an integrated dose greater than 400 r over an area of 5000-6000 square miles. The Navy wash-down system proved to be of great value on the vessels exposed to fallout. Dr. Graves believed that the integrated fallout from the barge shots was about the same from the land shots, but spread over a larger area.

Present Status  
IN  
Weapons

Next, Dr. R. E. Schreiber reviewed "the present status of weapons following immediately from the Castle operation". The following table gives the essential information.

Current  
Weapons



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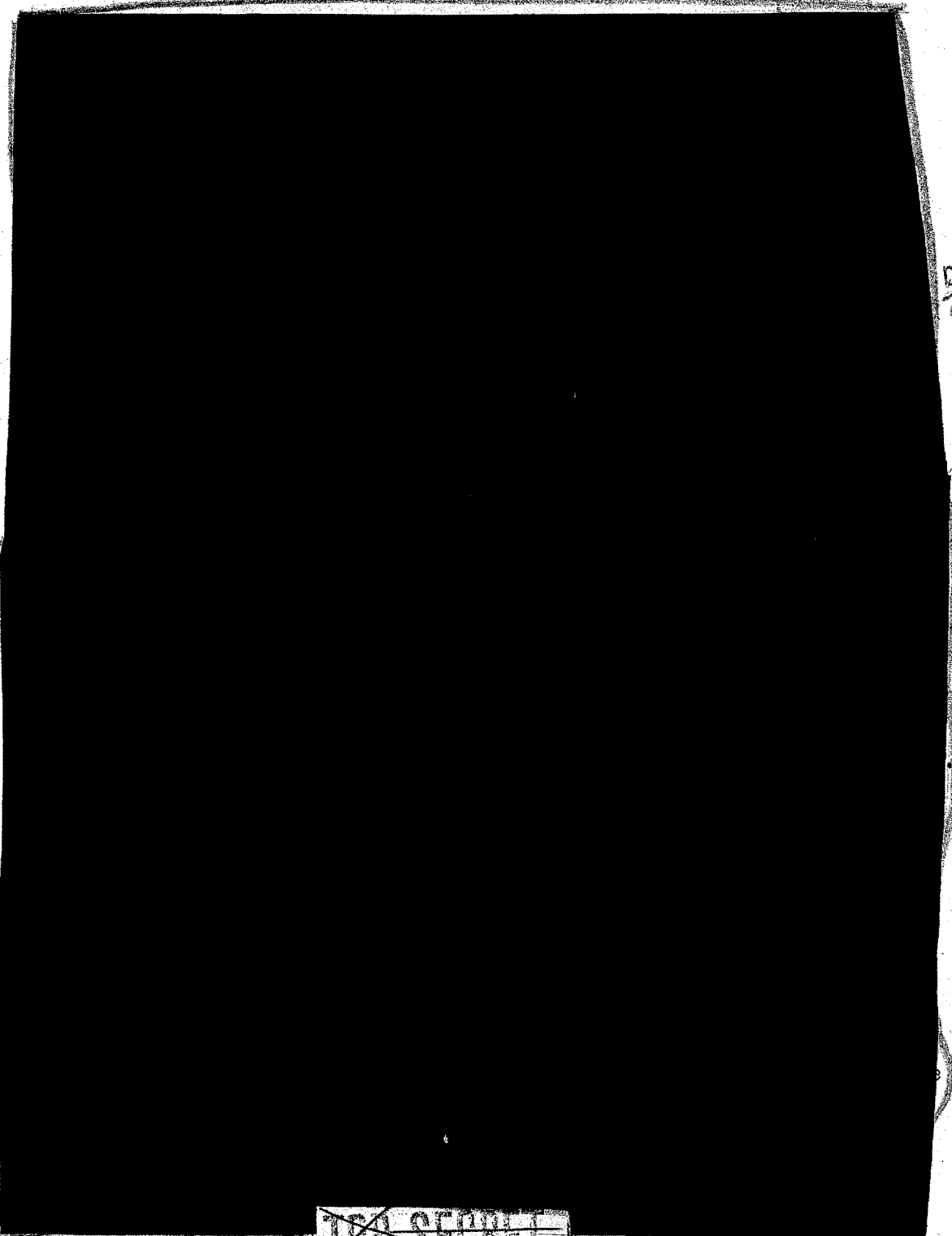


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The class entries above refer to guidance descriptions established by the military, and have the following meanings, approximately.

TN  
Weapon  
Classes

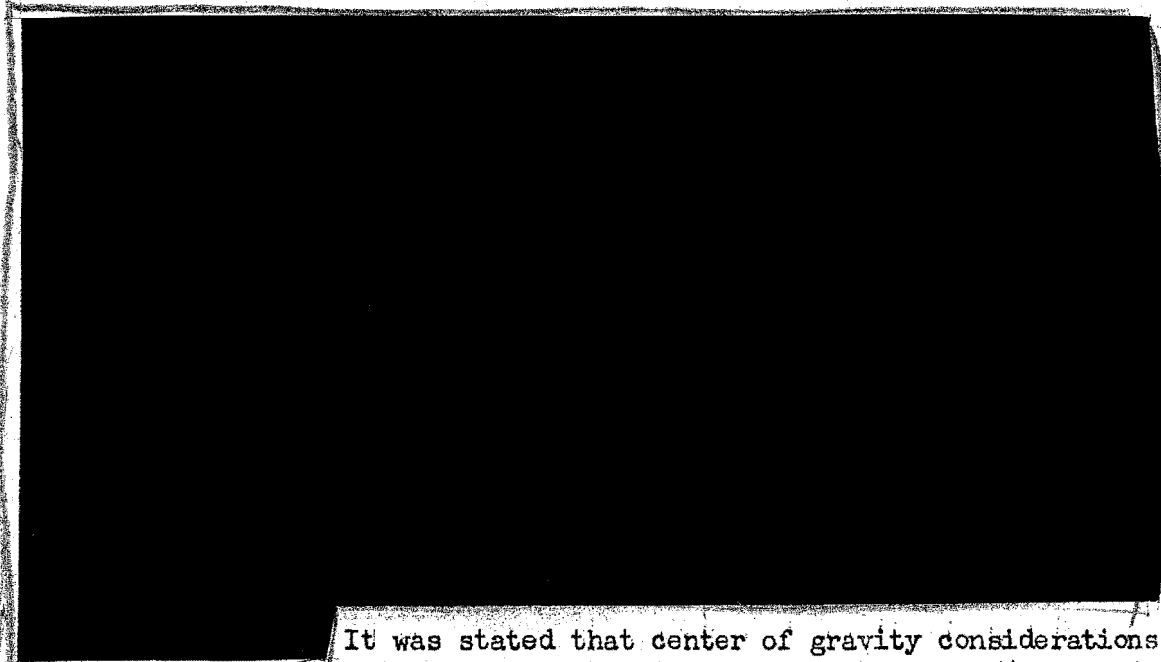


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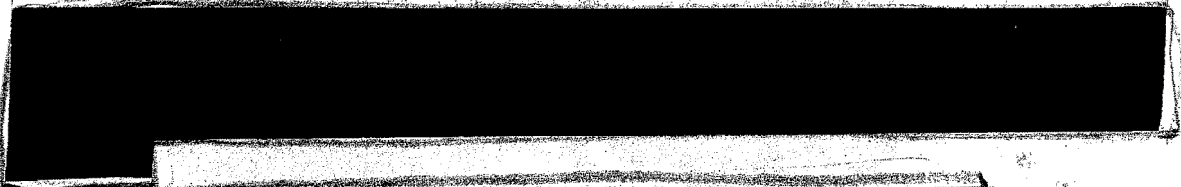
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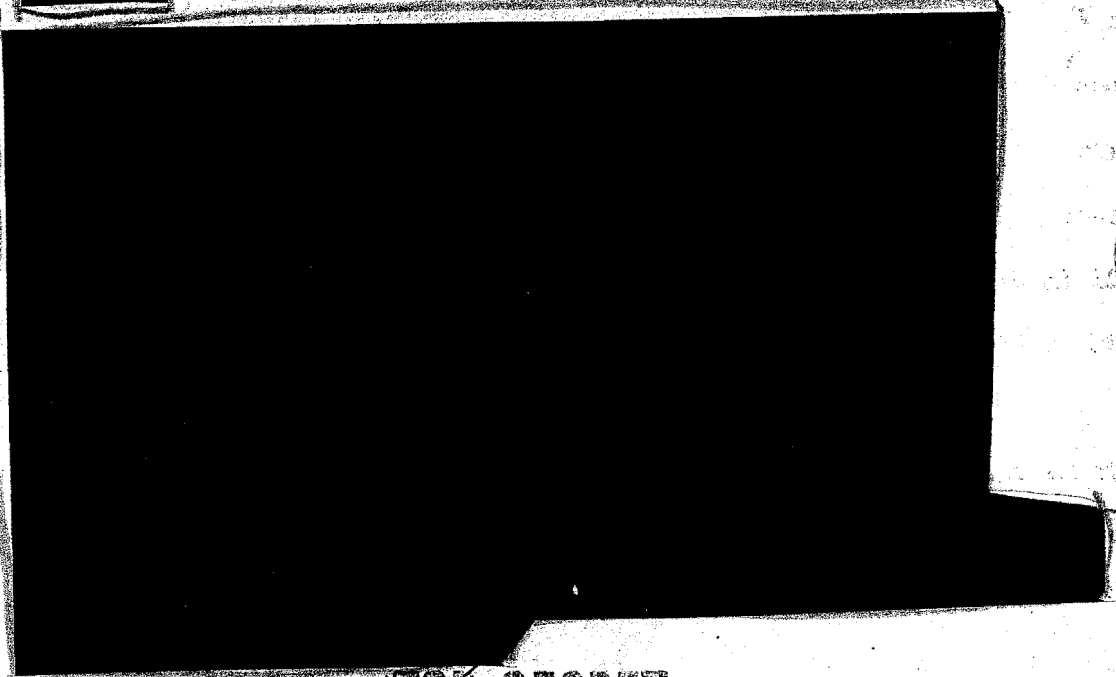
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It was stated that center of gravity considerations prevent the use of a light weight superstructure at this end. There was some discussion of the possibility of contact fuzing the TX-15.



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Equiva-  
lent  
Oral-  
loy  
Costs



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It is no longer to think that the... could have done more than the...  
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Bomb  
Weight

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Dr. Mark observed that in general the best type of case might be a very thin and light one far out from the fuel, lots of plastic being used.

Turning to the subject of primary bombs, Dr. Mark said that there are many open questions.

Primary  
Bombs

There is a recent Canadian report that the number of neutrons per fission has a broader distribution than previously believed. If this is true the predetonation probability estimates would be reduced.

