RADIOLOGICAL DEFENSE IN THE CIVIL DEFENSE PROGRAM

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The peculiar dangers characteristic of atomic attack are those arising from the presence of ionizing radiations, a physical phenomenon loosely termed radioactivity.

While it is hoped that international control of atomic energy, which would eliminate the possibility of atomic attack, may be achieved, our national security demands immediate development and implementation of a specific plan for radiological defense as a part of the national civil defense program.

All those passive measures of atomic defense directed toward the prevention or mitigation of personnel injuries resulting from over-exposure to radiological hazards are collectively termed radiological defense.

As related to atomic attack, any and all risks arising from, or attributable to, the presence of ionizing radiations are called radiological hazards.

With respect both to atomic attack and to radiological defense, the term ionizing radiations may be taken to mean those nuclear emanations, gamma rays, neutrons, beta particles and alpha particles, which are capable of penetrating the human body to varying depths. They may cause injury through ionization of the countless tiny cells of which all living tissue is composed. For purposes of this discussion, there is no need to be concerned with their detailed physical characteristics.

ESTIMATE OF PROBABLE EFFECTS OF ATOMIC ATTACK

Use of Bomb Assumed. The possibility of employment of atomic weapons in attack against our country increases with time, but detailed discussion

of enemy capabilities, both present and future, does not properly lie within the scope of this report. In order to provide some definite conception of the devastating effects of atomic attack, it will be assumed, solely for purposes of simplification, that a single atomic bomb is dropped without warning on some densely populated industrial area in the nation.

Aerial Burst Probable. In view of the numerous technical advantages which may reasonably be expected to accrue, it is probable that the bomb used by a theoretical enemy would be detonated well above the earth's surface, as was the case at both Hiroshima and Nagasaki.

Casualty Estimates for Aerial Burst. Detailed analysis of pertinent data provides the following estimate of probably casualties resulting from this type of aerial detonation of a single atomic bomb:

Total Numbers of Fatal and Non-Fatal Casualties. It is estimated that human casualties of various types would total roughly 100,000, including:

Fatal. Approximately 40,000 in all, with 20,000 persons killed outright and 20,000 additional dying within the first week following detonation.

Non-Fatal. Approximately 60,000 in all, with 20,000 serious cases in the first week, plus 20,000 requiring extensive and 20,000 lesser degrees of medical treatment during the first three weeks after detonation.

Generalized Types of Casualties. The two general types of injuries to be expected are:

Those Common to Ordinary Attack. These would include shock, burns from flash and flame and varied trauma

produced by blast, flying debris and structural collapse. They would be similar to those resulting from ordinary high explosive raids of comparable destructive force and would cover a wide range of individual severity.

Those Peculiar to Atomic Attack. These injuries, which may be observed either alone or in combination with other listed immediately above, are caused by exposure to ionizing radiations. In non-fatal cases, the general signs and symptoms of such injuries usually become apparent from three to 21 days after exposure. They include malaise, nausea, bloody diarrhea, prolonged blood clotting time, and reduced resistence to infection and disease. Administration of whole blood represents the principal form of effective treatment. Promptly administered, it may be expected to save the lives of many "borderline" cases.

Georgraphical Distribution of Casualties. In general, but with marked "spotiness" attributable to "chance shielding" and other factors, the nature and percentage of casualties would be directly dependent upon distance from the point of detonation. Over-all distribution estimates, based on distances from the center of impact, are as follows:

Within 500 Yards. Nearly 100% immediate fatalities may be expected. They would be due to exposure to ionizing radiation, blast, burns, structural collapse and numerous other factors.

Between 500 and 1,000 Yards. Nearly 100% fatalities may be expected, with deaths occuring at various times within the first three weeks after detonation and depending upon the degree and nature of exposure. The types of injuries sustained would again vary widely. In practically all cases, ionizing radiation could be the primary cause of death, though in many instances it may not be.

Between 1,000 and 1,500 Yards. The likelihood of fatal injury due to the effects of ionizing radiations would be greatly reduced, but the likelihood of serious injury by flash and flame remains high. It may be expected that fatalities in this area would total approximately 50% of all individuals present.

Between 1,500 and 2,500 Yards. Ionizing radiation may be expected to cause many non-fatal injuries, but practically all fatalities would be directly attributable to other factors. It is likely that approximately 15% of all people in the area would be killed.

Between 2,500 and 3,000 Yards. Fatalities would be rare, probably 1% to 2% of all persons in the zone. Most of them would be due to thermal burns or to indirect effects of the blast.

