EFFECTS OF NUCLEAR WEAPONS

AND

THE NATURE OF THE FALLOUT HAZARD

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At the end of a conflict during which nuclear weapons were used on a large scale, the survivors of the warring powers would face a scene of destruction and contamination without precedent.

Recovery would be a long tedious process complicated by lingering effects. Adequate preparations will have a positive effect on the number of survivors and the spirit and dispatch with which our people will set about the task. Accordingly, it is necessary and timely that those of us in positions of responsibility give attention to the nature of modern nuclear weapons which can produce profound and widespread effects on the United States and the world, if employed on a massive scale.

The basic facts from which my remarks were prepared are unclassified and are published in the handbook "Effects of Nuclear Weapons" and a brochure, "Comparative Effects Data of Biological Interest," copies of which are available here for your retention.

Let me state at the outset that it is my belief that [illegible] nation will continue to be able to control its own destiny after a nuclear attack. This prospect, I believe, is not destroyed by the awful realities of the effects of nuclear weapons which I shall relate to you. It is, however, entirely dependent upon our energetically carrying out a substantial fallout shelter program and associated protective measures.

In the early days one thought of defense against a possible attack from weapons in the [illegible]-kiloton range such as those used at Hiroshima and Nagasaki. The effects of these two bombs have been widely publicized.

Then the megaton range weapons were developed by the United States, Great Britain and the USSR. To give you some idea of the effects of these large weapons, I have a few facts pertaining to a five megaton, [illegible] per cent fission, [illegible] per cent fusion, surface explosion. [illegible] is selected [illegible] arbitrary.

Substantially larger [illegible] in our testing program. Moreover the effects of a weapon will change as its fission product content or height of detonation change.

When a five megaton weapon is exploded, an intensely brilliant fireball forms and grows to about 2.5 miles in diameter. Its initial effects are thermal radiation, blast and prompt nuclear radiation. All are casualty producers.

The thermal radiation or heat emitted within a few seconds by a five megaton surface explosion may produce third degree burns, charring, out to about nine miles from the point of explosion, and second degree burns, that is, burns with blisters, can occur within 11 miles, covering an area of about 380 square miles. At closer ranges, fires will be started. With an air burst we would expect third degree burns to 15 miles and second degree burns to 17 miles.

A great destructive effect of the nuclear weapon comes from the blast. A high pressure wave proceeds at about the speed of sound in all directions from the fireball. For a five megaton surface burst, the blast will destroy typical homes out to about five miles from ground zero and seriously damage them to 10 miles. The blast also contributes to the fire hazard by overturning stoves, breaking electrical circuits and by damaging structures so as to expose flammable parts to small fires.

Blast will also produce casualties among personnel by blowing fragments of building materials against them, by structurally collapsing buildings, and by displacing the individuals themselves.

The third effect, initial or prompt radiation, affects a limited area, out to less than three miles from ground zero, and for convenience is described as the radiation occurring within one minute after the explosion. Since unprotected personnel out to about [illegible] to 7 miles would probably die from thermal effects and personnel in buildings out to about 3 to 4 miles would probably be killed by blast, we are concerned with prompt radiation only as it might penetrate blast resistant shelters.

I have given this very quick sketch of the initial effects because they tend to be overlooked in our interest to deal with fallout. The Atomic Energy Commission has [illegible]

with other agencies of the Federal Government in a number of studies over the past several years involving a wide range of attack patterns. Speaking generally, attacks directed primarily against population centers produce a much larger number of deaths due to blast and thermal effects than from radiation. When the attack pattern is composed primarily of military bases the converse is true.

Now let's turn our attention to residual radiation or fall-out. Residual radiation is that emitted after one minute from the instant of the explosion.

Detonated on the surface, our five megaton, 50 per cent fission bomb will produce a large crater drawing up tens of thousands of tons of earth and mixing it with the radioactive fission products of the bomb, which at the moment of explosion are equal in radioactivity to slightly over 250 million tons of radium. This mixture of earth particles and fission products is widely distributed by the winds through which it falls.

For example, the total accumulated dose 18 hours after a surface burst with a fission yield in the megaton range might run to 1,000 roentgens or more in an area roughly 20 miles across at the widest place and 100 miles long, nearly the distance from here to Philadelphia. Closer to the point of detonation the accumulated dose would be higher. Such a radiation dose of 1,000 roentgens or more received within a period of 48 hours would prove fatal to all unprotected persons within one to three weeks. Now, of course, the radiation hazard would extend well beyond the 100 miles in the example I have given. However, generally speaking, we should expect the hazard to decrease as the distance grows.

Following an attack we should also expect to find overlapping of the fallout patterns from separate detonations. That is, areas which might be lightly contaminated by one explosion would receive more fallout from a second explosion in another area and perhaps still more from third and subsequent explosions. The net result is that much of the lightly contaminated area can become heavily contaminated by the later additions. It is conceivable that the enemy could deliver an attack from which virtually the entire land area of the United States would be heavily contaminated because of the overlapping of fallout patterns.

Usually in a discussion of casualties, we are talking about those from acute radiation doses. These are the radiation doses received at high rates over a relatively short period of time.