Another problem for the future is to improve the design of the

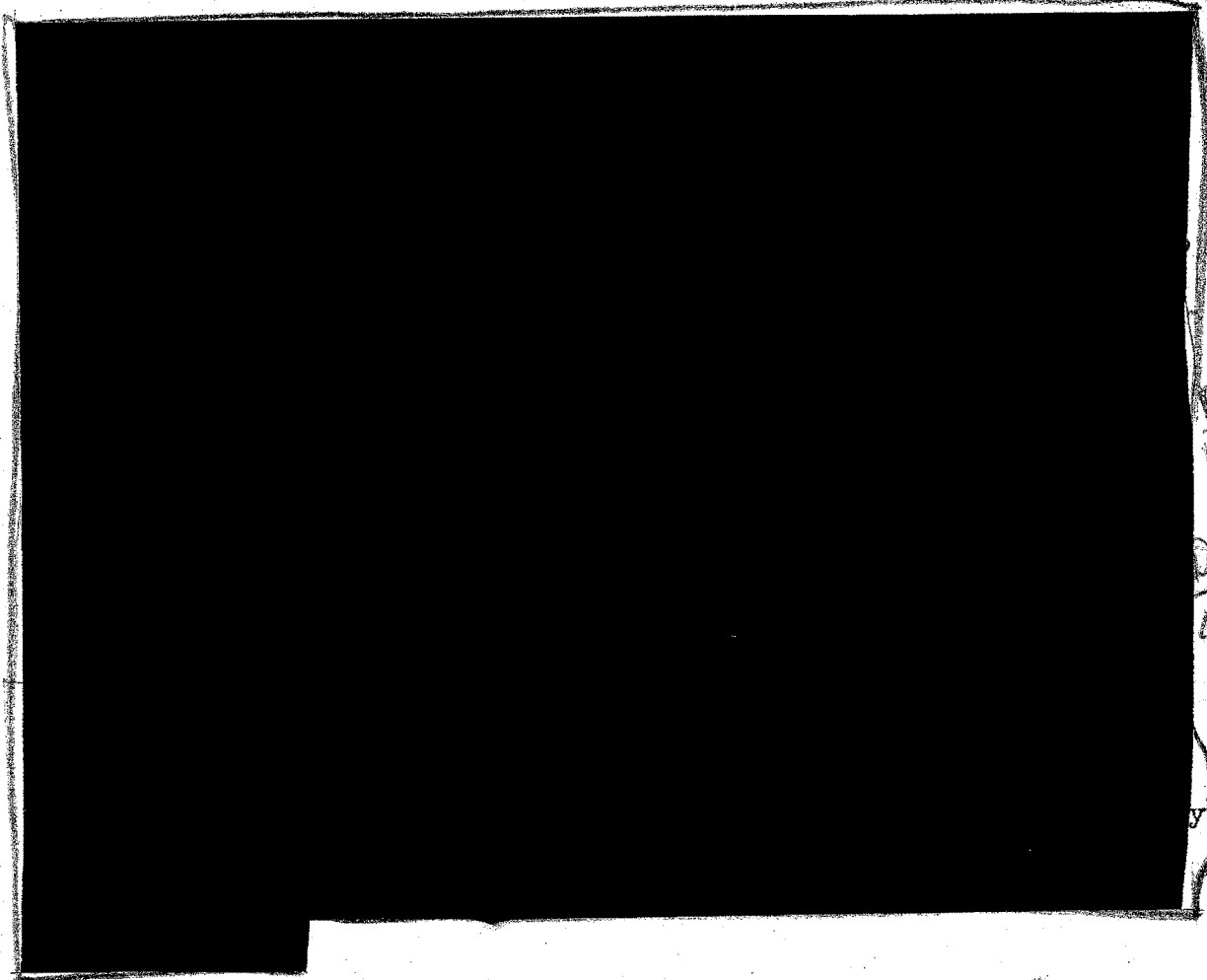
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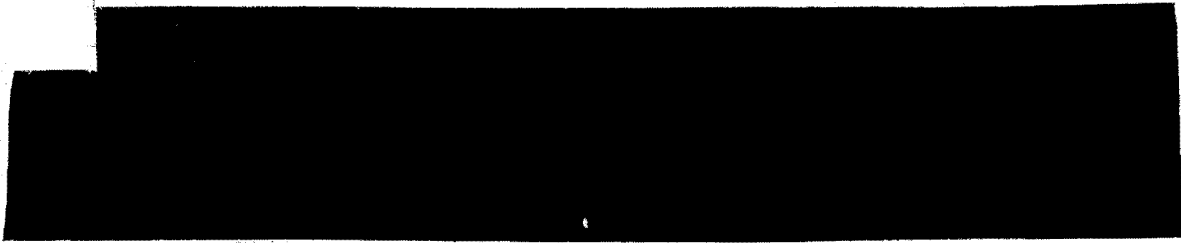
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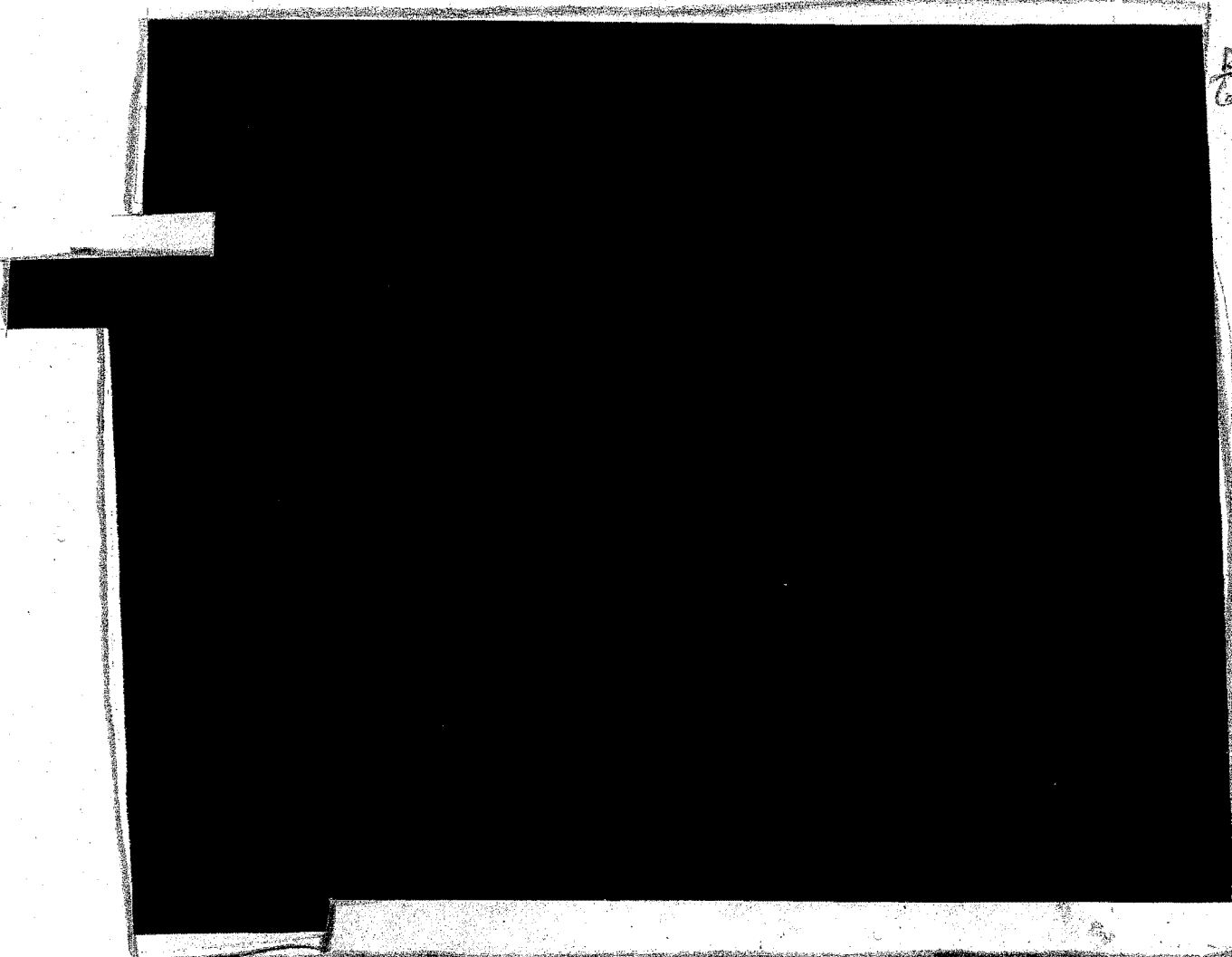
This session was adjourned at 12:15 p.m.

FOURTH SESSION  
(July 13, 1954)

The briefings were resumed at 1:30 p.m. Dr. Bradbury introduced Tactical Dr. Duncan MacDougall, who talked on the development of tactical weapons Weapons of small size and yield.



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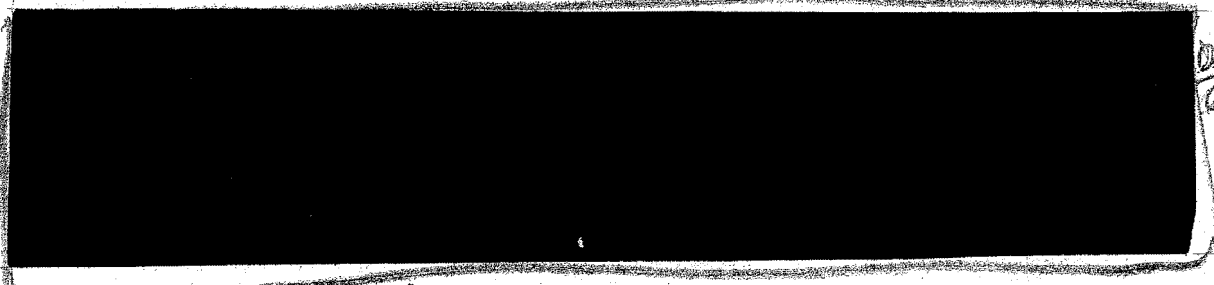
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It sacrifices cheapness for deliverability. On the other hand the need for large numbers will put a premium on low cost. In this region of size and yield the cost probably changes 15-20% per inch.



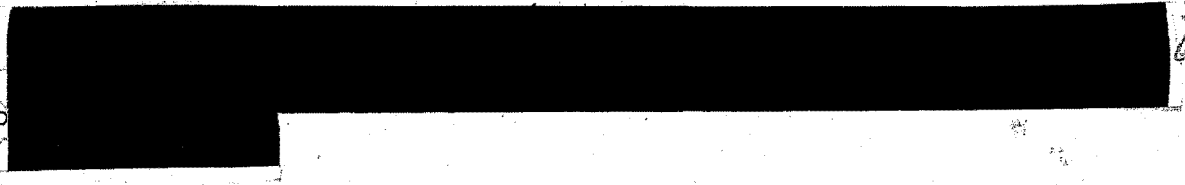
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22"  
Tactical  
Bomb

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Tacti-  
cal Bomb  
Tests

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6.1(a)

Dr. MacDougall mentioned work on an alternative scheme for external



Thermo-  
nuclear  
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nal  
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ator

initiation.

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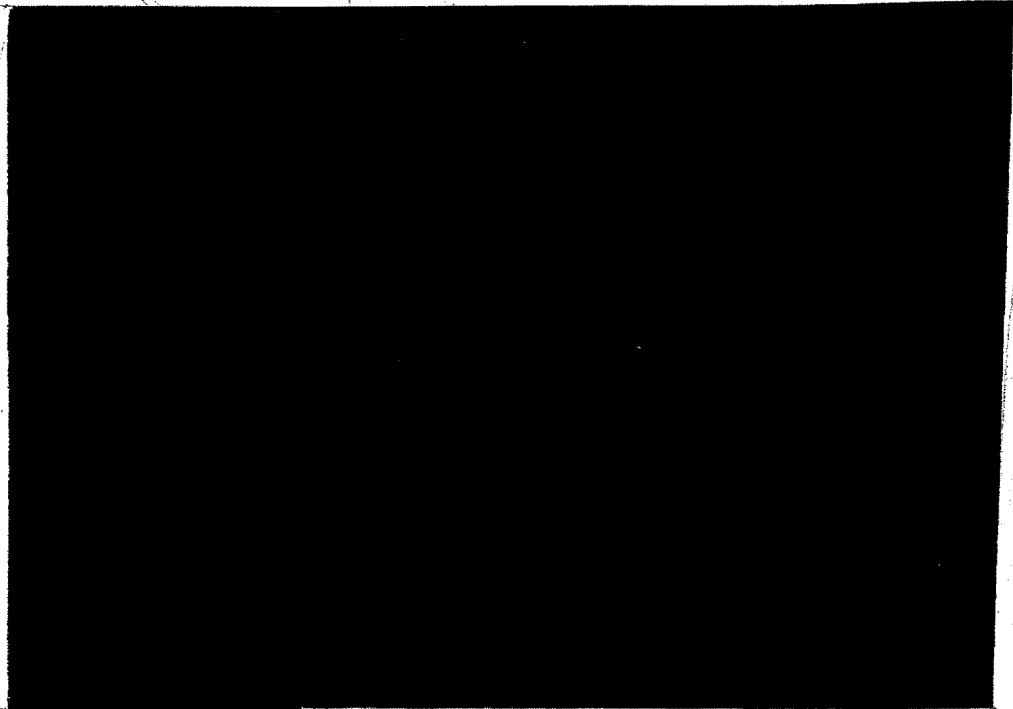
It would have the

advantage of simplicity in using the same X-unit as the main implosion system.

A 2 KT 30" weapon can be made now, with conventional methods. If there were real interest on the part of the military establishment in a weapon of this size-yield characteristics considerable savings in


fissionable material could be accomplished relative to the smaller weapons. However the degree of such interest is not at the moment clear.

In a brief question period the following points were brought out:



DOE  
G.I(a.)

However, the difficulty of measuring the exact neutron yield and the probability of large fluctuations seem inevitably to require overdesign.

The next presentation was by Dr. Schreiber on the subject of nuclear safeing. 

Nuclear  
Safeing

DOE  
G.I(a.)

It is assumed that any accidental detonation will occur at one point only, i.e. that the electrical safeing is completely reliable. The basic circumstance being worried about is crash on take-off, followed by fire. The following were given as possible criteria for nuclear safeing:



Safing  
Criteria

(1) alpha is never positive;

(2)

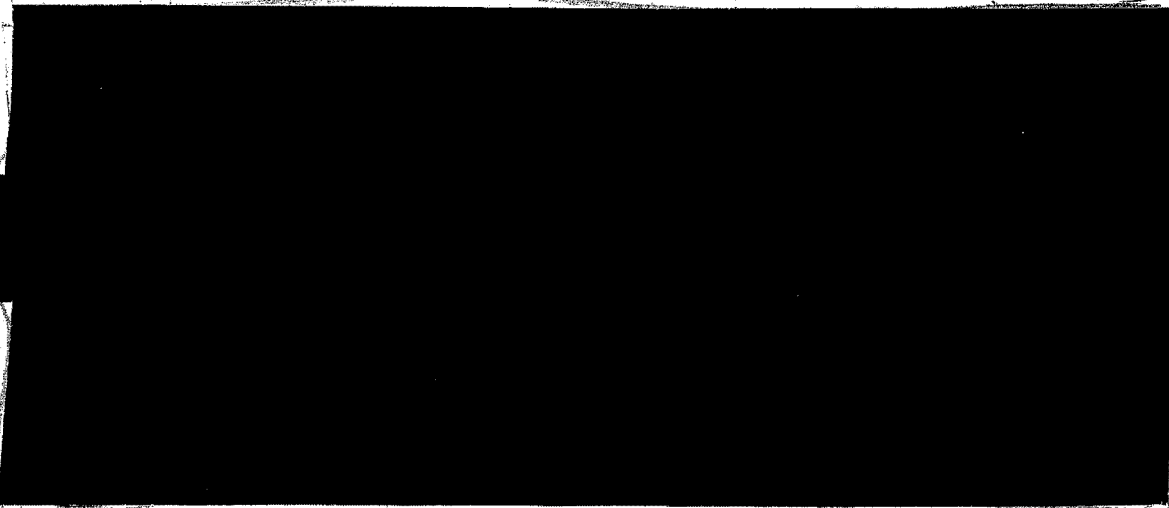


DOE  
6.1 (a)

(3) the nuclear explosion resulting from a one point detonation should not exceed that possible with the normal HE load carried by the aircraft;

(4) "safety by probability", i.e. that the net estimate of the compound probability for the sequence of events leading to an accidental nuclear explosion be acceptably small.

Dr. Schreiber favored (3), as a workable criterion. It would require that the maximum accidental nuclear yield be less than about five tons.



DOE  
6.1 (a)

Possible Nuclear Safety Test  
Dr. Schreiber said that an experimental one point detonation test would probably be proposed eventually.

At this point there was a brief coffee break.

