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326 US ATOMIC ENERGY COMMISSION

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MR+A - Pacific Proving Grounds (Rpt) 1955

SUPPLEMENT TO REPORT

ON THE RADIOACTIVE

FALL-OUT FROM ATOMIC BOMBS

W A R N I N G

THIS MATERIAL CONTAINS INFORMATION AFFECTING [redacted] S
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MILITARY RESEARCH & APPL - T-1 P.P. Bk

I. The purpose of this supplement is to analyze in greater detail the fall-out from JANGLE - Surface shot utilizing air readings obtained by the Air Force Special Weapons Center.

II. During Operation BUSTER/JANGLE (R), the Air Force Special Weapons Center collected radioactive fall-out data from the air to a distance of approximately 150 miles downwind. Since the air monitor's logs show the gamma ray reading, the time, the altitude and grid location of the aircraft, it is possible to extrapolate the gamma ray readings taken in an airplane to a reading 3 ft above the ground. By this method the fall-out has been plotted in Figure 1c in terms of infinity dose in roentgens assuming a decay rate of $t^{-1.2}$. Figure 1c gives only the fall-out beyond 10 miles of ground zero. The fall-out within 4 miles of ground zero has been studied in great detail, and it appears that 11.5% of the total bomb activity was deposited immediately downwind within 3.23 square miles. The downwind fall-out beyond 10 miles from ground zero indicates that approximately 60% ± 20% of the total bomb activity was deposited on the ground. This means that approximately a total of 70% ± 20% of the residual activity of the JANGLE - Surface bomb fell-out downwind. An inspection of Figure 1c shows that there is a maximum fall-out immediately downwind, then there is a second maximum approximately 20 miles NNE of ground zero and there is a third maximum at a distance of 65 miles NNE of the target area. A wind vector plot shows that the second maximum was due to fall-out from approximately the 9000 ft msl level of the cloud, and the third maximum was due to fall-out from 13,000 ft msl. The minimum between these two maxima was due to fall-out from 10,000 ft msl. Keeping these things in mind the following quotation is made from Page 71 of the AFSWP Report on Project 7.1, "Transport

[redacted]

[redacted] [redacted]

of Radioactive Debris from Operations BUSTER and JANGLE," WT-308, SECRET.

"The JANGLE - Surface cloud reached a maximum height of 15,000 ft msl in 4 minutes and 45 seconds. The base of the primary mushroom was 11,000 ft. A second mushroom composed of surface dust in an air current which was heated by the hot crater formed and its top reached a level just beneath the base of the first mushroom. In a minute or two, diffusion had closed the gap between them, but the rosy colored upper mushroom remained distinctly separated from the lower, grayish-white mushroom."

The above-mentioned quotation shows that there were two mushrooms to the JANGLE - Surface shot. The top mushroom was 4000 ft in depth (from 11,000 ft to 15,000 ft msl). The lower mushroom had its top at 11,000 ft. This means the centers of the two mushrooms were at approximately 13,000 ft and 9000 ft msl. These centers of the mushrooms coincide with the two maxima shown in Figure 1c and increases our confidence in the fall-out data collected by aircraft. It is assumed that the particle size of the sand in the lower mushroom was 70 microns in diameter and the particle size in the upper mushroom was 60 microns in diameter.

III. There has been some talk of exploding a bomb on the surface at NPG during Operation TEAPOT (SECRET) with a yield greater than 10 KT. From an analysis of the one kiloton surface shot at JANGLE, it appears that a 10 KT shot would be potentially highly contaminating. Figure 1d shows the assumed fall-out from a 10 KT shot detonated on the surface at NPG when the vertical wind distribution is as follows:

LEVEL	WIND	
Surface	190°	2 knots
6000ft msl	170°	13
8000	180°	15

[redacted] [redacted]

