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INTER-OFFICE MEMORANDUM

DATE 17 December, 1945

TO: Mr. N. E. Bradbury

FROM: Henry W. Newson

SUBJECT: Possible Difficulties in Naval Tests

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FINAL DETERMINATION
UNCLASSIFIED
L. M. Redmon
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Radiation Slick:

Since we now know very little about the probable distribution of fission products in sea water, we must estimate their distribution pessimistically. Let us assume that all the fission products are captured by water warmed by the bomb explosion (under water) and are carried to the surface and spread uniformly. If no self absorption occurs, we will have a situation similar to the Trinity crater. Rough calculations made on the basis of the plutonium recovery there indicate that the crates captured 1% of the fission products. To maintain our pessimistic outlook, let us consider the seriously contaminated area increased by a factor of ten. This gives us a region about a half mile in radius which would irradiate a man at about $10^5 \frac{R}{h}$ a few hours after the shot if he should cross the region at uniform speed along its diameter. This is 10^7 times the tolerance level. If mixing occurred so that the fission products were uniformly distributed in a layer one meter thick, the dosage rate would decrease by a factor of ten (based on formulas by Morrison in Chap. V of The Chicago Handbook), and mixing to a greater depth would decrease the effects in proportion to the depth. Thus, uniform mixing to a depth of

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7

1000 m (nearly to the bottom) would reduce the radiation level to $10\frac{R}{hr}$. This level is still too high for any kind of sustained activity, and the assumptions are no longer very pessimistic since it has been assumed that the surface water is no more contaminated than that at a depth. Induced radioactivities such as 30 min Cl and 14 hr Na may make the situation appreciably worse for times not long after the shot.

While it is unsafe to assume that water will not rise to the surface, it is quite possible that clean water will be carried in by wind or current. The thickness of this layer to give full protection need be only 2 or 3 meters for protection factors of 10^4 and 10^6 respectively. The same reductions might be obtained by 8 or 12 inches of steel.

Unless it can be shown fairly conclusively that none of the contaminated water will reach the surface, difficulty may be anticipated in boarding and inspecting test ships which have not been sunk by the explosion. The test ships should be so disposed as to take every possible advantage of wind and current which might wash at least the top layer of contaminated water away from them.

The same difficulty is far more likely in the case of a surface explosion. Here the ball of fire will roll over the sea to a radius comparable to that at Trinity and the fission

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products will undoubtedly be spread even farther by the large waves generated by the explosion. As was pointed out before, surface mixing will not reduce the dosage by a great deal. If the ball of fire should actually touch a test ship, and that ship survive, it might not be possible to board it for days. Paint melted by the radiation would be an excellent collector of fission products delivered either by the ball of fire or a dust cloud.

If the bomb were dropped from a plane, no very important deposit of fission products would occur if it exploded 1000 feet or more in the air (Japanese experience). However, should the ball of fire touch ships or water, the same effects could be expected on a lesser scale.

Induced radioactivity will in general be much less of a nuisance than fission products. Its effect may predominate for a high drop but it will be much less serious than fission products are in the other types of test. Furthermore, it may be predicted fairly accurately from a few simple experiments. The activation of the steel bulls of ships will probably cause trouble for no more than 24 hours. A piece of reinforcement iron taken from the base of the Trinity tower showed no activity about three weeks after the shot. The 2.4 hour manganese activity is by far the most prominent effect in iron bombarded by slow neutron. The most intense fast reaction induced periods are even shorter.

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9

The air and surface explosions will certainly give rise to clouds of fission products which are definitely dangerous. (Witness the hasty retreat from N 10,000 at Trinity.) This should be handled by careful study of the wind at all altitudes. No observer or any other human being should be alee of the explosion. In addition, only fast vessels should be near so that they may outrun a sudden shift of the cloud. Planes with sealed cabins should be able to maneuver rather freely over the whole region.

The water near a recent surface explosion will be a witch's brew, and this will be true to a lesser extent for the other tests. There will probably be enough plutonium near the surface to poison the combined armed forces of the United States at their highest wartime strength. The fission products will be worse. The probable number of fish casulaties, in addition to those caused by the explosion, can probably be calculated when more is known about the probable mixing conditions and the fish population. Considerable study of this general problem has been made in connection with the Hanford and Clinton Plants.

Effects of the Actual Explosion:

The protection of personnel from the effects of the actual explosion is relatively simple. We know from the Japanese experience that an unprotected man two miles from the bomb

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10

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is fairly safe from all effects except the flying debris of flimsy structures. Special precautions could shorten this distance, but the uninvestigated effects - water shock, waves, unfavorable distribution of radioactivity, etc. - would make any such procedure foolhardy. Unless there are very compelling reasons, no man should be within five miles of the explosion, and the bulk of the personnel should be much farther. However, it might be well to populate the test ships which seem likely to survive the explosion with experimental animals. This would be a considerable undertaking if the results of the experiment were to simulate the effect of radiations on the crew.

The protection of experimental equipment located on test ships, particularly photographic plates, will be very difficult, and special calculations will be necessary for each case.

HWN:cl

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cc: N. E. Bradbury
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11