Improvements in the 30 KT Region

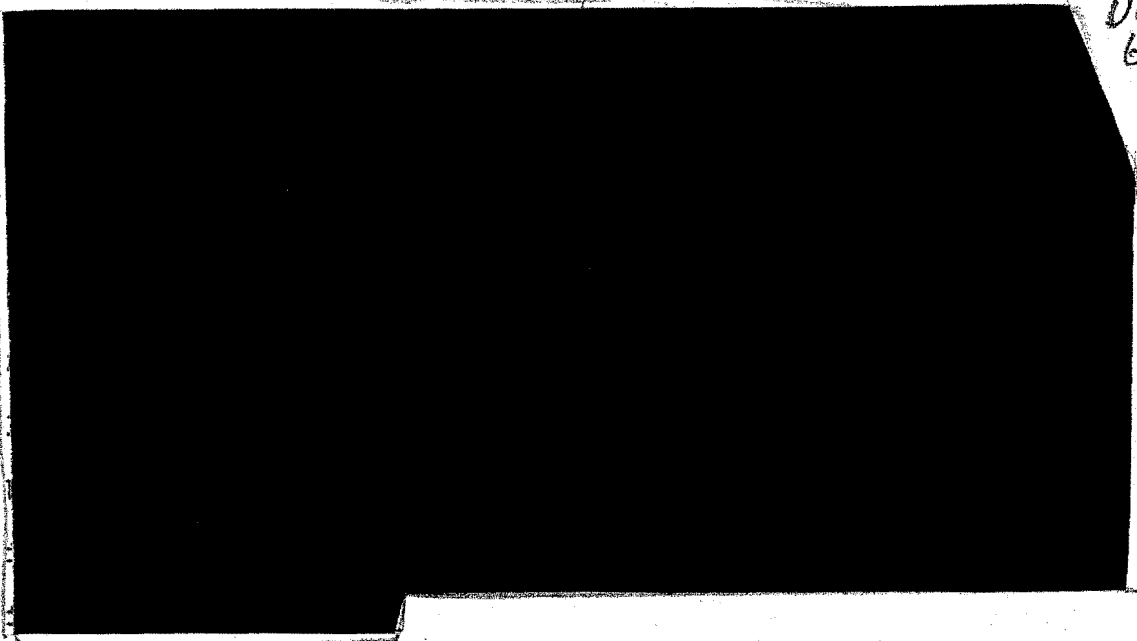
Next, Dr. MacDougall spoke on ideas for improvements in the 30 KT region.



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6.1 (a)

DOE  
6.1(a)

Recessed  
Detona-  
tors



It may be possible to modify the design of the pit and active  
Hydro- material so as to obtain hydrodynamic improvements leading to higher  
dynamic compressions, at which considerable gains could be achieved from  
Im- improvements--  
provements--  
Exter- external initiation.  
nal  
Initia-  
tion

DOE  
6.1(a)

[Redacted]

DOE  
6.1(a)

Possible Tests

It is not intended to push these developments for a test of Teapot, but a test might be made in about a year and a half.

Weapon Use of Dirty Plutonium

If "dirty" plutonium (high 240 content) becomes cheap and plentiful through production in power reactors, it is of interest to consider how it might be used in weapons. Dr. Mark made a few comments on this subject.

[Large Redacted Area]

DOE  
6.1(a)

DOE  
6.1(a)

DOE  
6.1(a)

Pre-detonation Probabilities

An obvious application would be in the 2 KT field. In general, hydrodynamic improvements could reduce the predetonation probabilities.

[Redacted]

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6.1(a)

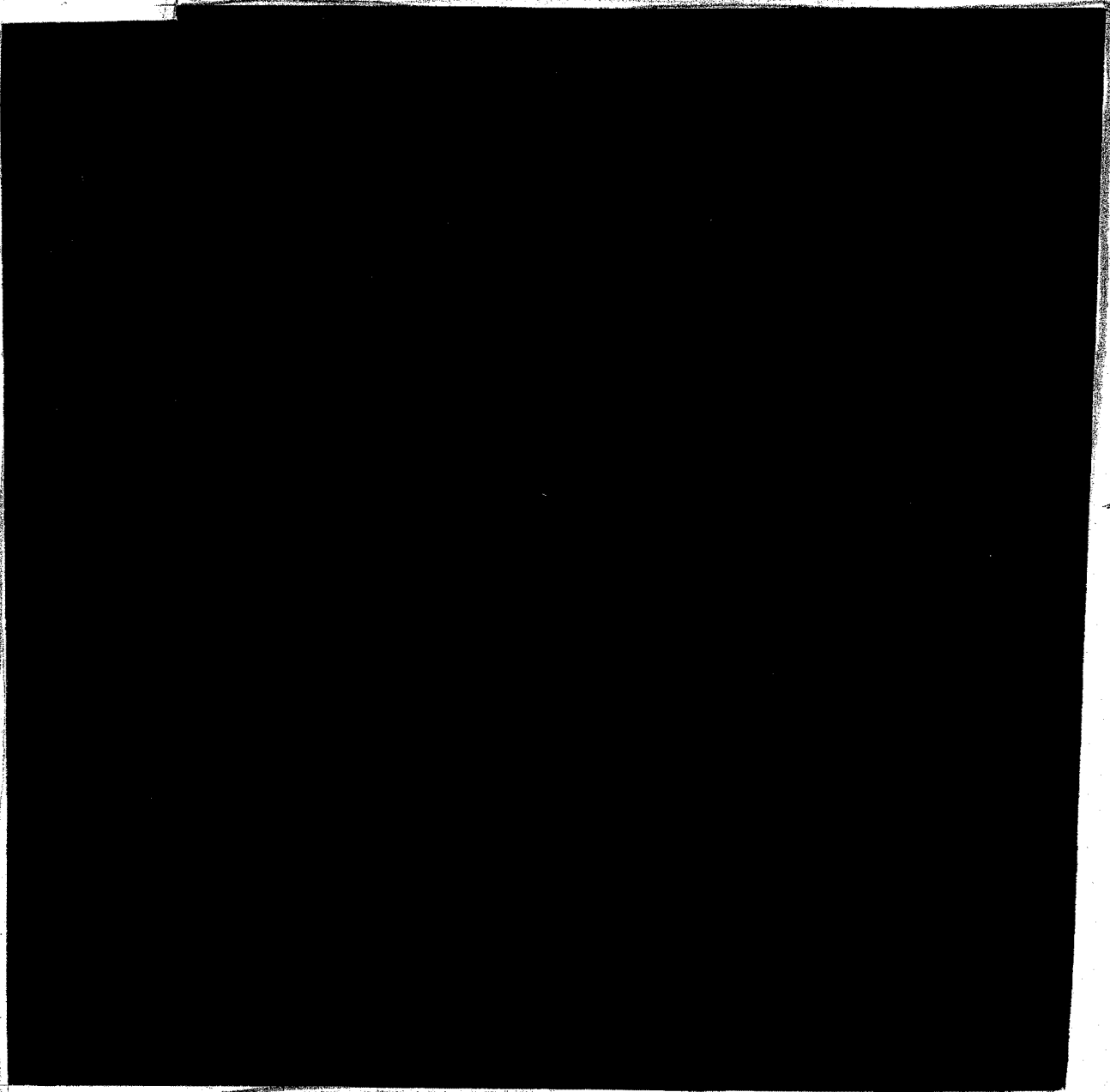
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-25-



DOE  
6.1(a)

Dirty plutonium could obviously have been used!



DOE  
6.1(a)

DOE  
6.1(a)

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-26-

Dr. Schreiber emphasized that the figures for the two sizes were calculated on different bases and hence could not be directly compared (it is not valid to conclude that the 7" is better than the 8").

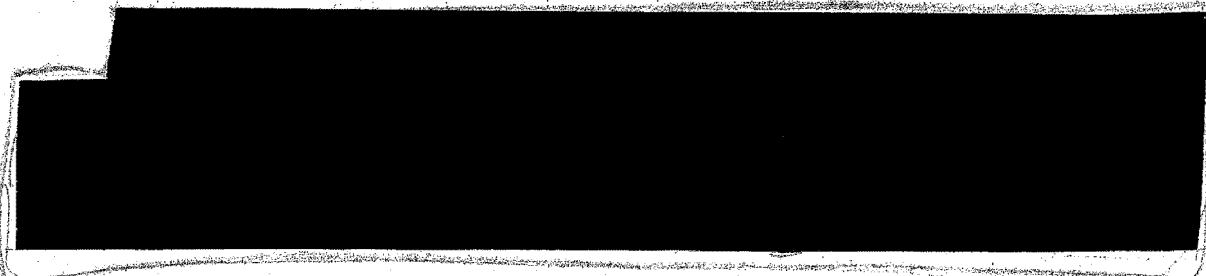
It is uncertain whether boosting would lead to any gains in these designs.

At 4:25 p.m. this session was adjourned.

FIFTH SESSION  
(July 14, 1954)

The meeting began at 9:00 a.m. All members of the Committee except Dr. Wigner were present. The Secretary and Mr. Tomei were present. The other groups involved in the briefings were also present.

Test Programs Dr. Graves gave the first presentation, on the subject of the test programs. After reviewing operational and safety problems, particularly as affected by weather, he outlined the thinking with respect to the next tests -- Teapot (Nevada, 1 March '55), Post-Teapot (Nevada, 1 September '55), and Redwing (Pacific, 1 March '56).



Consideration is also being given to a group of shots proposed by the military: a 2 KT high-altitude (40,000 ft) shot for effects studies bearing on ground-to-air uses; a 15-30 KT tower shot for effects studies on drone planes; and a 1 KT underground (65 ft) shot, bearing on demolition applications. The Federal Civil Defense Agency has two

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-27-

proposals, an effects test on shelters and an "open" shot (meaning open to large numbers of visitors). These will probably be combined with other tests. Dr. Graves remarked that it was a long list, with only limited possibilities for making combination shots. He said it was proposed to group together the shots of different organizations.

[REDACTED]

DOE  
6.1(a)

Dr. Graves said that a good predetonation or beryllium tamper experiment had not been thought of yet.

[REDACTED]

DOE  
6.1(a)

There was some discussion on: operational problems in tests, fallout from air drops, the possibility of even larger, multimegaton shots, the importance (pro and con) of doing a good predetonation experiment.

At 10:40 a.m. there was a coffee break; the meeting resumed at 11:00 a.m.

At this time Dr. Bradbury delivered a critique on the philosophy

Philosophy of Weapon Design

[REDACTED]

DOE  
6.1(a)

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[REDACTED]

DOE  
6.1(a)

He expressed concern that this thinking -- "we don't know what we want to do but want to be able to do anything" -- is no longer relevant or appropriate.

[REDACTED]

DOE  
6.1(a)

DOE  
6.1(a)

\*The A to D classes appear to cover the strategic area.

Dr. Bradbury spoke for abandoning the array concept. He suggested, instead, additional classes to cover the tactical area.

[REDACTED]

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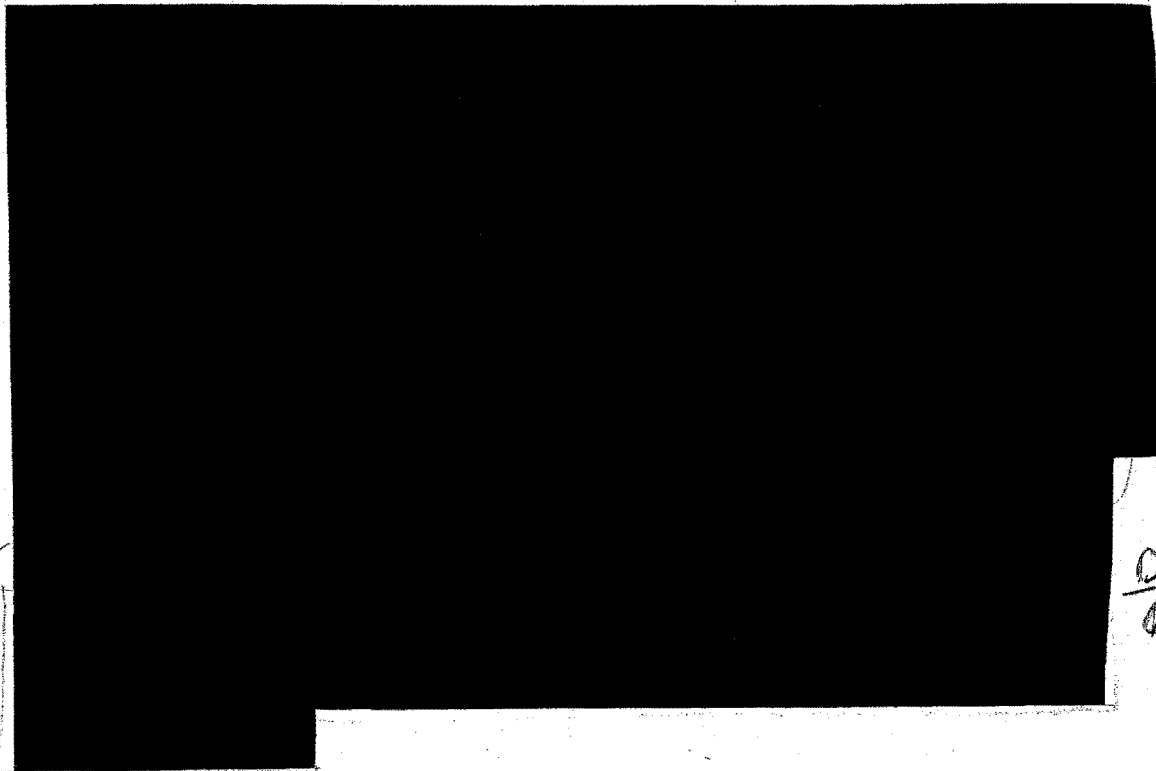
The real point is to fix on a device with characteristics that people want, and then to make that weapon the best we can.

[REDACTED]

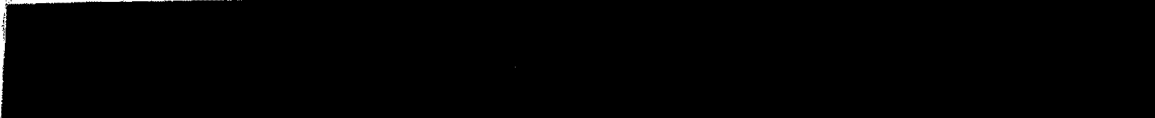
DOE  
6.1(a)

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-29-



\*  
The gain to be achieved from abandoning the array concept could be an increase in the number of weapons by a factor of  $1\frac{1}{2}$ - $2\frac{1}{2}$ , without the use of boosting. If one accepts the further specialization of boosting, the factors are probably larger still.



There was an animated discussion following Dr. Bradbury's remarks. One point in particular was whether the gap between 30 KT and 1 MT was without interest. Opinions pro and con were expressed. No one present, however, voiced any dissent of principle with the changes in attitude proposed by Dr. Bradbury.

This session was adjourned at 12:05 p.m.