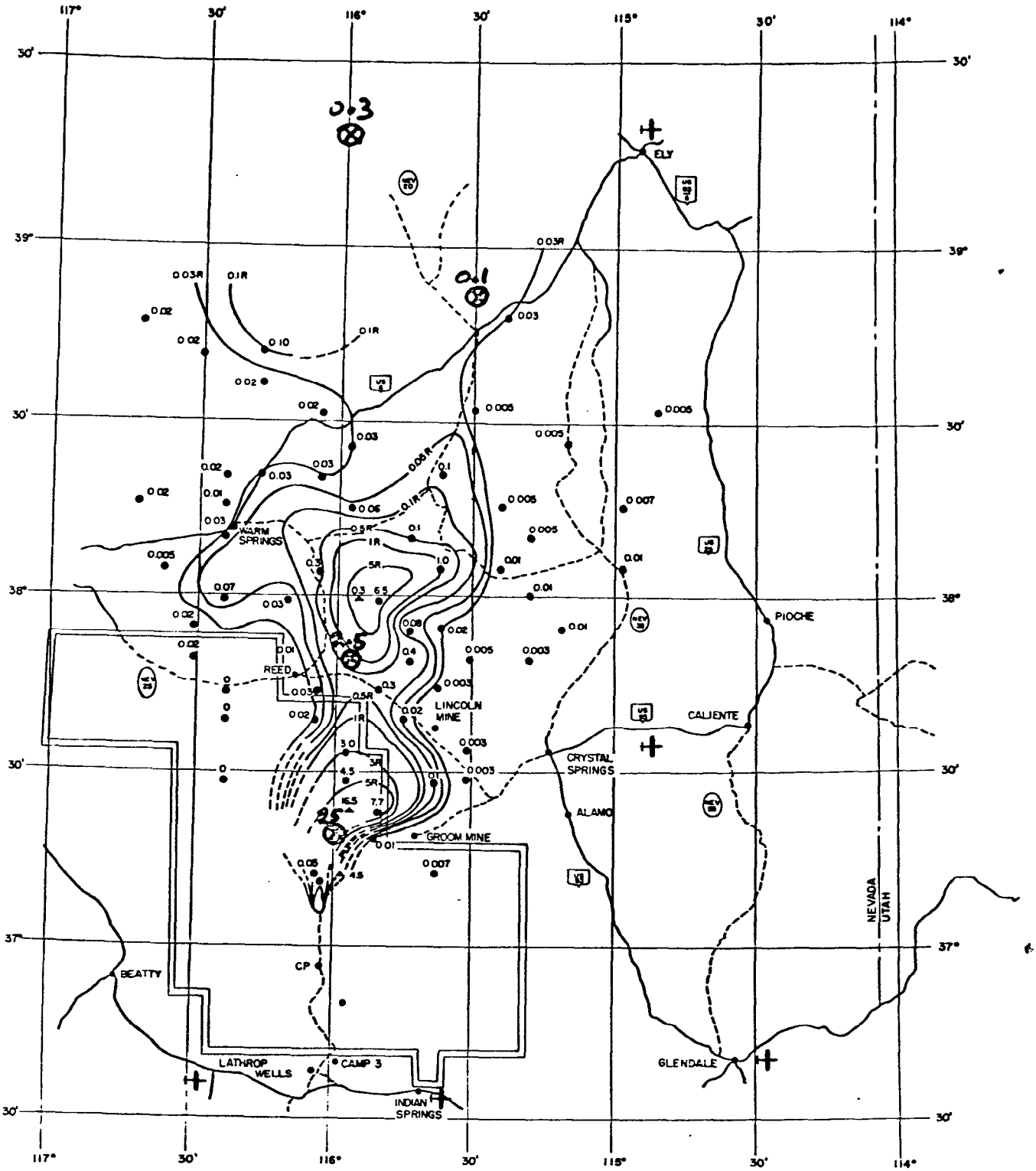
LEVEL	WIND	
10,000	200°	20
12,000	200°	22
14,000	210°	25
16,000	220°	30
18,000	210°	35
20,000	210°	40
25,000	200°	50
30,000	190°	55
35,000	210°	55
40,000	220°	60