Beyond 3,000 Yards. Few, if any, injuries may be anticipated.

Radiological Hazards Produced by Aerial Burst. The detonation of an atomic bomb produces two generalized types of radiological hazards. In an aerial burst, the first, and by far the most injurious to people, is caused by the intensive gamma radiation and the vast shower, or "flux", of neutrons released during the split-second period of actual detonation. While this particular hazard lasts only a few seconds, its killing power is incredible. In combination with injuries from other causes, it may be expected to result in death to practically all persons within 1,000 yards of the center of impact. Being an adequate distance from the point of detonation is the only practical measure of mass protection from this hazard, although some persons in near-by positions may escape its effects due to "chance shielding". This "accidental" form of protection may be provided by terrain, earthen embankments, heavy walls of concrete or similar radiation barriers.

The second type of radiological hazard produced by atomic bomb explosions is the lingering, or persistent, hazard attributable to the presence of radioactive fission products, or "bomb ashes". In an aerial burst, these are of only minor importance, as most of the harmful "waste materials" are swept skyward with the hot gases resulting from the explosion. There they are widely dispersed by the varying winds at different levels of altitude. The likelihood of serious ground contamination attributable to fission products is small, even near the center of impact. Aerial contamination may, however, temporarily provide serious hazards to aircraft operating within some miles downwind of the site of detonation. Then, too, "fall out" from the bomb cloud may produce localized hazards at points far removed from the place of actual attack. The principal effects of the latter would be psychological rather than physical.

Radiological Hazards Produced by Surface and Sub-Surface Bursts. In planning for radiological defense, the possibility of surface and sub-surface bomb detonations cannot be entirely disregarded, though likelihood of their employment is considered comparatively small.

In a surface burst, the radiological hazards produced at the actual time of detonation are grossly comparable to those of an aerial burst, although the range of the blast effects may be noticeably lessened. On the other hand, the lingering radiological hazards will usually be of far greater importance than in those instances in which the bomb is exploded in mid-air. Persistent radioactive ground contamination may reasonably be expected to be encountered in the target area. It will represent a serious hazard, particularly to personnel whose civil defense duties may require entry therein. Downwind contamination of the air will be much the same as that resulting from an aerial burst. In addition, there may be contamination of nearby bodies of water as a result of "fall out", while spread of ground contamination through surface drainage and movement of sub-surface waters is also a distinct possibility. Any distant, downwind hazards attributable to cloud "fall out" will be primarily of psychological significance, as in the case of an aerial burst.

Should the bomb be detonated beneath the surface of a body of water, as was the case in the second Bikini experiment, the radiological effects will differ widely from those produced by surface or aerial explosions. Under these circumstances, the radiations released at the instant of detonation may largely be "absorbed" by the water and so be rendered of minor importance. On the other hand, aerial contamination, though greatly limited in extent, may be of high intensity. All nearby land areas and above-surface objects, as well as the water body itself, will doubtless be heavily contaminated with

radioactive fission products. As a rule, this contamination will persist for unusually long periods of time, depending upon rate of radioactive decay, dispersion and dilution in the water and other factors.

OBJECTIVES OF A PLAN FOR RADIOLOGICAL DEFENSE

The primary objectives of the radiological defense plan should be:

a. To prevent or mitigate personnel injuries resulting from exposure to radiological hazards, through detection and avoidance of such hazards;

b. To facilitate the work of relief and the restoration of essential services, through the protection of personnel whose civil defense duties require their entry into radiologically hazardous areas; and

c. To prevent or minimize confusion and panic, through the collection and proper dissemination of factual information concerning the existence, or non-existence, of radiological hazards.

SPECIAL CONSIDERATIONS IN PLANNING FOR RADIOLOGICAL DEFENSE

The peculiar characteristics of atomic attack present new and highly technical problems of defense, requiring special consideration in all phases of radiological defense planning. The more important of these are:

Detection and Avoidance of Radiological Hazards the Basic Principle in Radiological Defense. Assuming lack of warning of attack and consequent inability to utilize available shelters, little can be done to protect persons within 3,000 yards of the point of bomb detonation from the extreme radiation

hazards existing at the moment of actual explosion.

On the other hand, personnel injuries caused by over-exposure to the persistent radiological hazards produced as a result of the detonation can very often be either prevented or mitigated through detection and avoidance of those hazards.

In view of these facts, the detection and avoidance of radiological hazards necessarily becomes the basic principle for all radiological defense operations within the civil defense program.

