U.S. AIR FORCE
Project RAND

The RAND *Corporation*
SANTA MONICA • CALIFORNIA

U.S. AIR FORCE
PROJECT RAND

RED STAR SERIES ON ATOMIC WEAPONS
AND ANTIATOMIC DEFENSE

F. J. Krieger

T-41

Part III

4 August 1954

"Atomic Weapons and Antiatomic Defense"

The RAND Corporation
1700 MAIN ST • SANTA MONICA • CALIFORNIA

In January, 1954, the Soviet Ministry of Defense organ Krasnaya Zvezda (Red Star) began publishing a series of signed articles on atomic energy. The articles are of an elementary nature and were presumably intended to give the lay reader a basic background for understanding not only the military effects of atomic weapons but also the practical applications of atomic energy. Translations of these articles are available in the RAND T-35 series.

Herewith is presented a translation of the third article in the Red Star series generally entitled "Atomic Weapons and Antiatomic Defense," the third of three by Professor B. Olisov. The importance of these articles from a military point of view is manifest by the fact that they were transmitted by radio broadcast to the Soviet Armed Forces in the Far East. The broadcasts were intercepted by U. S. monitors during the latter part of August.

Other articles in this series will be presented in order as they become available. Since the content of the articles may be of interest to persons in verious fields, a complete translation of this series may serve a useful purpose.

F. J. Krieger

ATOMIC WEAPONS AND ANTIATOMIC DEFENSE*

We have already said that an atomic explosion is accompanied by the simultaneous action of a powerful shock wave, intensive light radiation, penetrating radiation and radioactive contamination of the terrain. Having briefly described the ways and means of defense against the shock wave, let us examine in the present article the physical basis of the other damaging factors of an atomic explosion and the measures which, in many respects, can avert their destructive effects on personnel and military equipment.

When an atomic bomb explodes in the air, about one-third of the energy of the explosion is spent in the production of light radiation. In its intensity the light radiation considerably surpasses sunlight and can be the cause of the ignition, charring or melting of various objects and can also cause burns to the exposed parts of the human body and temporary loss of sight.

At the moment of the atomic explosion, the light radiation appears in the form of a blinding flash which is visible at a distance of more than a hundred kilometers. Following the flash, a brilliant fireball can be observed in the region of the explosion. As the temperature drops in the zone of luminosity the power of the light radiation diminishes and ceases 2 to 3 seconds after the beginning of the explosion. When the luminosity ends a wreathing radioactive cloud of smoke with a characteristic mushroom shape forms.

The light radiation lasts only a few seconds, but in spite of this, the force of its effect on an unprotected human body and other objects is rather substantial. Thus, in Nagasaki it was observed that on the tile of houses located approximately 1200 meters from the epicenter of the explosion

---

Conclusion. For beginning see Krasnaya Zvezda for 3 and 4 August.

*Krasnaya Zvezda, 6 August 1954, p. 2

characteristic blisters appeared as a result of the high temperature which indicated its melting. In laboratory investigations similar blisters were observed on the same kind of tile by the action of a temperature of 1800 degrees Celsius on it for 4 seconds.

This example shows that the most vulnerable points of installations and military equipment will be the details which easily ignite or melt. Most liable to ignition are wood, paper, textiles and other readily inflammable materials. Metals are hardly affected by light radiation. For example, as the American press duly reported thereon after the atomic bomb tests at Bikini, tanks and weapons standing at a distance of up to 500 to 800 meters from the center of the explosion suffer substantially no damage. Surfaces screened from the direct effect of the light radiation showed, as a rule, no visible signs of the effect of high temperatures. This is explained, to a considerable degree, by the fact that the light radiation, notwithstanding its high temperature, is of very short duration. The transitory character of the radiation accounts for the fact that objects do not have time to heat through to a great depth, and this, to a large degree, lowers the danger of ignition and facilitates the organization of means of defense.