It is assumed that a 10 KT bomb exploded on the surface will reach 40,000 ft msl. As shown in Figure 1d, the fall-out from a 10 KT Surface shot is highly contaminating. It may be possible to choose a weather situation where the contamination does not hit cities like Ely, Nevada, but it would be almost impossible to prevent fall-out into some populated community in the periphery of the test site. The fall-out from a 10 KT Surface shot will extend out to approximately 200 to 250 miles from ground zero depending on the speed of the upper air winds. Reference the reconstruction of fall-out shown in Figure 1d. The fall-out area has been made wider than that anticipated in order to account for the normal dispersion of the fall-out about the mean position indicated by the H-hour winds. It is because of this that the percentage fall-out shown in Figure 1d may be 100% or greater. This may be confusing to the reader, but in our opinion, forecast fall-out plots should either indicate the probability that the fall-out will be in a given area by indicating a circular probably error, or by widening the area of fall-out to account for the probable variation. It is believed that the radius of the 2σ circle may be indicated by a value equal to 20% of the radial distance of the fall-out from ground zero, or the distance represented by a change in direction of 15° from the calculated fall-out direction. Hence a variation of ± 15° in

direction and ± 20% in distance should be expected in the actual fall-out as compared to the fall-out calculated from H-hour winds using Stokes' Law of Fall-out.

IV. The problem of forecasting fall-out areas and intensities is complex. It may be possible to formulate a theoretical fall-out plot if the sand particle size distribution throughout the cloud were known accurately. After analyzing the fall-out from the ten tower shots of TUMBLER/SNAPPER (R) and UPSHOT/KNOTHOLE (R) test operations, it is still not clear just what is the actual soil particle size distribution in the atomic cloud from tower shots. This is because during the domestic test operations there is very little direction shear to the winds. If the direction shear had been large, then it would have been easier to determine the sand particle size distribution. As it stands now, it may be that the average particle size of the soil is 70 microns in diameter and the size spectrum is small, or it may be that the particle size in the cloud is a function of the height. For example, it was assumed in the main body of the report that the average particle size decreased with height from 125 to 90 microns in the cloud stem, and the sand particle size in the mushroom was assumed to be between 80 and 60 microns. However, it may be possible to prepare a fall-out plot which approximates the actual fall-out by assuming that the soil particle size throughout the cloud is 70 microns. It is because of this uncertainty in particle size distribution that the writer has made no attempt to develop a formula which will indicate the intensity of fall-out accurately. It is the contention of the writer that if the actual fall-out plots are studied (figures 1 through 9 of main report) then it would be possible for the reader to determine for himself whether a given shot would be potentially contaminating or not. For example, if the fireball does not touch the ground, the percentage fall-out will be 1% or less, but if

the fireball touches the ground the percentage fall-out increases to a value between 10% to 30%. For this reason an attempt is made to give some guidance to the reader in the main report as to the order of magnitude of the intensity of fall-out and the general area of fall-out. The method is illustrated in Figures 1b, etc of the main report. At some future date, if there is more accurate information available concerning the soil particle size distribution, an attempt will be made to prepare a method of indicating more accurately the intensities of downwind fall-out and the area of contamination. The method indicated in the main body of the report to forecast the fall-out should not be construed to be accurate beyond indicating an order of magnitude.



AIRPORT
PRIMARY ROADS
SECONDARY ROADS
[redacted] DATA

Air Readings Taken On D-day
Air Readings taken on day after detonation
Ground Readings taken by Dr. Schulte

FIGURE IC

JANGLE - SURFACE SHOT
1.1 KT

ALL DATA FROM AIR READINGS EXTRAPOLATED TO THE GROUND ASSUMING 1 MEV GAMMA PHOTONS

CONTOUR LINES SHOW INFINITY DOSE IN ROENTGENS.

