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AEC 540/37

February 16, 1955

COPY NO. 21

ATOMIC ENERGY COMMISSION

FCDA DRAFT ADVISORY BULLETIN ON RESIDUAL RADIATION IN RELATION TO CIVIL DEFENSE

Note by the Secretary

1. The attached letters from the Administrator, FCDA, with enclosure, are circulated for the information of the Commission.

2. The attachments have been referred to the Special Assistant to the General Manager for Liaison.

W.B. McCOOL

Secretary

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FEDERAL CIVIL DEFENSE ADMINISTRATION
WASHINGTON

OFFICE OF
THE ADMINISTRATOR

February 10, 1955

Honorable Lewis L. Strauss
Chairman
Atomic Energy Commission
Washington 25, D. C.

Dear Admiral Strauss:

If for any reason your efforts to make the fallout data available to the American people do not meet with success, as we hope they will, I submit in writing the proposal which I discussed with you personally the other day in Arthur Flemming's office.

Should your efforts fail, I suggest that we move in this direction expeditiously.

Sincerely,

/s/ Val Peterson

Val Peterson

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FEDERAL CIVIL DEFENSE ADMINISTRATION
WASHINGTON 25, D. C.

OFFICE OF THE ADMINISTRATOR

February 10, 1955

Honorable Lewis L. Strauss
Chairman
Atomic Energy Commission
Washington 25, D. C.

Dear Admiral Strauss:

The recent decision not to release your statement on fallout at this time leaves State and local Civil Defense officials lacking any planning base for protective measures. Many stories have appeared in the press, purporting to give the dimensions of the seriously affected areas, but ranging from observations that at 80 miles radiation was not fatal to the Japanese fishermen, to dire predictions of death and uninhabitable areas many hundreds of miles from the detonation of a thermonuclear weapon. I find it increasingly difficult to justify our failure to furnish to State and local Civil Defense planners official data which will at least give the order of magnitude of the fallout effect.

There is one point of some importance which deserves attention in this connection. Under the Federal Civil Defense Act of 1950, the primary responsibility for civil defense rests with the States and their political subdivisions. The civil defense program, unlike our military defense program, must be built upon the willingness of State Governors, legislatures, Mayors and local legislative bodies to support it. If we in the Federal Government are to provide effective leadership, we must present convincing facts to the leaders in the States and cities; we cannot compel their support.

While I appreciate the delicacy involved in the international situation, and have no desire to argue the point, I feel that it may be possible to find a vehicle for the release of essential data without the dramatic impact that it was feared your statement might have had around the world.

There is attached a copy of the FCDA Advisory Bulletin which was prepared to be released, with the concurrence of the AEC, at the time your statement was released. Your people are already familiar with this and have concurred in its contents. I am writing now to ask officially that the classification be removed from any data therein now considered RESTRICTED, in order that it may be circulated to State and local Civil Defense officials.

If the Commission agrees to such declassification, the statement would be distributed, without any accompanying press release, in the normal manner. I appreciate that the contents of such a bulletin will probably be released to the press locally, but it would not attract nearly the concentrated attention that would be accorded a national release. Furthermore, against the dangers

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of such disclosure, we must weigh the fact that these data have been available for nearly a year, and the U. S. Government has done nothing to advise the American people as to the dimensions of the problem.

In view of recent events and decisions, you may wish to consult the Operations Coordinating Board or the National Security Council with respect to my request. If so, I should appreciate being advised so that I may participate in any discussion of the matter.

I am, of course, fully aware of your sympathetic views and hope that we may find in this proposal a vehicle for accomplishing our mutual objective, while minimizing any untoward effects abroad.

Sincerely,

/s/ Val Peterson

Val Peterson

Enclosure

DRAFT

ADVISORY BULLETIN NO.

(DATE)

TO: STATE AND LOCAL CIVIL DEFENSE DIRECTORS

SUBJECT: RESIDUAL RADIATION IN RELATION TO CIVIL DEFENSE

I. Purpose

The purpose of this Advisory Bulletin is to revise Advisory Bulletin No. 72, issued in 1951, to summarize information on residual radiation with particular reference to fallout, and to state interim FCDA policy recommendations in regard to civil defense plans and operations.