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-30-

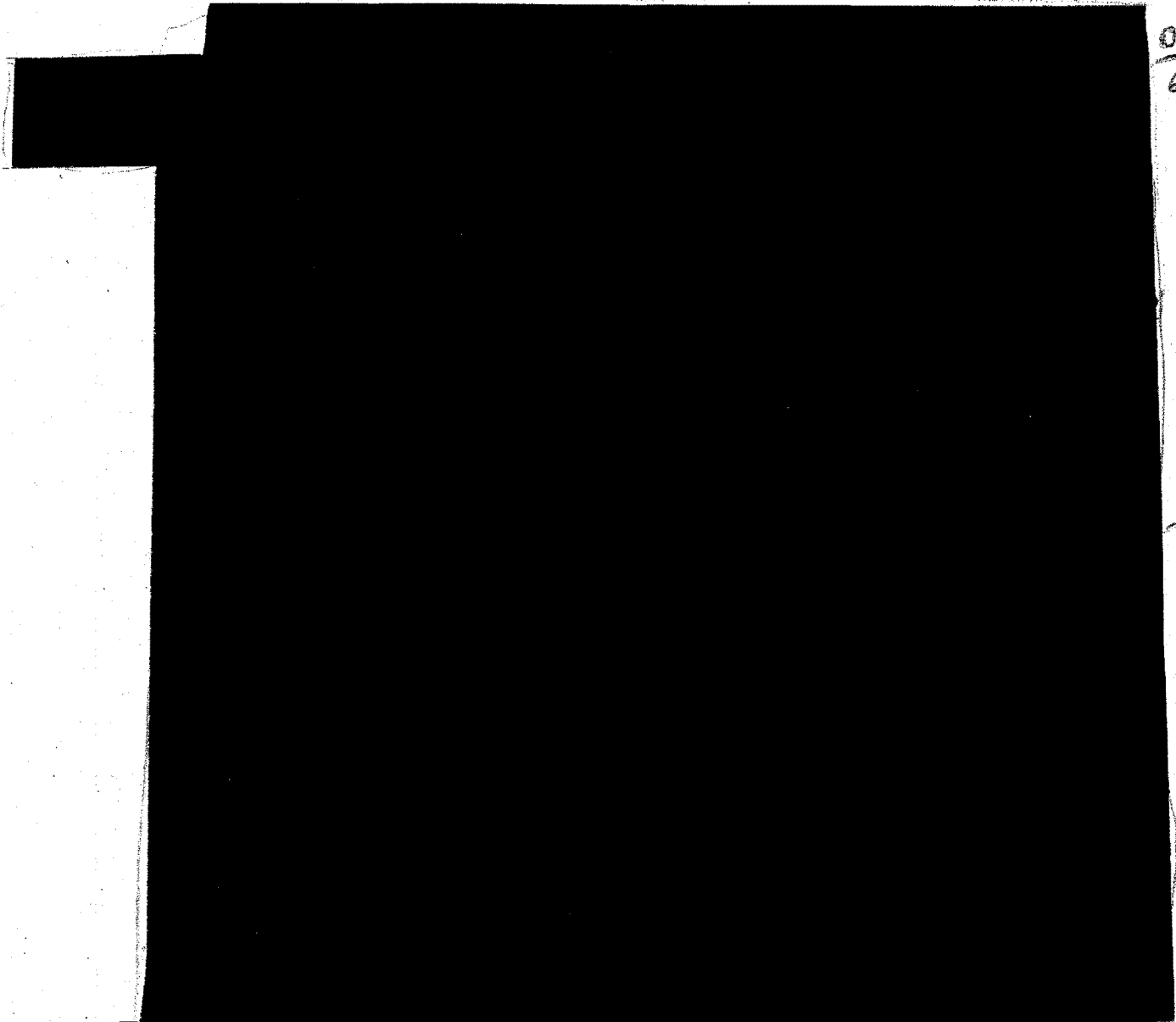
SIXTH SESSION  
(July 14, 1954)

The final session of the briefings was devoted to Livermore matters.

Liver-  
more  
Brief-  
ings

The meeting began at 1:30 p.m.

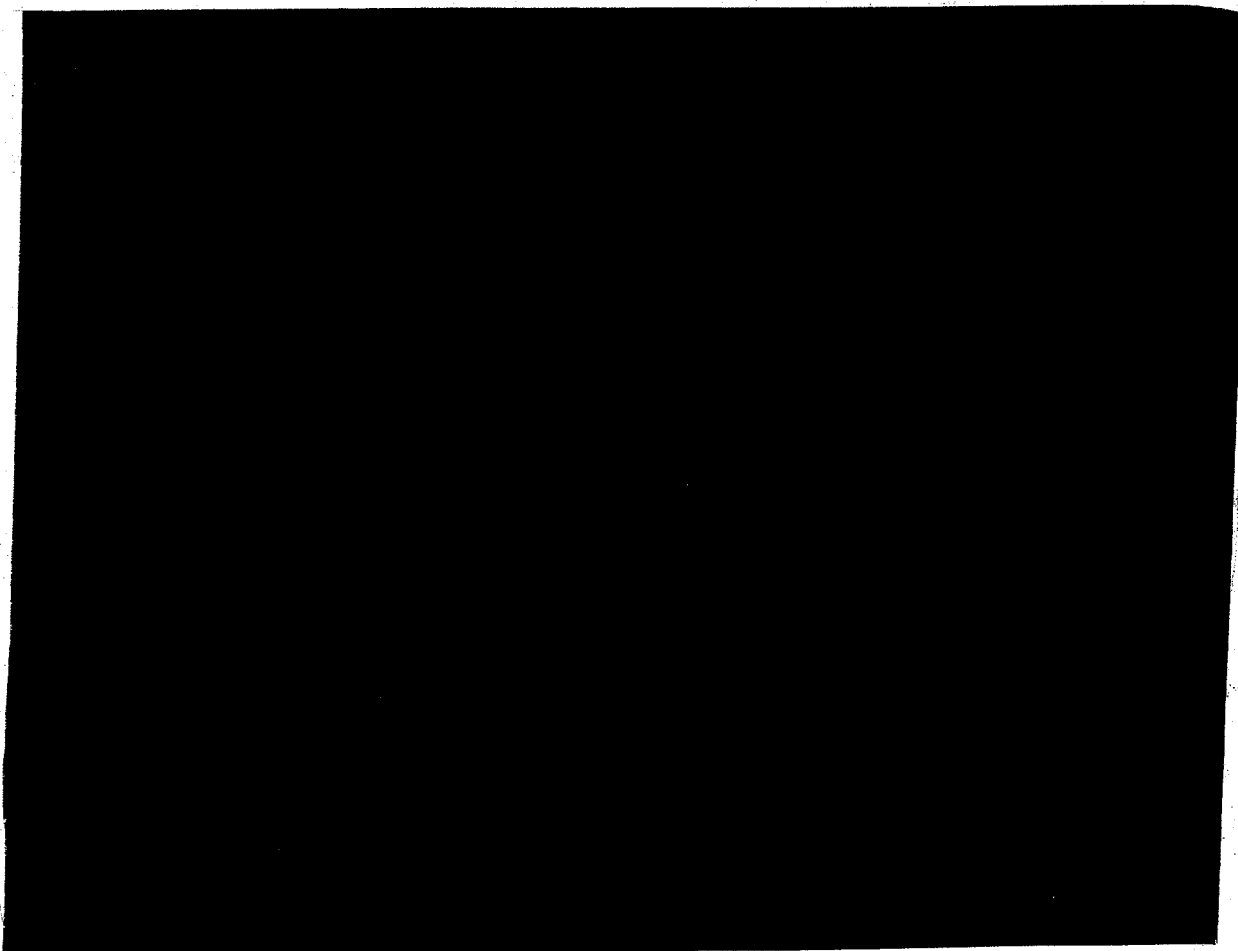
After brief comments by Dr. E. O. Lawrence, Dr. Edward Teller reviewed Livermore's thermonuclear program.



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DOE  
6.1 (a)

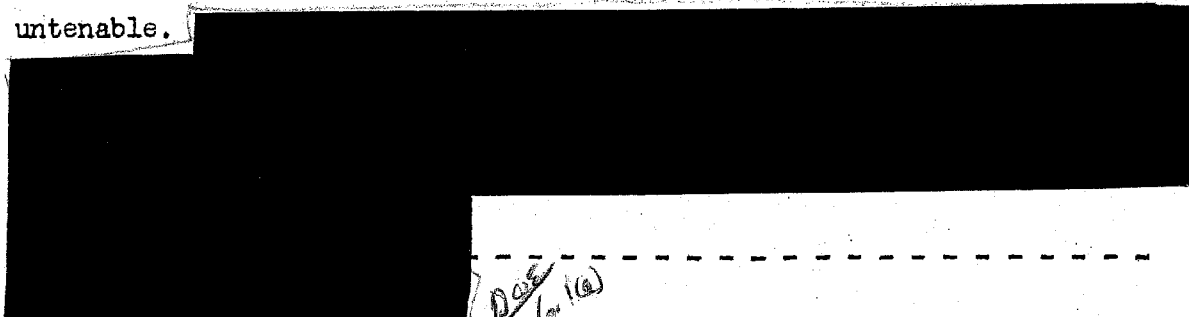
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DOE  
6.11c

Dr. Teller then went into a detailed analysis of why there happened to be so many more neutrons than expected in the neighborhood of the secondary.

A very large number of possible explanations (about a hundred) had been explored by the group at Livermore. Several involving the premature onset of thermonuclear reactions were mentioned; these were considered untenable.



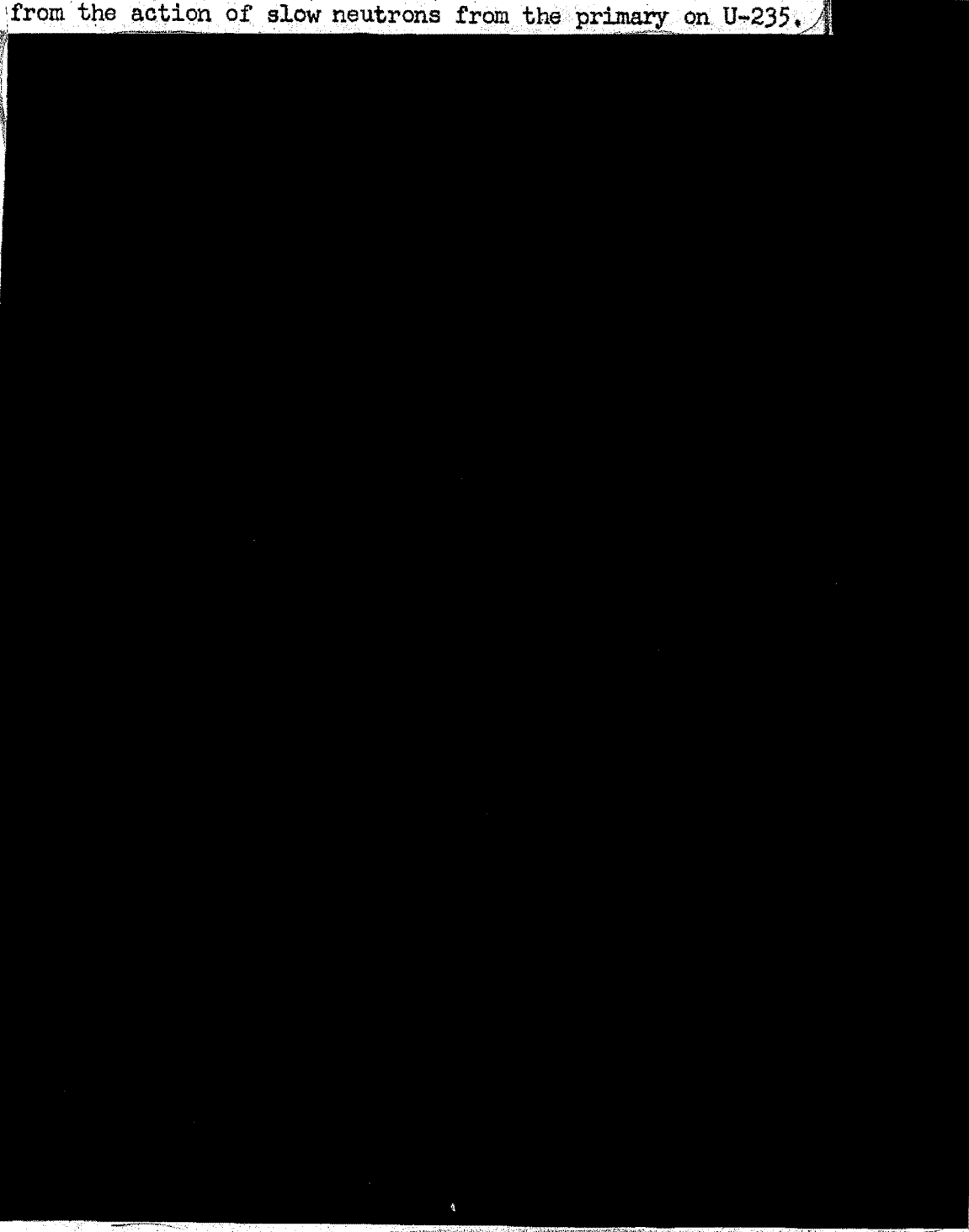
DOE  
6.11c

DOE  
6.11c

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-32-

The explanation believed most probable involved the generation of fast neutrons in the neighborhood of the secondary. This could result from the action of slow neutrons from the primary on U-235.



Liver-  
more  
Thermo-  
nuclear  
Plans

Possible  
Tests

DOE  
6.1.10

DOE  
6.1.10

DOE  
6.1.10

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Then,

DOE  
6.7(a)

[REDACTED]  
perhaps, a full scale test might be made at Redwing. The best fuel mixture hasn't yet been settled on.

Returning to the subject of light cases, Dr. Teller mentioned a "wild idea" of using no case at all, just air. [REDACTED]

DOE  
6.1(a)

Turning to another topic, Dr. Teller said he wished to comment on the possibility of much bigger bangs. [REDACTED]

DOE  
6.1(a)

[REDACTED]

Dr. Teller

DOE  
6.1(a)

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said the gadget would not present any appreciable problem aside from  
Possible the Gnomon. If the latter begins to look good, Livermore might want  
Gnomon Tests to test it.

There was a coffee break at 2:55 p.m.

At 3:15 p.m. the meeting was resumed. Dr. York spoke about Liver-

Small more's small weapons program.

Weapons,  
Liver-  
more

DOE  
G. 1(a)

Linear  
Implosion  
Gadgets

DOE  
G. 1(a)



Characteristics of some various sizes were given as follows.

DOE  
G. 1(a)

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-35-

Some shots have been done for Livermore by LASL. In the 10" diameter a velocity of one millimeter/microsecond was obtained. Various calculations about shock, reflected shock, and the time behavior of alpha were mentioned.