One can firmly state that any obstacle (walls, sides and overhead covers of installations, armor and the like), which protects against the direct action of light, completely eliminates burns. At considerable distances from the explosion, a military uniform, of course, also affords protection against light radiation. The following facts point this out in particular. In the atomic explosions, which the Americans produced in the Japanese cities of Hiroshima and Nagasaki, the degree of the burns, which the people suffered, depended on the nature of their clothing, its color, its thickness and even its proximity to the body. People dressed in dark clothing were more severely burned than people dressed in white or other light-colored clothing. Cases

were observed in which Japanese soldiers, dressed in khaki-colored uniforms, suffered no body burns, even though they were 1500 meters from the point of explosion.

As is evident from the above, the direct effect of light radiation does not represent a serious danger to troops who are in shelters. More dangerous are the fires which arise as a result of the radiation. In all cases, therefore, troops must know how to contend with fire and to apply anti-fire protection measures. In order to prevent exposed wooden parts from burning, they should be plastered with clay, lime, or covered with earth.

The radioactive radiations accompanying the explosion are capable of penetrating various materials, and when they act on a man in large doses they can cause radiation sickness. The radiation dose sharply decreases with distance from the epicenter of the explosion.

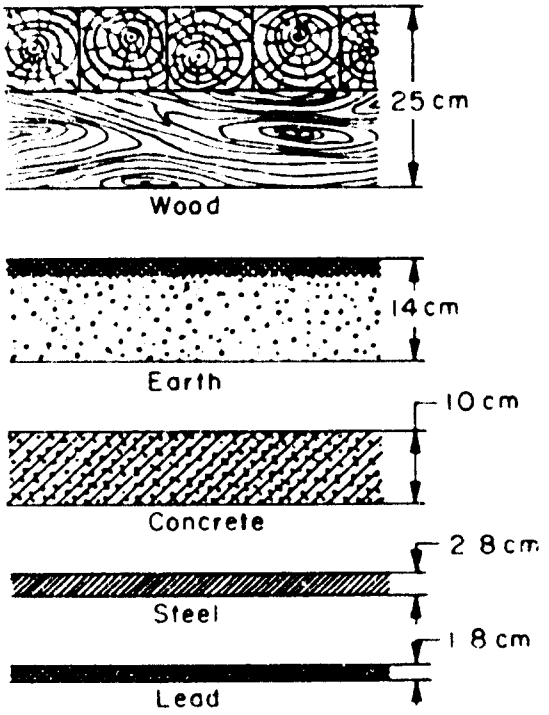
Clinical observations on the course of the sickness of the people, who were stricken by penetrating radiations in Hiroshima and Nagasaki, have shown that the degree of affection sometimes varied even in the case when, at the moment of the explosion, the people were at equal distances from the epicenter of the explosion. This indicates that the hardier organisms are less susceptible to radiation sickness caused by penetrating radiations. In particular, considerable physical hardening of the organism increases its resistance to various ordinary kinds of sickness, as well as to radiation sickness.

After the explosion, radioactive substances fall out and contaminate the terrain in the vicinity of the center of the explosion. A similar contamination of the terrain, but to a lesser degree, is also observed along the path of the smoke cloud formed during the explosion and carried along by the wind.

Strong contamination of the terrain can be observed after a surface explosion, but this contamination is much less when the bomb explodes in the air and is not a danger to man.

Combat radioactive substances, which can be used in the form of liquids, powders and smokes for contaminating the terrain and the air, have the same harmful effects as the radioactive substances which fall out after an atomic explosion.

How then can one protect himself from the effect of penetrating radiation? Protection against penetrating radiation at short distances from the point of explosion is provided by shelters. This is based on the fact that radioactive radiation, in passing through various materials, is attenuated according to the density of the material and the thickness of the layer. Thus, for example, 14 centimeters of soil reduces the radiation dose twice, 6 centimeters of steel 5 times, and 1 meter of earth or 60 centimeters of concrete approximately 100 times. In the figure are shown the thicknesses of various materials which give approximately the same attenuation of penetrating radiation doses.