External and Internal Radiation Hazards. One highly insidious characteristic of many radiological hazards is the fact that they may exist either outside of or within the human body. In most instances, the source of radiation remains outside the body and causes injury through penetration of the tissues from without. Under these circumstances, the rays or particles are termed external radiations. Broadly speaking, injuries attributable to this type of hazard usually become apparent within three weeks after exposure.

On the other hand, radioactive fission products, or "bomb waste", may inadvertently enter the body. This usually takes place by direct methods, such as inhalation or contamination of open cuts or wounds. It may, however, occur indirectly, as is the case when humans eat fishes whose bodies contain radioactive materials picked up in feeding. Once inside the body, the radiations from such materials penetrate and ionize the tissues from within and are consequently called internal hazards. Since the amount of material entering the body is usually small and its radioactive intensity comparatively low but often long-lived, injuries attributable to internal hazards may not become apparent for several years.

Limitations of Protective Clothing and Devices. Insofar as highly intensive radiations are concerned, truly protective clothing is non-existent and there

is little reason to believe that its future development is possible. Ordinary clothing, however, not only provides protection against certain of the less penetrating radiations, such as alpha particles, but also prevents, at least to a degree, surface contamination of the skin with fission products which may unavoidably be picked up in contaminated areas. As a general rule, contaminated clothing should be removed and disposed of as soon as possible after leaving contaminated areas. Disposable hats and gloves are desirable for use by those persons whose civil defense duties require their entry into radiologically hazardous areas in which they are likely to pick up contamination.

While it may prove desirable to provide certain civil defense personnel who are required to work in radiologically hazardous areas with face masks of a type effective in preventing inhalation of radioactive materials, their widespread use by members of the civil population is currently deemed to be neither necessary nor desirable.

Limitations of Decontamination Procedures. Decontamination procedures as they pertain to extensive land areas, buildings, ships or large items of special equipment have proved to be impractical. On the other hand, human decontamination, confined to the removal of contaminated clothing plus thorough washings and re-washings of the face, hands and body with soap and water, often is both practical and effective. This should be routine procedure for personnel required to work in contaminated areas.

Detection of Ionizing Radiations Requires Special Equipment in Hands of Trained Personnel. It is impossible to see, hear, feel or smell ionizing radiations. Their presence can be detected only by means of special equipment, such as ionization chambers and Geiger counters, operated by technically trained personnel.

Protective Measures for the Individual. While the primary measures of radiological defense are of a highly technical nature and would necessarily have to be carried out by members of a specially trained and equipped radiological defense organization, the private invidivual should be prepared to take the following precautions in order to assure the maximum possible degree of personal protection from radiological hazards:

a. He must be thoroughly aware of the insidious nature of the radiological dangers inherent in atomic attack and must strictly comply with all instructions and regulations promulgated for the purpose of minimizing their devastating effects;

b. He must avoid designated radiological hazards;

c. He must make every effort to avoid bodily contamination with radioactive materials and must follow the prescribed measures for personal decontamination should he have reason to believe this body may have become contaminated; and

d. He must exercise every possible precaution aimed at prevention of internal radiation hazards caused by entry of radioactive materials into the body. For example, he would refrain from eating or drinking foods and liquids which there is reason to believe may be contaminated, would refrain from smoking while working in or near radiologically hazardous areas and would wash the hands thoroughly before handling foodstuffs.

In this general connection, it is naturally assumed that he would take full advantage of available shelters should the time factor permit.

RADIOLOGICAL DEFENSE OPERATIONS IN STRICKEN AREAS

Collective operations carried out in stricken areas by members and

components of local radiological defense organizations represent the backbone of the entire radiological defense program. In many instances, they may prove to be not only the means of prevention of countless human injuries caused by over-exposure to ionizing radiations, but also the key to safe, orderly and effective operation of all civil defense activities within a stricken area.

Practically all organized measures of radiological defense are carried out by local organizations. They take the form of area survey and technical service operations. Each is discussed below.

Area Survey Operations. Each local radiological defense organization should number among its components 50 or more Radiological Defense Area Survey Units. These are groups of from four to ten individuals fully trained and specially equipped for detection and measurement of ionizing radiations. Under technical direction of the Radiological Defense Operations Officer (Area Survey Units), they would conduct surveys of assigned areas for the purpose of detecting and delimiting radiological hazards.

Except as otherwise prescribed and with such variations as may be necessitated by operational exigencies (radiations of extreme intensity, physical destruction, irregularities of terrain and similar obstacles), area surveys would be made on a uniform line transect basis, following parallel lines from 150 to 200 yards apart. In "built up" sections, streets would be followed, surveying each one, or every other one, depending upon the size of the blocks.