  
 He also mentioned, in reference to predetonation, that if reproducible yields were insisted on, the yields would be a few hundred tons. Composites do not appear much cheaper, but would reduce predetonation somewhat.

In reply to Dr. MacDougall, Dr. York said that the weights and lengths given included the warhead only, with no electronics, except that the 240 lb figure was for a complete 8" shell.

Possible  
Tests

A test shot program for this development has not yet jelled. The current thinking is to make one quite conservative shot (not a prototype), to be followed by a second shot.

Hydride  
Program

In the hydride program, Livermore was exploring the possibilities of substituting  $UH_3$  for U metal. The critical mass is smaller with hydride but the multiplication factor is less. So far, it appeared that in a 16" diameter about half the yield could be obtained, at half the price. However, the situation was very uncertain. Various fabrication and handling methods are being investigated.

There were a number of questions and some discussion about the ideas Dr. York had reported.

This final session of the combined briefings closed at 4:20 p.m.

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SEVENTH SESSION  
(July 14, 1954)

The Committee met in executive session at 8:10 p.m. All members were present except Dr. Wigner. The others present were the Secretary and Mr. Tomei.

The topic of discussion was the aircraft reactor program, in view

Aircraft of:

Nuclear  
Propul-  
sion  
Program

- (1) The comments in the Chairman's Report of the 40th Meeting (letter I. I. Rabi to Lewis L. Strauss, June 3, 1954, item 2) to the effect that the Committee was favorably impressed by the plan to marry the ORNL-Pratt and Whitney programs for the "fireball propulsion mechanism", had heard of the GE and NDA proposals, and suggested a study of the program as a whole to avoid unnecessary duplication and to sharpen the objectives.
- (2) The request in the pre-meeting letter (H. D. Smyth to I. I. Rabi, July 9, 1954) for an elaboration of these comments.

Dr. Rabi asked whether he had correctly expressed the Committee's position in (1) and received assurances that he had.

Mr. Murphree remarked on some considerations by the Atomic Energy Panel of the DOD which had also felt a study would be in order.

Attitudes of the Air Force

Dr. Rabi asked Dr. von Neumann to set forth his understanding of current attitudes of the Air Force, in the light of his recent conversation with Mr. Zimmerman, head of the Operations Research Section of SAC. Dr. von Neumann responded with the following remarks.

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- (1) It is realized that the main mission is now anti-air force, e.g. destruction of aircraft on the ground, and not industrial destruction. All else is secondary.
- (2) There is great interest in large weapons. The problem of the destruction of air fields is of enormous urgency. Large scale cratering is required. Even empty air fields would be bombed.
- (3) The weapons which now exist can essentially fulfil their needs. The carriers leave much to be desired.
- (4) They are very interested in contact fuzing, and unhappy that this is not receiving more attention.
- (5) Ballistic missiles may become very important, but they will not supplant aircraft. At least one more heavy plane past the B-52 is needed. Nuclear propulsion is very much desired; it is considered more important than bomb development.
- (6) The dispersion ideal would be about five planes on an air field. Considerable dispersion may be expected in the next 2-3 years.
- (7) Speed may not be decisive in a heavy plane. High altitude may be more important.

There was a lengthy discussion on the proper attitude for the GAC to take with respect to nuclear aircraft development and its organizational arrangements. Most of the members were prepared to endorse the great urgency of this development. Mr. Murphree, Dr. Rabi, and Dr. von Neumann were particularly inclined to this view. Mr. Whitman, on the other hand, tended to take a more cautious position. He said he was in favor of a nuclear powered plane but was not convinced it should have first priority.

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The Committee found no reason to revise its conclusions as expressed in the Minutes and Chairman's Report of the 40th Meeting. The present problem appeared to be one of emphasis, and of the best organizational arrangements for achieving the desired ends. It was tentatively decided that the Reactor Subcommittee would study the situation, and visit Oak Ridge and GE, before the next meeting.

The following two paragraphs convey an idea of the discussion which took place.

Dr. Rabi said that he had changed his opinion on the urgency of this development in view of the way the Air Force now understands its mission. He cited a discussion which Dr. Fisk and he had had with General Bunker on the need for a long flying air platform, one aspect being its possible use in very early warning. Long range rockets may not come in in time for the air field demolition missions. Mr. Whitman felt that one way missions would be inevitable, and therefore that chemically powered planes would serve. Dr. von Neumann said that it will be seven or eight years before intercontinental missiles furnish a slight retaliatory capacity, ten years before they supplant manned planes. Therefore another generation of manned planes is needed. Nuclear fuel will be an important supplement to chemical.

Dr. Rabi wondered whether the proposed organizational arrangements, involving Oak Ridge, GE, and NDA, really would give the best way to get the best effort behind a high priority program. Would a special organization set up for the purpose be more effective? He worried that a collection of little projects would tend to dissipate effort, and

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-39-

would fail to concentrate enough push on the program. Mr. Whitman observed that the best Oak Ridge people were not on the aircraft reactor program; it seemed to be grudgingly carried because of the Laboratory's commitment. He did not feel that the program should take priority over the homogeneous reactor development at Oak Ridge. Dr. Rabi and Mr. Murphree disagreed, pointing out that Oak Ridge's responsibility is relatively much less in the power program than in the aircraft reactor program -- perhaps a fifth vs a half. Mr. Murphree felt there should be two, or perhaps three, concurrent developments; the art is still too fresh for the job to be left with a single organization. The responsibilities assigned to GE could not be taken away at this stage, but their effort might be pepped up. The Oak Ridge-Pratt and Whitney combination is a logical one. However, Oak Ridge is probably not going to push hard enough; perhaps the responsibility should be given to Pratt and Whitney. A third logical combination would involve NDA, with responsibility for experimental work assigned to one of the laboratories.

Dr. von Neumann left during the above discussion, at 9:00 p.m.

After this discussion, Dr. Rabi brought up a matter concerning the distribution of the Minutes. The General Manager had asked whether they might be shown to Commission staff concerned with certain matters discussed by the Committee. Dr. Rabi had advised the General Manager not to do so, commenting that the Chairman of the Committee could not approve such a step without authorization from the full Committee. There was some discussion on this matter. The standing restriction on

Distribution  
of GAC  
Minutes

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-40-

distribution of the Minutes and access to them was felt necessary in order that the members should feel free to speak frankly and freely in their discussions, and in order that the record might preserve as much of the character of these discussions as possible. The Chairman's Reports to the Chairman of the Commission, on the other hand, are the property of the AEC; and their distribution is determined by the AEC. The Committee unanimously agreed to continue its standing restrictions on distribution of the Minutes and access to them -- and specifically, in the case in point, that the Commission staff should not have access to them.

This session was adjourned at 9:35 p.m.

EIGHTH SESSION  
(July 15, 1954)

The Committee met in executive session at 9:05 a.m. All members were present except Dr. Wigner and Dr. von Neumann. The Secretary and Mr. Tomei were present.

Minutes of the 40th Meeting

Attention was first given to the Minutes of the 40th Meeting. Dr. Wigner had submitted a correction; this was accepted. Other members also had some corrections. Final approval was postponed until later.

Letter re Dr. Oppenheimer

Next, Dr. Rabi read to the Committee the letter which he had written on June 14 to the Commissioners on the case of Dr. Oppenheimer. Since it was necessarily semi-official because of his own position he felt it proper to ask whether the Committee wished it incorporated in the Minutes. Various expressions of approbation for the letter were made; the Committee agreed not to make it a part of the Minutes.

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-41-

Next, the Chairman asked Dr. Libby for comments on the progress of Project Sunshine. Dr. Libby briefly reported that fallout over the continents from the Castle series had been very large, that it had not yet shown up in food and human samples. It was expected to show up in vegetation and food by Thanksgiving, and in humans by Easter. Rise by a factor twenty was anticipated. The project is under the AEC Division of Biology and Medicine. Dr. Libby has responsibility for food and human assays, Dr. Kulp and Mr. Eisenbud for fallout measurements.

At 9:30 a.m. the following persons joined the meeting: Mr. Strauss, Dr. Bradbury, Dr. Mark, Dr. Schreiber, Dr. Froman, Dr. Jane Hall, Mr. Quinn, Dr. Fine, and General Fields. Dr. von Neumann also entered at this time. Dr. Max Roy entered a few minutes later.

Dr. Libby went on to say that the subject was likely to become a matter of more and more urgency. The effort was being expanded somewhat; further expansion might be needed, depending on results which should be in by the end of the year. He said that ruthenium as well as strontium contamination might become dangerous in the region of 2-20 x 10<sup>3</sup> megatons.

Dr. Rabi then called on Mr. Strauss for remarks; the latter had none at this time.

The meeting was turned over to General Fields, who had asked to bring up the question of U-233 production.

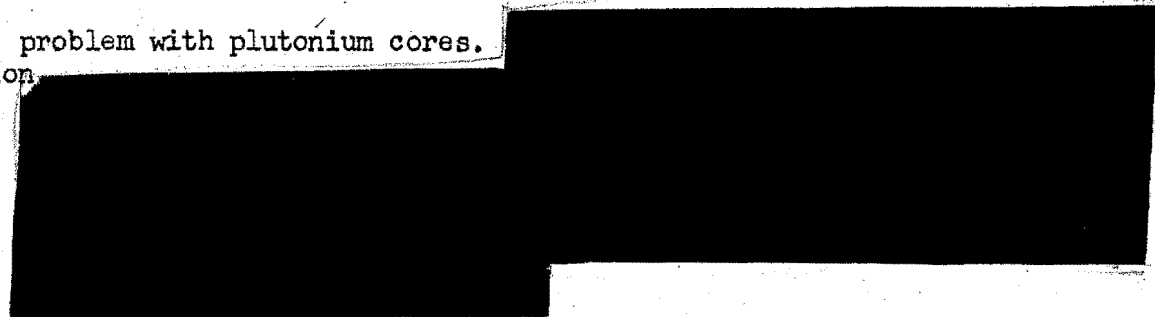
General Fields reported that the Divisions of Military Application and Production had recommended to the General Manager, for approval on a planning basis, the large scale production of uranium-233. If

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approval was granted, the immediate dollar costs would not be large, but instructions would be given to the duPont Company to look toward such production. Advance instruction was needed by duPont for their planning and process development.

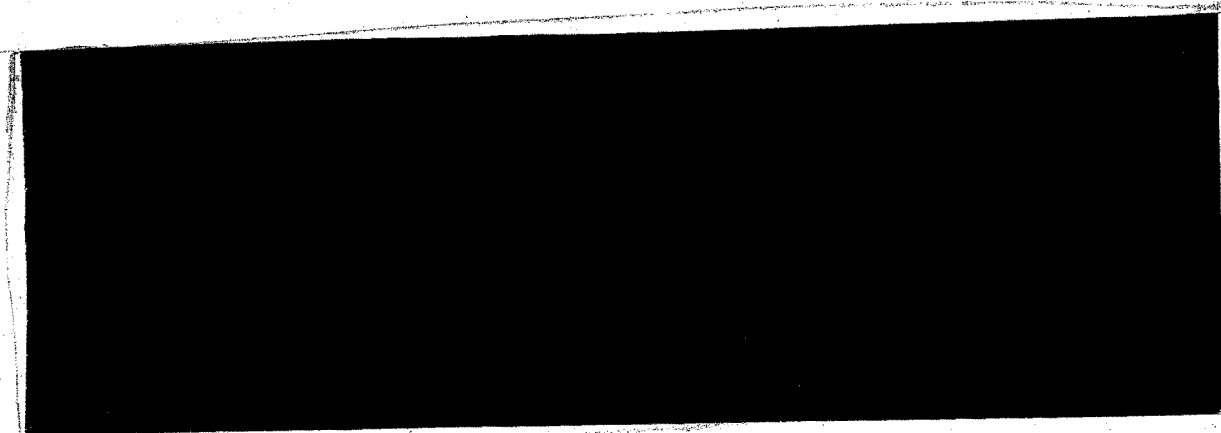
The central reason for the recommendation is the predetonation

U-233 problem with plutonium cores.  
Production Program



DOE  
6.1 (a)

The following production schedules have been proposed for consideration. Case A refers to no U-233 production, Case B to the proposed schedule including U-233.