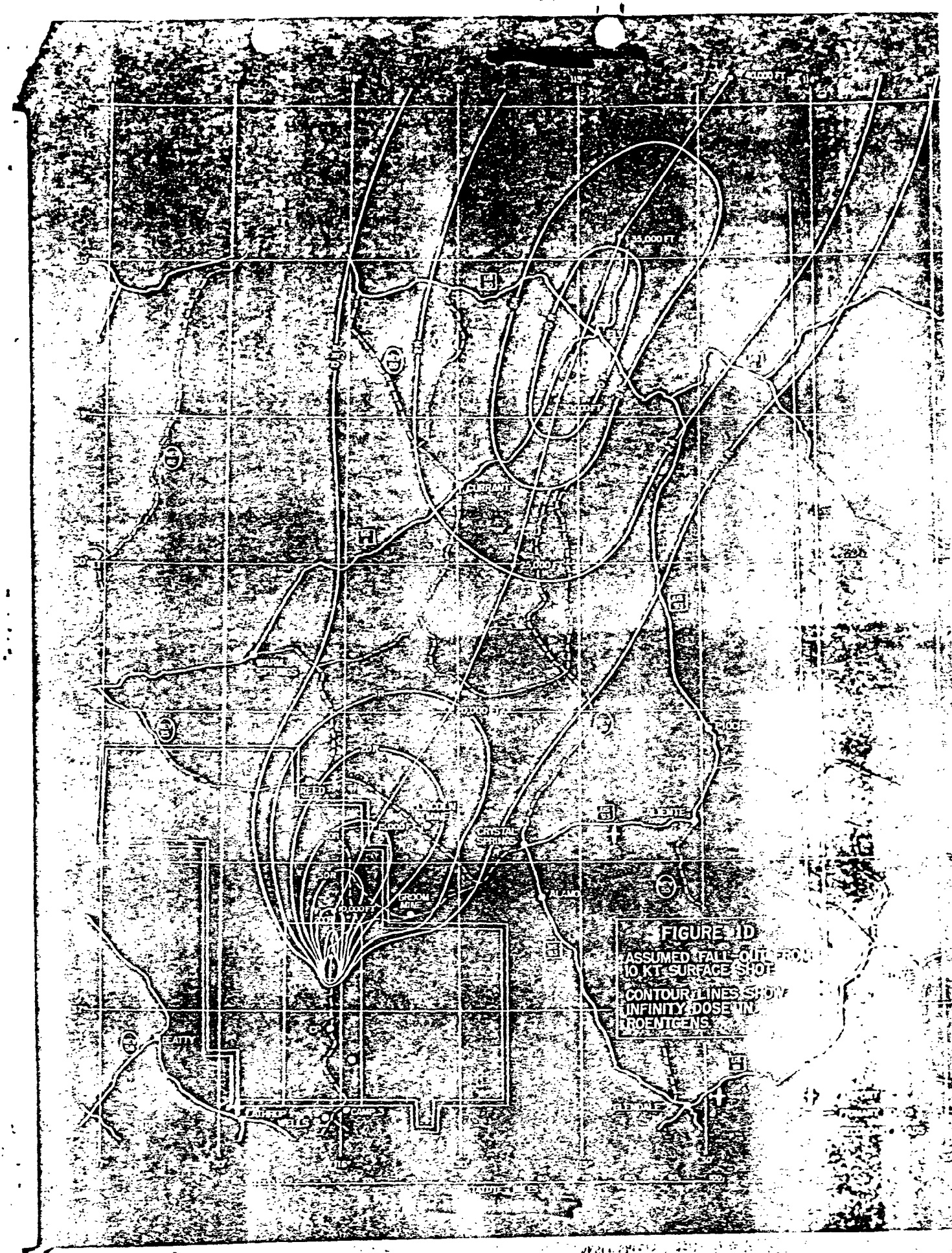


FIGURE 1D

ASSUMED FALL-OUT FROM
10 KT SURFACE SHOT

CONTOUR LINES SHOW
INFINITY DOSE IN
ROENTGENS