In the vicinity of the so-called "incident area", or "area of total destruction", the lines of survey would take the form of converging radii directed toward the center of destruction. These particular operations are aimed primarily at determining the perimeter of the radiological hazard

which may reasonably be expected to exist in or near the incident area. The information gained will be of especial value to firefighting, rescue and other civil defense groups operating within this vital area.

The so-called "rear areas" include territory extending back from six to eight miles on all sides of the incident area. Here the radiological surveys would be made on the standard parallel-line-basis. They may be expected to provide facts essential for safety in the directed movements of the civil population. On the basis of information furnished by the Area Survey Units, the police service then would post, and where necessary patrol, the boundaries of all radiologically hazardous areas in order to prohibit entry therein by unauthorized persons.

The "immediate down-wind area" extends up to 50 miles from the center of the incident area in the general direction of the winds prevailing at the time of and immediately following the incident. Area survey operations conducted in these areas would take the form of "spot checks" aimed at detection of any radiological hazards attributable to cloud "fall out". Down-wind surveys at greater distances would be made by Area Survey Units from other local organizations in accordance with directions from the appropriate State Civil Defense Director, acting with the advice of his Radiological Defense Advisor.

The so-called "down-water" operations are surface surveys of streams and rivers aimed at detection of radiological hazards which may be considered capable of later producing hazards at points downstream from the incident area.

Individuals engaged in area survey operations would record all significant radiation data on standardized grid sheets. Essential digests of these data, especially information concerning the nature and location of radiological hazards would be periodically transmitted to the Radiological Situation

Plotting Center in the operational headquarters of the local Civil Defense Director via established channels of communication. There they would be graphically portrayed on charts of the locality in order to provide current information on the radiological situation.

Evaluation of the data collected by the Area Survey Units and summarized on the Radiological Situation Plot would provide the local Civil Defense Director with information vital to proper discharge of his duties and responsibilities. It also would furnish the police, firefighting, rescue and other civil defense groups with facts essential to proceeding safely with their respective operations.

In this connection, it should be obvious that negative information -- that is, no radiations detected — gathered by Area Survey Units may often be of as great, and sometimes even greater, importance than positive data. For example, should the area survey operations disclose no radiological hazards within certain areas, all civil defense activities within those particular sections can be conducted without fear of injuries resulting from over-exposure to ionizing radiations. In addition, the civil population can also be assured that no radiological dangers exist therein.

Technical Service Operations. Each local radiological defense organization should have among its components from ten to 100 Radiological Defense Technical Service Units for assignment to various Civil Defense Services. These groups should be composed of from two to 20 individuals fully trained and specially equipped to detect and measure ionizing radiations. They would operate under technical direction of the Radiological Defense Operations Officer (Technical Service Units) and under tactical direction of the individual in charge of the police, firefighting, medical or other operational unit to which assigned.

Their duty would be to collect and interpret technical information on rate and intensity of radiation necessary to prevent over-exposure of personnel whose civil defense duties require their entry into radiologically hazardous areas.

Radiological Defense Technical Service Units should always accompany, or precede, the police, firefighting, rescue and other operational groups to which assigned into any and all areas where there is reason to believe that ionizing radiations may be encountered. On the basis of the radiation rate and intensity data secured, the radiological defense personnel would advise the leaders of those units concerning the maximum period of time which workers may remain in specific radiologically hazardous areas without likelihood of injury. Withdrawals and replacements made in accordance with the advice furnished should provide protection from radiation injuries for all persons engaged in post-attack civil defense operations.

Radiological Defense Technical Service Units assigned to firefighting groups are likely to be among the first, if not the very first, radiological defense units to detect the presence of ionizing radiations in bombed areas. Therefore they report their initial detections to the Radiological Situation Plotting Center in the operational headquarters of the local Civil Defense Director via established channels of communication. All significant data must, of course, be incorporated in the plot.

THE RADIOLOGICAL DEFENSE ORGANIZATION

General Organization Requirements. Effective radiological defense on a nationwide scale necessitates not only immediate establishment of a separate Radiological Defense Division in the Office of Civil Defense, but also immediate

development of Radiological Defense Organizations, including operational units, in states and communities. All plans of organization for oradiological defense must be fully integrated with those for the over-all civil defense program.

The primary purpose of the organization must necessarily be the collection and interpretation of the technical information on existence of ionizing radiations which is required to achieve the objectives of radiological defense.