Thus, trench slopes, overhead covers and walls of various protective structures sharply diminish the effect of radiation. In constructing sub-breastwork recesses, shelters and dugouts, they must be sunk into the ground

so that the protective thickness above them is no less than one meter. As to the effect of penetrating radiation on military equipment, it must be noted that the lenses of optical instruments darken under the influence of substantial doses of radiation. But on other materials radiation has no injurious effect whatever.

We have already said that the explosion of an atomic bomb is accompanied by the fallout of radioactive substances which contaminate the air and the terrain. In an air explosion, the radioactive contamination is usually insignificant, and therefore one can enter the region of the explosion several minutes after the explosion without fear of injury. The terrain is subject to greater contamination from surface or underground explosions. Mixing with the soil, the radioactive substances remain dangerous to man for a rather long time. One can also observe the same thing when the terrain is contaminated by combat radioactive substances which can be dispersed from aircraft in the form of liquids, powders and smokes, or cast into the combat zone of the troops by special artillery shells.

When a man enters contaminated terrain, he may be subjected to the effect of radioactive radiations (irradiation) and to the radioactive contamination of the skin surfaces of the body. It is also possible for the radioactive substances to find their way into the organism. Radioactive substances, which have fallen on the skin and the mucous membranes of the eyes, nose and mouth and have not been removed in time, may cause ulcers and inflammations.

When operating in contaminated terrain (after the explosion of a bomb or as a result of using combat radioactive substances) it is necessary to take special protective measures to prevent radioactive substances from falling onto the skin and entering the organism. A gas mask, for example, completely prevents the radioactive substances from entering the organism through the respiratory tract and also protects the face and head. Protective capes,

suits, stockings (worn over the foot-wear) and gloves are used to protect the remaining parts of the body.

In case standard means are absent, improvised materials may be utilized, such as cotton gauze bandages for the nose and mouth, cloak-tents, for protecting the body, and sacking, tarpaulin and other materials for protecting foot-wear against contamination. Should dosimetric instruments (instruments which determine the presence and degree of radioactive contamination) reveal the radioactive contamination of parts of the body, uniform, weapons or combat equipment, it is necessary to clean the uniform, and in certain cases, when the contamination is strong, to replace it, to go through sanitary processing, and to subject weapons or combat equipment to deactivation. Sanitary processing is carried out by washing away the radioactive particles from the surface of the body or, when water is at a premium, by wiping with moistened tampons of cotton and gauze. Deactivation of weapons or equipment is achieved by removing the radioactive particles from their surfaces by rubbing them with oakum or rags soaked in water, benzine or kerosene. The tampons must be changed after every rubbing.

For purposes of protection against the penetration of radioactive particles, it is expedient to cover weapons and equipment with tarpaulin covers or other available materials.

One must not sit, lie, eat, drink or smoke in contaminated terrain. If it is necessary to work lying down in contaminated terrain, one should place under him a cloak-tent, cape, branches, straw or other available materials.

Speaking of protective measures, separate mention should be made of such an important factor as speed of action under conditions of atomic attack. The timeliness of occupying shelters is of great importance. For this purpose a special atomic alarm signal is set up in advance. This signal and the order of action when it is given must be announced by commanders and known to everyone.

In no case, however, when the atomic alarm signal is given, must anyone cease carrying out his combat task.

* * *

In the present article an attempt was made to give the reader a general description of the damaging effect of atomic weapons, to briefly consider the ways and means of protection against the shock wave, light radiation, penetrating radiation and the radioactive contamination of the terrain. Let us repeat, the questions considered are only a part of those measures which enter the concept of the antiatomic defense of troops. But even they permit one to conclude that troops, well prepared for defense, can successfully carry out their combat tasks.

Professor, Doctor of Technical Sciences,
Stalin Prize Laureate, Major-General of
Engineering and Technical Service
B. OLISOV.

BLANK PAGE