II. General Statement

Recent developments in nuclear weapons have increased the probability that serious amounts of radiation from fallout may be experienced in addition to the blast and thermal effects. Previous civil defense thinking and planning will not have to be abandoned, but rather must be re-evaluated, broadened, and intensified. Civil defense preparations must continue to contemplate initial radiation problems, the smaller weapons, non-contaminating bursts, detonations with little or no warning time and all of the other problems which have previously confronted planners. The increased attention to fallout, which is by no means a new problem (see "Effects of Atomic Weapons", 1950, Chapter VIII), re-emphasizes the fact that civil defense must provide a variety of specified operational capabilities to meet a variety of situations.

III. Discussion

Initial radiation (the gamma rays and neutrons released instantaneously with the explosion) produced by a large nuclear weapon detonated on or near the ground does not present a serious hazard beyond the area where heat and blast are of greater concern.

Residual radiation, however, from such a detonation may be expected to affect very large areas for a considerable period of time. Fallout is the phenomenon responsible for the major part of the residual radiation hazard.

A. Description of Fallout

The term "fallout" is used to describe the radioactive particles produced by a nuclear detonation when they fall back upon the earth from the upper air. It is composed of fission products, particles of the bomb itself, substances made radioactive by neutrons, and material from the surface of the earth carried aloft by the explosion. In the case of an air burst, where the fireball does not come into contact with the earth, the radioactive products of the detonation are carried high into the atmosphere as very small particles and are scattered widely by the winds. The great bulk of this material will undergo radioactive decay before the particles have fallen to the earth. When, however, the detonation is such that the fireball rests upon the ground, great amounts of earth are drawn into the rapidly rising fireball resulting in coarse, highly radioactive particles which tend to fall rapidly while being carried along by the wind.

The cloud of a thermonuclear explosion rises rapidly to the highest levels of the atmosphere and spreads over hundreds of square miles in the first hours. During this time the particles are being acted upon by the winds, including those up to 60,000 or 80,000 feet, which may vary greatly in direction and velocity at different heights. Particle size will affect the rate of fall, and as the material descends through the rain cloud bearing levels the fallout may be slightly accelerated by rain or snow.

For a considerable distance around the point of detonation, radioactive particles will be distributed up-wind and cross-wind, as well as down-wind. The actual distance to which this close-in

[redacted]

contamination will extend depends on the yield of the weapon, and may be expected to cover at least the area bounded by the outer limits of the D-ring of blast damage. It will probably be of a high degree of radioactivity.

Outside the zone of close-in contamination radioactive fallout can be expected to occur progressively in the direction of the effective wind over a number of hours and over an area of a great many square miles. The radioactive material may or may not be visible but can be detected with radiological monitoring instruments. Falling dust or ash, if visible, will most likely be radioactive.

The intensity of the radioactivity is very high immediately after the burst, but "decays" or diminishes rapidly. Therefore, since not much time will have elapsed, the particles reaching the ground near the burst will be very highly radioactive while those which are carried a long distance will have lost much of their radioactivity before they alight.

The fallout material on the ground, of course, continues its radioactive decay. After 24 hours the rate of radiation per hour based on the decay rate formula given in "The Effects of Atomic Weapons", published by the U.S. Atomic Energy Commission, September 1950, is about 2% of the rate at one hour after the burst. This may still be very dangerous at some points, however.

B. <u>Energy Range of Residual Radiation</u>

Radiation emitted from fallout is of a lower penetrating power than the initial radiation produced at the time of bomb detonation. Therefore, the effectiveness of a given thickness of shielding will be greater for residual than for initial nuclear radiation.

[redacted]

C. Dose - Effect Relationship

Civil defense operations will always be carried out under the philosophy of the least possible radiation exposure consistent with the mission. The greatest possible protection will be the goal of all facilities and procedures for the public. For orientation and quick reference the following statements will be paraphrased from "Health and Special Weapons Defense", A.C. 11-1 published by FCDA in 1950 and from "Emergency Exposures to Nuclear Radiation", T.B. 11-1, published by FCDA in 1952. Less than 25 roentgens of whole body exposure to gamma rays over a brief space of time will not result in obvious injury. Doses of about 100r will produce nausea and vomiting in some individuals but will not seriously affect the working efficiency of a group. About $\overset{450}{400}$r would probably prove fatal to some 50% of people so exposed. 600r or more would probably be fatal. Somewhat larger doses are required to produce a given effect if the radiation is received over several days or in intermittent exposures.