Proper interpretation of data concerning the rate and intensity of ionizing radiations requires their collection on a uniform basis. Furthermore, the necessity for close cooperation, not only between various state and local components within the Radiological Defense Division, but also between Division units and comparable units within the Armed Forces, demands absolute uniformity of all radiological defense procedures. These two factors combine to require an umusually high degree of standardization throughout all levels of the radiological defense organization.

In addition, there are two other organizational requirements which are of vital importance. First, in order to have an effective organization comprised of fully qualified technical personnel available at the time of attack, it is imperative that the Radiological Defense Division be immediately formed and activated, if only on a limited scale. Secondly, in order adequately to train and prepare for radiological defense in time of war, it is necessary during the present peacetime period to develop an organization of essentially the same design and strength as may be required in the event of war. These particular requirements are peculiar to radiological defense in that no nucleus of organization for such defense now exists. Most other elements of the civil defense organization currently exist in some degree and

are capable of comparatively rapid expansion and coordination.

In organizing for radiological defense, the following facts must constantly be borne in mind:

Practically all actual defensive operations would be performed by Area Survey and Technical Service Units within local organizations.

The operational activities carried out by State units would be limited, but highly technical in nature.

The functions of the national organization would be largely concerned with development of sound training and operational plans and maintenance of tight technical direction of activities.

Responsibilities within the regional offices would be those of inter-state coordination.

National Organization (Chart). In addition to promulgation of sound training and operational plans, the Radiological Defense Division of the Office of Civil Defense would establish policies, principles and standards to be followed in activities of the state and local organizations.

The personnel immediately required within the Radiological Defense Division, includes:

a. Chief, Radiological Defense Division.

He would be responsible for over-all administration, supervision and coordination of the radiological defense program and for its scientific and technical application within the civil defense program. He should possess outstanding ability and national recognition in the field of radiological defense, as well as thorough appreciation of the scientific and technical aspects of this highly specialized field, including its medical implications. His academic background should include a

doctorate in a physical science or in medicine, preferably the latter. He should be of professorial rank, or the equivalent, while military experience related to atomic warfare is highly desirable. He should be a "career employee".

b. Deputy Chief for Technical Direction.

He would serve as senior advisor in the technical aspects of radiological defense, with cognizance over all scientific and technical matters pertaining to detection and measurement of ionizing radiations and standards relating thereto. He should possess outstanding ability and recognition in a field of science basic to radiological defense. His academic background should include a Ph.D. or D.Sc. degree in a physical science related to radiology. He should be of professorial rank, or equivalent. He should be a "career employee".

c. Administrative Assistant.

He would serve as general administrative assistant to the Chief, Radiological Defense Division and be responsible for all administrative details. He should possess both experience and demonstrated ability in high level staff procedure.

As implementation of the over-all civil defense program progresses, there will be required in the Radiological Defense Division four Assistant Chiefs, one for Personnel, one for Security and Public Information, one for Plans and Operations and one for Logistics.

The Division should be served by an Advisory Committee on Radiological Defense, composed of five nationally recognized authorities in the fields of

medicine, physics and chemistry who are also experienced in the practical aspects of radiological defense. Its primary mission would be to advise the Chief of the Division in matters of over-all policy and to submit recommendations pertaining to general operation of the Division.

In addition to the Advisory Committee, the Division should also be served by a number of advisory sub-committees. These so-called Task Committees would be actual working groups composed of recognized authorities in specialized scientific fields. They would be assigned specific tasks aimed at the solution of key problems, such as those pertaining to education of the public, instrument standards and training methods. Their work would be of vital importance in the development of a sound and effective plan for radiological defense.

Regional Organization. When Regional Offices are established, each should have a Radiological Defense Division primarily concerned with inter-state coordination of operations. It would be comprised of a Chief, an Assistant for Plans, Operations and Training and an Assistant for Logistics.

State Organization. (Chart). The State Radiological Defense Division should be headed by a Chief, with an Assistant for Plans, Operations and Training and an Assistant for Logistics. He would be served by a State Advisory Committee on Radiological Defense, composed of recognized authorities in the fields of physics, medicine and chemistry.

The only truly operational units within the state radiological defense organization should be Technical Service Units assigned to Mobile Reserve Battalions, plus limited numbers of Special Purpose Units which would operate under technical direction of the Chief of the state Division. The latter units, as ordered by the State Director for Civil Defense, would perform

detailed technical functions requiring highly specialized knowledge and skills.