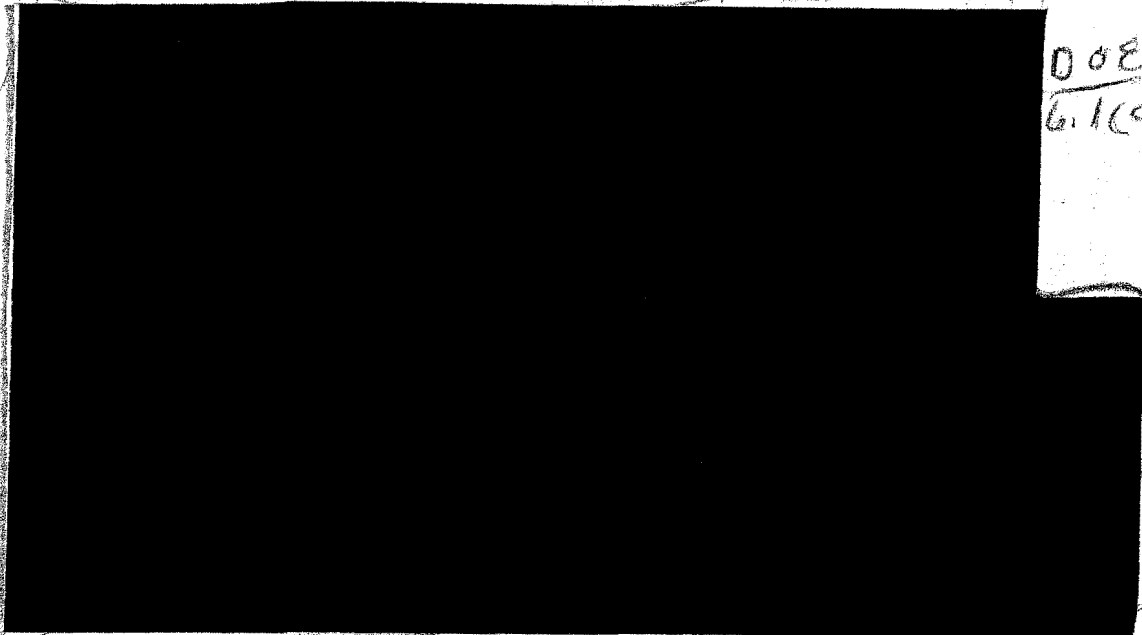


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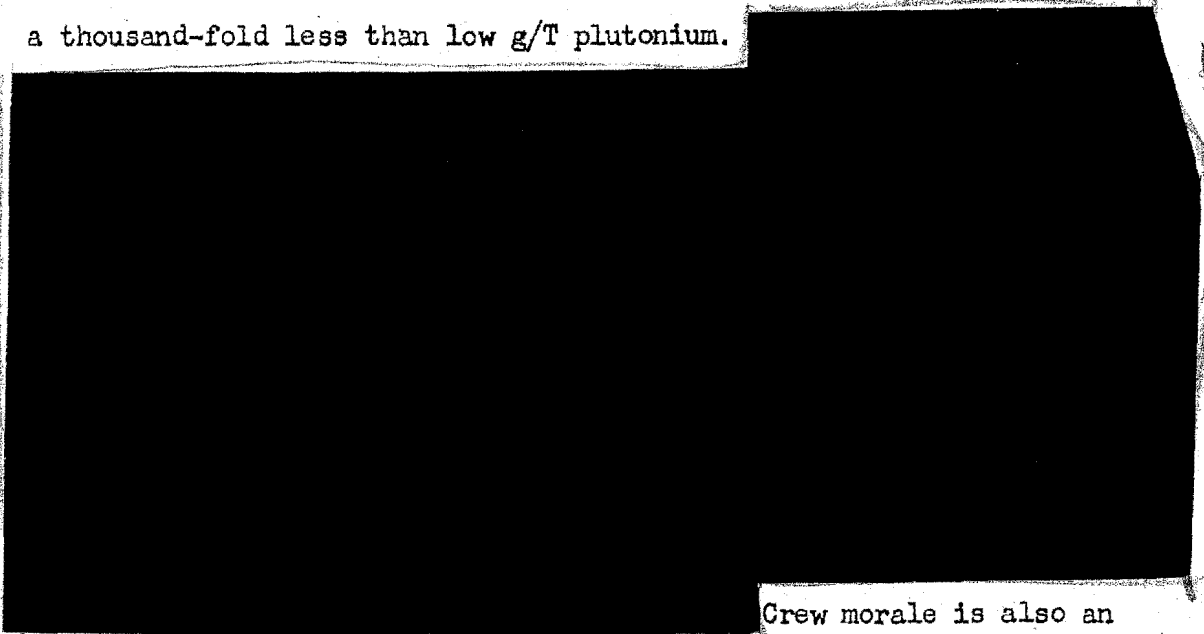
Corresponding Number of Cores



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G.1(a)

DOE  
G.1(a)

Dr. Rabi asked what was known about the predetonation properties of U-233. Dr. Jane Hall replied that its neutron background was about a thousand-fold less than low g/T plutonium.

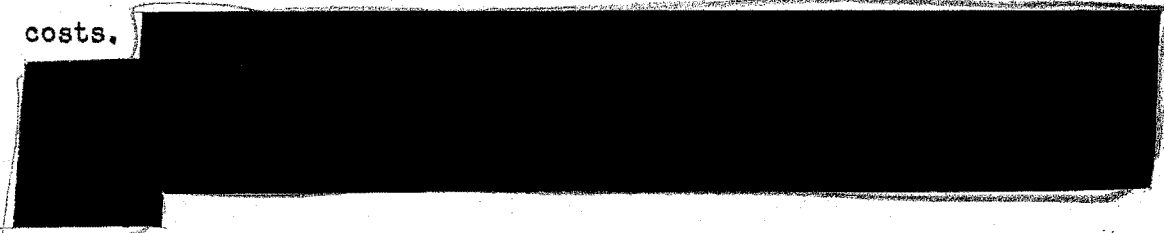


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G.1(a)

Crew morale is also an important factor.

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At the suggestion of Dr. P. C. Fine, some figures pertaining to the steady state after 1961 were given. Advantages: (1) 35 more good TN weapons per year, (2) dollar savings of \$30 million/year in processing costs.



DOE  
6.1(a)

Dr. Schreiber said that the 3:2 relative value figure contained an assumption about the neutron velocity in U-233 which is somewhat uncertain. If Pajarito measurements are correct the velocity may be higher than assumed, and the relative value correspondingly higher.

Dr. von Neumann put the argument for case B as: the bookkeeping mainly shows that case B would not make a major upset in the thermo-nuclear program; for all other purposes case B provides an important degree of freedom.

Turning to Mr. Strauss, Dr. Rabi asked "why ask us, since so many advantages are evident?" Mr. Strauss replied that the advantages had previously not been so clear, and that in any case it was an appropriate matter for GAC consideration.

Dr. Libby inquired as to the certainty of the cost estimates. Mr. G. F. Quinn said that they were the best available, although it was true that experience was lacking in large scale thorium processing.

Discus-  
sion of  
Case B

Mr. Murphree asked whether there was a possibility that U-233 might have some disadvantage in weapons. Mr. Strauss said he had wondered about this and whether one should make a test before rushing into large scale production. Dr. Bradbury commented that a test would certainly be wanted, but that the low neutron background is definite

Possible  
U-233  
Bomb  
Test

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-45-

and U-233, which is intermediate between Pu-239 and U-235, can't do anything funny in a bomb.

There was some discussion, contributed to by Dr. Hall and Dr. Impurity Froman, about the neutron background. Impurity specifications would be about 5 times more rigorous than for production grade U-235. On the basis of U-233 in hand, which had been purified by the standard production processes, it appeared that the specifications could readily be met. Even if the impurity levels were 50 times those specified, the predetonation probability would be about 10%.

Dr. Rabi asked what would be the effects year by year if the program were started in the immediate future. Mr. Quinn replied that: next January one Savannah reactor would be put on U-233 production, nine months later a second, and then a third. Operations would continue with three reactors on U-233 and two on low g/T plutonium, as controlled by the separations capacity.

Two years from now the thermonuclear requirement will be met by either schedule A or schedule B. The main differences are in U-235 and high g/T Pu. The present steps would be to approve duPont planning and to commit \$35 million late in the fiscal year for plant modifications and construction. The duPont people anticipate no great difficulties. Dr. Rabi asked how upsetting it would be if one had to reverse the program later. Mr. Quinn indicated the main thing would be the conversion of the Purex plant back to its original functions.

Thorium  
Ore  
Supply

Dr. Rabi asked about the supply of thorium ores. Mr. Quinn indicated that the amount now available is sufficient for three years;

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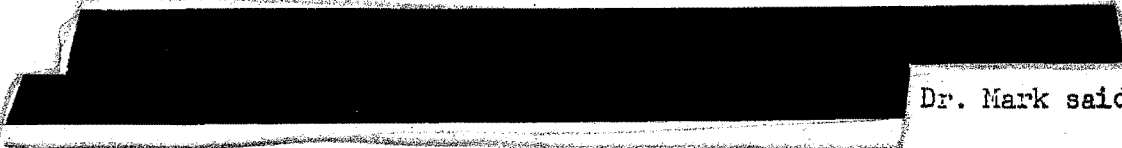


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after 1957 a few hundred tons per year would be needed. Several of those present commented that this was a more favorable situation than the one with respect to uranium ores.

Dr. Rabi inquired from Dr. Bradbury what arguments were against it. None appeared. Dr. Bradbury said that the strongest argument for U-233 was the increased degree of flexibility in weapon design. He would still advocate the proposal even if a bright idea developed which would greatly reduce the predetonation probability with plutonium. The neutrons were not being thrown away; the added cost is not great; the weapon design and ore supply advantages are very considerable. To a question of Dr. Rabi's on possible effects on the Livermore program he said it would give them another parameter to work with.

 Dr. Mark said this consideration was already in the exchange rate. DOE  
b.1a

Mr. Whitman said it would be a good thing to get a second raw material into the program. He also felt that the reactor program would probably benefit from this extension of technology.

Dr. Libby, who said he had been searching for an objection to schedule B, observed that it might remove the pressure from developing the technology of separating Pu-240 from high g/T plutonium. It was felt, however, that this was not too likely.

Dr. Rabi said his view was that the proposed step may be a good thing but is not likely to be of practical significance in the thermo-nuclear program.  DOE  
b.1(a)

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DOE  
6.1(a)

[REDACTED]

Another advantage of U-233, pointed out by Dr. Fine, was that it would permit higher yields in gun type weapons.

Further advantages were seen to be the lower toxicity of U-233 (Dr. Libby), and the related technological and fabrication advantages (Dr. Schreiber).

Inter-  
action  
with  
Tritium  
Produc-  
tion

Dr. Rabi asked if the program would interfere with tritium production in case a requirement for that material came along.

DOE  
6.1(a)

Mr.

Quinn said that the changeover to thorium does not affect the tritium picture as it is now understood.

Pre-  
detonation

Consideration was next given specifically to the subject of pre-detonation. Dr. Bradbury expressed awareness of the Committee's concern on the reliability of preinitiation estimates, particularly as they affect expensive production programs. However, there is every evidence that the subject is understood. Considering all of the bombs which have been shot, there is about a 50% chance that a case of preinitiation would have been observed.

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[REDACTED]

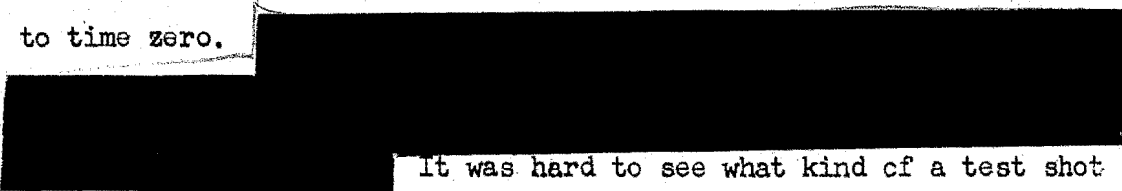
He was not inclined to think that a

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preinitiation test shot was called for; if there was anything really strange involved, e.g. in the neutron distribution, it could best be studied in the laboratory. Experiments might be done at Pajarito. Referring to the curve of yield versus initiation time, as established by the three available points and the existing theory, he said it seemed extremely improbable that the curve should have a kink or shoulder which would make invalid the present smooth extrapolation to time zero.

 008  
611 (9)  
It was hard to see what kind of a test shot to make except possibly an XR (external initiator) shot; even this would be of questionable value.

Dr. Rabi said these arguments would make him perfectly happy if there existed a good theory for the yield. However, he would like to see another point on the curve closer to zero time, in order to check the validity of the extrapolation.

Dr. Mark said that the difficulties in predicting yields before the shots were not now relevant. The yields of all of the shots made -- 40 to 50 in number, and in assorted configurations, etc. -- can now be calculated well. There is every evidence that the calculations are sound, and no reason to think there is anything mysterious or interesting in the untested region of the yield curve. It is not clear what use could be made of a minor correction.

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Dr. Rabi said that he could see a use from the customer end. There will be a lot of bombs of high g/T, and the military users would want to have solid knowledge of the spectrum of yields. He felt that military interest in such information about the stockpile might develop considerably.

It was pointed out that the two significant technical questions are (1) what is the probability that a neutron is present, and (2) given that, what is the yield. Dr. Bradbury favored a laboratory investigation of (1) for a period of about six months before returning to the question of a test shot.

Dr. Libby asked about the British report that the number of neutrons per fission has a wide spread. Dr. Mark said the report was that the number varies with the energy of the fissioning neutron.



DOE  
6.1(a)

With these remarks the discussion on preinitiation was concluded.

Dr. Rabi asked Dr. Bradbury whether there were any other matters he would like to bring before the Committee. There were none, and with the remark that it had been a superb briefing Dr. Rabi said that this part of the meeting was concluded.

Meeting  
with the  
Chairman  
of the  
Commis-  
sion

There was a brief break. The Committee reassembled at 11:20 a.m., for a discussion with the Chairman of the Commission. Those present were: Mr. Strauss, all members of the Committee except Dr. Wigner, and the Secretary.

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Mr. Strauss spoke at some length on the Oppenheimer case, referring particularly to the Commission's difficulties in maintaining its policy of no comment and to reactions to the Commission's decision, as manifested in letters and in the press. He expressed understanding for the feeling at Los Alamos. The fact that Dr. Oppenheimer's stand on the thermonuclear question had had no weight in the Commission's decision probably helped in regard to the Los Alamos reaction.

He mentioned that he was delivering a Presidential citation to the Laboratory on its extraordinary accomplishments.

After-  
math of  
the  
Oppenheimer  
Case

Dr. Rabi asked what would be the aftermath of the Commission's decision on the Oppenheimer case. Since associations had played such a prominent role in the case, there was considerable apprehension that a large drive overemphasizing associations as derogatory information would be made by security offices. Mr. Strauss assured the Committee that this apprehension was unfounded. Several Committee members remarked on the very grave morale problem in the Commission's laboratories which resulted from the case. Dr. von Neumann said that from a practical point of view this problem made it very important for the AEC to make clear its criteria of associations, particularly in view of the opinions recorded by Mr. Zuckert and Mr. Murray. Mr. Strauss indicated that the Commission would bring out in September a statement clarifying the security regulations.

GAC  
Opinions  
on U-233

Attention was next turned to the U-233 question. Dr. Rabi asked the individual members in turn to express their views for the benefit

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of the Chairman of the Commission. The members responded as follows.

Mr. Whitman: We should go ahead with the proposed U-233 program.

Dr. Warner: Agreed. At the worst, we aren't losing much.

Dr. Fisk: It is essentially a stand-off in terms of numbers of weapons. The preinitiation question has been bothersome. There is apparently a real gain. If decision is to be based on this consideration, it is essential to obtain the opinion of the military establishment. However, the flexibility argument, and the fact that it is not a significantly costly program suffice to support proposal B.

Dr. von Neumann: Agreed with Dr. Fisk. The nuclear situation contains many plus-and-minuses and the bookkeeping is very qualitative; but the gain in flexibility is very important. There are many advantages in chemistry and metallurgy. It is fortunate that the reactor situation is such that U-233 production can now be injected into the program with no major dislocations. As a secondary effect it will be of value in helping free us from bias and be more attentive to possibilities of what others, e.g. the Russians, may be doing.

