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THIS DOCUMENT CONSISTS OF 3 PAGE(S) NO. 4 OF 4 SERIES B

WAR AND NAVY DEPARTMENTS
ARMED FORCES SPECIAL WEAPONS PROJECT
P. O. BOX 2610
WASHINGTON, D. C.

HS/mwd/5A518
5104

9 September 1947

IN REPLY REFER TO:
I-16

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MEMORANDUM FOR: CAPTAIN JAMES S. RUSSELL, U. S. N.
Military Applications Division
Atomic Energy Commission
Room 146, 1901 Constitution Ave., N. W.
Washington, D. C.

SUBJECT: Nuclear Radiation Measurements for Atomic Bomb Tests.

1. In view of the importance of nuclear radiation, several studies of their effects after atomic bomb detonation are desirable in order to obtain information of both military and scientific value. Many measurements were made during earlier tests but due to lack of time or inadequate knowledge a number of factors were left undetermined. Serious gaps exist in our information on the effects of a Nagasaki type bomb detonation. Insofar as possible these gaps should be filled in. Furthermore, many measurements must be made on any new type weapons in order to be able to correlate nuclear radiation effects with weapon design.

2. The inclosed suggestions are only preliminary and tentative and undoubtedly experts will be able to suggest additional measurements or modifications which would be of extreme value. In most cases the projects which have been listed could be carried out with relatively simple equipment which is readily available. Complicated telemetering devices are, in most cases, not necessary, however, many instruments will require heavy shielding as protection against extraneous gamma radiation and heat.

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Per R D Krohn 4/10/62
(Person authorizing change in classification) (Date)
By Dorothy Ezell 4/20/64
(Signature of person making the change, and date)

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Projects

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Nuclear Radiation Projects for Atomic Bomb Tests

1. Gamma radiation measurements.

Radiologists

a. Gamma dosage versus distance - This was measured quite adequately at Bikini for the Nagasaki type bomb with film badges and should be repeated for new types being tested.

b. Gamma ray spectrum - The effective energy of the gamma radiation can be computed from the dosage versus distance data but additional measurements should probably be made using shields of different materials and thicknesses. The iron cassettes used at Bikini did not give data which led to absolutely clear interpretation and, if possible, the material and design should be modified.

c. Gamma intensity versus time - Dr. Tuck's ionization chambers which were used at Bikini were not too successful since they were incapable of measuring the initial high intensities and did not have sufficient time resolution. High speed camera instrumentation would appear more desirable and probably would not provide insuperable difficulties.

2 shields
2 times

NRL

d. Location of source - The location of the gamma source and the diffuseness of the beam could be quite easily measured by means of a series of orientometers containing films for measuring the gamma radiation. These could be aimed not only at the center but at various distances or angles on either side and above and below the point of detonation.

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e. Absorption by thick and angular shields - This could be accomplished by placing films behind various thicknesses of shielding material placed at different angles to the point of detonation. (This project would not appear to have exceptionally high priority since it probably could be done on a laboratory scale if the results were correlated with those obtained from the orientometers)

2. Neutrons.

a. Neutron spectrum - At Bikini the neutron flux was measured only by means of phosphorus and sulphur capture. Since these elements have low cross-sections for neutrons with energies between thermal and 3 Mev, there is a very serious gap in the data on neutron flux. In future experiments other elements should also be used, and by combining a number of different elements it may be possible to measure practically the entire neutron energy range. It is understood that such measurements have been made for pile neutrons, and it would seem likely that similar techniques could be used with the bomb.

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b. Neutron flux versus distance - This could be accomplished by placing the elements used in (2a.) at various distances from the point of detonation.

c. Neutron absorption and scattering - This could be measured by placing the elements used in (2a.) behind known shields and at different heights above water and land.

d. Neutron flux versus time - This measurement would appear much more difficult than the corresponding measurement for gamma radiation. If it can be worked out it would be a desirable factor to investigate since it has been the subject of considerable theoretical speculation. However, from a practical point of view it is not too vital, since it is fairly well established that essentially all the neutrons are emitted almost instantaneously at the time of detonation.

3. Residual contamination.

a. Direct contamination - Ground samples should be collected at various locations around the point of detonation and subjected to radiochemical analysis. These results should be correlated with distance from the center and type of surface. Preliminary analyses of the chemical and physical characteristics of the soil should be made prior to the detonation in order to correlate them with the crater characteristics.

b. Downwind fall-out - The areas downwind should be surveyed for deposition of radioactive material from the cloud. Attempts should be made to correlate these findings with the soil characteristics of the crater and the weather conditions. It might be even desirable to place collecting slides at various locations downwind in order to measure the particle size of the active material.

4. Radioactive cloud.

a. Air sampling - Air samples should be collected from the cloud at different times after the detonation. These should be subjected to radiochemical analysis and determinations made of the ratio of gamma, beta, and alpha activity.

b. Radiation field from cloud - The gamma field, both outside and within the cloud, should be measured. This could be done by means of recording ionization chambers placed in any drone planes that may be used to collect samples. Film badges should also be placed in any such planes in order to measure directly the dosage which would be obtained in planes passing through a cloud.

c. Long range detection - The program on this project should be correlated with those groups interested in this subject.

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