Local Organization. (Chart). Each Local Radiological Defense Division would be composed of the following members and components:

a. Chief, Local Radiological Defense Division. He must be specially trained and fully qualified in the duties of the assignment. He would serve as advisor to the local Director for Civil Defense, furnishing technical information concerning the radiological aspects of civil defense. He would be responsible for the technical direction and coordination of all radiological defense activities within the locality and would advise the director in all matters relating to radiological defense.

b. Radiological Defense Operations Officer (Area Survey Units). He must be specially trained and fully qualified in the duties of the assignment. Under technical direction of the Chief, he would serve as Radiological Defense Operations Officer (Area Survey Units), furnishing technical information on the nature and location of radiological hazards. He would be responsible for maintenance of the central or headquarters Radiological Situation Plot and for technical direction of all radiological defense area survey operations.

c. Radiological Defense Operations Officer (Technical Service Units). He must be specially trained and fully qualified in the duties of the assignment. Under technical direction of the Chief, he would serve as Radiological Defense Operations Officer (Technical Service Units), furnishing technical information concerning the

radiological protection of personnel comprising operational units of the firefighting, police, medical and other services. He would be responsible for the technical direction of all radiological defense Technical Service Units, and for the assignment of such units, or personnel therefrom, to other operational units.

d. Radiological Defense Logistics Officer. He must be specially trained and fully qualified in the duties of the assignment. Under technical direction of the Chief, he would serve as Radiological Defense Logistics Officer, supplying all radiological defense equipment and materiel required by the local radiological defense organization. He would be responsible for the supply, maintenance and re-supply of all operational equipment required by Area Survey, Technical Service and other radiological defense operational units.

e. Radiological Situation Plot Group. This unit is composed of from one to five individuals of officer grade and from five to twenty-five of technician grade, all specially trained and fully qualified. Under technical direction of Radiological Defense Operations Officer (Area Survey Units), the Group would maintain Radiological Situation Plot in the operational headquarters of the Local Civil Defense Director, and would be responsible for the correlation, charting and recording of information concerning the nature and location of all radiological hazards within the local operational area.

f. Radiological Defense Operational Supply Group. This unit would be composed of one individual of officer grade and from two to

ten of technician grade, all fully qualified and specially trained. Under technical direction of the Radiological Defense Logistics Officer, the Group would supply, repair and re-supply radiological defense operational equipment required for use within the local operational area. It would be responsible for emergency supply and maintenance of all operationd equipment required by Area Survey and Technical Service Units during periods of actual defensive operations.

g. Area Survey Units. (Ten to 100 Units). Each would be composed of from two to four individuals of officer grade, one of whom should be designated as leader, plus from four to eight individuals of technician grade, all fully qualified and specially trained. Under technical direction of the Radiological Defense Operations Officer (Area Survey Units), the Units would conduct area surveys for the purpose of locating radiologically hazardous areas through the detection and measurement of ioniaing radiations. They would be responsible for delimiting all such hazards and for trammsmission of detailed information concerning the nature and location of each to the local operational headquarters through established channels of communications. They would serve a primary function of providing the Local Civil Defense Director with information vital to proper discharge of his duties and responsibilities.

h. Technical Service Units. (Ten to 100 Units). Each would be composed of from two to four individuals of officer grade, one of whom should be designated as leader, plus varied numbers of individuals of technician grade, all specially trained and fully

qualified. They operate under technical direction of the Radiological Defense Operations Officer (Technical Service Units) and under tactical direction of the individual in charge of the operational unit to which assigned and with which they move in operations. They would collect and interpret that technical information (intensity and rate of radiation) which is necessary to prevent over-exposure of personnel whose duties require their entry into radiologically hazardous areas. Their primary function would be the radiological protection of members of the various technical service operational units. They would not normally engage in area survey operations.

Both because of the likelihood that enemy attack may come with little or no warning and because the initial strike may be so devastating as to render a large percentage of all members of a local Civil Defense organization essentially "hors de combat", it is important that development of the local radiological defense organization incorporate the following characteristics.

First, reserve personnel for the four key positions (Chief, Operations Officers and Logistics Officer) should be "at least two deep". In other words, there must be for each of these positions at least one additional individual capable of immediately assuming the positions in the event that the regularly designated personnel be for any reason unavailable. These reserves should not only be fully qualified and trained, but should also be widely dispersed insofar as their regular places of residence and employment are concerned. Only then will constant availability of necessary personnel be reasonably assured.

Secondly, all radiological defense operational units, especially Area Survey and Technical Service Units and the personnel comprising them, must be

so organized and trained that they not only can serve as replacements for other units, but also can operate either as units, or as individuals performing unit functions. In other words, Area Survey and Technical Service Units must be capable of performing either survey or service functions as may be assigned, while all personnel comprising such teams must be capable of functioning as units, part-units or individuals.