Making precise predictions of the effect of acute radiation on individuals who may be in a fallout area is presently impossible. Our medical experience in treating acute radiation sickness is quite limited. Generally speaking the severity and length of acute radiation sickness depends upon the total dose received and upon the rate at which it is received. To put it another way, the same amount of radiation which would make one very sick if he received the dose in two days might not be immediately disabling if he received the dose gradually over the course of a couple of months. The total dose will, of course, depend upon the length of time spent in the area and available shielding. In addition, the difference between survival and death may depend not only upon the actual dose received, but upon such factors as the particular individual's constitution, other injuries and the adequacy of medical treatment. Those people receiving radiation doses from about 100 to 250 roentgens may show some signs of acute radiation sickness such as nausea and vomiting but almost all of them will survive even with little or no medical care. On the other hand, almost everyone receiving doses over 250 roentgens will certainly suffer from acute radiation sickness and must have medical care. As the radiation dose increases from 250 to 800 roentgens the chances of survival change from favorable to a very unfavorable position. We expect [illegible] from doses greater than 1,000 roentgens.

It is most important to remember that the degree of radiation injury is dependent upon the radiation dose and that even staying in the cellar of almost any type of home will materially reduce the radiation dose and even at dose rates of 500-1000 roentgens may mean the difference between survival and death. Moreover, the intensity of the radiation decreases with the passage of time rapidly at first and then more slowly. For example, a radiation dose rate of 1,000 roentgens per hour will have fallen to about one roentgen per hour by the end of two weeks.

Now we cannot all remain in shelters [illegible] the dose rate falls to an acceptable level. [illegible] actions, such as radiological monitoring and rescue work, which will have to be performed. Furthermore, regardless of the state of home preparedness, people will have to come out some day to get more food.

Fortunately, it happens that the body repairs radiation damage, and if people get radiation doses in small increments, they can receive a few hundred roentgens over a period of several months without becoming a casualty. This is not to say that we can indiscriminately expose ourselves in the post-emergency period. Until the authorities say that the situation is safe, we must continue to take advantage of protection in the interest of keeping to a minimum the total radiation dose and attendant long term effects. In the interest of brevity, I shall not discuss long range radiation effects, such as life shortening or genetic effects.

As can be seen, through provision of shelters we can get our people through the death or sickness period of the radiation hazard, accomplishing substantial reductions in numbers of casualties. But this doesn't tell the whole story. If we are to survive as a nation we are going to do it above ground and will require the essentials of life-food, water and medical care. Our normal means of providing and distributing these essentials will be drastically curtailed by a nuclear attack. Substantial programs for local stockpiling of supplies for use in the first few weeks and for reestablishing their production and distribution are almost as essential to our survival as the provision of radiation shelters. Reestablishment of food production and its distribution will probably be the most difficult problem.

In contaminated areas our food animals, as well as people, would require protection from external radiation or they would become casualties. Added to this would be the additional hazard to life -- animal or human -- from eating contaminated food and water. Unrestricted consumption of exposed foodstuffs and crops would threaten the lives of all survivors in these areas.

In the heavily contaminated areas a very large percentage of our food animals would perish from the combined effects of external radiation and the consumption of contaminated fodder. For some months essentially all milk supplies would be too highly radioactive to use even if the cows survived.

Although exposed foods would be suspected of being too highly contaminated to be eaten for periods of weeks, or even months, this contamination would be on the surface of the foods. Most of it can be removed from the surface by washing or peeling. Canned goods in the fallout area, for example, could be made safe by washing the can.

Radioactive contamination would also be in sources of water supply. However, if operative, existing water treatment processes will help reduce the hazard.

When I have talked about food, I have had reference to existing stocks. New production is another matter, one with which the survivors must expect to have difficulty. Much of our valuable agricultural lands will be highly contaminated and crops raised in these areas will take up radioactive materials from the soil. Reclamation of these lands will be a particularly critical matter. The principal problem is that presented by strontium 90 which, unless removed, will contaminate the land and its crops for decades. The most effective removal method as yet is the removal of ground cover or the surface soil. This is time consuming, would require a great deal of labor, and equipment and we are left with the problem of disposing of large quantities of contaminated material. Intensive cropping is another method, but here again considerable time is required -- about 40 crops to remove the strontium 90 to acceptable levels. One can, of course, shift production of milk and vegetables to uncontaminated land, raising only non-food crops such as cotton and flax on contaminated lands. This has a disadvantage. When contaminated lands are cultivated, the possibility of physical removal of the fallout is gone. The Department of Agriculture has the principal interest in this subject, and is actively working on practical countermeasures.

Survival is also dependent on the manufacture and transportation of goods and the reestablishment of the system for the distribution of food, energy and fuels. The communications upon which we depend so heavily must be restored. Some sort of housing must be provided for the displaced, and so on. The work must be accomplished with fewer resources and with fewer people in the face of some remaining hazards. It will be a grave situation.

Nevertheless, I believe that the post-attack odds may not be insurmountable. What is accomplished before can help greatly afterward. There is a wealth of information in unclassified publications on which any government, community or any family can base plans. The plans will have some grim aspects, but this derives from the nature of war. Failure to make the best use of what is available in advance of the ordeal certainly will not make things easier.