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AUG 3 1960

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SEP 24 1957

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Case No. 407.9

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Route	Date	Code
	MacNair	
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4/13/53

SERIAL INTERIM PRE-CLASSIFICATION REVIEW

1st Review Date 2-03-97

Authority ☒ ADD ☒ ADD W. Layne

2nd Review Date 2/3/97

Authority ADD R.T. Duff

Classification Required

Classification Changed to U

Contains No DOE Classified Information

Contains Web

Contains UCNI

Contains

S. C. HIGHT - 5100

Subject: Surface Bursts

The pressure distance curve for a surface burst should be determinable from the free air curve, if the surface can be assumed to be a perfect reflector and if cratering effects are negligible. Assuming a weapon of yield W for which the free air curve is known, the pressure distance curve along the ground for the weapon burst on the surface should be the same as the free air curve for a weapon of yield 2 W.

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The thermal intensity for a surface burst will be the same or less depending on whether the radiation is considered to come from the whole volume of the fireball or whether the fireball is considered to be a black body. In the latter case the thermal intensity would be less by the ratio of the areas of the fireball surface for a surface burst and for a high air burst; i.e. by $2\pi(1.26 r_0)^2 / 4\pi r_0^2$ where r_0 is the radius of the fireball for an air burst. (Density of the air is assumed constant.) This ratio is nearly 0.8. Thus the thermal intensity might be less by 20% for a surface burst. The angle of incidence of the thermal is of course very important. More of this and attenuating effects later.

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Radioactive contamination from a surface burst, especially when a surface wind is blowing, far exceeds fall out from an airbrust. Contamination from surface bursts can be roughly estimated from Jangle Surface.

The crater for a surface burst, within the area of the crater, has a serious effect on underground installations. Crater sizes for surface bursts are roughly known from Operation Jangle.

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The assertions in the above four paragraphs have to be examined in the light of experiment and practical usage situations. Considering first the pressure-distance curve, there are just two actual surface bursts from which data have been obtained: Jangle Surface (1.1 KT) and Ivy Mike (10.5 ± 1 MT). The pressure distance data from the latter fit the 21 MT free air curve within the spread of the data, except at very low pressures (< 3 psi). Thus in the range of 3 - 20 psi (20 psi was the upper limit of acquired data) the 2 W

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CLASSIFICATION CHANGED TO U

Emilia Salah 3/5/97

CHANGING MARKING & DATE

Carmela Dellino

PERSON VERIFYING MARKING & DATE

AUTHORITY R.T. Duff

RECORD ID 97SW594

DATED 2/3/97

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assumption is verified by Ivy Mike. This is not the case for the Jangle Surface shot, however. For Jangle Surface three types of measurements were obtained -- 1) pressure - distance 2) shock velocity along the ground and 3) shock velocity vertically above ground zero. From these data the "2" in 2 W is found to vary from 1.4 to 2.0. The data have been averaged by AFSWP in "The Capabilities of Atomic Weapons" in such a way that the "2" in 2 W varies from 1.75 to 2.0. As with Mike, the pressure data are only available up to 20 psi. In both cases the shock waves were observed to be textbook in form; i.e. there was no evidence of the precursor effect observed on tower shots and air bursts up to about 600 ft scaled burst height (i.e. scaled to 1 KT). (Clean wave forms are considered more destructive to structures than wave forms with slow rise times.) There are however many uncertainties about the Jan le Surface Shot. The radiochemical yield is not well known; the fireball yield is subject to inaccuracy due to the large mass effect of the bomb parts on this low yield weapon; and as mentioned above the three methods of obtaining pressure data are at variance. For Mike the radiochemical yield is inac urate; the yield quoted is a fireball yield which is believed accurate within 10%.

Now departing from the realm of facts, it is our feelin that for all operational weapons the 2 W assumption is proper for predicting pressure-distance for surface bursts for pressures 20 psi to 3 psi. For higher pressures this is still probably true but must be verified experimentally (it is hoped on Operation Castle, Spring 1954).

How does all this pressure discussion affect fusing for surface burst? Reference to the height of urst chart in "Capablities of Atomic Weapons" indicates that for pressure in excess of perhaps 12 psi a surface burst gives the largest radius of effect. On the other hand for pressures below 8 to 6 psi, an air burst is most satisfactory. In the region 8 - 12 psi the scatter of the data is such that no clear cut answer can be obtained. Examination of tower shot data from Sandstone and Greenhouse verifies the notion that for high pressures a surface burst is better than a low air burst, due to the fact that the precursor effect is already reducing pressures and rounding off the shock wave.

At this point of discussion it is customary to bring up the question of hill & dale ef ects. Confining comment to the region of high pressures and therefore low burst heights, it should be noted that the Mach Stem rises so fast for low bursts that the que tion of hill & dale effects is nearly the same for a low burst and a surface burst.

BFM
I think I am supposed to understand something implied but not said here. What is the difference between a surface burst and one high enough to "look over into the adjoining valley" [redacted]

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Thus as far as low bursts vs. surface burst in concerned, it is suggested that for pressures in excess of 12 psi the surface burst probably is more satisfactory.

From the viewpoint of the effects of thermal radiation, it is generally assumed that a burst of at least one fireball raius away from the ground is more satisfactory than a surface burst. This is certainly so. The observed degradation, presumably due to absorption by dust kicked up by the shock wave, is somewhat greater than that just due to the different fireball surface areas as indicated at the beginning of this memorandum. Roughly speaking the thermal output seems to be reduced to 1/3 to 2/3 over the range of 1 to 83 KT. The result of this is to reduce the radius of a given thermal level to from 60% to 80% of the radius for an air burst of about one fireball radius away. For higher burst the R^2 law cuts down on the level of thermal radiation available at the ground. The angle of incidence must also be considered. However, it is important to remember that vertical surfaces (draperies) must be considered as well as horizontal surfaces (troops in ox holes). Also fires existing on vertical surfaces have been shown by Forest Service tests to be less susceptible to blowout by the shock wave than horizontal surfaces. The point it is desired to indicate here is that the degradation of thermal for surface burst, though real, may not be as serious as it sometimes casually expressed.

For a surface burst fall-out contamination and cratering are bonus effects which, though not negligible by any means, are difficult to evaluate in terms of Military worth -- indeed this is also true of fire damage which might be brought about by thermal for either surface or air bursts.

To summarize briefly it would appear from the above that for nearly all "hard" targets the surface burst is likely as effective and perhaps more effective than a low air burst. For very soft targets the height of burst chart clearly indicates a high burst is desirable. For 8 - 12 psi targets no difinite conclusions can be drawn, but probably a surface burst is as good as any other, within the scatter of available data.

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S. C. Hight - 5100

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Case No. 407.9

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BYRON F. MURPHEY

B. F. Murphey - 5111

BFM:5111:mn

Memorandum to:

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File - 5111

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