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IN REPLY ADDRESS BOTH COMMUNICATION AND ENVELOPE TO COMDR ARDC, ATTENTION FOLLOWING OFFICE SYMBOL

RDTWA

MEMORANDUM FOR DR. LIBBY, Commissioner, United States AEC

108065

SUBJECT: (U) Measurement of Local Fall-out in Atomic Test Operations

1. Reference our meeting of 3 April at which time you asked me to put down my thoughts on the measurement of close-in fall-out in atomic test operations. I am indicating below my own impressions on this subject in the hope that this may be of some assistance to you. (UNCLASSIFIED)

2. Local Fall-out Measurements in the Nevada Test Site.

a. We have had a sufficient number of air bursts and tower shots to prove the fact that there is no significant fall-out downwind unless the visible fireball comes in actual contact with the ground.

b. The three surface and subsurface shots unfortunately, have been in the range of 1 KT which cannot be realistically scaled to the fall-out model for megaton weapons. What is required at Nevada is a 50 to 100 KT clean weapon whose fission yield should not exceed 1 to 5 KT. I believe that if such a weapon can be developed it would go a long way in solving the many problems of fall-out. For example, if such a weapon could be surface detonated at the NTS, it would definitely and perhaps once and for all determine the percentage of gross fission product fall-out from a surface yield weapon for dry land. As you know, now we believe that this percentage may be anywhere from 5 to 95 percent. Here is a factor of 19 which is unknown. If we accept the best guesses which are fashionable today, we may say that the total gross fission product fall-out from a land surface detonated weapon is anywhere between 40 and 80%, but even this is a factor of 2 unknown, which needs to be pinned down. Once we determine the percentage of total fall-out of fission products we are of course, faced with the problem of fractionation of the various radio-nuclides such as Sr^{90}. I believe the only way to determine this matter is to detonate a 100 KT weapon in the desert and to measure the Sr^{90} within the fall-out region in sufficient detail and with sufficient accuracy to make the measurements statistically significant. I believe that once we determine the fractionation within a 100 KT atomic cloud perhaps we can safely assume that a simple extrapolation to the megaton case will be valid. This of course, is open to question, although it appears reasonable to me at

this time. I want to stress that the best way and perhaps the only way of measuring the many unknowns of fall-out would be to detonate a 100 KT clean device in our country, within our own test site, on dry land so that we can study all aspects of the fall-out in great detail. Since at the present time we cannot detonate anything above 1 KT of fission yield on the surface in the Nevada Test Site, we are forced to study fall-out in the Pacific Proving Ground. [redacted]

3. Measurement of Local Fall-out in the Pacific Proving Ground.

a. Since the PPG is mostly water, we have a great deal of difficulty in measuring the fall-out which gets deposited on the water and which then sinks with different rates of fall, which dissolves with different rates of solubility, and which comes under the influence of the ocean currents which can be measured with different degrees of accuracy. We must also consider the mixing of the ocean water by the surface waves (as indicated by you) and what may be even more discouraging, we must also consider zones of divergence and convergence in the ocean similar to such an effect in the atmosphere where water may rise or fall in a large scale circulation in the vertical direction. I am amazed and pleased with the measurements of Scripps. Apparently, they have developed a method which can determine the order of magnitude of the total percentage of fall-out by oceanographic sampling methods. However, I question whether this system could ever be improved to a point where it measures with sufficient degree of accuracy, the extent of the local fall-out so that we can be advised of what is left for intermediate and long range world-wide fall-out. A study of all past test operations in the PPG has borne out the fact that it is next to impossible to determine with any degree of accuracy the total percentage of gross fall-out. The Sr^{90} fallout is subject to even greater errors of measurement at the PPG.

b. The accident of CASTLE BRAVO is an exception to this rule. Here the Japanese in a 99 ton fishing vessel were able to scoop up and put into cellophane bags handfulls of the fall-out material 75 to 85 miles downwind of ground zero. In this same CASTLE accident some of the islands to the east of the Bikini came under excessive fall-out which may be surveyed even today for possible fission products or Sr^{90} content and for other measurements well known to you. But this was an accident. Accidental though it may have been, it represented very good sampling for the few sampling stations such as the fishing vessel and the few islands involved. I am afraid, Dr. Libby, that this problem of measuring total

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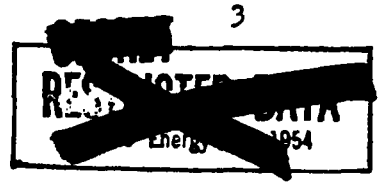
Memorandum For Dr. Libby, Commissioner, United States Atomic Energy Commission, Subj; (U) Measurement of Local Fall-Out in Atomic Test Operations

fall-out in the Pacific Test Site is so complicated that the only answer to the question is to make a brute force measurement by the use of a large number of ships such as the 99 ton fishing vessels or yags, etc. Certainly we can not use rafts except possibly in the lagoon. We must decide that if we want to go into such a measurement, the price of the minimum project may be in the order of 15 to 30 million dollars depending on where we start the cash register and what type of cost accounting is involved. The density of stations must be at least one station every 10 miles in a direction normal to the long axis of fall-out and one station every 25 to 50 miles in a direction parallel to the long axis. This would involve a minimum of 40 to 120 sampling stations which I call ships. Obviously such a proposal is out of the question at this time for HARDTACK. If such a proposal is taken seriously at all, it is absolutely mandatory that the shot or series of shots in which it is scheduled to measure fall-out, be fired at the command of the program director of the fall-out projects and he must base his decision primarily on the meteorology of the day. He may have to wait several weeks to several months to get the right kind of surface and upper air winds to increase the possibility of placing the downwind fall-out pattern upon the proposed ship measuring stations. It is also the meteorologist who will determine the magnitude of the time and space variability of the winds aloft that have plagued practically all of the measurements of fall-out in the PPG to date. There are days when the atmosphere is most suitable toward producing a finely defined, quite sharp, cigar shaped fall-out plot. There are other days where the fall-out plot is scattered all over a 90° quadrant thus making the total measurement job next to impossible.

c. It appears to me that the determination of the total percentage of local fall-out within the limitations of our present two test sites is difficult, if not insurmountable. If the problem is as important as I believe it is, perhaps it may even be worthwhile to consider the development of new test sites in order to determine the local fall-out.

d. When I look upon the difficulties of measuring local fall-out, I wonder whether it is not worthwhile to sample the rest of the planet in order to find out the true atmospheric burden of fission products rather than try to determine this from local fall-out. On the other hand, I need not tell you of the many more problems associated with the world-wide sampling fall-out.



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e. I believe that the members of the AEC and the Defense Department that have been engaged in measurements of fall-out during past atomic test operations ought to be commended for their diligence, for their patience, and for their capability in getting some results in the face of odds that appear insurmountable to me. The Air Force has been conscious of the many errors involved in any fall-out measurement in the PPG to date. Hence, we have not participated in such tests nor have we even suggested such participation. This is because we have felt that the effort to date, although relatively large compared to some other test projects, has nevertheless been too small to measure total fall-out in the PPG with any high probability of success. [redacted]

Norair M. Lulejian

NORAIR M. LULEJIAN
Lt Colonel, USAF
Chief, Nuclear Applications Division

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