D. Probability of Extensive Radiological Contamination

Radiological contamination, although in no sense exclusive to high-yield thermonuclear detonations, does become a matter of major concern when a large weapon of the type used in the 1954 Pacific tests is exploded near the ground. The fallout of radioactive materials from such an explosion may, under certain circumstances, settle over wide areas far removed from the point of detonation.

E. Distances and Areas

The areas seriously affected by heat and blast of a thermonuclear weapon are large, but are small indeed compared to the area of residual radiation hazard produced by fallout. Because of the many uncertainties, especially wind direction and speed at

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different heights, it is impossible to apply a single fallout pattern to all detonations. The area of significant contamination will be largely dependent upon the yield of the bomb. Its location, with regard to ground zero, and its width and length, will be determined by the resultant direction and velocity of the winds at various heights and distances. In general terms it will be an elongated cigar-shaped area extending "down-wind" from the point of burst.

It is obvious that dimensions depend upon so many uncertainties as to preclude precise predictions. Realistic assumptions, however, based on experimental data from the Pacific Proving Grounds provide an adequate basis for civil defense planning for operational preparedness.

The thermonuclear bomb fired at the Bikini Atoll on March 1, 1954, resulted in an area of contamination (100 roentgens or more cumulative dose 24-48 hours after the detonation) of nearly 14,000 square miles, with the heaviest concentration falling on the central portion of the ellipse extending some distance from the point of burst. Some of the early fallout from this explosion occurred in the form of a fine dust which looked like snow. On an the inhabited island~~s~~ about 170 miles down-wind, the fallout began about eight hours after the detonation and continued for several hours.

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On the basis of gamma dose radiation effect, the March 1, 1954 explosion heavily contaminated (500 roentgens or more cumulative dose 24-48 hours after the detonation) an area extending approximately 160 miles down-wind and up to 40 miles in width. On the same basis and with the assumption of no shelter or other protective measures, it has been estimated that in a down-wind belt about 140 miles long and up to 20 miles wide the residual radiation would have been fatal to nearly all persons

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remaining exposed, out of doors there for 24-48 hours; and that at about 190 miles the radiation would have been fatal to about 5 to 10 percent of the people similarly exposed.

Thus about 7,000 square miles of territory would have been so severely contaminated that survival would depend upon the most prompt protective measures. Beyond a point about 220 miles distant it is unlikely that any radiation deaths would have occurred.

Fortunately, adequate protection against dangerous fallout is usually found in and around American cities, and if proper precautions are taken to avoid exposure, as indicated below, casualties from radiation can be reduced to very small numbers.

IV. Summary Conclusions for Civil Defense

A. Early protective action is vitally important since the dosage a person completely exposed might receive in the first few hours after fallout has started will exceed that which the same person would receive over the rest of a week spent in the same location.

B. In an area surrounding ground zero and in a much larger area in the direction of the effective wind, radiation intensities may be so high that most civil defense activities will have to be postponed or conducted with great caution. Danger areas must be determined by radiological monitoring techniques and civil defense decisions must be made with serious regard to the radiological situation.

C. The threat to many rural areas, especially to those which are on the prevalent down-wind side (usually eastward) of large target cities, necessitates extensive civil defense preparations.

D. Civil Defense organizations must vastly increase the capability of radiological defense services, particularly monitoring.

E. Operational plans for services such as engineering, fire, police, rescue and wardens must provide flexibility and versatility. The radiation situation may require that personnel of such services for a time perform duties other than those for which they are primarily trained, or may deny the performance of those duties.

F. The term "shelter" as distinguished from "cover" is used to mean construction which is sufficient to afford substantial protection to persons within it, from blast, thermal effects, and initial and residual radiation. "Cover" refers to structures which will offer protection from radioactive fallout, beyond the range of other effects.

G. Since fallout progresses over a considerable period of time and its path can usually be predicted within broad limits, in contrast with the almost instantaneous blast and thermal effects, civil defense countermeasures can be adjusted to the developing situation and thereby greatly increase survival chances.

H. Any evacuation plan to avoid the blast and thermal effects must take into account the availability of shelter or cover, the speed of movement which can be achieved and the possibility of identifying areas of relative safety with reasonable accuracy. Beyond the probable range of blast and thermal effects, the emphasis should be placed on advising people to seek the most effective cover available (see para V. B 2) and to remain there until the radiation outside has fallen to safe levels.

I. People must be informed concerning the nature of the danger and the measures which they can take, including personal decontamination. Standing instructions must be prepared and issued by civil defense officials establishing the procedures which are to be carried out.