Mr. Murphree: Was in favor. The program might have more advantages than can be foreseen at present.

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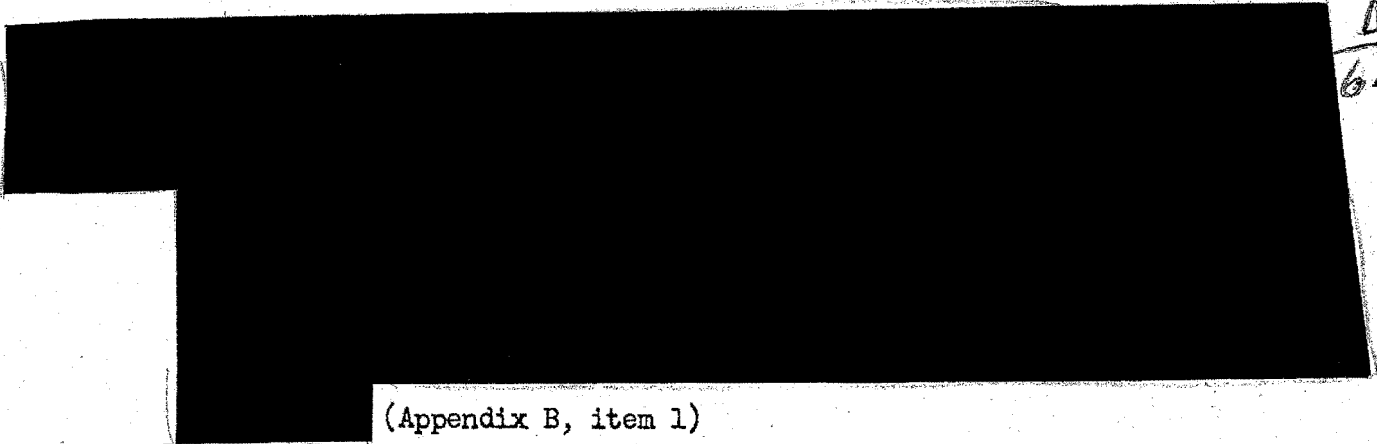
Dr. Libby: Was completely in favor. Hoped the effort to purify plutonium of Pu-240 would not be set back.

Dr. Buckley: Did not feel qualified to give an independent opinion. Was always against more complications, but if there were a real advantage to U-233 would be swayed by that consideration.

Dr. Rabi: Was convinced in the meeting. No loss or long term disadvantages are involved, and no element of danger was discovered. The advantages of simplicity and flexibility are impressive. Strongly supported the proposal.

(Appendix B, item 1)

Mr. Strauss inquired whether the opinions would be changed if it were found that the overall capability in number of crits would be less. Dr. Rabi said his own feeling of approval would continue as long as there were no short term disadvantage. A long term one could always be made up by building another plant. He would have opposed the proposal had it shown a short term loss, i.e. fewer weapons in '58.

  
(Appendix B, item 1)

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Brief consideration was given to the aircraft reactor program.

Aircraft Nuclear Propulsion Program  
 Dr. Rabi advised Mr. Strauss that the Committee would defer any additional recommendations until the Reactor Subcommittee had studied the matter further and had reported. He mentioned the Subcommittee's plan to visit Oak Ridge in September. Mr. Whitman announced that Dr. Wigner had been reached by telephone, and would be able to attend on the proposed dates of September 21, 22, and 23. (Appendix B, item 2)

Reactor Subcommittee Visit to Oak Ridge

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

NINTH SESSION  
(July 15, 1954)

The Committee met in executive session at 1:45 p.m. All members were present except Dr. Wigner, and Dr. Libby, who was absent from this session. The Secretary and Mr. Tomel were present.

GAC Discussion of Weapon Briefings  
 The Chairman called for views on the weapons programs as presented in the three-day briefing.

Sandia  
 Dr. Fisk, and others, remarked on the very great importance of the Sandia Laboratory. The time has come when the demands on Sandia should be determined by the mission of the Armed Services rather than by the potentialities of new weapons. The Laboratory, and what it represents, should grow more and more in importance relative to Los Alamos. The weapon philosophy arguments set forth yesterday by Dr. Bradbury were illuminating, and should be very carefully considered in planning Sandia's future efforts. Systems studies, in which Sandia



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has a strong capability and a strong interest, are a prerequisite to what Dr. Bradbury is trying to do.

The Revolution in Weapons and the Growing Importance of Sandia

Dr. Rabi commented in this vein, saying that Dr. Bradbury's remarks had made clear the complete revolution which has occurred in atomic weapons. There will be very little resemblance between the situation two years from now and that two years ago. Dr. Rabi remarked on the maturity of the weapons art, the great prominence that systems engineering must now have, and its intimate relation to missions and to the stockpile. The duty of ensuring the most effective use of weapons, and of developing a general philosophy of weapon utilization will devolve more and more on Sandia.

There were several comments on the need for encouraging and utilizing Sandia's capability and interest in systems engineering.

Need for Encouraging Systems Studies at Sandia

Some members had gathered that the new Area Manager was not providing such encouragement. There was some discussion of the matter. The Committee did not feel it would be appropriate to make formal comment at present; however it was hoped that ways would be found to encourage this vital work. The feeling was expressed that the Committee should manifest a lively and continuing interest in the work of the Sandia Laboratory.

It was remarked that the Sandia presentations were in general very good, although the weapon effect presentation was poor. The latter was probably a case of having misjudged the audience. There was also some disappointment about the to-do raised by Sandia on the difficulties of contact fuzing. However the significance of this was difficult to

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judge in the context of the general situation on systems studies.  
(Appendix B, item 3a)

Los  
Alamos

Mr. Whitman said that the Los Alamos presentation was a very high grade job, and this seemed to be the unanimous feeling. Dr. Fisk added that, moreover, one gained an increasing feeling of strength and maturity in the Laboratory. Mr. Murphree said that Dr. Bradbury's proposal on weapon philosophy was a sound one. Dr. Fisk suggested that the Committee not attempt to judge that point of view now, but should call attention to it, to its real importance, and to the importance of examining it. (Appendix B, item 3b)

Liver-  
more

The next subject discussed was the Livermore report, [REDACTED]

DOE  
6-11a)

[REDACTED] The Laboratory

clearly has very capable people on its staff; it is unfortunate that they are not being effectively utilized up to their abilities.

Dr. Fisk said he felt the Committee could endorse the small weapon program. [REDACTED]

DOE  
6-11c

[REDACTED] Mr. Whitman had been shocked by the thought of 10,000 MT; it would contaminate the earth. Dr. Rabi's reaction was that the talk about this device was an advertising stunt, and not to be taken too seriously.

With regard to the small weapons, Dr. Rabi said he had felt there was something very amateurish in the way the objectives were defined. The program was being set up without any study of how the war would be fought, what the planes and rockets actually would carry, etc.

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Diffi-            Two different explanations were advanced to explain the state of  
culties            the Livermore program, (a) the way the objectives are set up and the  
with                problems originate, and (b) the administrative organization.  
Livermore  
Program

Dr. von Neumann said that the objectives are being defined essentially as to do something more risky than Los Alamos. This puts them in the frustrating position of not having a real program of their own. Dr. Rabi said that Livermore has no responsibility for any necessary part of the weapons program. He would like to see a clear division between Los Alamos and Livermore with respect to defined and different objectives.

However, the main problem, according to Dr. Rabi, was administrative. The Laboratory would become a very effective organization if it really had a director. At present, responsibilities are divided in such a way that the arrangement works against the development of strength and purpose in the organization. The Commission should insist on a full-time director; the Laboratory is too big to run in a haphazard way. Dr. Fisk agreed. He also felt that Dr. von Neumann's point that the Laboratory lacked a clear job to do was serious. This situation needed correction. Dr. von Neumann agreed that the Laboratory was being run by very bad organizational principles; but it was functioning pretty well in spite of this. He said that the presentation had been good.

Weapon            The general feeling seemed to be that the Livermore program needed  
Subcom-            more rational definition and greater strength of purpose, and that the  
mittee                method of administration should be improved. Before the Committee would  
Study of  
Liver-  
more

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be in a position to make any detailed recommendations, however, it would be necessary for the Subcommittee on Weapons to study the situation and render a report. The work at Berkeley should probably be included in this study. (Appendix B, item 3c)

Test Programs The next subject considered was that of the test programs. Dr. Rabi felt that the plans were perhaps over-elaborate. Dr. Fisk pointed out, however, that a criticism to this effect was scarcely justified, since Dr. Graves had cautioned the audience repeatedly in his presentations that he was merely describing candidates for test shots. There were not as yet any firm proposals. All of the items were interesting to consider. (Appendix B, item 3d)

Philosophy of Weapon Development The next point considered was how the Committee should comment on Dr. Bradbury's concluding talk. Dr. Fisk summed up the discussions by saying that attention should be directed to the revolution in the weapon situation, to the things which are now important to be done. The Committee should point to the need for clarity in the objectives of the weapons programs, and the need for joint participation by the laboratories and the military establishment in studies aimed at achieving this clarity. (Appendix B, item 3e)

Minutes of the 40th Meeting The Minutes of the 40th Meeting were further considered. On the motion of Dr. Fisk and second of Dr. Warner, the Minutes, with inclusion of certain rephrasings suggested by the individual members, were approved.

As the next item, Dr. Rabi called for a report of the Reactor Subcommittee on the meeting at Chicago.

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Report of Reactor Subcommittee

Mr. Whitman began with the boiling reactor. Dr. Zinn was now testing excursion conditions and various types of shutdown fuses. The final test was to be a runaway experiment in which the assembly would be allowed to destroy itself through melting of the fuel elements.

Boiling Reactor

Then a new assembly would be set up at Arco and operated till the snow flies. The new assembly would incorporate various improvements and would be used for additional tests of boiling operation.

A tentative, and somewhat tight schedule had been established for building the BER (experimental boiling reactor) at ANL. It provides for:

preliminary design	now completed
selection of architect-engineer	1 September '54
construction begins	1 April '55
core fabrication	<u>ca.</u> 1 year
reactor critical	end of '56

The Subcommittee was in accord with these plans. Mr. Whitman said there was a problem about the contractual arrangements. Dr. Zinn thought the work would go better with a lump sum plus fixed fee contract; but the AEC had not yet assented. Dr. Zinn believed that \$3.5 million would be adequate for the job.

The BER would use light H<sub>2</sub>O and slightly enriched fuel. It would produce 600 lb steam and furnish 5 megawatts of electric power for distribution.

Some other points on boiling reactors were the following. It is hoped that 40% burnup can be achieved with fully enriched fuel, 1% with natural uranium. Heavy water might be preferable in a large unit; the

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cost of a turbine system does not seem excessive. Dr. Zinn wants to concentrate his efforts on small reactors and specific problems, not on a big power reactor. He felt that industrial interest in a big reactor would not interfere with his own interests. A large number of component tests need to be carried out, e.g. on the resistance of fuel elements to burnup and corrosion.

Mr. Murphree added the following points:

(1) Dr. Zinn has some worries about the use of radioactive steam in turbines, and wants to do experiments to evaluate the possible troubles.

(2) He also wants to evaluate chemical costs. It appears that to throw away the spent fuel instead of reprocessing it would add only 1-1½ mills to the cost per kwh.

(3) Under some conditions of operation, fuel elements would have to last as long as seven years in order to achieve the desired burnup. Hence, corrosion problems become of particular importance, and they require study. Some work is being done on corrosion resistant "meat"; but at present they feel they have to rely on jackets.

Mr. Whitman added:

(1) that Dr. Zinn wants his boiling experiment to be thought of as "trivial" so that more chances can be taken in bolder experimentation; and

(2) that the program presupposes a long term development of fuel elements.

At 3:15 p.m. Dr. von Neumann left the meeting.

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Dr. Rabi asked the Subcommittee to prepare a written report on the Laboratory and the boiling and fast breeder reactor work to serve as a basis on which the Committee could answer the questions which had been put to it. (Appendix B, item 4)

Breeder Mr. Whitman then commented briefly on the fast reactor. The critical question is whether it can breed if diluted with structural materials. The relevant experimental data should be available in about a year.

It is proposed to build EBR number 2 at Arco, at a cost of \$19 million, according to the following schedule:

development only	till July 1955
architect-engineer	" "
building construction	April 1956
ready for operation (optimistic estimate)	January 1958

Mr. Whitman said he had been impressed by the fact that Dr. Zinn's enthusiasm on the breeder seemed much less than on the boiling reactor. Mr. Murphree commented that breeding had only a long range importance, in view of the available ore supply. He was inclined to support the breeder on a long range basis, but not as an urgent project. It could be pushed harder than it is being pushed, but it would be difficult to find justification for doing so.

A number of other topics received passing mention in this discussion. (Dr. Zinn's attitudes toward homogeneous and liquid bismuth reactors; his apprehension about the leak hazard in the use of liquid

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sodium in graphite reactors; the lack in the reactor program of a working policy team composed of experts in the field; question as to why build a power reactor at Los Alamos; naval reactor studies; opinion that the reactor program should be pushed now for reasons of international prestige and that economic reasons would eventually be valid.)

Availa-  
bility  
of  
Hanford  
and  
Savannah  
Reports  
to ANL

Mr. Murphree noted a specific point relevant to the health of the program, that ANL does not at present receive reports from Hanford or Savannah River. This was felt to be unfortunate. The Secretary was directed by the Chairman to record this point in the Minutes.

The Committee agreed to comment favorably on the ANL program for developing the boiling water reactor and to recommend that it should receive strong support, including the minimization of contractual delays. Other recommendations should await the more detailed written report from the Reactor Subcommittee. (Appendix B, item 4)

At this point Mr. Tomei was excused from the meeting.

Dates  
Next  
Meeting

The question of dates for the next meeting was considered. In view of uncertainties as to the membership of the Committee at the time of the next meeting, no firm dates were established. It was agreed that the meeting would be held sometime between October 1 and 11, 1954; and the 4th, 5th, and 6th were tentatively selected. (Appendix B, item 5)

Matters  
for  
Next  
Meeting

Mr. Whitman suggested that there be a session on weapon effects and on Project Sunshine at the next meeting, with Dr. Scoville to attend if possible. (Appendix B, item 5) Dr. Fisk suggested that Dr. MacNair might also be asked to take part in the presentations. The latter possibility was left open. However, it was generally agreed that it was time for closer contacts between the GAC and the Sandia organization.