PROCUREMENT OF PERSONNEL

General Personnel Requirements. In the procurement of personnel for the radiological defense organization, all thought and action must be directed toward employment of individuals possessing the highest possible qualifications, particularly pertinent ability, training and experience.

Personnel prerequisites for various positions within the Radiological Defense Divisions differ widely. In some cases, the requirements call for extensive technical or scientific training and experience, but only limited administrative ability. In others, the reverse holds true. Between these two extremes there are many demanding a balanced combination of qualifications.

It is of utmost importance that the duties of each particular grade or position be clearly set forth and that minimum qualification standards for them be not only established, but rigidly adhered to in filling all positions within the radiological defense organization.

Sources of Personnel. In general, it should be possible to obtain personnel for the Radiological Defense Divisions from the following sources:

a. Personnel for Local Organizations.

It is believed that a nucleus of personnel suitable for local radiological defense organizations can be drawn

from the ranks of the teachers of physics and related sciences in the secondary schools.

b. Personnel for State Organizations.

It is believed that professors of physics and related sciences in the various colleges and universities provide an adequate source of personnel for state radiological defense organizations.

c. Personnel for National and Regional Offices..

In view of the unique prerequisites required, it is believed necessary to draw key radiological defense personnel for the National and Regional Offices of the organization either from the faculties of various colleges and universities or from those persons privately engaged in pertinent professional pursuits.

TRAINING OF PERSONNEL

General Training Requirements. In the main, all radiological defense personnel require not only technical training and practical experience in physics or some closely related science, but also specific instruction and practice in the special techniques of detecting and measuring ionizing radiations. It is highly desirable that key administrative personnel possess, in addition to the technical background just mentioned, military experience in problems pertaining to atomic warfare.

All technical training of radiological defense personnel should be conducted under the technical direction and supervision of the Chief of the Radiological Defense Division, Office of Civil Defense and in accordance with a specific program approved by the Advisory Committee on Radiological Defense.

This training must be characterized by the highest possible degree of uniformity and standardization and must be closely integrated with related courses of instruction in the National Military Establishment. Furthermore, since the development of radiological defense personnel fully qualified to perform their respective duties requires appreciable time, immediate peacetime inauguration of an approved training program is imperative. Its initiation cannot be postponed until the moment of attack.

In addition to the technical training of radiological defense personnel, it is necessary to orient all other members of the Civil Defense organization with respect to the specific radiological problems which they are likely to encounter in performance of their assigned duties.

Specific Training Procedures. In order to obtain the high degree of proficiency required for effective radiological defense, it is essential that the following training procedures be adhered to at the several levels of organization:

a. Local Training.

Training in the local organizations must be directed primarily toward the development of maximum individual proficiency in area survey and technical service operations. It would consist largely of instruction and practice in the techniques of detecting and measuring ionizing radiations, plus detailed discussion and analysis of the specific problems likely to be encountered in performance of their duties. Selected teachers of physics and related sciences from the secondary schools would be given extensive basic training in radiological defense at various colleges and universities stressing the practical techniques employed in area survey

and technical service operations. Those who successfully complete this course of instruction will be qualified for positions as leaders of Area Survey and Technical Service Units. Thereafter, those interested individuals who have demonstrated outstanding ability in the basic training would be given additional instruction which will qualify them to serve not only as unit leaders, but also as local instructors.

b. Training of Personnel for Special Purpose Units.

The training of personnel for Special Purpose Units would be conducted at various colleges and universities under the administrative direction of the Chief of the State Radiological Defense Division. All personnel assigned to such units would require, in addition to their own special technical training and experience, specific instruction in the more complex problems of radiological defense.

c. Training of Key Personnel.

Insofar as possible, key administrative and technical personnel in the radiological defense organization should be given such advanced training in the problems of atomic warfare as may be offered within the several branches of the National Military Establishment.

LOGISTICS

General Logistics Policy. The procurement and supply of radiological defense equipment and materiel is a major problem, complicated by the fact that it is currently impossible to state what specific types of special

equipment are best suited for radiological defense training and operations. In general, it may be said that the over-all equipment and materiel requirements for radiological defense would be computed by the Office of Civil Defense; that procurement preferably would be through a common source and in accordance with plans and specifications jointly agreed upon by the Office of Civil Defense, the Armed Forces Special Weapons Project, the Armed Forces and the Atomic Energy Commission; and, finally, that supply should be in general accord with the over-all civil defense logistics plan.