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J. Since the radioactivity will decay at a high initial rate, it is possible that vital civil defense operations may be undertaken even within the first few days without serious overexposure of personnel. This is especially true if they can be used in relays. They should, of course, be carefully monitored when thus exposed.

V. Recommendations with Respect to Residual Radiation

Precautionary measures can greatly reduce the residual radiation hazard. The guidance provided herein is based on information currently available. Improved knowledge of phenomena, the ability to predict fallout patterns, the speed with which evacuation can be accomplished, the availability of adequate cover or shelter, and other factors will require modification of these policies from time to time. In each instance a decision will have to be made between evacuation, shelter or some combination of the two. Warning time, distance to a relatively safe area and the existence of reception facilities will be prime considerations. The possibility of moving into the fallout area from another target must be also considered in making a decision.

Because larger areas will be involved, the problems of communication, warning and transportation become increasingly complex. Since operating decisions may of necessity be made on the basis of a large area analysis, they become increasingly important.

Methods used by meteorologists for plotting wind vectors can be applied to the prediction of fallout patterns. FCDA Advisory Bulletin No. 178, issued in November 1954, contains a method suggested by the U.S. Weather Bureau. These methods will permit a rough but useful approximation of the probable direction of fallout and give some indication as to the area of contamination. Improved and faster methods of deriving this pattern and means of testing their reliability for civil defense purposes are under study.

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Intensities of radiation within such areas may be assumed to be least on the edges and greatest toward the center, but actual levels will have to be determined by radiological monitoring.

The following principles should be borne in mind in developing civil defense plans:

A. Evacuation

Advisory Bulletin No. 158 and Supplement No. 1, indicate that the feasibility of evacuation is for city determination and recommend that each city study its own problems and develop evacuation plans in accordance with certain principles which are delineated. Megaton range weapons with their greater blast and thermal damage areas emphasize the initial objective of evacuation which is to escape these effects. Residual radiation hazards from fallout may be avoided to a considerable degree by the extension of the basic principles of evacuation planning, in combination with the location and designation of shelter and cover.

The following principles are recommended for consideration in adapting evacuation plans to the fallout threat:

1. The fallout prediction plot will be useful in determining the general direction and distance to move. More accurate prediction and quantitative appraisal will be possible as a result of continued meteorological analysis of data on hand and new data as they are obtained. Since any prediction is susceptible to error, however, post-attack actions which depend on freedom from radiation hazards should generally be initiated only on the basis of radiological monitoring results.

2. Several or year-round average data on wind directions including high-level winds may be obtained from weather stations and will be useful in locating permanent installations, such as control centers. These data, however, should not be used to determine the direction of movement of people.

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3. From the standpoint of evacuation, fallout may impose hazards or calculated risks in the use of certain routes and areas. What the Civil Defense Director will be able to do will depend on his ability to successfully take into account factors such as available warning time, availability of weather information, accuracy of predicted fallout patterns, size of population to be moved, geography of the city (including traffic lanes and natural obstructions) and location of other target cities with reference to evacuation routes.

4. It is essential that communications be maintained so that the public can be continually informed regarding the developing situation and of civil defense activities. It may be impossible to direct and control their movement in a direction which to them seems to be downwind, unless by means of constant communication they are assured that the plan is giving them the best opportunity to survive.

5. Evacuation plans should stress the greatest possible flexibility and mobility. It is recognized that planning in certain functional areas requires the pre-selection of locations such as transportation centers and welfare reception areas. Since the use of these locations may be seriously threatened because of radiological contamination, such services must achieve flexibility either by increasing the numbers of such locations, by improving the ability to operate from alternative sites, or by providing protection from fallout at the site.

6. Traffic engineering studies and specific (alternate if possible) plans should receive early consideration and continuing review.

7. Routing should be selected with reference to the availability of cover enroute and at destination. Plans must not result in concentrating large numbers of people in areas where no

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cover of any kind is available or can be provided unless rapid secondary movement is feasible. A weighing of relative risks may suggest the selection of destinations for evacuees in areas where some fallout is probable rather than to attempt a more radical movement in the hopes of escaping the pattern completely. This consideration would be especially valid in populous areas where there is danger of overlapping fallout patterns.