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At this time Dr. Buckley took occasion to express his regret that, in view of the expiration of his term of appointment, he would not be present at the next meeting. Dr. Rabi and other members expressed their warm best wishes to Dr. Buckley and their appreciation for his services on the Committee.

There being no further business, this final session was adjourned at 4:05 p.m.

Richard W. Dodson  
Secretary

Attachments (3)

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41st Meeting of the General Advisory Committee

Tentative Schedule and Agenda

Monday, July 12 (at Sandia)

8:00 a.m. - 12:00 noon -- Presentation by the Sandia Laboratory  
1:00 p.m. - 3:15 p.m. -- Presentation by the Sandia Laboratory

Tuesday, July 13 (at Los Alamos)

9:00 a.m. - 12:15 p.m. -- Technical Presentation by LASL  
1:30 p.m. - 4:30 p.m. -- Technical Presentation by LASL

Wednesday, July 14

9:00 a.m. - 12:15 p.m. -- Presentation by LASL  
1:30 p.m. - 3:30 p.m. -- Technical Presentation by UCRL  
8:00 p.m. - 9:30 p.m. -- Executive Session (Committee business  
and NDA matter)

Thursday, July 15

9:00 a.m. - 12:15 p.m. -- Executive Session (Report of Reactor  
Subcommittee and other matters. The  
Committee will meet with the following  
persons at the latter's convenience:  
Gen. Fields, Dr. Pittman, Dr. Bradbury,  
Mr. Strauss -- probably commencing at  
about 10:00 a.m.)  
1:30 p.m. -- Executive Session

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

July 16, 1954

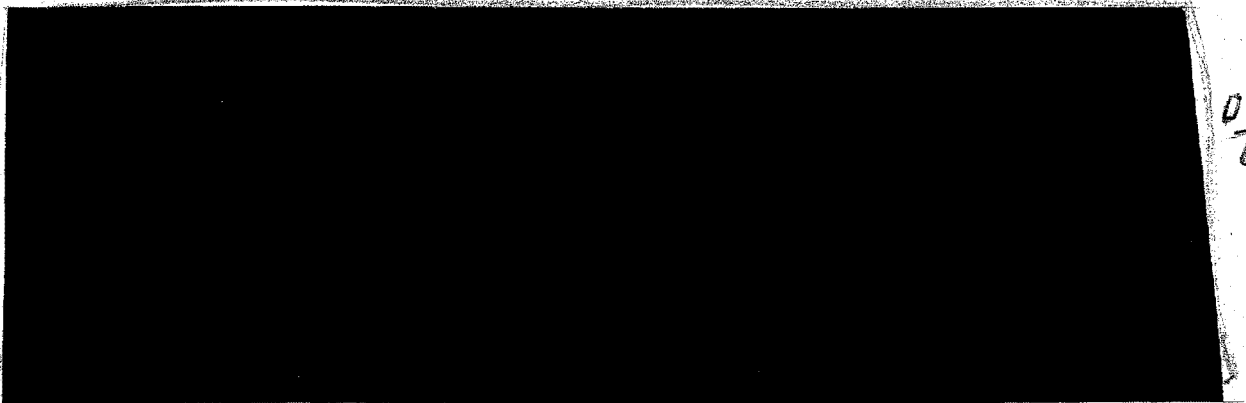
Mr. Lewis L. Strauss, Chairman  
U.S. Atomic Energy Commission  
Washington 25, D.C.

Dear Mr. Strauss:

Herewith is the summary report of the 41st Meeting of the General Advisory Committee held in Los Alamos and at the Sandia Corporation in Albuquerque on July 12, 13, 14, and 15, 1954. All members with the exception of Dr. Wigner were in attendance.

The first three days were devoted to briefings by the Sandia Corporation, the Los Alamos Scientific Laboratory, and the Livermore Laboratory in connection with a simultaneous visit by the Military Liaison Committee to the AEC, the Defense Department's Coordinating Committee on Atomic Energy and its Technical Advisory Panel. The 15th was devoted to a meeting of the GAC with Commission and Los Alamos staff. At this time, we had the benefit of the presence of the Commission Chairman for an important discussion of the U-233 program with the Director of the Division of Military Application, the Director of the Los Alamos Laboratory, and AEC and IASL staff.

Our comments and recommendations follow.



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6.1 (a)

For these reasons we unanimously recommend the immediate initiation of Program "B" with such modifications as may appear desirable after further discussion and after consultation with the duPont Company.

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We also recommend that a test of a device using U-233 be made as soon as practicable when a sufficient quantity is available.

2. Aircraft Nuclear Propulsion Program. The pressure of time, and the injection of the U-233 problem into our agenda at a very late date, combined with the lateness of the Commission request for further elaboration of our comments on the ANP program as given in the report of the Chairman of the GAC dated June 3, 1954, made it impossible to study the ANP problem in greater detail at this meeting. However, the Subcommittee on Reactors proposes to meet at Oak Ridge for three days, September 21, 22, and 23, 1954, to consider the whole ANP program and hopes that the Commission will invite attendance at this meeting of representatives of the Nuclear Development Associates and the General Electric Company, as well as AEC staff and other interested parties. We hope that a report, which may be useful to the AEC, will result from this meeting.

We wish to reiterate our belief in the importance of the ANP program for our national defense, and our hope that it can be so organized as to proceed to its objectives with minimum delay.

3. Comments on the Discussions of July 12, 13, and 14. Jointly with the MLC and the CCAE, we had three days of review and discussion at Sandia and Los Alamos with the principal staffs of Sandia Corporation, LASL, and Livermore Laboratory.

(a) Sandia. We were impressed with the strength of the organization for engineering development and design, and the great attention which was given by the organization to reliability and effectiveness in weapon designs. Significant progress was reported in the development of fuses in the direction of reliability and simplicity.

We noted with special interest and approval the careful effort which is being made in system studies toward understanding the nature of weapon systems which make for maximum effectiveness.

We were also gratified to observe the close and friendly cooperation of Sandia with LASL and with the military organizations.

(b) Los Alamos. The day and a half of briefing and discussion by the staff of Los Alamos was illuminating and complete. We heard from: Dr. Graves on the CASTLE tests and the future TEAPOT, Post-TEAPOT, WIGWAM, and REDWING tests; Dr. Schreiber on present weapon status, nuclear safing and U-233 in guns; Dr. MacDougall on tactical and small weapons, and also on possible improvements in the 30 KT region; Dr. Mark on CASTLE and forward-looking prospects in two-stage weapons, and also on the use of "dirty" plutonium; and, finally, Dr. Bradbury on future directions in weapon design, utilization and stockpiling.

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We were impressed by the broad range of Laboratory objectives, and by their realistic formulation in relation to military utilization, which are indicative of the great strength and maturity of this Laboratory. Although many formidable technical problems in the forward-looking program remain to be solved, particularly in the small weapon field, the prognosis for continued success seems favorable.



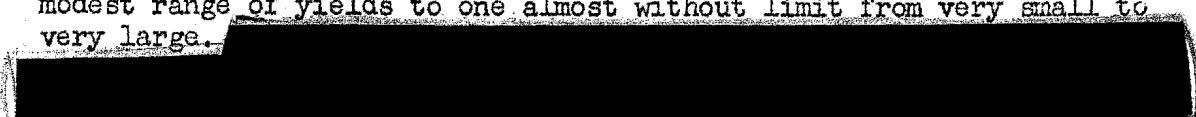
There was expressed in the Committee a certain concern with the program as a whole, particularly in the light of the altered two-stage weapon situation. Although no specific suggestion on the program is offered, it was felt that some thought should be given to a firm assignment of responsibility and authority to a full-time director of the Livermore Laboratory which may result in a more crisp program and a more effective sharing of weapon responsibility with LASL.

(d) Test programs--TEAPOT, WIGWAM, Post-TEAPOT, and REDWING. We do not wish to comment on specific items of the test program at the present time since the plans may still be subject to drastic change. However, it is very gratifying that even after the numerous advances of the last years there are so many items which are worthy of the effort and expense involved in weapon tests. This may be an appropriate time again to emphasize the importance and value of the test programs.

(e) Weapons Development Philosophy. The proposal by Dr. Bradbury of a philosophy to guide weapons development over the next years, we believe, deserves particular attention.



The present is a period of transition -- from scarcity to relative abundance, from a modest range of yields to one almost without limit from very small to very large.



We would, therefore, urge a careful reappraisal of the relations between the types of design of nuclear weapons and the missions for which they are appropriate, with the objective of establishing guidance principles for optimizing the design of the several classes of weapons, small and large, which could accomplish these missions. In such a reappraisal, both LASL and Sandia should take part with the Military Departments in the necessary comprehensive system studies.

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4. Argonne Reactor Program -- Boiling Reactors. At this Meeting the Committee heard a report from its Subcommittee on Reactors covering a three-day set of detailed and thorough briefings by Dr. Zinn and his associates at ANL during the preceding week. This study was undertaken so that the Committee could respond to the General Manager's request for an appraisal of the boiling water reactor development being carried out as part of the ANL reactor program.

We wish to endorse the general program outlined by Dr. Zinn, including the long-range development of the fast breeder reactor. In the following, we comment specifically on the boiling reactor program.

Present plans call for testing the existing boiling reactor installation at Arco under conditions of high operating power leading to destructive melting of the fuel elements. Further tests will be carried out on a new and improved installation this fall. It was also noted that a tentative schedule has been established for constructing, at the Argonne National Laboratory, an experimental boiling reactor (BER) capable of delivering five megawatts of electric power. This schedule provides for construction to begin April 1, 1955, and for the reactor to go critical by the end of 1956. The component tests and studies, outlined by Dr. Zinn, on fuel element design, corrosion, burn up, the use of radioactive steam in turbines, and chemical costs are integral and essential parts of this program.

The Committee continues to believe that the boiling water reactor development program is one of great promise. We recommend continued strong support, with arrangements which will minimize contractual delays.

In our study of this subject we have been reminded of the importance of maintaining a flow of information between different groups with common technological interests; and we hope that arrangements can be made to facilitate the exchange of technical reports between ANL, Hanford, and Savannah River.

A more detailed report is being prepared by the Subcommittee and will be available at a later date.

5. The Meeting was the last meeting of the General Advisory Committee before the terms of office of Dr. Buckley, Dr. von Neumann, and Dr. Rabi expire. It was therefore impossible to fix a definite date for the next meeting. However, a tentative date was set for October 4, 5, and 6, 1954.

In any event the meeting will occur in a period between October 1st and October 11th. Among other matters, the Committee hopes to discuss weapons effects, and Project Sunshine.

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In the meantime the members of the Committee will continue to be available to the Commission for any problems which may arise.

Sincerely yours,

I. I. Rabi  
Chairman

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INDIVIDUALS SCHEDULED  
TO ATTEND ORIENTATION TOUR

Lt. Cmdr. Robert E. ADAMSON, Jr. - MLC  
Mr. Paul W. AGER - AEC-SFO  
Dr. Robert F. BACHER - CCAE  
Dr. D. P. BARNARD - CCAE  
Lt. Col. L. L. BECKEDORFF - AEC-DMA  
Dr. Norris E. BRADBURY - LASL  
Dr. Oliver E. BUCKLEY - GAC  
Brig. Gen. H. G. BUNKER - MLC  
Col. David O. BYARS, Jr., JTF-7 - MLC  
Brig. Gen. William W. CANTERBURY - CG, AFSWC  
Dr. Richard W. DODSON - GAC  
Col. Elmer T. DORSEY, USMC - AEC-DMA  
Brig. Gen. K. E. FIELDS - AEC-DMA (CCAЕ)  
Dr. Paul C. FINE - AEC-DMA  
Dr. James B. FISK - GAC  
Dr. Darol K. FROMAN - LASL  
Dr. C. C. FURNAS - CCAE  
Rear Adm. Robert GOLDTHWAITE, C/S, JTF-7  
Dr. Alvin C. GRAVES - LASL  
Lt. Col. David R. GRIFFIN - MLC  
Col. L. V. HARMON - MLC  
Mr. R. W. HENDERSON - Sandia Corp.  
Brig. Gen. Kenner F. HERTFORD - MLC (CCAЕ)  
Mr. S. C. HIGHT - Sandia Corp.  
Mr. L. A. HOPKINS - Sandia Corp.  
Dr. J. E. JACKSON - CCAE  
Mr. Don JOHNSTONE - AEC-SFO  
Brig. Gen. B. F. KELSEY - CCAE  
Mr. George P. KRAKER, AEC-SFO  
Dr. Ernest LAWRENCE - UCRL  
Mr. Donald J. LEEHEY, Manager - AEC-SFO  
Dr. Willard F. LIBBY, GAC  
Maj. Gen. A. R. LUEDECKE, CG, AFSWP (CCAЕ)  
Dr. Duncan P. MacDOUGALL - LASL  
Dr. Walter A. MacNAIR - CCAE  
Dr. J. Carson MARK - LASL  
Mr. James W. McRAE - Sandia Corp.  
Capt. H. G. MUNSON, USN - CCAE  
Dr. Eger V. MURPHREE - GAC  
Mr. A. J. O'DONNELL - AEC-SAN

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Dr. I. I. RABI - GAC  
Capt. Paul H. RAMSEY, USN - MLC  
Col. Orin S. RICHARDSON - MLC  
Col. O. J. RITLAND - MLC  
Maj. Gen. Harry McK. ROPER - MLC  
Mr. R. E. SCHREIBER - LASL  
Mr. Herbert SCOVILLE, Jr. - MLC  
Capt. Courtney SHANDS, USN - MLC  
Mr. T. E. SHEA - Sandia Corp.  
Lt. Col. Morris L. SHOSS - MLC  
Lt. Col. Clark J. SMITH - MLC  
Dr. Henry D. SMYTH, Commissioner, AEC  
Dr. J. C. STARKS - CCAE  
Maj. Gen. L. S. STRANATHAN, CG, FC/AFSWP  
Dr. Edward TELLER - UCRL  
Lt. Col. Mark H. TERREL - MLC  
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Dr. Walter G. WHITMAN - GAC  
Lt. Col. Harold L. WHITTEN - MLC  
Mr. Harry A. WINNE - CCAE  
Mr. D. F. WORTH, Jr. - AEC - SFO  
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Lt. Col. Dantes A. YORK - MLC  
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