CL 12

20 December 1951

Bob Campbell, J-6

Tom White, H-1

IVY CP Building on Parry

SYMBOL: H-1-34

1. The following notes are provided in response to your recent request for an opinion on rad-safe requirements for subject shelter for the PANDA SHOT. The estimation of requirements is based largely on intuitive reasoning, and the results are highly debatable. Criticism is invited. This memo does not purport to represent the views of the Task Force 132 Rad Safe Unit.

2. Fairly conservative estimates are attempted on the ground that more damage would probably be suffered during escape than by remaining in the CP, if it is designed to provide any reasonable measure of protection.

3. The discussion concerns a CP building approximately 61' x 141', 7' above ground, 4' below ground, with one-foot concrete walls and roof; precipitron and filters with overall 95% dust removal efficiency proposed for cleaning incoming air.

4. It is understood that preparation for the PANDA SHOT will require about four days; that once the preparation is started, it must be continued, and that the shot will have to be fired within a day or two of completion. From this it is concluded that there will not be as much freedom in the selection of favorable meteorological conditions as at Greenhouse.

5. The following hazards are considered:

a. Fission product contamination of the atmosphere
b. Fall-out of neutron activated particles
c. Carbon 14 contamination of the atmosphere
d. Poisoning by oxides of nitrogen (not a radiological hazard)

6. It is concluded that fall-out is the most probable hazard, but that fission product contamination of the atmosphere could be much more serious, and difficult to deal with by any conventional air-cleaning methods. Adequate protection from the gamma radiation from fall-out appears to require about three feet of concrete equivalent and the elimination of all non-essential windows. Since the proposed air-cleaning system appears to provide inadequate protection from the worst that could happen, it is suggested that it might be better to replace it with an oxygen supply for the whole building sufficient for 24 hours. This would introduce a problem of moisture control. The cost and difficulty of solving these problems would probably not be much greater than for an air cleaning system, and the assurance of adequate protection would be much greater. The desirability of an emergency storage battery power supply is suggested. It appears possible that the diesel-electric system could break down at a time when it might be too "hot" to service it. The basis for these conclusions is set forth below

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7. Scaling cloud dimension by the one-third power of yield, it appears that a vortex might be produced with a diameter of a few tens of miles, and that the final extent of the cloud might be to a distance of 50 miles or more from zero. Since these distances are comparable to the depth of the atmosphere, there is a reasonable chance that the CP may be engulfed in the cloud. It is noted that the kinetic energy of ordinary wind motion within a vertical cylinder of 20 mile radius is quite small compared with the expected yield (LAMS-993 p. 8,9). Noting again the lack of assurance of highly favorable wind conditions, it does not seem too conservative to assume that the bomb products are uniformly mixed with the atmosphere to a lateral distance of 20 miles, and to the top of the atmosphere, and to assume that the CP may be bathed in this atmosphere for a period of hours.

8. Assuming 500 KT of fission product yield distributed in the above volume, 2.4×10^{19} cc of air at normal density, gives at 3 hr 2×10^{-3} μc/cc which if breathed for the following 3 hours would give about 100 life-time doses of fission products. If no more than 10% of a life-time dose is acceptable, the efficiency of an air-cleaning system is required to be 99.9%, which is very difficult to attain.

9. In LAMS-983, E.C. Anderson estimates that 1200 supers would be necessary to produce a life-time tolerance concentration of carbon 14 in the earth's atmosphere. One super could produce about 1000 times this concentration in the atmosphere over a circle of 20 miles radius. Anderson expects that the carbon would be converted quickly to monoxide, which reacts reversibly with the blood. This concentration would probably be radiologically tolerable for a few hours. (The carbon monoxide concentration, of the order of 10^{-3} parts per million, would not be a problem from the viewpoint of carbon monoxide poisoning.)

10. Scaling of data in "Effects of Atomic Weapons" pp 183 and 53 indicates that shock temperatures at about 2 miles would be in the right range to produce oxides of nitrogen. Even if equilibrium concentrations were produced during cooling at all intermediate distances, and the quantity was then evenly distributed out to 20 miles, the concentration would be only about 100 parts per million, not much in excess of the permissible 25 ppm.

11. To estimate fall-out relative to Greenhouse, it is assumed that 10^4 times as much active material would be spread over an area greater by the 2/3 power of the yield ratio. This gives an overall factor of the order of 100, and it is supposed that a protection factor of 100 would be desired against the gamma radiation. One-foot concrete will provide a factor of about 10, and an additional factor of 10 can be provided by a

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foot or two of sand. It is noted that this is a pretty uncertain estimate offall-out, and that once the fall-out has occurred there isn't much that the occupants of the CP can do except sit and absorb radiation. A safety factor of 10 is not too conservative, and a requirement for three feet of normal concrete or equivalent does not seem excessive.

12. A machine taking in at 1000 c.f.m., air containing 2×10^{-3} μc/cc (cf.par. 8) and retaining all the activity would accumulate about 0.4 curie per hour. A one hour accumulation would give about 2 r/hr at 3 foot distance. This indicates in a general way that a diesel electric plant or an air-cleaning system could become pretty "hot" under some circumstances.

13. The activity of air-borne radioactive material during the Greenhouse fall-out was of the order of 5×10^{-6} μc/cc. On the basis of preceding estimates, the air concentration of Ivy fall-out would be about an order of magnitude less than the fission product concentration considered in paragraphs 8 and 12. It is the opinion of H. F. Schulte that the proposed air-cleaning system would deal satisfactorily with fall-out about 100 times worse than Greenhouse. He is not available at present to give an opinion on the other problem.

ORIGINAL SIGNED BY THOMAS N. WHITE

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