In the state organization, responsibility both for development and implementation of the radiological defense logistics plan and for technical supervision of logistics operations would rest with the Assistant for Logistics. He would act in accordance with the general provisions of the over-all civil defense logistics plan promulgated at the national level. Within local organizations, corresponding responsibility would rest with the Radiological Defense Logistics Officer. He too must act in strict accordance with national policies.

Types of Equipment Required for Local Operations. The principal types of radiological defense equipment required for Local operations are;

a. Survey Meters. These instruments (ionization chambers and Geiger counters) are utilized for the purpose of detecting and measuring ionizing radiations.

b. Dosimeters. These instruments (primarily special purpose electroscopes) are utilized to record total periodic exposure of personnel to ionizing radiations.

c. Plotting and Charting Equipment. This includes area maps, grid charts and all other items of equipment used for

standardized recording and graphic portrayal of technical data relative to the presence of ionizing radiations.

For the most part, radiological defense equipment and materiel required for use by local organizations both in training and in actual defensive operations should be stored, under lock, in police and fire stations and in those schools and buildings regularly utilized as training centers.

COMMUNICATIONS

General Communications Problems. Because of the many complicated problems involved, establishment of a separate communications system for use by the Radiological Defense Division is deemed neither sound nor practical. In actual operations, Area Survey and Technical Service Units, which normally operate in close association with the police and fire services, would depend primarily upon communication facilities of those services and secondarily upon telephone, telegraph and other public service facilities.

Particularly in the event of atomic attack, it is reasonable to suppose that for a period of hours immediately following the incident -- which may reasonably be expected to be the critical period for most radiological defense operations -- the principal communication facilities available for use by radiological defense personnel actually engaged in defensive operations may be the two-way radio systems maintained by the police and fire services. It is, of course, possible that these and other facilities may be inoperative and that messenger service will have to be inaugurated.

Post-Incident Communications Procedures. In the event that the police and fire radio systems are the only communication facilities available in the immediate post-incident period and in view of the great volume of essential

traffic which must be handled by these facilities, individual members and functional components of the local radiological defense organization should be required to adhere to the following communication procedures:

Transmissionsof all types must be kept to an absolute minimum. In the main, radiological defense messages should be confined to issuance of directions and reporting of essential digests of information concerning the radiological situation. Radiological defense personnel should not undertake personally to operate (that is, call or talk over) either police or fire radio communication facilities. Instead they should write out, in the briefest possible form embodying absolute clarity of meaning, any and all messages which require transmission. These would be turned over to the police and fire communications operators for transmission in accordance with approved procedures and established priority schedules.

As soon after attack as operational procedures permit, available telephonic communication service should be utilized in order to reduce traffic on the radio systems. As a general rule, direct lines to the local civil defense operational headquarters would be available at regular or emergency police or fire stations and sub-headquarters.

Special Radiological Defense Communications Code. Serious consideration should be given the desirability of developing a simple, standardized communication code for use in radiological defense operations. Such a code would allow for brevity of operational messages. It would also provide the security essential in transmission of technical information.

PREPARATION OF THE PUBLIC ESSENTIAL TO EFFECTIVE RADIOLOGICAL DEFENSE

Maximum Protection Requires Thorough Public Preparation. The effectiveness

of any and all radiological defense operations conducted at the time of and immediately following atomic attack will be in large measure directly dependent upon the extent to which the public may previously have been prepared to meet the eventualities of such attack. Maximum protection requires sound and thorough preparation of the entire civil population well in advance of the time of actual attack.

Education of the Public of Paramount Importance. Education of the public in respect to the true potentials and actual limitations of atomic warfare is the only means by which the civil population may be adequately prepared to meet the eventualities of atomic attack. Prompt development and implementation of such an educational program is a major undertaking of vital importance to national security.

Objectives of the Educational Program. It is generally agreed that the psychological aspects of atomic warfare are of maximum military and political significance. No previous type of warfare has offered such rich opportunities to exploit fear of the unseen and the unknown. It is, therefore, obvious that the primary objective of a program of education of the public in respect to atomic warfare should be to dispel the current unjustified fear of the radiological hazards involved in such warfare and to develop a wholesome understanding of and respect for the potentials of atomic weapons.

Development of an Educational Plan a Civil Defense Responsibility. In view of its vital importance to our national security, development of a plan for the education of the public designed adequately to prepare the civil population for the eventualities of atomic attack properly is a primary responsibility of the Office of Civil Defense. Detailed preparation of the plan would be the duty of the Chief of the Training Division. However, the