B. Shelter and Cover

1. Programs for the construction of home shelter and the selection and marking of shelter areas as outlined in TM 5-1, TM 5-5 ("Shelter from Atomic Attack" - Part 1, and "Home Shelter for Family Protection") should be completed especially in target areas, along escape routes, and within satellite communities. In the event that warning is insufficient to permit evacuation many lives can be saved by taking shelter and by utilizing simple decontamination measures until such time as persons could leave the area. The shelter program is no longer a city and reception area program; it is a general program since almost no area is free from some threat from fallout contamination.

2. Beyond the range of probable blast and thermal effects, such "cover" as is available should be used. The best protection from residual radiation is that which places the occupants farthest removed from the fallout particles on the ground and roofs of buildings and which places the greatest amount of dense material between the occupants and the radioactive material. Examples are basements of homes, lower floors, of barns which may have thick stone or masonry walls, cyclone cellars, caves, and tunnels. Within each the most protected area or spaces should be designated.

Test data indicate that the radiation level indoors on the first floor of an ordinary frame house would be about one-half the level out of doors. Greater protection would be afforded by a brick

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or stone house, and the basement of an average residence would reduce the exposure to about one-tenth. It has been stated that shelter in an old-fashioned cyclone cellar, with a covering of earth three feet thick, would reduce the radiation dose to about 1/5000.

3. Adequate food and water should be stocked and proper sanitation measures taken to permit shelter occupancy for several days. To the extent that concentration of evacuees is necessary sanitation problems will be magnified. In the individual home, however, it should be noted that people may emerge from the basement for a few minutes at a time without appreciably increasing the hazard. Precautions should be taken to reduce the possibility of contaminated material getting into the protected area. Surface sources of drinking water, reservoirs, and the distribution system should be repeatedly checked for serious radiological contamination and other pollution.

C. Operations

1. The greatly increased probability of a serious residual radiation hazard makes it necessary that all civil defense programs be re-evaluated and that necessary changes in operational plans be made. For the purpose of preliminary planning, it may be assumed that a city struck by a high-yield weapon will have a serious radiological problem within the "D" ring of blast damage and that continuing monitoring will be necessary to provide information for operational guidance.

2. Certain fixed operational sites, such as assembly areas and communications centers must be given special protective consideration if operations at that location are a strict necessity.

3. Decontamination may be required for certain essential facilities such as communications centers, water pumping stations,

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vital industrial plants, control centers, and access or exit routes; and for certain essential equipment such as fire fighting apparatus and ambulances. The principles involved are discussed in "Radiological Decontamination in Civil Defense TM 11-6" but much needs to be done in developing more adequate methods.

4. Radiological contamination of the clothing, hair or skin is of particular importance because of the greater contribution to the total dose by beta radiation. Where there is reason to believe that personal contamination has occurred, the clothing should be removed and the exposed parts of the body should be thoroughly washed. Unless there has been exposure to serious contamination, it may not be necessary to destroy the clothing since in most cases it could almost invariably be rendered safe by laundering or by simply waiting for natural radioactive decay.

5. Radiological contamination of large areas would reduce the availability of local resources and facilities for civil defense operations, with heavier demands placed on outside support. These demands may be complicated by increased numbers of evacuees. Recovery, testing, rehabilitation and decontamination of supplies and equipment will become an immediate and paramount problem.

E. <u>Public Education</u>

In order to insure the greatest possible savings of life through proper protective action by the general public considerable emphasis should be placed on the public civil defense education program. As much as possible should be accomplished in the pre-attack period so that the necessary civil defense instructions given during the attack and immediate post-attack periods will be understood and willingly obeyed.

It is suggested that the public information program stress the effectiveness of the counter measures which have been developed. Though radioactive contamination as a threat has been given little emphasis in the past, it is now becoming a more important factor and should be presented to the public in balance with the other threats of enemy attack. Compared with the blast and thermal effects the fallout problem is more manageable. Among important civil defense instructions to the public are those involving:

1. The choice of the best cover and the most protected locations in structures with regard to radiation shielding.

2. Personnel decontamination by removing at least the outer clothing and washing the exposed parts of the body.

3. The possible necessity of remaining in shelter or cover for many hours or for several days.

4. The importance of avoiding exposure by spending a minimum of time away from the most protected location.

5. The desirability of maintaining in or near the shelter or cover a means of receiving official civil defense instructions from the outside.

VI. RECISSION

Advisory Bulletin 72, dated September 26, 1951, is hereby rescinded.